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Aramis Pipeline Route
Integrated Geophysical Survey Results Report

Managementsamenvatting geofysisch onderzoek

Op instructie van TotalEnergies MV hebben Fugro Discovery, Fugro Seeker en Fugro Searcher een geofysisch onderzoek uitgevoerd langs het tracé van de Aramis-zeeleiding (trunk line). Het algemene routeprogramma is onderverdeeld in de volgende gebieden: geofysisch onderzoek, UXO, 2D-UHRS, EBS en geotechnisch onderzoek.

De gegevens werden verzameld tussen juli 2022 en januari 2023.

Dit rapport geeft informatie over de resultaten van de geofysische onderzoeken die zijn uitgevoerd boven de Aramis-route.

Sectie 2 van het rapport geeft informatie over mobilisatie, werkzaamheden, methodologie en interpretatie van gegevens. Secties 3 en 4 geven een overzicht van de omstandigheden op de zeebodem en onder de zeebodem. Gedetailleerde resultaten en beschrijvingen voor elk deel van de route vindt u in de secties 5 tot en met 14.

<table>
<tr><th colspan="3">Locatieonderzoek Aramis-trunklijn</th></tr>
<tr><td>Onderzoeksdata</td><td>Geofysisch</td><td>Juli 2022 tot januari 2023</td></tr>
<tr><td rowspan="2">Uitrusting</td><td>Geofysisch</td><td>Multibeam echolood (MBES), side scan sonar (SSS), enkelvoudige magnetometer (MAG), sub-bottom profiler (SBP), 2D-UHRS.</td></tr>
<tr><td>UXO</td><td>Dicht bij de kust: Miniwing (2 x G882 MAG)
Offshore: dubbele Katria Scanfish magnetometer array, (8 x G882 MAG)</td></tr>
<tr><td colspan="2">Coördinatensysteem</td><td>ETRS89 / UTM zone 31N</td></tr>
<tr><th colspan="3">Bathymetrie</th></tr>
<tr><td colspan="3">De algemene waterdiepte varieert tussen 0 m en 39,5 m langs het traject van de Aramis-trunklijn.</td></tr>
<tr><th colspan="3">Morfologie van de zeebodem</th></tr>
<tr><td colspan="3">De volgende morfologische kenmerken werden geïdentificeerd: bedvormen (rimpelingen, megarippels en zandgolven), onregelmatige zeebodem, gebied met talrijke keien, gebied met af en toe keien.</td></tr>
<tr><th colspan="3">Sedimenten van de zeebodem</th></tr>
<tr><td colspan="3">De interpretatie en classificatie van zeebodemsedimenten was gebaseerd op een combinatie van gegevens van MBES en SSS, waarbij gebruik werd gemaakt van akoestische kenmerken zoals algemeen patroon, ruwheid en reflectiviteit. De interpretatie is herzien aan de hand van de resultaten van geotechnische gegevens. De geïdentificeerde zeebodemsedimenten zijn: (1) kiezelhoudend ZAND, (2) licht kiezelhoudend ZAND, (3) modderig (ziltig) ZAND en (4) ZAND</td></tr>
<tr><th colspan="3">Doelen op de zeebodem en potentiële locatiespecifieke gevaren</th></tr>
<tr><td>Wrakken</td><td colspan="2">4 Wrakken zijn geïdentificeerd en geïnterpreteerd</td></tr>
<tr><td>Pijpleidingen/kabels</td><td colspan="2">Verschillende pijpleidingen kruisen de route. Sommige pijpleidingen liggen gedeeltelijk bloot en gedeeltelijk begraven, maar de meeste pijpleidingen liggen begraven.</td></tr>
<tr><td>Puin / vermoedelijk puin</td><td colspan="2">159 sonarcontacten zijn geclassificeerd als puin
517 sonarcontacten zijn geclassificeerd als vermoedelijk puin</td></tr>
<tr><td>Matrassen</td><td colspan="2">2 Matrassen zijn geclassificeerd in de nabijheid van het Platform L4A</td></tr>
<tr><td>Keien</td><td colspan="2">3110 keien zijn geïnterpreteerd</td></tr>
<tr><td>Andere doelen</td><td colspan="2">Er zijn schuurplekken van vistuig en sporen van sleepnetten gevonden</td></tr>
<tr><td>Magnetische anomalieën.</td><td colspan="2">2745 magnetische anomalieën zijn gevonden</td></tr>
<tr><td>Gekruiste gecorreleerde contacten</td><td colspan="2">11 SSS-contacten zijn gekruist gecorreleerd met MAG doelen</td></tr>
</table>

Ondergrondse geologische kenmerken	
Begraven kanalen	Interne ondergrondse geulen en geulen aan de basis werden waargenomen in alle units, behalve Unit A. Ingegraven geulen in Unit B werden in kaart gebracht op basis van SBP-gegevens. Deze kanalen bevinden zich vaak aan de bovenkant van de eenheid, zijn NW-ZO georiënteerd en hebben een beperkte omvang. Ze hebben vaak een gelaagde vulling. De basis van Unit B, Unit C en Unit D is plaatselijk gekanaliseerd. De basis van Unit F vormt de diep ingesneden glaciale tunneldalen. Nabij de top van Unit F werden plaatselijk beddingvormige, kanaalachtige reflectoren waargenomen. Deze kenmerken lijken een late fase van de opvulling van deze tunnelvalleien te vertegenwoordigen, die mogelijk in een lacustriene omgeving plaatsvond.
Veen	Hoge negatieve amplitudeanomalieën werden waargenomen in de 2D-UHRS seismische gegevens. Deze gebeurtenissen met een negatieve amplitude vertegenwoordigen waarschijnlijk veen en/of organisch-rijke klei. Er werden veenlagen geïdentificeerd op drie stratigrafische niveaus: *veenniveau 1* - behorend bij Unit B, *veenniveau 2* - behorend bij Unit C, Unit D en Unit E en *veenniveau 3* - behorend bij Unit F en Unit G. Op de SBP-gegevens werden de reflectoren met hoge amplitude, die op veen en/of organische klei kunnen duiden, geassocieerd met eenheid B. Veen komt het meest voor in het noordelijke deel van de route, met uitzondering van 2D-UHR_peat level 3, dat langs de hele route aanwezig is, maar de verspreiding ervan is zeer beperkt.
Ondiep gas	Akoestische blanking kan de aanwezigheid van gas in de bodem aangeven. Het werd plaatselijk in het kustgebied waargenomen. De kleine akoestische blanking of signaalvervorming die onder enkele van de negatieve amplitudeanomalieën werd waargenomen, houdt vermoedelijk verband met de aanwezigheid van veen. De aanwezigheid van met gas/vloeistof gevulde sedimenten kan echter niet volledig worden uitgesloten.
Rotsblokken, keien en grind	In de SBP-gegevens werden een paar diffractiehyperbolen waargenomen. Deze worden geïnterpreteerd als mogelijke rotsblokken, keien en/of grof grind. Er moet opgemerkt worden dat de interpretatie van deze kenmerken speculatief is en dat hyperbolen van diffractie het resultaat kunnen zijn van andere factoren dan de aanwezigheid van rotsblokken, keien of grof grind. Gezien de geologische omgeving (d.w.z. de verwachte aanwezigheid van periglaciale en glaciale sedimenten) kunnen keien en keien worden verwacht langs de Aramis-route. Hun aanwezigheid kan dus niet worden uitgesloten.
Glaciale vervorming	Glaciale vervorming komt typisch tot uiting in seismische gegevens als chaotische interne reflecties, hellende afschuifvlakken, vervormde en geplooide lagen en verstoring van de oorspronkelijke interne structuur. Bewijzen van mogelijke vervorming werden waargenomen in Unit G, vooral in de buurt van glaciale tunneldalen (Unit F). Men denkt dat deze kenmerken verband houden met de Elsteriaanse ijstijd.
Fouten	Breuken werden niet eenduidig geïdentificeerd in de seismische reflectiegegevens. De aanwezigheid van breuken en/of scheuringen kan echter niet worden uitgesloten.
Geologie van de ondergrond	
Unit A	Unit A is over de hele route aanwezig. Het lijkt akoestisch transparant te zijn. Plaatselijk werden hoge amplitude interne puntreflecties of korte reflectoren waargenomen. In de grotere zandgolven werden lokaal zwakke progradatiestructuren waargenomen. De eenheid wordt geïnterpreteerd als afgezet in een open mariene omgeving, als reactie op de mariene transgressie tijdens het Laat-Holoceen, en behoort tot de zuidelijke Bocht Formatie. Bodemtype: Zeer los tot zeer dicht zwak ziltig tot zwak fijn en matig ZAND, plaatselijk zwak zandige KLEI.
Unit B	Unit B is aanwezig in de hele route, behalve in het Maasmondkanaal. De unit heeft een variabel intern seismisch karakter, variërend van semi-transparant tot chaotisch met talrijke discontinue en vaak onder een grote hoek liggende reflecties met middelhoge tot hoge amplitude. Interne kanalen en kanalen aan de basis met verschillende afmetingen werden waargenomen in de unit.

Geologie van de ondergrond	
	De vulling van de geulen is variabel, maar meestal goed gelaagd en met reflectoren met een hoge amplitude. Hoge negatieve amplitudeanomalieën komen vaak voor in deze eenheid, vooral in het noordelijke deel van de route, die mogelijk lagen veen en/of organisch-rijke klei voorstellen. De unit wordt geïnterpreteerd als kust- en getijdenafzettingen uit het vroege Holoceen en behoort mogelijk tot de Naaldwijk Formatie. Plaatselijk kan de eenheid sedimenten van de Formatie van Boxtel bevatten en vooral in het zuidelijke en zuid-centrale deel van de route kan een groot deel van deze eenheid tot de Kreftenheye Formatie behoren. Het onderscheid tussen deze formaties is moeilijk te maken vanwege de vergelijkbare bodemgesteldheid (voornamelijk zand). In het kustgebied liggen afzettingen van de Kreftenheye Formatie onder de basis van de geïnterpreteerde Naaldwijk Formatie. Bodemtype: Matig tot zeer dicht zwak ziltig fijn en matig ZAND, plaatselijk met bedden van zandige KLEI en VEEN.
Unit C	Unit C is aanwezig in het centrale en gedeeltelijk in het noordelijke deel van de route. De unit wordt voor het grootste deel van de route gekarakteriseerd door bedding van seismische facies, bestaande uit parallelle reflectoren. Plaatselijk, in het bovenste deel van de unit, werden structuurloze, semi-transparante intervallen waargenomen. In het noordoostelijke deel van de route wordt de unit gekenmerkt door algemene semi-transparante seismische facies met lokale negatieve reflectoren met hoge amplitude (2D-UHRS) van verschillende omvang. De reflectoren met hoge amplitude kunnen duiden op lagen met lagen veen en/of organische klei. De gelaagde aard van de unit zal naar verwachting correleren met afwisseling van zand en klei en plaatselijke veenbedden. De unit wordt geïnterpreteerd als afgezet in een reeks van kust- (estuariene), getijdenvlakte- of laguneomgevingen en komt overeen met het Brown Bank Lid. Bodemtype: Zeer los tot dicht zeer ziltig fijn en middelfijn ZAND, plaatselijk zandig KLAAR en zandig kleiig SILT.
Unit D	Unit D is over de hele route aanwezig, met uitzondering van een klein deel van de route (ongeveer 15 km) in het centrale deel, en in het meest zuidelijke deel. De unit heeft over het algemeen een structuurloos en semi-transparant akoestisch karakter. Plaatselijk gelaagde intervallen, interne erosieoppervlakken gemarkeerd door sterk hellende reflectoren of die brede kanaalachtige kenmerken vormen. Inwendige begraven kanalen zijn plaatselijk aanwezig. Unit D bestaat naar verwachting voornamelijk uit zand, met zeer plaatselijk klei- of veenafwisselingen, afgezet in omgevingen van open zee en getijden. Men denkt dat de eenheid tot de Eem Formatie behoort. Bodemtype: Los tot zeer dicht zwak ziltig fijn en matig ZAND, af en toe licht grindig.
Unit E	Unit E is alleen aanwezig in het noordelijke deel van de route. Wordt gekenmerkt door akoestisch transparante tot semi-transparante en structuurloze seismische fracties. Unit D zal naar verwachting voornamelijk uit zand bestaan, afgezet in omgevingen van open zee en getijden. Men denkt dat de eenheid behoort tot de Egmond Formatie. Bodemtype: Gemiddeld dicht tot zeer dicht ZAND plaatselijk met bedden van KLEI en ZOUT.

Unit F	Unit F is plaatselijk aanwezig in de noordelijke helft van de route. De unit vormt de opvulling van diep insnijdende U-vormige kanaalachtige kenmerken met steile flanken. Ze snijden in de onderliggende Unit G en bereiken plaatselijk diepten onder de penetratie van de 2D-UHRS gegevens. Dergelijke kenmerken in dit deel van de Noordzee worden beschouwd als glaciale tunneldalen. De unit zal naar verwachting voornamelijk bestaan uit klei met frequente (ziltige) zandbeddingen afgezet in glaciale, glaciofluviale en glaciolacustriene omgevingen. Deze afzettingen worden geïnterpreteerd als behorend tot de Peelo Formatie. Het interne karakter wordt over het algemeen gekenmerkt door semi-transparante tot chaotische seismische facies. Vaak, vooral in het bovenste deel, werden discontinue, onregelmatige en golvende (geplooide?) reflectoren van gemiddelde tot hoge amplitude waargenomen. Bodemtype: Verweven matig dicht tot zeer dicht (ziltig) ZAND en hoogvast tot zeer hoogvast (zandige) KLEI
Geologie van de ondergrond	
Unit G	Unit G is de diepste unit die is waargenomen in de seismische gegevens binnen de diepte van interesse en is aanwezig over het hele traject. De basis van deze unit ligt buiten de penetratiediepte van de 2D-UHRS. Het interne akoestische karakter van de unit is complex, van semi-transparant tot chaotisch, met plaatselijk discontinue reflectoren, interne erosieoppervlakken en verschillende interne kanalen. Deze complexiteit is het gevolg van de aard van de afzettingsomgeving van deze unit (fluviatiel tot deltaïsch) en post-depositionele processen zoals glaciale activiteit, inclusief erosie en mogelijk vervorming. De eenheid bestaat naar verwachting voornamelijk uit zand met af en toe klei- en sliblagen en plaatselijk dunne veenbedden. De eenheid wordt geïnterpreteerd als overeenkomend met de Yarmouth Roads Formatie. Bodemtype: Matig dicht tot zeer dicht ZAND, plaatselijk met lagen hoogvaste tot zeer hoogvaste KLEI of ZILT, plaatselijk gelamineerd

Geophysical Survey Results Report

Aramis Project – Geophysical and Geotechnical Site Investigation

Survey Period: July 2022 – January 2023

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Executive Summary

On the instruction of TotalEnergies MV Fugro Discovery, Fugro Seeker and Fugro Searcher performed a geophysical survey along the Aramis trunkline route. The overall route program has been divided into following scopes: geophysical survey, UXO, 2D-UHRS, EBS and geotechnical surveys.

Data acquisition was carried out between July 2022 and January 2023.

This report provides information on the results of the geophysical surveys conducted over the Aramis route.

Section 2 of the report provides information about mobilisation, operations, methodology and data interpretation. Sections 3 and 4 provide overview of the seafloor and sub-seafloor conditions. Detailed results and descriptions for each section of the route are provided in Sections 5 through 14.

Site Investigation Aramis trunkline		
Survey Dates	Geophysical	July 2022 to January 2023
Equipment	Geophysical	Multibeam echo sounder (MBES), side scan sonar (SSS), single magnetometer (MAG), sub-bottom profiler (SBP), 2D-UHRS.
	UXO	Nearshore: Miniwing (2 x G882 MAG) Offshore: dual Katria Scanfish magnetometer array, (8 x G882 MAG)
Coordinate System		ETRS89 / UTM zone 31N
Bathymetry		
The overall water depth varies between 0 m and 39.5 m along the Aramis trunkline route.		
Seafloor Morphology		
The following morphological characteristics were identified: bedforms (ripples, megaripples and sand waves), irregular seafloor, area with numerous boulders, area with occasional boulders.		
Seafloor Sediments		
Seafloor sediment interpretation and classification was based on a combination of data from MBES and SSS, using acoustic characteristics such as overall pattern, roughness and reflectivity. The interpretation has been revised using geotechnical data results. The seafloor sediments identified are: (1) gravelly SAND, (2) slightly gravelly SAND, (3) muddy (silty) SAND and (4) SAND		

Seafloor Targets and Potential Site-Specific Hazards	
Wrecks	4 Wreck have been identified and interpreted
Pipeline/Cables	Several pipelines are crossing the route. Some pipelines are partially exposed and partially buried, however most of the pipelines are buried.
Debris / Suspected debris	159 sonar contacts have been classified as debris 517 sonarcontacts have been classified as suspected debris
Mattresses	2 Mattresses have been classified in proximity of the Platform L4A
Boulders	3110 boulders have been interpreted
Other targets	Fishing gears scours, trawl marks have been found
Magnetic anomalies.	2745 magnetic anomalies have been picked
Cross correlated contacts	11 SSS contacts have been cross correlated with MAG targets

Sub-Seafloor Geological Features	
Buried channels	Internal buried channels and channels at the base were observed in all units except Unit A. Buried channels in Unit B were mapped based on SBP data. These channels are often located towards the top of the unit, have NW-SE orientation and limited extent. They often have a layered infill. The base of Unit B, Unit C and Unit D is locally channelised. The base of Unit F forms the deeply incised glacial tunnel valleys. Near the top of Unit F, locally bedded, forming channel-like shape reflectors were observed. These features appear to represent a late stage of the infill of these tunnel valleys that may took place in lacustrine environment.
Peat	High negative amplitude anomalies were observed in the 2D-UHRS seismic data. These negative amplitude events most likely represent peat and/or organic-rich clay. Peat layers were identified at three stratigraphic levels: *peat level 1* – associated with Unit B, *peat level 2* – associated with Unit C, Unit D and Unit E and *peat level 3* – associated with Unit F and Unit G On the SBP data, the high amplitude reflectors that may indicate peat and/or organic clay were associated with Unit B. Peat is most common in the northern part of the route, except 2D-UHR_peat level 3, which is present along the entire route, but its distribution is very limited.
Shallow gas	Acoustic blanking can indicate presence of gas in soil. It was observed locally in the nearshore area. The minor acoustic blanking or signal distortion that was observed below some of the negative amplitude anomalies is thought to be related to the presence of peat. However, the presence of gas/fluid-charged sediments cannot be excluded entirely.
Boulders, cobbles and gravel	A few diffraction hyperbolas were observed in the SBP data and are interpreted to represent possible boulders, cobbles and/or coarse gravel. It should be noted that interpretation of these features is speculative and diffraction hyperbolas may be the result of factors other than the presence of boulders, cobbles or coarse gravel. Given the geological setting (i.e. the expected presence of periglacial and glacial sediments), boulders and cobbles can be expected along the Aramis route. Hence, their presence cannot be ruled out.
Glacial deformation	Glacial deformation is typically expressed in seismic data as chaotic internal reflections, inclined shear planes, deformed and folded strata and disturbance of the original internal structure. Evidence of possible deformation was observed in Unit G, especially in proximity of glacial tunnel valleys (Unit F). These features are thought to be related to the Elsterian glaciation.
Faults	Faults were not unequivocally identified in the seismic reflection data. However, the presence of faults and/or fractures cannot be ruled out.
Sub-Seafloor Geology	
Unit A	Unit A is present across the entire route. It appears to be acoustically transparent. Locally, high amplitude internal point reflections or short reflectors were observed. In the larger sand waves, locally weak progradational structures were observed. The unit is interpreted to be deposited in an open marine environment in response to the marine transgression during the Late Holocene and belongs to the southern Bight Formation. Soil type: Very loose to very dense slightly silty to silty fine and medium SAND, locally slightly sandy CLAY.
Unit B	Unit B is present in the entire route, except in the Maasmond Kanaal. The unit has a variable internal seismic character, ranging from semi-transparent to chaotic with numerous discontinuous and often high-angle medium to high-amplitude reflections. Internal channels and channels at the base with different dimensions were observed in

Sub-Seafloor Geology	
	the unit. The infill of the channels is variable, but typically well-layered and with high-amplitude reflectors. High negative amplitude anomalies are common in this unit, especially in the northern part of the route, which potentially represent layers of peat and/or organic-rich clay. The unit is interpreted to represent early Holocene coastal and tidal deposits, and possibly belonging to the Naaldwijk Formation. Locally the unit may include sediments of Boxtel Formation and especially in the southern and south-central part of the route, a large part of this unit may belong to the Kreftenheye Formation. The differentiation between these formations is difficult due to similar soil conditions (predominantly sand). In the nearshore area, deposits of the Kreftenheye Formation are below the base of the interpreted Naaldwijk Formation. Soil type: Medium to very dense slightly silty fine and medium SAND, locally with beds of sandy CLAY and PEAT.
Unit C	Unit C is present in the central and partially in the northern part of the route. The unit for most of the route is characterised by bedded seismic facies, consisting of parallel reflectors. Locally, in the upper part of the unit, structureless, semi-transparent intervals were observed. In the north-eastern part of the route, the unit is characterised by overall semi-transparent seismic facies with local high amplitude negative (2D-UHRS) reflectors of various extent. The high amplitude reflectors may indicate layers of pockets of peat and/or organic clay. The layered nature of the unit is expected to correlate with sand and clay alternations, and local beds of peat. The unit is interpreted to be deposited in a range of coastal (estuarine), tidal flat or lagoonal environments and corresponds to the Brown Bank Member. Soil type: Very loose to dense very silty fine and medium SAND, locally sandy CLAY and sandy clayey SILT.
Unit D	Unit D is present across the entire route, except small part of the route (approximately 15 km) in the central part, and in the most southern part. The unit has in general a structureless and semi-transparent acoustic character. Locally, layered intervals, internal erosion surfaces marked by strong inclined reflectors or forming broad channel-like features. Internal buried channels are locally present. Unit D is expected to comprise predominantly sand, with very locally clay or peat alternations, deposited in open marine and tidal environments. The unit is thought to belong to the Eem Formation. Soil type: Loose to very dense slightly silty fine and medium SAND, occasionally slightly gravelly.
Unit E	Unit E is present only in the northern part of the route. Is characterised by acoustically transparent to semi-transparent and structureless seismic facies. Unit D is expected to comprise predominantly sand, deposited in open marine and tidal environments. The unit is thought to belong to the Egmond Ground Formation. Soil type: Medium dense to very dense SAND locally with beds of CLAY and SILT.
Unit F	Unit F is present locally in the northern half of the route. The unit forms the infill of deeply incisive U-shaped channel-like features with steep flanks. They cut into the underlying Unit G, reaching locally depths below the penetration of the 2D-UHRS data. Such features in this part of the North Sea are considered as glacial tunnel valleys. The unit is expected to consist of mainly clay with frequent (silty) sand interbeds deposited in glacial, glaciofluvial and glaciolacustrine environments. These deposits are interpreted to belong to the Peelo Formation. The internal character is characterised in general by semi-transparent to chaotic seismic facies. Often, especially in the upper part, discontinuous, irregular, and wavy (folded?) medium to high-amplitude reflectors were observed. Soil type: Interbedded medium dense to very dense (silty) SAND and high strength to very high strength (sandy) CLAY

Sub-Seafloor Geology	
Unit G	Unit G is the deepest unit observed in the seismic data within depth of interest and is present across the entire route. The base of this unit is beyond the penetration depth of the 2D-UHRS. The internal acoustic character of the unit is complex, from semi-transparent to chaotic, with locally discontinuous reflectors, internal erosion surfaces and various internal channels. This complexity results from the nature of the depositional setting of this unit (fluvial to deltaic) and post-depositional processes such as glacial activity, including erosion and possibly deformation. The unit is expected to consist of predominantly sand with occasional clay and silt interbeds, and local thin beds of peat. The unit is interpreted to correspond to the Yarmouth Roads Formation. Soil type: Medium dense to very dense SAND, locally with layers of high strength to very high strength CLAY or SILT, locally laminated

Document Arrangement

Document Title	Description	Client Document No.
F197217-REP-ENV-001	Environmental Desk Top Study	
F197217-REP-MOB-SK	Mobilisation Fugro Seeker	
F197217-REP-MOB-SR	Mobilisation Fugro Searcher	
F197217-REP-MOB-DIS	Mobilisation Fugro Discovery	
F197217-REP-OPS-SEA	Operations Report Fugro Searcher	
F197217-REP-OPS-FD 01	Operations Report Fugro Discovery	
F197217-R-1 01	Field Operations and Preliminary Results Report NMM & K.Orca	
F197217-REP-RES-001	Nearshore Geophysical Survey Report (preliminary results)	
F197217-REP-001	Geophysical Survey Results Report	
F197217-REP-002	Environmental Field Report	
F197217-REP-003	Diversity Observation Report	
F197217-REP-004	EBS (includes Habitat Report)	
F197217-REP-005	eDNA Report	
F197217-REP-006	Measured and Derived Geotechnical Parameters and Final Results Report	

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Abbreviations

bsb	Below seabed
BS	British Standard
BSF	Below seafloor
CPT	Cone penetration test
CRP	Common reference point
CUBE	Combined Uncertainty and Bathymetric Estimator
DGPS	Differential global positioning system
DTM	Digital Terrain Model
EBS	Environmental baseline survey
EPSG	European Petroleum Survey Group
ETRF	European Terrestrial Reference Frame
ETRS	European Terrestrial Reference System
EVT	Equipment verification test
FF	Fugro Frontier
Fm	Geological formation
FNLM	Fugro Netherlands Marine
FV	Fugro Venturer
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GRS	Geodetic Reference System
GS	Grab sample
HVF	Hips vessel file
IHO	International Hydrographic Organization
ISO	International Hydrographic Organization
ITRF	International Terrestrial Reference Frame
IAC	Inter-array cable
KP	Kilometre post
LAT	Lowest Astronomical Tide
LGM	Last Glacial Maximum
MAG	Magnetometer
MASW	Multichannel analysis of surface waves
Mb	Geological member
MBES	Multibeam echosounder
MSL	Mean Sea Level
MV	Motor vessel
OCR	Offshore client representative
OPS	Operations

OWF	Offshore windfarm
PSD	Particle size distribution
QA	Quality Assurance
QC	Quality control
REP	Report
RPL	Route Position List
SBP	Sub-bottom profiler
SHP	Shapefile
SSS	Side scan sonar
SVP	Sound velocity profile
THU	Total horizontal uncertainty
TPU	Total propagated uncertainty
TVU	Total vertical uncertainty
TWTT	Two-way travel time
UHRS	Ultra high resolution seismic
UKHO	United Kingdom Hydrographic Office
USBL	Ultra-short Baseline
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
UXO	Unexploded ordinance
VC	Vibrocore
VORF	Vertical Offshore Reference Frame
WP	Work package
WTG	Wind turbine generator

1. Introduction

1.1 Project Description

The Carbon Capture and Storage (CCS) Aramis Project is developing CO_2 transport facilities to enable offshore gas storage. Once captured, the CO_2 is collected at the compressor station and shipping terminal at Maasvlakte, a hub in the port of Rotterdam. From this hub, CO_2 is transported to offshore gas fields to be injected into depleted offshore gas field at a depth of approximately 3 km to 4 km below the seafloor.

TotalEnergies contracted Fugro to perform an offshore geophysical, geotechnical and environmental site investigations of the proposed offshore pipeline corridor, running from landfall at the Maasvlakte to offshore Blocks L4/K6. A map of the site investigation location, including the proposed pipeline routes is shown in Figure 1.1.

1.2 Scope of Report

This report provides results of the geophysical survey and interpretation of the proposed 500 m wide pipeline corridors and a 2 km radius offshore distribution hub (Hub Area).

The report includes:

- Multibeam echosounder (MBES) data to provide accurate bathymetry in order to determine water depths, seafloor morphology and seafloor gradient;
- High-resolution side scan sonar (SSS) data to determine seafloor features, possible presence of boulders, seafloor sediments, objects / debris and items that may impact foundation and pipeline installation;
- Magnetometer (MAG) data across the site to determine any metallic objects / debris items;
- High-resolution sub-bottom profiler (SBP) and 2D-UHRS data to determine the sub-seafloor conditions that may influence foundation and pipeline installation such as shallow geology, geological features and geohazards;
- Cone Penetration Tests (CPT) and vibrocore samples (VC) along the pipeline route to ground truth the seismic reflection data and to allow for geotechnical soil characterisation of the interpreted units.

The CCS Aramis trunkline route has been divided into sections (Figure 1.1). Report Sections 3 and 4 provide a general overview of the results and interpretation, while Sections 5 to 14 provide a detailed description of each section of the CCS Aramis trunkline route.

This report is one in a series of reports that are prepared as part of this project and relate to offshore operations, processing, environmental and geotechnical surveys (refer to page 'Document Arrangement').

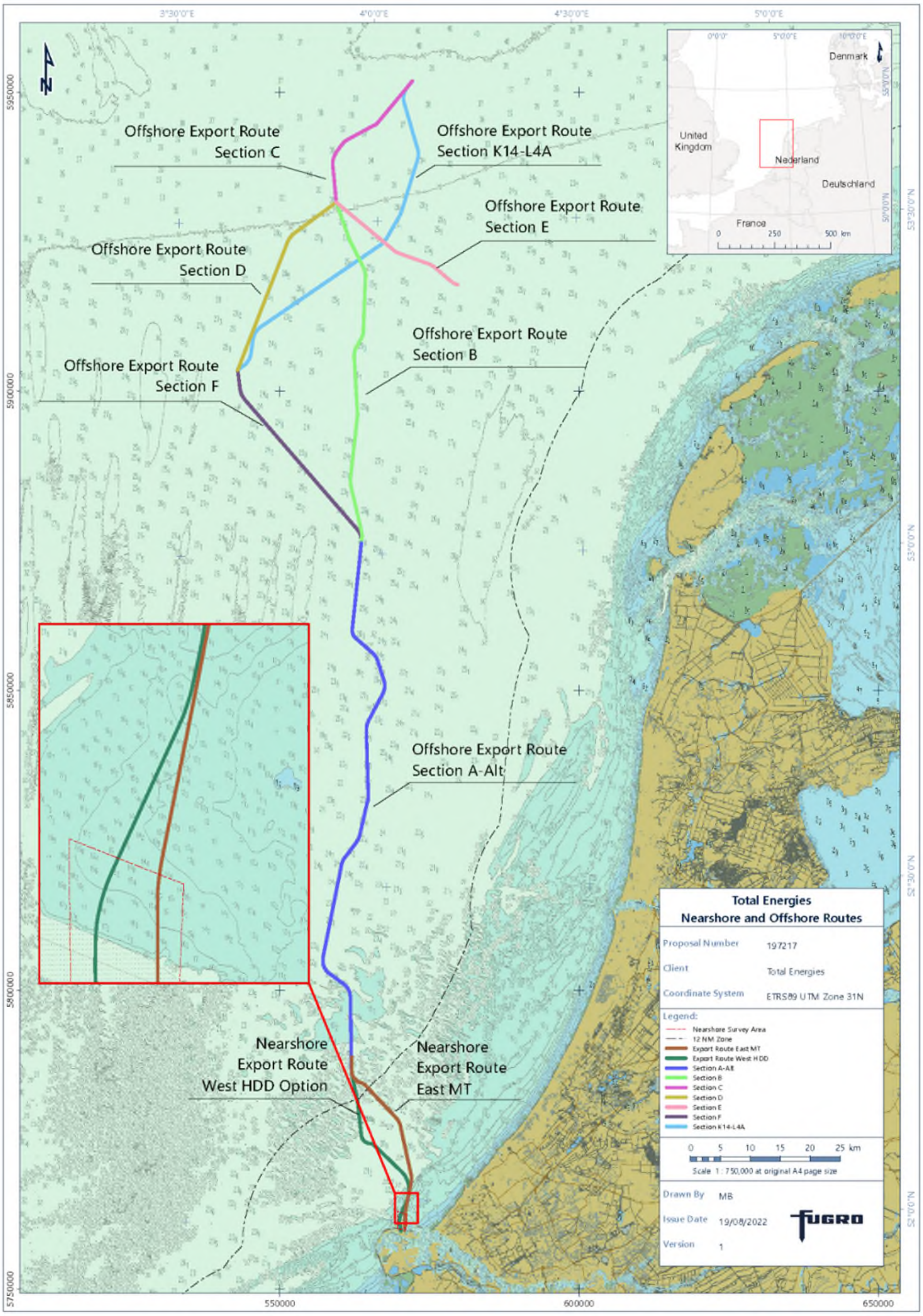


Figure 1.1: Overview of the Aramis trunkline route section divisions.

1.3 Geodesy

The project geodetic and projection parameters are summarised in Table 1.1.

Table 1: Project geodetic parameters

Name: ETRS89 / UTM zone 31N {ETRF2000-ITRF2014}, LAT (NL) [NLLAT2018]		
EPSG Code	EPSG:25831	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum:	International Terrestrial Reference Frame 2014	EPSG: 1165
Ellipsoid:	GRS 1980	
Semi major axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257 222 101	
Local Geodetic Datum Parameters		
Datum:	ETRS89	EPSG: 6258
Ellipsoid:	GRS 1980	
Semi major axis:	a = 6 378 137.00 m	
Inverse Flattening:	1/f = 298.257 222 101	
Datum Transformation Parameters from ITRF2014 to ETRS89 (Note 2, Note 3)		
X-axis translation 0.05595 m	X-axis rotation –0.0027132″	Scale difference 0.00349455 ppm
Y-axis translation 0.05345 m	Y-axis rotation –0.016413″	Coordinate Frame Rotation
Z-axis translation –0.09784 m	Z-axis rotation 0.0265287″	FUGRO: 41366
Project Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 31N	EPSG: 16031
Latitude origin:	00° 00′ 00.000″ N	
Central meridian:	003° 00′ 00.000″ E	
Scale factor on central meridian:	0.9996	
False easting:	500 000 m	
False northing:	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	LAT (NL)	FUGRO: 41043
Datum	LAT Datum (NL)	FUGRO: 40917
Transformation	ETRS89 to LAT (2018)	FUGRO: 41475
Notes: *The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2022.496 (01/07/2022)		

Table 2: Validation calculation

ITRF2014	Test Point [Position]	Computed Point
Latitude	53° 32′ 37.50000″ N	53° 32′ 37.50000″ N
Longitude	004° 16′ 30.00000″ E	004° 16′ 30.00000″ E

ITRF2014	Test Point [Position]	Computed Point
Ellipsoidal height	0.000 m Ell	0.000 m Ell
ETRS89		
Latitude	53° 32′ 37.48043″ N	53° 32′ 37. 48043″ N
Longitude	004° 16′ 29.97086″ E	004° 16′ 29.97086″ E
Ellipsoidal height	-0.023 m Ell	-0.023 m Ell
UTM zone 31N		
Easting	584 484.290 m	584 484.290 m
Northing	5 933 516.515 m	5 933 516.515 m
Chart datum height	-40.248 m	-40.248 m

1.4 Vertical Datum

All vertical data for the survey were reduced to Lowest Astronomical Tide (LAT).

Vertical Datum	
Vertical coordinate reference system	ETRS89 to LAT height using NLLAT2018

2. Mobilisation, Operation and Processing

2.1 Mobilisations

The geophysical survey was carried from 3 July 2022 with the Fugro Seeker to 24 January 2023 when the Fugro Searcher left the project.

Table 3: Summary of events

Event	Dates
Mobilisation of Fugro Seeker	3-12 July 2022
Demobilisation of Fugro Seeker	14-15 October 2022
Mobilisation of Fugro Discovery	8-11 November 2022
Demobilisation of Fugro Discovery	17 December 2022
Mobilisation of Fugro Searcher	7 October 2022
Demobilisation of Fugro Searcher	24 January 2023

Please refer to the single vessel mobilisation reports for details regarding the equipment calibrations performed prior the project (*197217-REP-MOB-SK(04)_Mobilisation Fugro Seeker, F197217-REP-MOB-DIS_R01_Mobilisation Fugro Discovery , 24-197217_FugroSearcher_Mobilisation_Report_Issue_01*)

2.2 Operations, Acquisition and Processing

Refer to table Table 2.2 for an overview of the different scope of work for each vessel.

Table 4: Survey structure

Vessel	Scope of Work
Fugro Seeker	Geophysical Survey, Nearshore Including: MBES, SSS, SBP, MAG, 2D UHRS, seismic refraction and MASW, UXO Survey
Fugro Discovery	Geophysical Survey, Offshore Including: MBES, SSS, SBP, MAG
Fugro Searcher	Geophysical Survey, Offshore Including: MBES, SSS, SBP, MAG, 2D-UHRS, UXO survey and EBS
Kommandor Orca / Normand Mermaid	Geotechnical Survey Including: CPT testing and Vibrocore sampling

2.2.1 Operations – Fugro Seeker

The Seeker conducted a geophysical survey for the Nearshore area with multiple scopes as detailed in Table 2.3.

The objective of the survey was to identify and delineate any possible constraints and hazards from man-made, natural and geological features, which may affect the integrity of the investigation site/development area.

Table 5: Scope of work of Seeker

Area of Operation	No. Lines	Line km	Scope Requirements
Analogue Geophysical Scope	91	141.4	MBES, SSS, SBP and MAG collected on all survey lines.
UXO Scope	225	58.1	UXO - Miniwing
UHRS Scope	41	71.9	2D-UHRS seismic equipment
Refraction Seismic and MASW Scope	32	31.7	150 m refraction and MASW streamer & 90m MASW streamer

Initial Quality Assurance (QA) and processing of data acquired by all sensors was carried out onboard the vessel. Multibeam backscatter (MBBS), multibeam echosounder (MBES), side scan sonar (SSS) and sub-bottom profiler (SBP) data were sent to the Fugro office in Portchester, UK for full quality control (QC), final processing, and interpretation. UHRS data were sent to the Geo Surveys office for full QC, final processing, and interpretation. Refraction Seismic and MASW data were sent to the Fugro France officer for full QC, final processing, and interpretations.

2.2.2 Survey Requirements – Fugro Seeker

Table 6: Survey requirements overview

Equipment Method	Survey Requirements
Vessels	Seeker
Proposed Pipeline Survey Line Spacing	■ Line spacing varied between blocks A & B: ■ Block A line spacing was 20 m ■ Block B line spacing was 40 m. ■ Crosslines were set along the two potential cable routes with parallel wing lines offset 50 m either side of the main crosslines.
Survey Priority	Where sufficient overlap was not created infill lines were collected;
Target Vessel Speed	4.0 Kts
Surface Positioning	■ Two independent positioning systems with full quality control amenities ■ Positioning accuracy ± 2 m
USBL	■ <10s gaps; ■ Positioning accuracy ± 2 m;
Multibeam Echosounder	■ As per Section 4.4 of the Scope of Work and tender deviations ■ THU < 1.0 m (1.141σ), TVU < 30 cm (1σ) ■ Acquisition of high-resolution swath bathymetry data within the planned survey area. ■ Minimum hit count of 16 soundings per 1 m DTM cell size. 200 m^2 of continuous area with <16 soundings per 1 m bin require infill. ■ 20 % overlap of MBES
Multibeam Backscatter	To be recorded and processed at 0.5 m resolution.

Equipment Method	Survey Requirements
Side Scan Sonar	■ As per Section 4.5 of the Scope of Work. ■ Dual operating frequency fish: minimum 300 kHz (low frequency) & minimum 600 kHz (high frequency). ■ 200 % coverage across the site, 100 % in the SSS nadir ■ Target resolution ≥ 0.5 m with high frequency (HF). ■ Mosaic resolution at 0.1 m
Innomar SBP	■ As per section 4.6 of the Scope of Work. ■ System resolution of up to 0.2 m penetration through unconsolidated sediments to a target depth of up to 10 m depending on water depth, geological and environmental conditions. ■ Output > 8 Kw ■ Beamwidth at 3 dBD ± 1º ■ Primary frequency 85 kHz to 115 kHz ■ Low frequency 2 kHz to 222 kHz ■ Soft start required
Magnetometer	■ As per section 4.7 in the Scope of Work ■ Single magnetometer with high sensitivity (0.01 nT) ■ Positioning known to within ± 2 m
SVP	■ Speed of sound in water measured in the survey area at the start of each day (as a minimum) and whenever deemed necessary (i.e. beginning to have MBES refraction artefact); ■ SVP sensor should have an accuracy of ± 0.05 m/s
2D-UHRS	As per section 4.9 in the Scope of Work.
Refraction Seismic and MASW	■ As per section 4.10 in the Scope of Work ■ 48 hydrophone streamer plus one spare; ■ Source (air gun) and trigger together with spare parts; ■ PC's in sufficient quantity to cover data acquisition and QC needs; ■ Software sufficient to cover data acquisition and QC/computing needs (refraction software); ■ Relevant Geodetic instrumentation for positioning/grid setting.

2.2.3 Processing – Fugro Seeker

2.2.3.1 Multibeam Echosounder

Table 7: Multibeam echosounder

Multibeam Echosounder	
Requirement	■ 0.25 m grid resolution ■ Minimum density 16 valid pings per 1 m^2 ■ Simultaneous recording of backscatter
Equipment	Two hull mounted Teledyne RESON 7125 multibeam echosounders with full rate dual head functionality.

<table>
<tr><th colspan="2">Multibeam Echosounder</th></tr>
<tr><td>Data Collection</td><td>

Multibeam data were collected in accordance with Fugro’s standard work instructions, a component of Fugro’s quality management system, which complies with the requirements of ISO 9001:2015, ensuring that data is collected in accordance with the scope of work and Fugro’s work instructions WI351,352,356,362,110-402.
On Seeker a dual-head Teledyne RESON 7125 multibeam echosounder system was pre-mobilised and consists of two transmit and receive arrays, one mounted on each hull.
A Valeport Mini SVP was deployed by hand to measure the sound velocity of the water column, prior to the start of survey operations and at least once during each 6 to12 hour period.
A RESON SVP-70 was mounted near the transmit array to determine the speed of sound at the transducer face and account for ray bending at the acoustic source. Continuous speed of sound measurements was provided by the SVS to the multibeam system.
A real-time comparison was set up between the SVS and SVP readings as an indication of MBES refraction errors. If the comparison was greater than 2 m/s, the online surveyor assessed the raw data for refraction artefact. If an unresolvable refraction error existed, another SVP cast was taken and input to Starfix NG.
Fugro used best industry practice to achieve the required 16 hits per 1 m bin requirement in the first instance by operating the multibeam echosounder at full rate dual head mode. During survey operations multibeam settings were constantly monitored to ensure optimal performance. Swath angle and vessel speed was monitored and reduced in deeper waters to focus the same number of receive beams over a smaller seabed area to ensure hit count was maintained. The effect of reducing swath width was reduced seabed coverage and therefore reduced line spacing.
Prior to commencement of the survey a verification was undertaken for the following variables: i) latency, ii) pitch, iii) roll, iv) yaw. The verification data were processed before the start of the survey as described in Fugro’s work instruction WI-207 and WI-229. At intervals throughout the survey this was repeated to ensure there has been no change to the calibration parameters. Calibrations were described in a mobilisation report.
During vessel calibrations, a comparison of all SVP’s was carried out with a simultaneous cast in a water depth similar to that expected during the survey.
Survey data were collected to the required survey specification and monitored using Starfix.NG online sounding grid and Caris HIPS&SIPS offline sounding grid QC statistics.

</td></tr>
<tr><td>Processing</td><td>

The data were processed according to Fugro’s standard procedures.

CARIS HIPS files were corrected for any sound velocity refraction errors.
When required, data point cleaning was conducted in CARIS using the CUBE algorithm, which used site specific parameters to ensure no valid data were removed (noise was flagged only and remained within the raw data set).

The CUBE algorithm search radius did not exceed the specified bin size. Data were finally quality controlled again to ensure compliance to the specification.

</td></tr>
<tr><td>Data Outputs</td><td>

Gridded soundings at 0.25 m (.XYZ ASCII / .tif);
Gridded hill shaded map (.tif)
Gridded THU at 1 m (XYTHU ASCII)
Gridded TVU at 1 m (XYTVU ASCII)
Gridded Slope at 1 m (XYS ASCII)
Vessel tracks (.shp)

</td></tr>
</table>

Multibeam Echosounder	
Methods and Resolution Limitations	■ The multibeam bathymetry data collected were of good quality. Any noise present in the data were removed and the remaining data were corrected for residual tide and sound velocity errors. Density, THU and TVU of MBES footprints were monitored during acquisition. This ensured all data met the requirements as set out in the technical specifications. ■ The multibeam backscatter data collected were of good quality. Optimum power and gain settings were utilised during data acquisition to ensure high quality acquisition. During the survey multibeam range changes were minimised to maintain the quality of the MBES data. ■ There was some nadir noise present, primarily on the lines in the shallowest areas. To counter this, noise filters have been applied over these areas and manual cleaning has been performed to remove the remaining worst affected areas.

2.2.3.2 Backscatter

Table 8: Backscatter methodology

Item	Description
Equipment	As per the Multibeam
Data Collection	A dual-head Teledyne RESON SeaBat 7125 SV2 FP3 multibeam echo sounder system was pre-mobilised and mounted onto the hull of the vessel. To minimise intensity variations of the backscatter mosaic, power and gain changes were kept to a minimum during the survey. Any setting changes were done during line turns if possible. Survey data were collected to the required survey specification.
Processing and Interpretation	Following acquisition, data were returned to Fugro's Portchester office and copied to a dedicated project network with replication between the Portchester office and an on-site location. Backscatter data contained in the files were imported to the Fledermaus Geocoder toolbox (FMGT) in order to generate a georeferenced mosaic at suitable resolution. The software package was processed by taking the backscatter intensity of each survey line and applying corrections in an attempt to normalise the backscatter intensities. Corrections applied allowed for the differing intensity due to beam angle gain power, beam pattern and radiometric correction due to signal attenuation. Once the corrections were applied the final mosaicked intensity values represented the actual reflectivity of the seafloor. Manual normalisation was carried out where necessary, within FMGT to apply a brightness bias to individual survey lines to further improve the mosaic.
Data Outputs	Multibeam backscatter data grid at 0.5 m resolution (.XYA ASCII / .tif)

2.2.3.3 Subsea Positioning

Table 9: Subsea positioning.

Subsea Positioning	
Requirement	■ Provide positioning information to towed seabed sensors; ■ Update rate of 0.5 Hz or better (preferred is 1 Hz); ■ Consistent dropouts of duration > 5 seconds not accepted; ■ Following calibration of the USBL system, 95% (2 sigma) of beacon positions within ± 1 m.

Subsea Positioning	
Equipment	■ Sonardyne Mini Ranger 2 USBL system ■ Sonardyne WSM6+ transponders.
Data Collection	■ Underwater positioning data were collected in accordance with Fugro's quality management system, which complies with the requirements of ISO 9001:2015 with specific reference to work instruction WI-212; ■ The USBL transceiver was pole mounted. The USBL system received the following data corrected for the USBL transceiver location from the Fugro Starfix.NG navigation system: • Position (from Fugro StarPack GNSS); • Heading (from Applanix POSMV); • Motion (from Applanix POSMV). ■ Additionally, SVP cast information was uploaded to the USBL system after each SVP was undertaken; ■ The Fugro Starfix.NG navigation software was setup with a visual alert to highlight consistent and/or long-duration beacon dropouts to the online surveyor; ■ Prior to the start of the survey the system was calibrated, and the calibration verified by "boxing in" a seabed transponder. During calibration a transponder beacon was deployed in an area where seabed depth was appropriate for the survey site and expected towing distance. An SVP cast was conducted and entered into the system, to ensure scale errors and errors due to refraction are minimised. A series of calibration lines were recorded while the USBL interrogated the transponder. After the calibration lines were recorded, the data were processed, and a calibration report generated. Data had to be filtered to ensure accurate calibration values. The calibration values were entered into Starfix and verified by confirmation lines recorded over the seabed transponder. Once the calibration was completed, the seabed transponder was recovered by use of an acoustic release system.
Methods and Resolution Limitations	The subsea positioning was generally good throughout the survey. At mobilisation, unprocessed SSS data were found to have an average target position deviating less than < 2.0 m from the position of the same target derived from MBES. Data required a very minimal amount of de-spiking, positioning was generally good throughout the survey.

2.2.3.4 Side Scan Sonar

Table 10: Side scan sonar

Side Scan Sonar	
Requirement	■ Minimum 200% coverage (100% nadir coverage is required); ■ Data resolution sufficient for detection of seabed objects/features ≥ 0.5 m (height, width or length); ■ XY precision and accuracy of ≤ ±2.0 m; ■ Survey speed of 4.0 knots ±10%, dependent on currents and acceptability of the data; ■ Infill required where USBL gaps of more than 10 seconds along the survey line; ■ Altitude of approximately 10% of operational range, dependant on water depth and operational safety considerations such as the height of the piggybacked MAG.
Equipment	■ EdgeTech 4200 side scan sonar (300/600 kHz); ■ USBL sub-sea positioning;

Side Scan Sonar	
	■ EdgeTech Discover data acquisition software; ■ Chesapeake SonarWiz data processing software.
Data Collection	■ Side scan sonar data were collected in accordance with Fugro's Standard Procedures WI02_351, WI02_353 and WI02_354; ■ The dual channel, dual frequency side scan sonar operated at a 50-75 m range to achieve the project requirements for coverage and resolution; ■ Throughout the survey, both the high and low frequencies were recorded. Data were recorded as both XTF and JSF formats. Survey logs listing the data collection parameters were maintained throughout the survey; ■ The SSS was positioned using USBL, with a beacon mounted on the aft handle of the instrument itself with no additional offset to the transceiver required. The system was set up, and data recorded in adherence to WI02_120 and WI02_220; ■ Comprehensive survey logs listing the data collection parameters were maintained throughout the survey. Quality was continuously monitored by the online geophysicist using the online displays; further details regarding quality, possible re-runs and equipment performance were noted in the online log.
Processing	■ Data QC, data processing and contact picking were completed by geophysicists at Fugro's Portchester office; ■ The high frequency data were processed in SonarWiz from the JSF files (processing of low frequency data were not required, as stipulated in the scope of work); ■ Data files were imported into SonarWiz processing software. The navigation was checked on import with corrections applied where required. The files were then bottom-tracked before the data files were gain adjusted. As a standard the Empirical Gain Normalisation (EGN) function was used to preserve changes in reflectivity from seabed sediment variations. Where required, additional Automatic Gain Control (AGC) was used to minimise the effects of motion on the data. ■ The processor undertook QC of the positioning quality by using contacts or seabed features on lines run in opposite directions. The bathymetry data were also checked to ensure the data positioning was within expected tolerances; ■ Contacts over 0.5 m in any dimension were picked and classified. Where required, contacts were rationalised to the MBES position or to their position within sonar files.
Methods and Resolution Limitations	SSS data quality was generally good across the site. Areas of data observed to experience excessive snatch were removed and subsequently infilled with acceptable data, whilst artefacts were always minor they were easily trimmed due to the high data density. Positioning of the SSS data was generally very good across the site and was continually checked throughout the survey to ensure that it remained within the project specification of ± 2.0 m. Features present at the survey site were used to check the SSS positioning against the MBES data. During acquisition four factors resulted in limitations within the SSS data. Limitations were mitigated through processing or data were recollected where required. The limitations were: ■ Snatch in SSS data during marginal weather ■ Interference from the MBES ■ Sea defences in south of the survey area that bounces some of the acoustic signal back towards the vessel ■ Steep escarpment resulting in shadowing On numerous SSS lines, snatch was observed in varying degrees of severity, from only minor intensity differences requiring additional automatic gain control (AGC) to

Side Scan Sonar	
	strong distortion of contacts and features resulting in infill or re-runs. This was attributed to a combination of marginal weather, marine and river currents, and passing ship waves and was therefore unpredictable and difficult to mitigate. The data were reviewed on a line-by-line basis with EGN applied to ensure quality was always sufficient to meet the interpretation requirements. After the data were deemed acceptable, high-resolution low-intensity AGC filters were applied to the final mosaic which greatly enhanced the interpretability of the data. On the majority of the SSS data acquired with 75 m range, noise in the outer ranges was observed in both channels. Due to sufficient data coverage and overlap it was determined that there was no significant impact on the interpretability of the data. All lines had their displayed ranges limited to 60 m in the final mosaic which removed this noise. The western half of the southern boundary of the survey area was characterised by an extensive sea defence related to the port of Rotterdam. This extends approximately 50 m from the boundary and consists of regularly shaped rock armour for 10-15 m from the boundary, becoming irregular rock dump for the final 35-40 m of the slope. Shadowing was observed in the centre of the site following a general trend of WNW-ESE. This represented an escarpment along the northern edge of the actively dredged channel. As lines were run near-parallel with this feature, many of the shadow zones were subsequently ensonified by adjacent lines, enabling identification of contacts. However, in regions where the gradient became very steep, the SSS was unable to ensonify these regions regardless of heading direction.

2.2.3.5 Sub-bottom Profiler

Table 11: Parametric sub-bottom profiler

Parametric Sub-bottom Profiler	
Requirement	■ 10 m penetration; ■ Vertical resolution: 0.2 metres; ■ Total horizontal uncertainty 2 m or better.
Equipment	■ System: Innomar SES-2000 Medium Parametric sub-bottom profiler; ■ Acquisition system: SESWIN; ■ Conversion Software: SES Convert; ■ Processing Software: RadExPro.
Data Collection	■ Sub-bottom profiler data were collected in accordance with Fugro's standard procedures, a component of Fugro's Quality Management System, which complies with the requirements of ISO 9001:2015, ensuring that data is collected in accordance with the scope of work and Fugro's procedures; ■ A test was undertaken at the start of the survey to determine the optimum settings to achieve the best records with the system. As the survey progressed the system was adjusted to obtain the best records. Each change was entered into the survey logs; ■ The data were acquired in a raw format and converted into SEGY. The data were frequency filtered online for the purposes of QA, although this filter was not applied to the recorded SES3 files. The optimum settings were determined as appropriate to the site; ■ All data were recorded digitally in the SESWIN acquisition system along with positional data from the positioning system provided by Fugro Starfix. Any duplicates in source coordinates caused by shot interval and navigation point separation were corrected using an interpolation method;

Parametric Sub-bottom Profiler	
	■ Comprehensive survey logs listing the data collection parameters were maintained throughout the survey. Quality was continuously monitored by the online geophysicist using the online displays; further details regarding quality, possible re-runs and equipment performance were noted in the online log.
Processing	■ All data were quality checked and processed according to Fugro's standard procedures; ■ Initial data QC, data processing and deliverables were completed at Fugro's offices in Portchester: • Heave compensation. • Amplitude Correction: Time raised to the power: 2.0; • Bandpass filtering Low cut frequency 2,200 Hz and High cut frequency 14,000 Hz; • Burst Noise Removal: Window size: 7 traces, Rejection percentage of alpha trimmed average: 50%, Exclude amplitudes lower than 5% of average. ■ Data and navigation QC.
Methods and Resolution Limitations	SBP data quality was monitored throughout the survey and generally deemed to be high. The acquisition frequency was kept constant (6 kHz) throughout the project to maximise penetration. Across the site average depth penetration of the SBP data ranged between 5 – 10 m. Positioning of the SBP data was verified to ensure that it remained within the project specification of ± 2 m. Features present within the survey site were used to check the SBP positioning against the MBES data. During acquisition several factors resulted in limitations within the SBP data. Limitations were mitigated or data were recollected where possible. Limitations included: ■ Anthropogenic features impacting data penetration and quality. ■ Regions of seismic data transparency ■ Masking of data due to acoustic blanking ■ Unfit data quality due to aeration of water column ■ Weather effects

2.2.3.6 Single Magnetometer

Table 12: Magnetometer

Single Magnetometer	
Requirement	■ 10 m maximum flying altitude; ■ Magnetometer sampling frequency: 10 Hz; ■ Maximum noise level: ±1.5 nT; ■ Lateral blanking distance shall be 2.5 m and cell size of 0.5 m for grids; ■ Data rejected for any USBL gap or altitude out of spec for more than 10 seconds.
Equipment	■ 1x Geometrics G882 magnetometer fitted with a depth sensor and altimeter; ■ USBL subsea positioning; ■ Starfix data acquisition software; ■ Oasis Montaj data processing software.
Data Collection	■ Magnetometer data were collected and processed in accordance with Fugro's standard procedures, a component of Fugro's Quality Management System, which complies with the requirements of BS EN ISO 9001:2008.

<table>
<tr><th colspan="2">Single Magnetometer</th></tr>
<tr><td></td><td>

The magnetometer was positioned using the USBL. Real-time positions for the sensor was then output to the acquisition software and recorded along with the magnetometer readings and altitude data. Magnetometers were towed at less than 10 m altitude, as close to the seafloor as possible.
Magnetometer values in nT, depth and altimeter readings were collected at an update rate of 10 Hz. The data were logged in Starfix acquisition software together with navigation information and a time stamp.
Additional required fields such as USBL sensor to vessel range were output from the navigation software and were logged as a separate text file. The data were sampled into the raw Oasis Montaj database on import.
Magnetometer data were continuously QC'ed by personnel in Fugro's office in Portchester, UK. Re-runs and infills were acquired based on out of specification cases for magnetometer data.

</td></tr>
<tr><td>Processing</td><td>

All data were processed and reported according to Fugro's standard procedures;
All magnetometer data were QC'ed for data quality and processed at Fugro's offices in Portchester, UK. Processing was followed by gridding, picking and preparation of final deliverables;
Magnetometer gaps / reruns and infill sections were finalized from onboard Seeker when required;
Fugro's magnetometer processing and interpretation procedure can be broadly separated into the following stages:

Data import;
Navigation processing and QC of all data;
Export of all data for processing in Oasis Montaj;
Import into Oasis Montaj;
QC all data channels and double check for navigational errors;
De-spiking and QC of total field and altitude data;
Removal of data where the signal strength <100;
Removal of data set sections exhibiting greater than ±1.5 nT noise tolerance;
QC of total field data, signal strength and altitude;
Filtering and calculating residual.
Gridding of the total field data, magnetic residual, signal strength and altitude;

Data were reviewed on a line-by-line basis and any sections exceeding system noise parameters (typically ±1.5 nT), altitude > 10 m and signal strength <100 were removed before gridding. Any data gaps resulting from such a process were infilled as required;
Filtering and calculating the residual values involved the selection of suitable parameters to ensure that background variations in the magnetic field were removed, without affecting any potential anomalies. Data were subject to a beta-spline filter, followed by a series of non-linear filters with decreasing width and tolerance;
The calculated background field was subtracted from the measured field to produce the magnetic residual;
Data were interpreted as gridded datasets and profiles.

</td></tr>
<tr><td>Methods and Resolution Limitations</td><td>The magnetometer data quality was monitored throughout the survey. Spatial accuracy within 2 m was achieved with a USBL positioning beacon placed on the towed side scan sonar fish. The overall data quality was good. The processors QCed the positioning and quality of the magnetometer data, all data met the specification requirements of the project.</td></tr>
</table>

Single Magnetometer	
	During acquisition, limitations to the data quality arose from challenges that were encountered as part of data collection. Limitations included: ■ Magnetic signal spikes (due to defect equipment) ■ Signal strength below 400 ■ Navigation gaps longer than 10 seconds due to USBL failures When limitations in the data quality arose, the data were checked. Where possible small spikes were interpolated and short drops in signal strength were assessed to identify the impact on data quality. For the navigation gaps, and in regions where the reduction of signal strength impacted the data quality, data were infilled.

2.2.3.7 2D-UHRS

The seismic data acquisition was performed using an ultra-high-resolution seismic system including a single Geo-Source 400 tips LW sparker, two 2000XFO HV Geo-Spark power supplies, 24- channel streamer with a 1+2 m group interval, a 24-channel recording system, a single element reference hydrophone and GNSS positioning systems for the streamer's front buoy and tail buoy and source.

Figure 2.1 describes the 2D-UHRS equipment and the general acquisition parameters used in this project.

Sources	1x Geo-Source 400 tips LW
Source Towing Depth	0.3 m
SP Interval	1 m
Operating Power	Source @ 400J
Tuned delay	-
Power Supply	2 X Geo-Spark 2000XFO
CDP Bin Coverage	≈24 fold for 1 m CDP bin
Recorder	4x Multitrace24 – Geomarine Survey systems
Sample Rate	0.1 msec
Record Length	200 ms
Format	SEG-Y
Multichannel Streamer	Geo-Sense LW 24 channels
Streamer Depth	≈ 0.4 – 1.3 m
Group Interval	1+2m
Group Active Length	35 m
Reference hydrophone	Geo-Sense reference hydrophone – single element
Hydrophone Depth	5 m from the source
Group Interval	Single element
Group Active Length	Point receiver

Figure 2.1: Fugro Seeker 2D-UHRS system and parameters.

The seismic spread geometry used during the survey is presented in the Figure 2.2 with the respective measurements - offsets.

Refer to the *2D UHRS Survey Field Report*, part of the *F197217-REP-RES-002_Nearshore Geophysical Survey Report*, for a detailed description of the 2D-UHRS processing method.

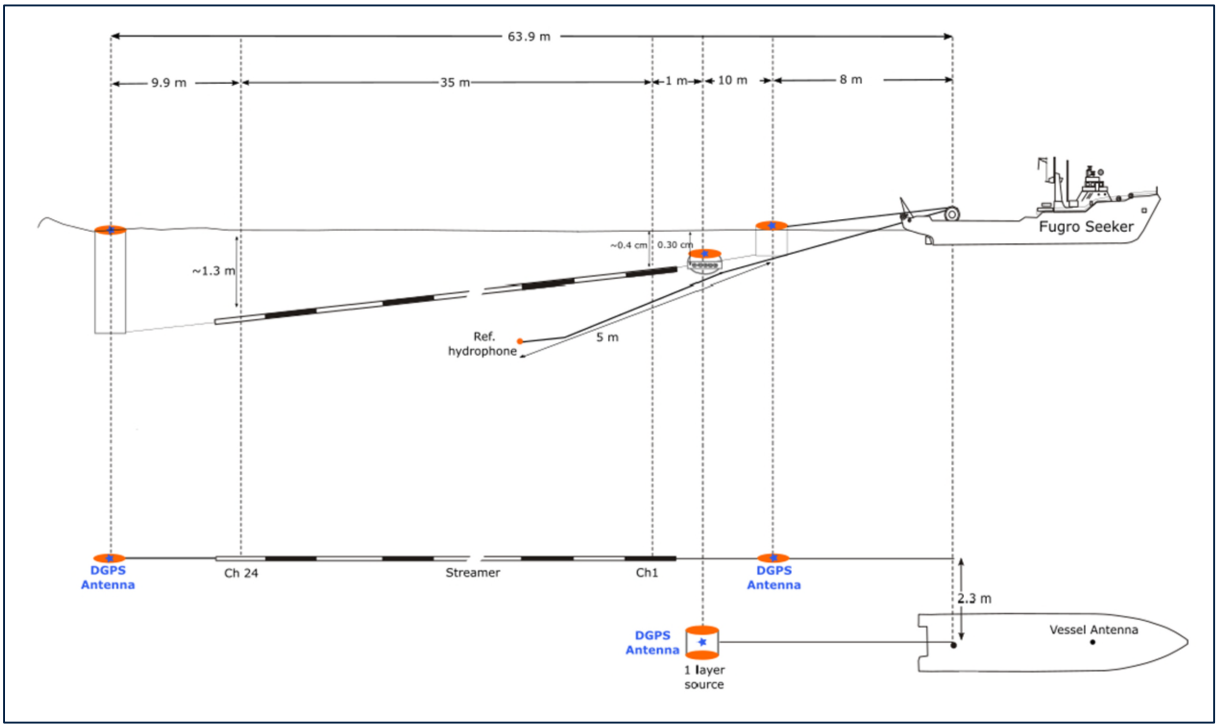


Figure 2.2: Vessel layout.

2.2.3.8 Refraction Seismic and MASW Scope

For the Refraction Seismic and GAMBAS scope, the line plan consisted of 39 lines in two parts. Within the shallow parts of the site, to the north and south of the channel, a 150m refraction and MASW stream was used. Within the deeper area of the channel, a 90m MASW streamer was used. The lines in the main channel, and some lines to the South, were parallel to the channel. The lines to the North of the channel were oriented North – South.

During acquisition, the Client requested Seeker concentrated on a set of priority lines due to the prospect of unworkable weather impacting progress. This reduced the number of remaining lines by half and involved acquiring every second line. Following the completion of priority lines, a further two non-priority lines were acquired whilst awaiting Client confirmation to cease acquisition. A total of 32 lines covering 31.7km were acquired.

Table 13: Refraction Seismic and MASW Scope

Single Magnetometer	
Requirement	■ Vessel speed <2.2knots ■ Sledge and streamer on the seabed
Equipment	■ Access channel: 48 hydrophones variable spacing, total length 90m, for MASW and Refraction acquisition ■ Shallowest water: Combination of 1 x 24 low frequency hydrophones (MASW+refrac) ■ 45m and 1x24 standard hydrophones (refrac only) 115m long. Total streamer length of approximately 150m allowing deeper penetration. ■ USBL subsea positioning for the sledge

Single Magnetometer	
Data Collection	▪ Streamer and sledge were lowered down on the seabed 300m before the start of a line and brought back at the surface when a line was completed. ▪ Acquisition started when the USBL showed that the sledge was at the beginning of the line and stopped when the sledge was after the end of the line to maximise coverage. ▪ Buffer zones were decided onboard, for example when we had to deviate from the line because a buoy was there and equipment could get tangled in it. ▪ The control panel on deck that fires the airgun gave the instruction to both the seismic recording system and the navigation system to log the data. ▪ Recording parameters: length of 2sec and sampling rate of 0.250ms. ▪ Air gun pressure between 95 and 110bars. ▪ On-line QC was done for refraction and MASW data. It consisted of a check of individual hydrophone validity, validation of signal to noise ratio, checking that we could pick the first arrivals on the whole streamer for refraction and checking that we could see a dispersion curve for MASW. The position of the sledge was also checked in real time.
Processing	▪ The processing involves 3 main steps: • Merge of positioning, bathymetric and seismic data; • Picking of regression curves for refraction; Picking of dispersion curves for MASW; • QC and exports of bar charts and maps. ▪ The seismic refraction processing itself includes starts with the picking of the first arrival of the compressional wave recorded at each hydrophone. Picked times measured for each trace feed a Time-Distance curve for each shot point. Regression of Time-Distance curve allows to extract a series of compressional wave velocities (Vp) and corresponding thicknesses are identified. Each pair of values Vp - thickness is representative of a layer of constant average velocity. ▪ The MASW processing starts with the picking and extraction of the dispersion curve of the fundamental mode for every shot. After inversion of every dispersion curve, data are merged and kriged to produce a 2D section of shear waves velocities (Vs).
Data Outputs	▪ Refraction: Gridded bar charts which is the raw VP profile, meaning no smoothing, filtering or kriging has been applied. ▪ MASW: Gridded 2D sections with kriging applied.

2.2.4 Operations – Fugro Discovery

The objective of the survey was to identify and delineate any possible constraints and hazards from man-made, natural and geological features which may affect the integrity of the exploration site/development area.

The geophysical survey line plan covers the pipeline RPL options with a centreline and contains a further eight wing lines, four per side. Line spacing is 60 m inside a 480-metre-wide corridor.

2.2.5 Survey Requirements – Fugro Discovery

Table 14: Work Element 3 survey requirements overview

Equipment Method	Survey Requirements
Vessel	Fugro Discovery
Line Spacing	Geophysical 60 m
Max. Vessel Speed	4 knots (±10%)
Surface Positioning	■ THU < 1.0 m (1.414 – σ) ■ TVU < 30 cm (1 - σ)
Subsea Positioning	Fugro will only be able to repeatedly achieve +/- 1 m accuracy for USBL calibration and +/-2 m accuracy for data acquired from towed sensors. i.e., a processed target accuracy of +/-2 m for SSS and magnetometer.
Multibeam Echosounder	■ 100% coverage with 20% overlap between lines ■ 0.25 m x 0.25 m bin size / 16 x pings per 1.0 m x 1.0 m
SVP	■ The speed of sound in water shall be measured in the survey area. ■ The Vertical Sound Velocity Profiles should be undertaken with an accuracy of ±0.05 m/s
Side Scan Sonar	■ ≥0.5 m target size ■ 200% coverage, 100% coverage in the SSS nadir ■ Infill required where USBL gaps > 10 s
Magnetometer	■ Single magnetometer ■ 5 - 10 m altitude ■ Magnetometer sampling frequency: 10 Hz ■ Target size 5 nT ■ Noise Level ± 1.5 nT (3 nT in total) ■ Lateral blanking distance shall be 2.5 m ■ Infill required where USBL gaps > 10 s, altitude out of spec for more than 5 m, or signal strength < 100
Sub-bottom profiler	10 m penetration with 0.2 m resolution

2.2.6 Processing – Fugro Discovery

2.2.6.1 Multibeam Echosounder

Bathymetry data collected from the hull mounted dual head Kongsberg EM2040 multibeam echosounder onboard the survey vessel, were processed with CARIS Hydrographic Information Processing System and Sonar Information Processing System (HIPS and SIPS) software (Version 11.4). The CARIS HIPS and SIPS general workflow is presented in Table 2.12. Neighbouring blocks were systematically merged towards completion of data processing.

Table 15: CARIS HIPS and SIPS bathymetry processing workflow

CARIS HIPS Work Step	Description
1. Raw MBES Data	MBES raw data as logged by Kongsberg SIS
2. HIPS Vessel File	Before data were converted into Caris HIPS, a so-called HIPS Vessel File (HVF) was defined. This HVF contains all relevant sensor definitions with information regarding offsets, correction values, and system configurations. The HVF defines amongst others: ■ Offsets relative to the centre reference point (CRP);

CARIS HIPS Work Step	Description
	■ Sound velocity information; ■ Dynamic MBES motion (heading, roll, heave, pitch); ■ Static corrections for gyro heading and error for roll, heave and yaw heading alignment of the multibeam system; ■ Static TPU (total propagated uncertainty) settings including offsets and survey equipment standard deviations (based on technical specifications).
3. Data Conversion to HIPS	The multibeam raw data exported from the acquisition software was converted into HIPS format. Positioning information included in the raw data is based on geographical coordinates.
4. Quality Control (navigation, attitude data)	Navigation and attitude data were checked for spikes. This was done manually or by using self-defined filters. Spikes were marked and flagged as 'not to be used for further calculation.' Coverage was carefully checked for gaps and data density and infill lines were surveyed if necessary. Secondary (backup) systems for navigation and attitude data could be added to the HIPS and SIPS project if required.
5. Swath Filter	Depth information of one survey line was filtered for spurious values and data not to be used. Filter settings for flagging data as rejected can include the following settings: ■ Min-max. accepted depth range; ■ Distance off nadir; The filters are applied according to the encountered morphology, weather conditions etc. The applied values may vary from area to area. Nevertheless, each line was checked separately, and the filter parameters were adapted if necessary.
6. Tide Reduction	All depths were reduced to LAT using the NL2018LAT MSS model within Caris HIPS & SIPS. Navigation, motion and StarFix.G4+ GNSS elevation data were processed using Novatel´s Intertial Explorer software package. Ellipsoidal heights of the GNSS antennas were corrected for motions. The heights were reduced to the water line using draught and dimensional offset measurements. Waterline elevations are further reduced to the vertical datum (LAT) by means of NL2018LAT MSS model. A smooth tide curve was created to reduce MBES data to datum.
7. Sound Velocity Correction	Each track line was corrected for sound velocity.
8. Calculation of Final Position and Depth for each Beam (georeferenced bathymetry)	For each individual beam a position and a depth value were calculated with respect to vessel (gyro) heading, tide data (including dynamic draft) and sound velocity correction using time as correlation. In addition, the TVU and THU[1] for each sounding was calculated.
9. Create Work Surface	The pre-checked data were used to calculate a CUBE (Combined Uncertainty and Bathymetric Estimator) surface.
10. Surface Filter using "Swath Angle" grids	A HIPS "Swath Angle" surface allowing maximum sounding footprints was then used as a base for a surface filter, for which a data window of acceptance around this surface must be specified using certain parameters. The survey data is then checked against these conditions. Data outside the specified window of acceptance were rejected.
11. Create Quality Control Surfaces (CUBE)	The CUBE algorithm creates a hypothesis for the depth value of a grid cell from the first depth value that falls into a cell. Every following depth value is checked against this hypothesis and according to a variety of settings selected to contribute to the existing hypothesis, to create a new, second hypothesis or to be rejected. A most probable surface is resulting from these calculations. New base surfaces were calculated to check the result. Having undergone these procedures, the data is in a final state for delivery. Contour calculation was achieved by using Fugro Starfix Workbench and ESRI ArcGIS.

CARIS HIPS Work Step	Description
12. Quality Control	The data quality is mainly checked using the standard deviation, density (hit count), TVU/THU and visual bathymetry inspection. Local anomalies are removed manually or by a locally applied filter.
13. Data Export	As a deliverable from HIPS, a gridded and ungridded datasets were produced and exported as ASCII files. Fugro Starfix.Workbench and ArcGIS were used to create final deliverables.
Note 1: TVU and THU values were calculated using Caris HIPS&SIPS considering all contributing factors applicable for the vessels. TVU and THU are defined as follows by the IHO Standards for Hydrographic Surveys (S-44), 6th Edition: • Total horizontal uncertainty (THU): Component of total propagated uncertainty (TPU) calculated in the horizontal dimension. THU is a two-dimensional quantity with all contributing horizontal measurement uncertainties included. Total propagated uncertainty (TPU): Three-dimensional uncertainty with all contributing measurement uncertainties included. • Total vertical uncertainty (TVU): Component of total propagated uncertainty (TPU) calculated in the vertical dimension. TVU is a one-dimensional quantity with all contributing vertical measurement uncertainties included. • Uncertainty: Estimate characterising the range of values within which the true value of a measurement is expected to lie as defined within a particular confidence level. It is expressed as a positive value.	

2.2.6.2 Side Scan Sonar

Table 16: Side Scan Sonar

Side Scan Sonar	
Requirement	■ Minimum 200% coverage (100% nadir coverage is required); ■ Data resolution sufficient for detection of seabed objects/features ≥ 0.5 m (height, width or length); ■ XY precision and accuracy of ≤ ±2.0 m; ■ Survey speed of 4.0 knots ±10%, dependent on currents and acceptability of the data; ■ Infill required where USBL gaps of more than 10 seconds along the survey line; ■ Altitude of approximately 10% of operational range, dependant on water depth and operational safety considerations such as the height of the piggybacked MAG.
Equipment	■ EdgeTech 4200 side scan sonar (300/600 kHz); ■ USBL sub-sea positioning; ■ EdgeTech Discover data acquisition software; ■ Chesapeake SonarWiz data processing software.
Data Collection	■ Raw SSS data were logged in XTF and JSF formats in the EdgeTech Discover acquisition software, with smoothed navigation integrated within them from the Qinsy online navigation software. ■ The dual channel, dual frequency side scan sonar operated at a 50-75 m range to achieve the project requirements for coverage and resolution; ■ Throughout the survey, both the high and low frequencies were recorded. Data were recorded as both XTF and JSF formats. Survey logs listing the data collection parameters were maintained throughout the survey
Processing	■ The JSF formats files were then imported into SonarWiz on two separate projects, one for LF and HF. Navigation was smoothed with a 50-ping rolling mean on import. ■ All data were bottom tracked to allow slant range corrections to be applied. Position and heading smoothing were applied to remove slight navigation jumps. Further navigation filters were applied in SonarWiz where required. Empirical gain normalization (EGN) was applied for every single line to level and average the sonar amplitudes by altitude and range to construct a homogenous

Side Scan Sonar	
	mosaic. Some manual adjustments to the gains were required to ensure a good match throughout. ■ To check the accuracy of the navigation data, SSS data from adjacent lines, run in opposite directions on a known MBES position, are compared and verified against each other and against the bathymetry. ■ Nadir transparency was set to 1.5 m and where necessary, the displayed sonar range was reduced to trim out any environmental artifact or fish ghosts. ■ Line order was adjusted to improve the overall appearance of the mosaic, sending marginal quality data to the back, and aiming to minimise the number of visible artifacts. ■ All contacts greater than 0.5 m in any dimension were identified and listed. Contacts were manually picked on a line-by-line basis from the waterfall display using the HF data. These were then measured (width, length, and height), classified, and moved to the MBES position, where possible. ■ The contact list was exported as csv and after curating, was converted to shapefile format in ArcGIS.
Methods and Resolution Limitations	■ SSS data quality was generally good across the site.

2.2.6.3 Parametric Sub-bottom Profiler

Table 17: Parametric sub-bottom profiler

Parametric Sub-bottom Profiler	
Requirement	■ 10 m penetration; ■ Vertical resolution: 0.2 metres; ■ Total horizontal uncertainty 2 m or better.
Equipment	■ System: Innomar SES-2000 Medium Parametric sub-bottom profiler; ■ Acquisition system: SESWIN;
Data Collection	■ Innomar SBP data were logged in SES3 format by the SESWIN acquisition software, with navigation integrated within them from the Qinsy online navigation software. The geometry correction of the transducers to the Centre of Gravity (COG) is applied during acquisition in Qinsy and SESWin. The SES3 files were converted to SEGY format with the Innomar SESConvert software and merged if the file had been split on different segments on acquisition. During conversion, deduplication and interpolation of the raw navigation was conducted to ensure each slot contained a unique coordinate. ■ The output SEGY files were processed in the GeoSuite Allworks processing software.
Processing	■ The signal processing flow comprised the following steps: ■ Shifting the data as per the record delay; ■ Amplitude correction Automatic Gain Control Window Length: 10 ms Percent: 25 %; ■ Butterworth bandpass filter with a low-cut of 2 kHz, and a high-cut of 15 kHz; ■ Burst noise removal (Window: 7, Rejection: 50 %); ■ Where occasional residual heave was observed, a swell filter was designed on a line-by-line basis over a 50 trace length smoothing filter

Parametric Sub-bottom Profiler	
	■ After signal processing the tide correction was applied as a trace-by-trace tidal reduction applied to the COG using the tidal curve and further corrections of the SBP data for the vessel's heave and reduction of the data to LAT. ■ Ultimately, the LAT corrected SEGY files were exported together with their headers and imported into the Kingdom software for QC against the MBES data to ensure that the tidal correction was successful and that there was a good correlation between the two datasets.

2.2.6.4 Single Magnetometer

Table 18: Magnetometer

Single Magnetometer	
Requirement	■ 10 m maximum flying altitude; ■ Magnetometer sampling frequency: 10 Hz; ■ Maximum noise level: ±1.5 nT; ■ Lateral blanking distance shall be 2.5 m and cell size of 0.5 m for grids; ■ Data rejected for any USBL gap or altitude out of spec for more than 10 seconds.
Equipment	■ 1x Geometrics G882 magnetometer fitted with a depth sensor and altimeter; ■ USBL subsea positioning;
Data Collection	■ The data was recorded in QPS qpd-format and exported in an ascii text file format, with raw navigation integrated. Exported ascii files were then imported into Oasis Montaj for processing.
Processing	■ Once into Oasis Montaj the navigation data were cleaned; large spikes caused by any jumps in the USBL navigation were identified, removed manually and data interpolated. A 150-ping rolling mean filter was applied to remove any smaller erroneous values. ■ The raw altitude, signal, and magnetic total field were checked and manually de-spiked, with altitudes above the 5 m specification being masked in most areas. ■ Areas with signal strength below 400nT were carefully reviewed to ensure the data quality was still sufficient and consistent, being removed if not. Areas with signal strength below 100nT were deemed unreliable and were masked. ■ The optimum ß-Spline filter settings for this project have been evaluated to be Smoothness 0.6 and Tension 0. These values were used to filter the raw magnetometer readings. ■ A series of non-linear filters were applied to fit a smoothed curve to the data. The results of the non-linear filters were then subtracted from the results of the β-spline filter to calculate a residual magnetometer data channel. ■ The filtered data were gridded using the minimum curvature gridding method. For gridding, a grid cell size of 0.5 m and a blanking distance of 2.5 m were used. ■ Magnetic anomalies were picked manually on the total field profiles and reviewed against the residual field grid to remove duplicates and erroneous picks, and to manually pick any missed anomalies. The reviewed list of anomalies was then manually measured for peak-to-peak amplitude.

2.2.7 Operations – Fugro Searcher

The objective of the survey was to identify and delineate any possible constraints and hazards from man-made, natural and geological features which may affect the integrity of the exploration site/development area.

The Fugro Searcher was assigned four sections (Section C, Section F, Section D and Section K14-L4A) of the offshore main pipeline corridor and the offshore hub area. The scope was divided in four scopes as presented in Table 2.13.

Table 19: Scope of work of Fugro Searcher

Area of Operation	Scope Requirements
UHRS Scope	2D UHRS, MBES Acquired on pipeline route centreline & offshore hub area
UXO Scope	MBES, SSS, SBP and MAG Acquired at two lines in the areas assessed as moderate UXO risk
Analogue Geophysical Scope	MBES, SSS, SBP, MAG Acquired at pipeline route centreline with 8 wing lines, as well as offshore hub area.
Environmental Scope	Environmental Baseline Study

The UXO Scope dataset is not presented in this report and dataset.

The results of the Environmental Baseline Study will be incorporate in the upcoming integrated report.

2.2.8 Processing – Fugro Searcher

2.2.7.1 Multibeam Echosounder

Table 20: Multibeam Echosounder

Multibeam Echosounder	
Requirement	■ 0.25 m grid resolution ■ Minimum density 16 valid pings per 1 m^2 ■ Simultaneous recording of backscatter
Equipment	■ Hull mounted dual head Kongsberg EM2040
Data Collection	■ Bathymetric data were logged within the Kongsberg SIS software for the EM2040 MBES, and within the Starfix. Logging application EA600 SBES system.
Processing	■ Data were post-processed using the Caris HIPS&SIPS suite of applications. Both single beam and multibeam echosounder data were corrected for transducer draught, acoustic velocity through sea water and vessel heave, pitch and roll, and then positioned with reference to the echosounder transducer. ■ Observed Mean Sea Surface (MSS) tides were recorded online. These tides were then reduced to Lowest Astronomical Tide (LAT) using the NL 2018 LAT model in the Dutch sector. ■ The multibeam echosounder (MBES) data were processed using both Kongsberg's online software, SIS, and Caris HIPS&SIPS SIS computed the x,y,z coordinates of the multibeam data by transforming the travel time and angle of the beams, using the water's sound velocity and the vessel's motion data. The MBES data were then processed using Caris HIPS&SIPS to monitor quality and overlap using automated methods and then edited using manual methods for final cleaning of any erroneous data from the swathes. The files were then merged to form one large regular 0.25 m× 0.25 m grid and filtered. Points

Multibeam Echosounder	
	outside the accepted tolerances were removed automatically. The resultant output file was generated to form a regular XYZ file. ■ All depths were reduced to Lowest Astronomical Tide (LAT).

2.2.7.2 Side Scan Sonar

Table 21: Side Scan Sonar

Side Scan Sonar	
Requirement	■ Minimum 200% coverage (100% nadir coverage is required); ■ Data resolution sufficient for detection of seabed objects/features ≥ 0.5 m (height, width or length); ■ XY precision and accuracy of ≤ ±2.0 m; ■ Survey speed of 4.0 knots ±10%, dependent on currents and acceptability of the data; ■ Infill required where USBL gaps of more than 10 seconds along the survey line; ■ Altitude of approximately 10% of operational range, dependant on water depth and operational safety considerations such as the height of the piggybacked MAG.
Equipment	■ EdgeTech 4200 side scan sonar (300/600 kHz); ■ USBL sub-sea positioning; ■ EdgeTech Discover data acquisition software; ■ Chesapeake SonarWiz data processing software.
Data Collection	■ Raw SSS data were logged in XTF and JSF formats in the EdgeTech Discover acquisition software, with smoothed navigation integrated within them from the Starfix online navigation software. ■ The dual channel, dual frequency side scan sonar operated at a 50-75 m range to achieve the project requirements for coverage and resolution; ■ Throughout the survey, both the high and low frequencies were recorded. Data were recorded as both XTF and JSF formats. Survey logs listing the data collection parameters were maintained throughout the survey
Processing	■ The JSF formats files were then imported into SonarWiz on two separate projects, one for LF and HF. Navigation was smoothed with a 50-ping rolling mean on import. ■ All data were bottom tracked to allow slant range corrections to be applied. Position and heading smoothing were applied to remove slight navigation jumps. Further navigation filters were applied in SonarWiz where required. Empirical gain normalization (EGN) was applied for every single line to level and average the sonar amplitudes by altitude and range to construct a homogenous mosaic. Some manual adjustments to the gains were required to ensure a good match throughout. ■ To check the accuracy of the navigation data, SSS data from adjacent lines, run in opposite directions on a known MBES position, are compared and verified against each other and against the bathymetry. ■ Nadir transparency was set to 1.5 m and where necessary, the displayed sonar range was reduced to trim out any environmental artifact or fish ghosts. ■ Line order was adjusted to improve the overall appearance of the mosaic, sending marginal quality data to the back, and aiming to minimise the number of visible artifacts. ■ All contacts greater than 0.5 m in any dimension were identified and listed. Contacts were manually picked on a line-by-line basis from the waterfall display

Side Scan Sonar	
	using the HF data. These were then measured (width, length, and height), classified, and moved to the MBES position, where possible. ■ The contact list was exported as csv and after curating, was converted to shapefile format in ArcGIS.

2.2.7.3 Single Magnetometer

Table 22: Magnetometer

Single Magnetometer	
Requirement	■ 10 m maximum flying altitude; ■ Magnetometer sampling frequency: 10 Hz; ■ Maximum noise level: ±1.5 nT; ■ Lateral blanking distance shall be 2.5 m and cell size of 0.5 m for grids; ■ Data rejected for any USBL gap or altitude out of spec for more than 10 seconds.
Equipment	■ 1x Geometrics G882 magnetometer fitted with a depth sensor and altimeter; ■ USBL subsea positioning;
Data Collection	■ The MAG data were recorded in StarfixNG and produced in FBF file.
Processing	■ Once into Oasis Montaj the navigation data were cleaned; large spikes caused by any jumps in the USBL navigation were identified, removed manually and data interpolated. A 150-ping rolling mean filter was applied to remove any smaller erroneous values. ■ The raw altitude, signal, and magnetic total field were checked and manually de-spiked, with altitudes above the 5 m specification being masked in most areas. ■ Areas with signal strength below 400nT were carefully reviewed to ensure the data quality was still sufficient and consistent, being removed if not. Areas with signal strength below 100nT were deemed unreliable and were masked. ■ The optimum ß-Spline filter settings for this project have been evaluated to be Smoothness 0.6 and Tension 0. These values were used to filter the raw magnetometer readings. ■ A series of non-linear filters were applied to fit a smoothed curve to the data. The results of the non-linear filters were then subtracted from the results of the β-spline filter to calculate a residual magnetometer data channel. ■ The filtered data were gridded using the minimum curvature gridding method. For gridding, a grid cell size of 0.5 m and a blanking distance of 2.5 m were used. ■ Magnetic anomalies were picked manually on the total field profiles and reviewed against the residual field grid to remove duplicates and erroneous picks, and to manually pick any missed anomalies. The reviewed list of anomalies was then manually measured for peak-to-peak amplitude.

2.2.7.4 Parametric Sub-bottom Profiler

Table 23: Sub-bottom profiler

Parametric Sub-bottom Profiler	
Requirement	■ 10 m penetration; ■ Vertical resolution: 0.2 metres; ■ Total horizontal uncertainty 2 m or better.
Equipment	■ System: Innomar SES-2000 Medium Parametric sub-bottom profiler; ■ Acquisition system: SESWIN;

Parametric Sub-bottom Profiler	
Data Collection	▪ Innomar SBP data were logged in SES3 format by the SESWIN acquisition software, with navigation integrated within them from the Starfixonline navigation software. The geometry correction of the transducers to the Centre of Gravity (COG) is applied during acquisition in Starfix and SESWin. The SES3 files were converted to SEGY format with the Innomar SESConvert software and merged if the file had been split on different segments on acquisition. During conversion, deduplication and interpolation of the raw navigation was conducted to ensure each slot contained a unique coordinate. ▪ The output SEGY files were processed in the RadExPro.
Processing	▪ The signal processing flow comprised the following steps: ▪ Shifting the data as per the record delay; ▪ Amplitude correction Automatic Gain Control Window Length: 10 ms Percent: 25 %; ▪ Butterworth bandpass filter with a low-cut of 2 kHz, and a high-cut of 15 kHz; ▪ Burst noise removal (Window: 7, Rejection: 50 %); ▪ Where occasional residual heave was observed, a swell filter was designed on a line-by-line basis over a 50 trace length smoothing filter ▪ After signal processing the tide correction was applied as a trace-by-trace tidal reduction applied to the COG using the tidal curve and further corrections of the SBP data for the vessel's heave and reduction of the data to LAT. ▪ Ultimately, the LAT corrected SEGY files were exported together with their headers and imported into the Kingdom software for QC against the MBES data to ensure that the tidal correction was successful and that there was a good correlation between the two datasets.

2.2.7.5 2D-UHRS

The 2DUHR Sparker data was recorded in Geometric GeoEel Controller with output file format as SEGD. The SEGD files were loaded into SeisQC software for quality check on acquisition geometry, basic geometry (streamer and gun depth), active channel, noise level, and velocity picking. Brutestack of SEGY data were prepared for onboard deliverable. Further processing such as noise filtering, processing derived stacking velocities and output to fully migrated SEGY were carried out onshore.

Detailed description of the processing flow can be found in Appendix C (F197217-REP-2UHR-SR Seismic Processing Report).

3. Seafloor Overview

3.1 Bathymetry

The bathymetry along the Aramis trunkline route ranges between 0 m and 39.5 m. The nearshore area is relatively flat intersected by the dredged Maasmond Kanaal (navigation channel). The middle of the route is characterised by bedforms such as ripple, megaripple and sand waves.

The seafloor in the northern part of the route, till the Platform L4A, is mainly featureless without bedforms and water depth decreases gradually towards the north.

Bathymetry and its relative slope are given per route section (Section 5 to Section 14).

3.2 Seafloor Morphology

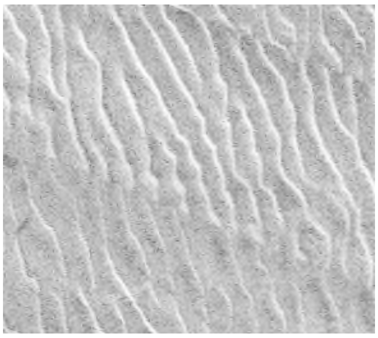
Seafloor morphology interpretation was based on the combination of data from MBES and SSS. The data analysis was carried out using acoustic characteristics such as overall pattern, roughness and reflectivity.

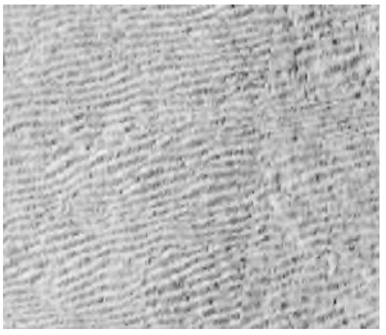
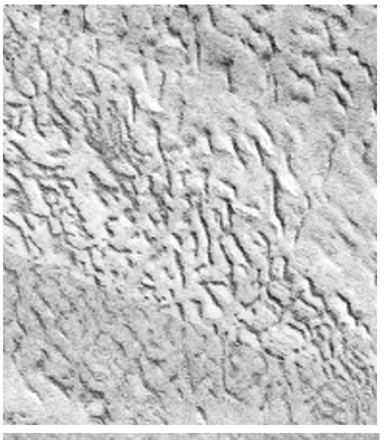
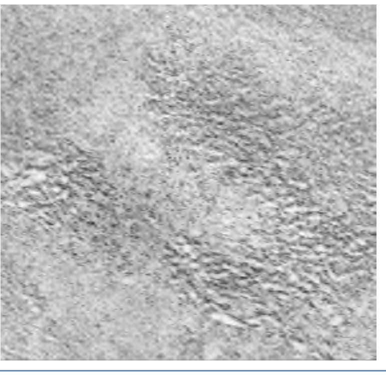
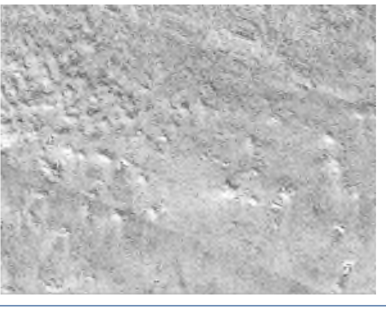
The following morphological characteristics / types were identified:

- Bedforms (ripples, megaripples and sand waves)
- Irregular seafloor
- Area with numerous boulders/debris
- Area with occasional boulders/debris

The acoustic characteristics of the identified morphological types are summarized in Table 3.1.

Table 24: Interpretation of seafloor morphology

SSS Image	Acoustic Description	Morphological Interpretation
	Low to medium reflectivity	Megaripples and sand waves

SSS Image	Acoustic Description	Morphological Interpretation
	Low to medium reflectivity	Ripples
 	Medium to high reflectivity	Irregular seafloor
	Medium to high reflectivity	Area with numerous boulders
	Medium reflectivity	Area with occasional boulders

The majority of the seafloor in the offshore area is featureless or characterised by presence of seafloor bedforms (i.e. ripples). Areas of boulders are observed through the entire route.

In the nearshore area, the seafloor is characterised by the presence of megaripples and sand waves, in addition, the seafloor is intersected by anthropogenic features.

3.2.1 Bedforms

Bedforms are produced by the action of bottom and tidal currents, which redistribute seabed sediments. Three types of bedforms were identified along the Aramis trunkline route:

- Sand waves
- Megaripples
- Ripples

Classification scheme by Ashley et al. 1990, was adopted in this report to distinguish and characterise bedforms and is detailed in Table 3.2.

Table 25: Classification scheme for bedforms (modified from Ashley et al. (1990)

First Order Description				
Size				
Spacing	0.6 to 5 m	5 to 10 m	10 to 100 m	>100 m
Height	0.075 to 0.4 m	0.4 to 0.75 m	0.75 to 5 m	>5 m
Term	*Small (ripples)*	*Medium (megaripples)*	*Large (sand waves)*	*Very large (sand dunes)*
Shape				
2D	Symmetric or asymmetric			
3D	Sinuous or hummocky			
Second Order Description				
Superposition				
Simple	No bedforms superimposed			
Compound	Smaller bedforms superimposed			

Along the Aramis trunkline route most of the bedforms fit in the range classified as ripples, although sometimes slight mismatch with the Ashley classification occurs.

Megaripples and sand waves can be found in topographical lows, where the sediment accumulates, and the currents rework the sediment creating these bedforms (Table 3.2 and Figure 3.1). In the nearshore area, the observed shape is symmetric, and the orientation is north-west to south-east. Their wavelength ranges from approximately 5.0 m to 8.0 m and the wave height varies between 0.3 m and 0.9 m. These bedforms are mostly associated with slightly gravelly SAND as interpreted from SSS and MBES data.

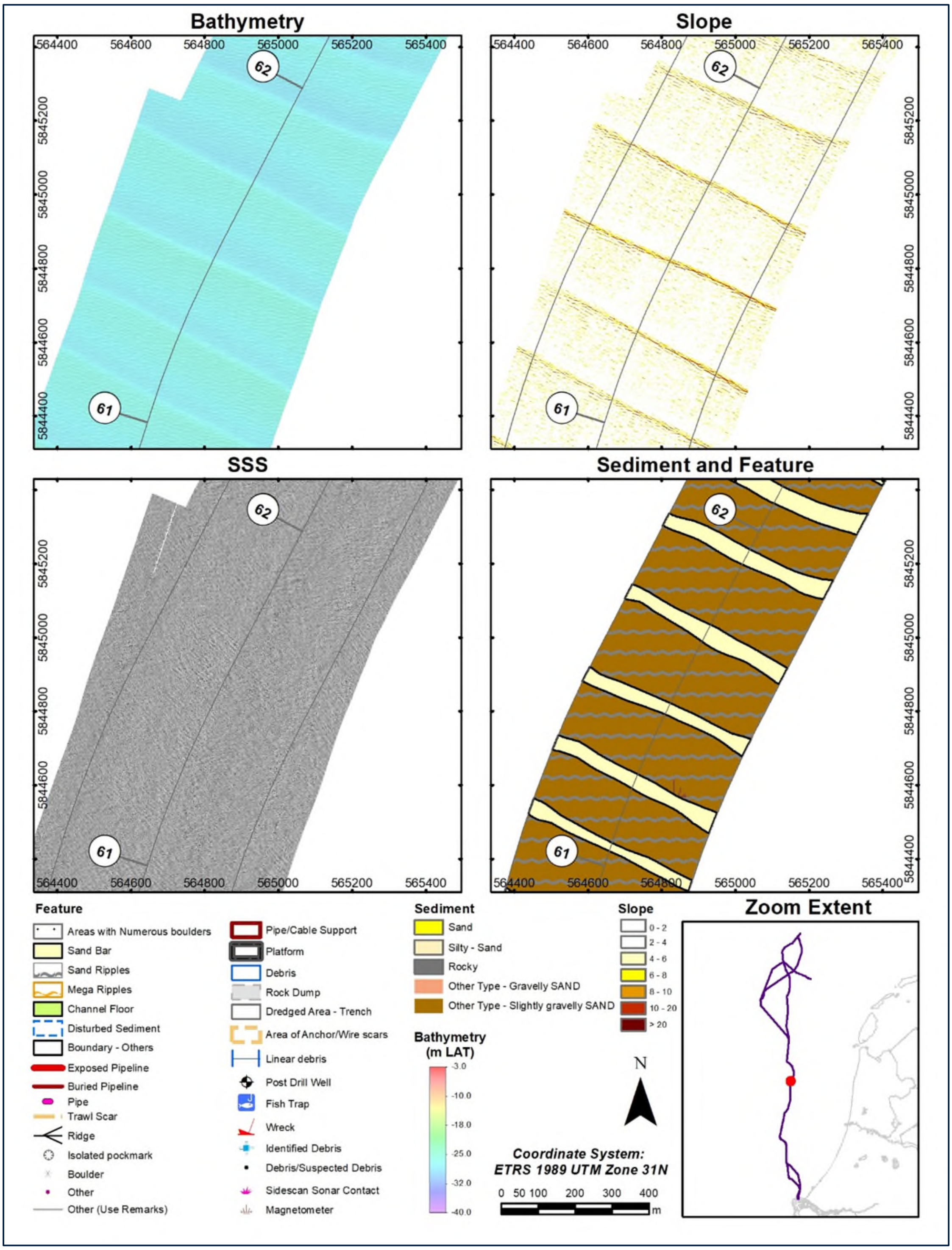


Figure 3.1: Example of megaripples ad sandwaves along the Aramis trunkline route.

In the offshore area, symmetrical (linear) ripples are the most common bedform type along the Aramis trunkline route. This type of ripples is typically found in shallow coastal waters and sandy substrate. They have generally north-west to south-east orientation. The wavelength ranges from approximately 3.0 m to 9.0 m and wave height varies between 0.1 m and 0.3 m (Figure 3.2). They are mostly associated with areas of slightly gravelly SAND as interpreted from the SSS and MBES data.

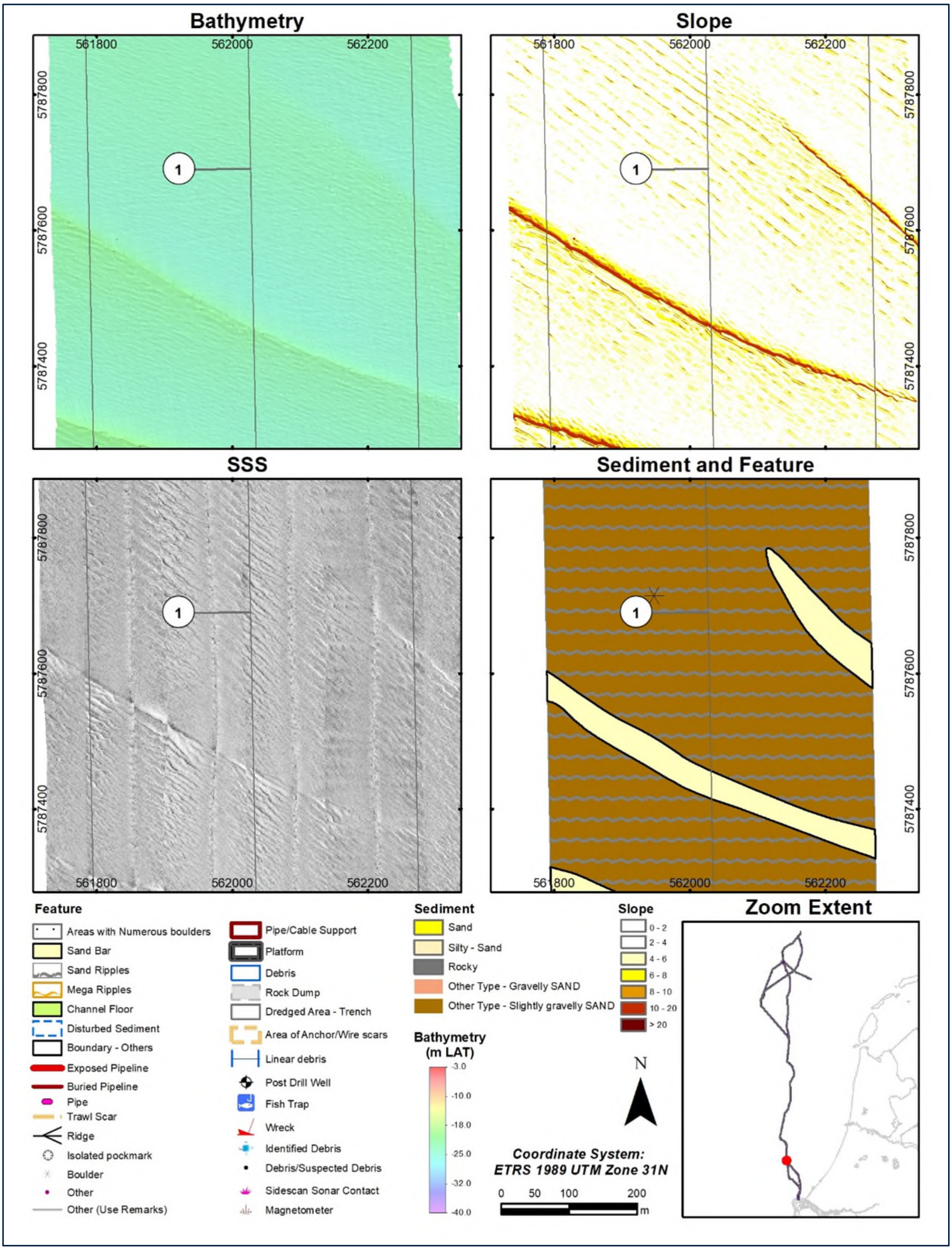


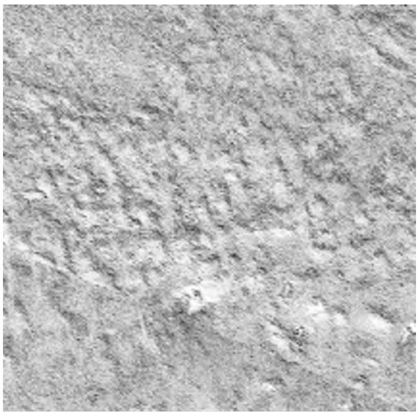
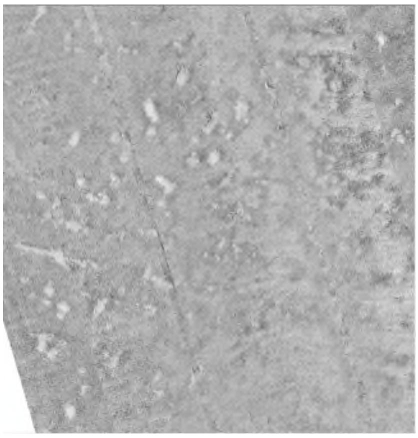
Figure 3.2: Typical area of symmetrical ripples along the Aramis trunkline route.

3.3 Seafloor Sediment Classification

Seafloor sediment interpretation and classification was based on a combination of data from MBES and SSS. The sediment classification was based on the British Standard code of practice (BSI, 2015). The data analysis was carried out using acoustic characteristics such as overall pattern, roughness and reflectivity.

The acoustic characteristics and the lithology (seafloor sediment types) identified are summarized in Table 3.3.

Table 26: Lithological classification

SSS Image	Acoustic Description	Lithological Classification
	High reflectivity	Gravelly SAND
	Medium to high reflectivity	Slightly gravelly SAND
	Patchy medium to high reflectivity areas	Muddy (silty) SAND

SSS Image	Acoustic Description	Lithological Classification
	Low reflectivity	SAND

The seafloor sediments identified by these sensors were as follows:

- Gravelly SAND
- Slightly gravelly SAND
- Muddy (silty) SAND
- SAND

3.4 Seafloor Features and Objects

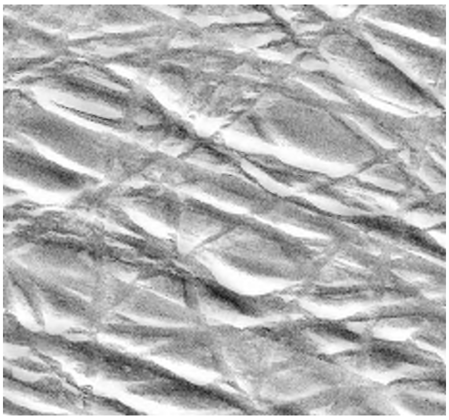
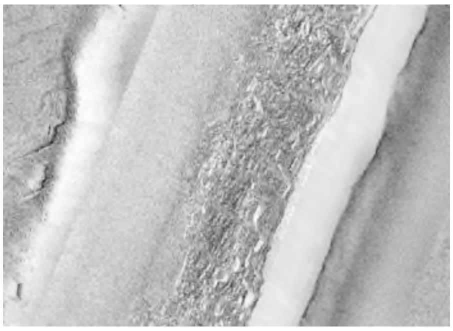
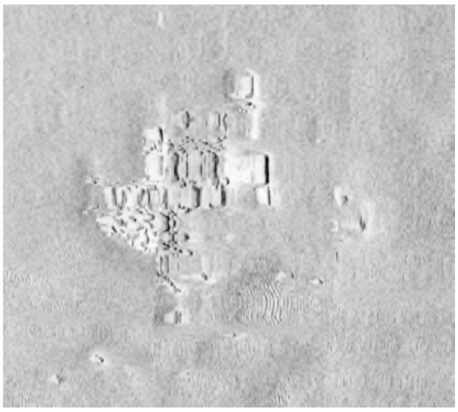
Seafloor features and contacts were identified from one or more of the SSS, MBES and MAG sensors and cross-correlated, where possible. Only contacts greater than or equal to 0.5 m in any dimension were interpreted along the Aramis trunkline route.

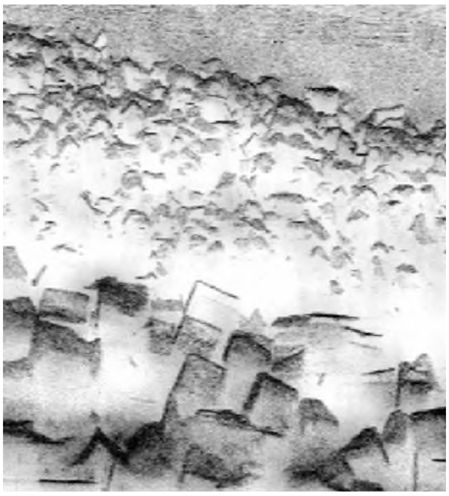
Table 3.4 summarises the identified seafloor features and Table 3.5 the quantities of contacts picked. Detailed description of distribution of the seafloor features is given in in Section 5 to Section 14).

The following seafloor features were identified:

- Scours/trawl marks
- Sediment dumping features
- Anthropogenic channel
- Wreck debris and possible wreck
- Possible fishing gear
- Cable trench (HKZ)
- Pipelines (buried or exposed)
- Cables
- Rock armour
- Unknown circular feature
- Unknown linear features

Table 27: Interpretation of seafloor features

SSS Image	Acoustic Description	Features Interpretation
	Low to medium reflectivity	Scours/Trawl marks
	Low to medium reflectivity	Sediment dumping features
	Low to high reflectivity	Anthropogenic channel
	Low to high reflectivity	Wreck debris and possible wreck

SSS Image	Acoustic Description	Features Interpretation
		
	Low to medium reflectivity	Possible fishing gear/fishing net
	Low to high reflectivity	Cable trench (HKZ)
	Low to high reflectivity	Rock armour

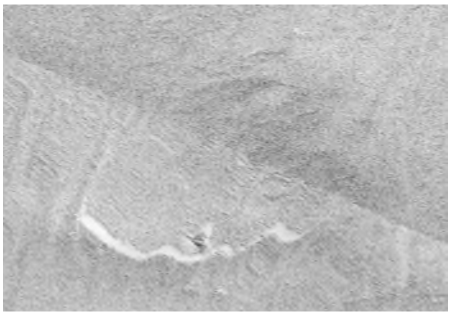
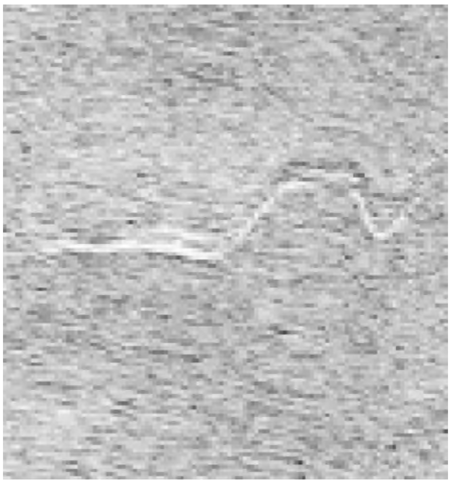
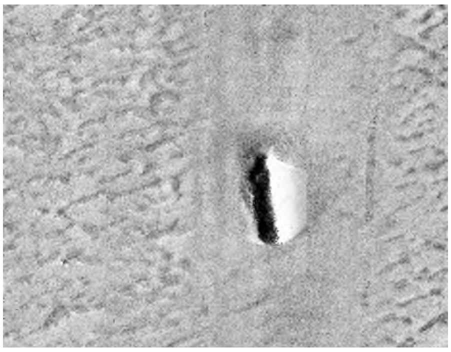
SSS Image	Acoustic Description	Features Interpretation
	Low to high reflectivity	Unknown circular features
	Low to high reflectivity	Unknown linear features
	Low to high reflectivity	Exposed pipeline

Table 28: Summary of seafloor contacts

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	3110
	Debris	159
	Depression pockmark	5
	Fishing gear	7
	Mattress	2
	Exposed pipe	4
	Seafloor mound	98
	Suspected debris	517
	Wreck	4
	Magnetic anomalies	2745
SSS/MBES/MAG	Debris	1

Sensor	Contact Classification	Quantity
Linear Features	Possible debris	1
	Fishing gear	4
	Possible fishing gear	42
	Large trawl scour	40
	Mound ridge	21
	Scour	7987
	Unknown linear feature	9
	Telecommunication cable	5
	Exposed pipeline	5
	Buried pipeline	41
	Magnetic linear feature	28

3.4.1 Cross Correlation of Contacts

A 2 m radius cross correlation between all SSS contacts and all MAG anomalies was performed. Only 11 point feature contacts cross correlate between the SSS and MAG sensors as reported in Table 3.6.

Table 29: Summary of cross corelating seafloor contacts

Section	SSS Target Name	MAG Target Name	Description
Section D	BK_FSEA_SSS_0084	BK_FSEA_MAG_0090	Debris
Section D	BK_FSEA_SSS_0086	BK_FSEA_MAG_0133	Debris
Section D	BK_FSEA_SSS_0163	BK_FSEA_MAG_0093	Debris
Nearshore area (Export Route East MT)	BB_FS_SSS_0593	BB_FS_MAG_0222	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0607	BB_FS_MAG_0247	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0642	BB_FS_MAG_0274	Suspected Debris
Nearshore area (Export Route East MT)	BB_FS_SSS_0884	BB_FS_MAG_0567	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0916	BB_FS_MAG_0605	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0929	BB_FS_MAG_0691	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0946	BB_FS_MAG_0710	Boulder
Nearshore area (Export Route East MT)	BB_FS_SSS_0678	BB_FS_MAG_0298	Wreck

4. Sub-seafloor Overview

4.1 Geological Setting

The investigation site is located in the southern North Sea.

The geological history of the southern North Sea started with the development of a complex system of basins and rifts in Northwest Europe during the Triassic (Geluk, 2005). Alpine inversion of these basins took place during the Late Cretaceous and early Paleogene as a result of the collision of Iberia and Europe. This was followed by multiple phases of subsidence from the Eocene up to recent times (Wong et al., 2007).

From the late Miocene onwards, a complex fan delta system developed, which gradually evolved into an alluvial plain prograding from the east. Until the end of the Neogene, deposition in the North Sea was dominated by sediment input from the Eridanos (Baltic) river system (Overeem, 2002; Knox et al., 2010; Rasmussen & Dybkjaer, 2014).

By the mid-Pleistocene (~1 Ma), the Rhine, Meuse and Scheldt Rivers had become important contributors of sediment influx to the North Sea basin, as a result of uplift of highland areas in Germany (Laban and Rijsdijk, 2002). Subsidence decreased during this time and the basin had become largely filled with deltaic deposits.

During the Middle and Late Pleistocene, the depositional evolution of the North Sea basin was strongly influenced by climatic variations, glaciations and associated sea level fluctuations. Series of an alternating glacial and interglacial periods occurred (Figure 4.1) This resulted in a complex interplay of glacial, glaciolacustrine, glaciofluvial, fluvial, aeolian, deltaic and (shallow) marine environments and deposits (Laban, 1995; Peeters et al., 2015).

Detailed description of the different glacial and interglacial stages during the Pleistocene in the southern North Sea is provided below Figure 4.1.

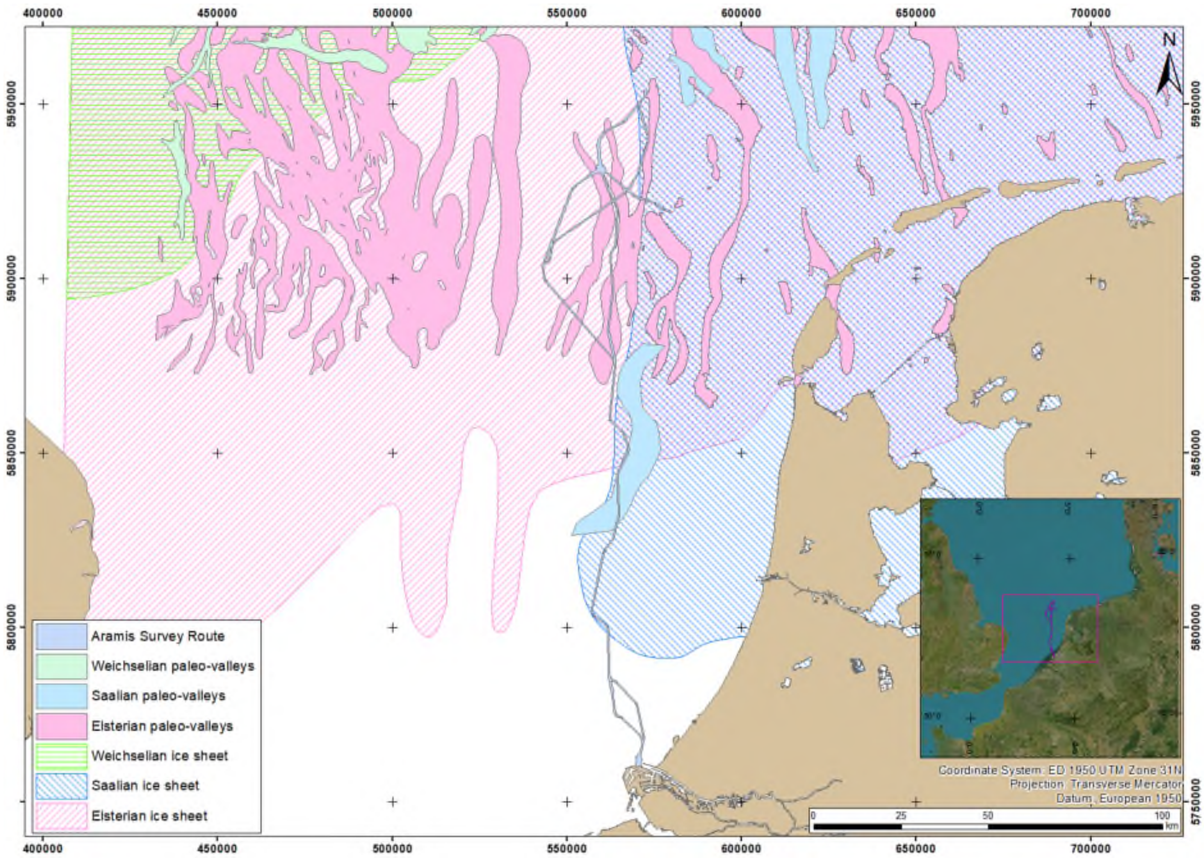


Figure 4.1: Maximum extent of the Quaternary glaciations in the southern North Sea.

<u>Elsterian Glaciation (Middle Pleistocene)</u>

During the Elsterian glaciation (475 ka to 410 ka BP), the Scandinavian and British ice masses coalesced and spread in southern direction to cover the northern part of the Netherlands and the southern North Sea (Ehlers, 1990; De Gans, 2007). The northern half of the Aramis route has been affected by the Elsterian ice sheet, while the southern half was influenced by the Rhine and Meuse River systems (Figure 4.2a). Deposition of predominantly low energy open marine deltaic sediments consisting of siliceous sands and clays resulted, which are thought to belong to the Yarmouth Roads Formation (Rijsdijk et al., 2005). Elsterian subglacial tunnel valleys were cut into the Yarmouth Roads Formation. They are present in the northern half of the route. The infill of these tunnel valleys comprises glaciofluvial (sand), glaciolacustrine (clay) and proglacial clays and sands of the former Swarte Bank Formation (now part of the Peelo Formation; Praeg, 1996; Graham et al., 2011; Moreau et al., 2012). The Elsterian valleys form a complex system of anastomosing, but mainly NNE–SSW trending, broad (approximately 1 km to 10 km wide) and deep (locally up to 400 m BSF) erosional features.

<u>Holsteinian Interglacial (Middle Pleistocene)</u>

During the subsequent Holsteinian interglacial (410 ka to 370 ka BP), sea level rose because of climate amelioration and melting ice masses. Fluvial and marine deposits were prevalent in this period. The fluvial deposits have been defined as the the Egmond Ground Formation (Bosch et al., 2003; Rijsdijk et al., 2005). Laterally, the Urk Formation grades into the Egmond

Ground Formation (Bosch et al., 2003). The Urk Formation can contain clay interbeds, while The Egmond Ground Formation comprise predominanlty marine sands, but locally can contain clay interbeds. The Egmond Ground Formation may locally incise into the underlying Yarmouth Roads Formation.

Saalian Glaciation (Middle to Late Pleistocene)

During the Saalian glaciation (370 ka to 130 ka BP), the Aramis route was near the Saalian Ice Margin (Figure 4.2.b). However, the exact limit of the ice sheet advance offshore remains uncertain.

Ice masses formed glacially scoured basins and several ice-pushed ridges (moraines). Numerous tunnel valleys were created during the Saalian in subglacial and proglacial settings. A major subglacial valley runs in a N–S direction, along the margin of the maximum extent of the Saalian ice sheet, located in the centre of the Aramis route. It is approximately 10 km wide and up to 80 m deep. The infill consists locally of glaciolacustrine clay (Uitdam Member) near the base, covered with marine sand of the Eem Formation (Laban, 1995). More tunnel valleys may be present near the north-eastern boundary of the Aramis route (Cameron et al., 1986; Joon et al., 1990).

During the Saalian glaciation, the Rhine–Meuse River system merged with a proglacial river system south of the ice margin (Peeters et al, 2015). This setting implies variable soil conditions dominated by extensive areas of glaciofluvial sands and gravels (outwash plains/sandurs) deposited in front of the ice sheet, with clays deposited in glaciolacustrine environments. Local aeolian deposition took place near the Saalian Ice Margin. The glaciofluvial and aeolian sediments belong to the Drachten Formation (formerly Tea Kettle Hole Formation), while the glaciolacustrine sediments belong to the Uitdam Member of the Drenthe Formation (formerly Cleaver Bank Formation). The latter is mainly confined to the Saalian tunnel valleys (Laban, 1995).

Saalian sediments in the southern North Sea have been largely eroded by the subsequent Eemian transgression but are still present in Saalian channels and valleys.

Eemian Interglacial (Late Pleistocene)

A major marine transgression affected the southern North Sea during the Eemian interglacial (130 ka to 115 ka BP). The area became part of the delta plain of the river Rhine (Figure 4.2.c). Shallow marine sands (Eem Formation), lagoonal and estuarine clays and sands, and fluvial sands (Kreftenheye Formation) were laid down in a complex depositional setting (Peeters et al., 2015). Existing glacial valleys and channels were inundated by the marine transgression.

With the onset of the marine regression at the end of the Eemian and beginning of the Weichselian glaciation, brackish marine clays and lagoonal or lacustrine silty laminated clays, identified as the Brown Bank Member (part of Eem Formation), were deposited in a low-energy environment in the northern part of the Aramis route (Figure 4.2.d; Cameron et al., 1986; GDN, 2018).

Weichselian Glaciation (Late Pleistocene)

During the youngest glacial period, the Weichselian (115 ka to 18 ka BP), the limit of the ice sheet extent was north-west of the Aramis site. At the time, deposition in the southern North Sea was dominated by periglacial conditions with temporary fluvial influences of the Rhine–Meuse River system (Figure 4.2.e).

The periglacial deposits comprise sand, sandy loam, peat, thaw-lake deposits and aeolian sediments. The aeolian deposits are considered to have little preservation potential in a dominantly (glacio)fluvial environment. The glaciofluvial deposits comprise sand, gravelly sand and locally clay of the Kreftenheye Formation. Erosion of underlying formations probably occurred.

Holocene (Recent)

With the transition from late glacial to early Holocene (11.6 ka BP to present), climatic amelioration resulted in sea level rise, and the North Sea basin became flooded. Deposition took place in a terrestrial periglacial environment, transitioning into tidal and lagoonal as the sea level rose. Sediments from this period belong to the Naaldwijk Formation and are preserved as (scattered) sands and clays that often infill of paleochannels. Locally, peat beds were deposited in shallow marsh settings (Nieuwkoop Formation). As transgression progressed, the site was overlain by sands of the Southern Bight Formation and muddy sands of the Urania Formation (only in the furthest north of the site).

The North Sea Basin has remained essentially sediment starved since the start of the Holocene, and deposits occur mainly in the form of sand banks and sand waves (Liu et al., 1993). Surficial sediments mainly consist of sand with shells and shell fragments typical of a high energy, open marine environment. These sands are partly derived from reworking of the sediments from the underlying fluvial deposits. Sands with a higher mud fraction are present in deeper parts and are indicative of a low energy open marine environment.

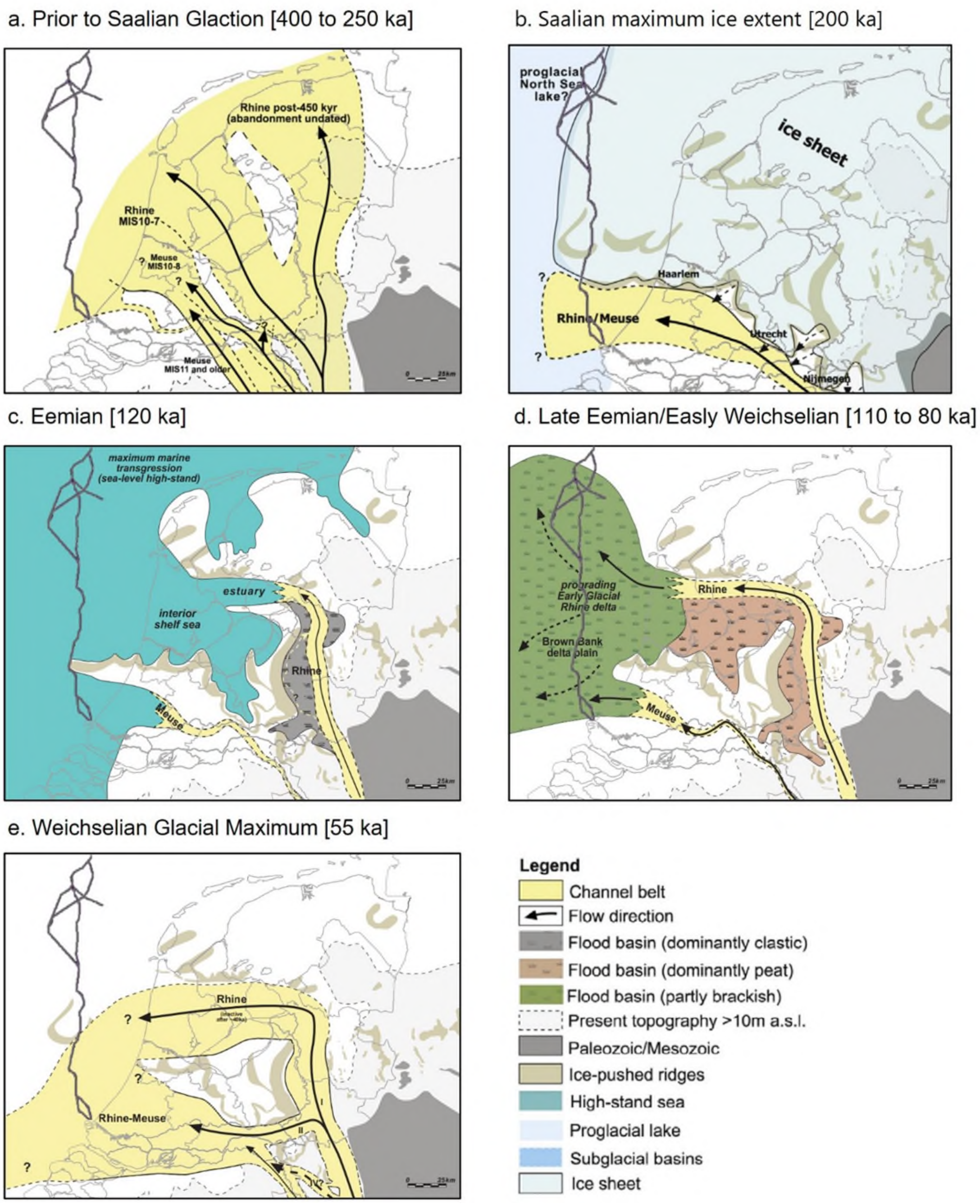


Figure 4.2: Palaeo-geographical reconstructions of the Netherlands during the Middle to Late Pleistocene. illustrated by five successive time frames. a) Rhine–Meuse drainage configuration prior to Saalian Glaciation. b) Maximum Saalian ice extent. c) Eemian interglacial maximum transgression during sea level highstand. d) Rhine delta prograding into lower-deltaic flood basin environment. e) Configuration of the Rhine and Meuse during the Weichselian glacial maximum (modified after Peeters et al., 2015).

4.2 Seismostratigraphy

4.2.1 Overview

Table 4.1 provides an overview of the seismic horizons and corresponding seismostratigraphic units as interpreted in the SBP and 2D-UHRS data. The table and this section should be read in conjunction with the charts provided in Appendix A.

Nine horizons were interpreted, each representing a significant acoustic interface consistent across the site, which forms the base of a seismostratigraphic unit. In addition, the extent of geological features, such as intraformational buried channels, layers of potential peat and acoustic blanking, indicating possible gas in soil were interpreted.

The sub-seafloor information presented in this section considers two seismic reflection datasets. These include:

- Sub-bottom profiler (SBP) data with a typical penetration of the seismic signal below seafloor between approximately 8 m and 15 m BSF;
- 2D ultra-high-resolution multichannel seismic (2D-UHRS) data with a typical penetration of the seismic signal below seafloor of approximately 200 m BSF.

The SBP data were acquired within an approximately 500 m-wide corridor and the 2D-UHRS data, except of the nearshore area and the HUB area, were acquired along the centre line only. The 2D-UHRS data were interpreted down to a minimum depth of 100 m BSF.

Shallow seafloor CPT data were used to aid the interpretation of the SBP data. Details on geotechnical data (CPT and VC boreholes) with be integrated and provided in the next issue of this report.

The vertical scale in the seismic data examples presented in the following sections and on the geological profiles is in two-way travel time (TWTT) in seconds below LAT. Included is a vertical scale bar in metres that was estimated using a constant sub-seafloor velocity of 1600 m/s.

Refer to Section 3 for details on data processing, interpretation methodology and data resolution limitations.

Section 4 provides a general overview of the sub-seafloor geology, while a more detailed description is provided in Sections 5 through 14, where each section of the route is treated separately.

Table 30: Overview of interpreted seismostratigraphic units

Dataset	Unit	Horizon Top	Horizon Base	Seismic Signature and Character of the Base	Distribution	Lithology	Geological Formation / *Member*	Depositional Environment
SBP	DS	H00	H_DS	Semi-transparent and chaotic. The basal reflector marks the change from chaotic to acoustically transparent or structured seismic facies.	Present in nearshore part only (Maaskanaal)	Very loose to very dense slightly silty fine and medium SAND	-	-
SBP	A	H00	H10	Acoustically transparent to chaotic, with locally high amplitude reflections. Base is marked by a medium to high amplitude, flat reflector.	Present across the entire route	Very loose to very dense slightly silty to silty fine and medium SAND with occasional shells and shell fragments Locally low to medium strength slightly sandy CLAY, with closely spaced thin laminae of silt Locally clayey fine SAND	Southern Bight	Marine
SBP, 2D-UHRS	B	H00, DS, H10	H15	Various; semi-transparent and structureless to locally bedded with low to medium amplitude parallel reflectors; locally, internal channels with high amplitude parallel reflectors observed; locally internal erosion surfaces observed. The base is locally channelised and the infill of these channels has typically chaotic or structured (layered) character with high amplitude reflections. The basal reflector has a medium to high amplitude; irregular to undulating. High amplitude (negative on the 2D-UHRS) reflectors may indicate layers/pockets of peat / organic clay frequently present in this unit.	Present basically across the entire route; locally absent in the southern part of the route	Medium to very dense slightly silty fine and medium SAND with occasional shells and shell fragments Locally with medium to thick beds of extremely low to high strength sandy CLAY Locally with very closely spaced thin laminae to medium beds of peat	Naaldwijk Boxtel Kreftenheye	Coastal to tidal-flat, locally lagoonal; locally periglacial to fluvial
2D-UHRS	C	H15	H20	Mostly structured (layered) with low to medium-amplitude parallel reflectors. Locally, in the upper part of the unit, structureless, semi-transparent interval locally semi-transparent, structureless. In the north-eastern part of the route, the unit is characterised by overall semi-transparent seismic facies with local high amplitude negative reflectors of various extent. The high amplitude reflectors may indicate layers of pockets of peat and/or organic clay. Base forms a sub-horizontal erosional surface, locally forming broad channels/depressions.	Present in the central and large portion of the northern part of the route	Very loose to dense very silty fine and medium SAND with occasional pockets of organic matter Locally low strength to high strength sandy CLAY with medium spaced very thin beds of sand Locally low to medium strength sandy clayey SILT	*Brown Bank*	Lagoonal, estuarine, tidal flat
2D-UHRS	D	H15, H20	H25	Acoustically transparent to semi-transparent, structureless. Locally, layered intervals, internal erosion surfaces marked by strong undulating or inclined reflectors. Internal channelling features are locally present. The infill of these channels is various from chaotic to structured (layered). Base forms a sub-horizontal erosional surface, locally forming channels.	Present almost across the entire route, except small area in the centre and in the most southern part of the route	Loose to very dense slightly silty fine and medium SAND, occasionally slightly gravelly	Eem Kreftenheye (nearshore)	Marine
2D-UHRS	E	H25	H30	Acoustically transparent to semi-transparent, structureless; locally chaotic. Base forms a sub-horizontal erosional surface, locally forming channels.	Present in the northern part of the route	Medium dense to very dense SAND locally with beds of CLAY and SILT	Egmond Ground	Marine
2D-UHRS	F	H25, H30	H35	Semi-transparent infill with occasional amplitude anomalies. locally discontinuous, wavy and steeply inclined medium-amplitude reflectors. Internal channels near the top. The basal reflector forms U-shaped channel / valley.	Present locally in the northern and central part of the route	Interbedded medium dense to very dense (silty) SAND and high strength to very high strength (sandy) CLAY	Peelo	Fluvio-glacial, glacio-lacustrine (subglacial valley infill)
2D-UHRS	G	H20, H25, H30, H35	H40 (internal) BPD	Chaotic to acoustically semi-transparent, locally discontinuous, inclined medium-amplitude reflectors. Locally, internal erosion surfaces and internal channels / channelling features. Horizon H40 marks internal erosion surface, at which locally high amplitude negative reflectors are present, indicating a thin bed or laminae of peat /organic clay.	Present across the entire route	Medium dense to very dense SAND Locally with layers of high strength to very high strength CLAY or SILT, locally laminated	Yarmouth Roads	Fluvio-deltaic to marine

Notes:
DS = disturbed sediments
Hyphen = not applicable
BPD = below penetration depth of seismic reflection data

4.2.2 Unit DS

Disturbed sediments are present exclusively in the dredged Maasmond Kanaal. The base of these sediments is uncertain and taken at the base of high amplitude reflections or at the top of structured seismic facies, which were very locally observed. The unit has semi-transparent and chaotic seismic character.

4.2.3 Unit A

Unit A is the shallowest unit and is interpreted to be present across the entire route. The unit is interpreted to be absent in the Maasmond Kanaal in the nearshore part. Locally it is very thin and may be absent (seismic data cannot resolve the top approximately 30 cm). The thickness variation of the unit largely follows the seafloor morphology. The unit is thickest (approximately 3 m) near the crests of sand banks and sand waves and thins towards the troughs, where it may be locally absent (Figure 4.3).

The base is marked as Horizon H10, which is characterised by a near-flat surface It is typically a medium to high-amplitude reflector and/or the interface between seismically different characters.

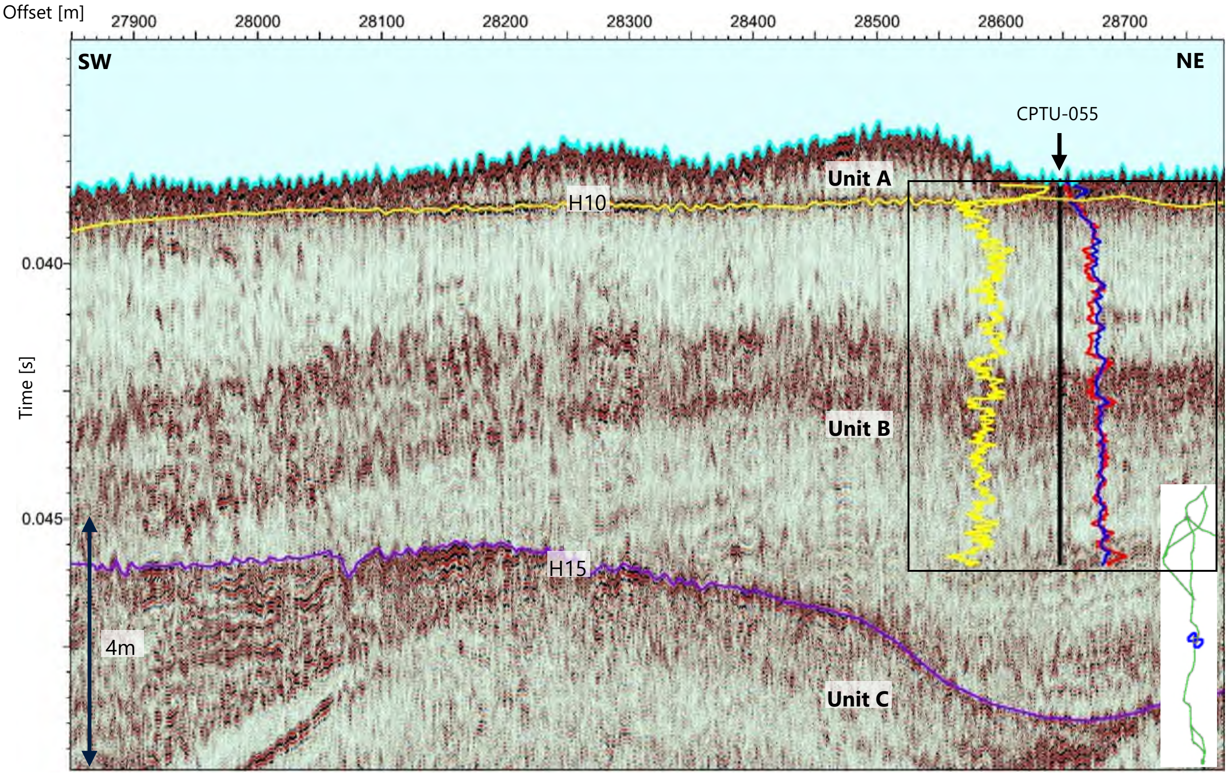


Figure 4.3: SBP data example of the internal seismic character of Unit A at sand waves. (Line SBP_TA3E2132P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 5 MPa, sleeve friction values (red curve) from 0 to 0.125 MPa and friction ratio (yellow curve) from 0 to 4 %.

Unit A generally appears to be acoustically transparent. Locally, high amplitude internal point reflections or short reflectors were observed. In the larger sand waves, locally weak progradational structures were observed.

The unit consists of loose to very dense sand. The unit is interpreted to be deposited in an open marine environment in response to the marine transgression during the Late Holocene and belongs to the southern Bight Formation. The unit represents mobile sediments, reworking material of underlying deposits.

4.2.4 Unit B

Unit B is interpreted to be present in the entire Aramis route, except in the Maasmond Kanaal. The thickness of this unit varies and is driven by the depth of the basal erosional surface, reaching locally a maximum depth of approximately 15 m BSF. Unit B is overlain by Unit A but may be locally exposed at seafloor, mostly in the troughs between the sand waves.

The base of Unit B is marked by Horizon H15, which forms a distinctive irregular erosional surface, locally cutting deeply into the underlying units (Figure 4.4).

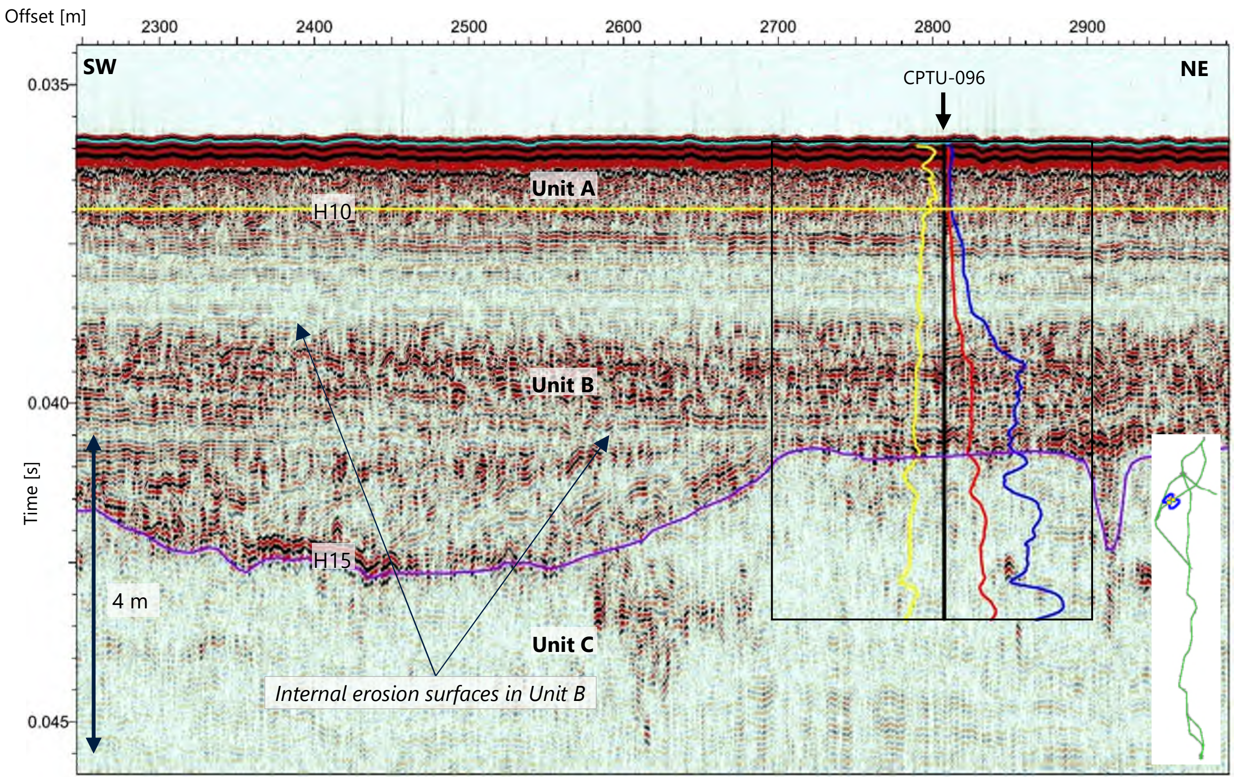


Figure 4.4: SBP data example of the internal seismic character of Unit B. (Line SBP_TA3M2320R1_2) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

In the SBP data, the basal reflector is typically a weak, low amplitude reflector in the southern part of the route and a medium to high amplitude reflector in the northern part of the route. In the south-central part of the route (Section A-Alt) the base of the unit is not visible or lies below penetration of the SBP data. This can be due the similar soil conditions (and thus low impedance contrast) between Unit B and the underlying Unit D in this part of the route.

In the 2D-UHRS data, the base of the unit is marked by a weak reflector of variable polarity, towards the north the base is marked increasingly by a medium to high amplitude negative reflector.

The unit has a variable internal seismic character, ranging from semi-transparent to chaotic with numerous discontinuous and often high-angle medium to high-amplitude reflections.

Internal channels and channels at the base with different dimensions were observed in the unit. The infill of the channels is variable, but typically well-layered and with high-amplitude reflectors.

High negative amplitude anomalies are common in this unit, especially in the northern part of the route, which potentially represent layers of peat and/or organic-rich clay.

The unit is variable in terms of soil conditions, comprising medium dense to very dense (silty) sand, with laminations and beds of clay, silt, and peat.

Based on its variable seismic character, stratigraphic position, and the presence of internal channels, this unit is interpreted to represent early Holocene coastal and tidal deposits, and possibly belonging to the Naaldwijk Formation. Locally the unit may include sediments of Boxtel Formation and especially in the southern and south-central part of the route, a large part of this unit may belong to the Kreftenheye Formation. The differentiation between these formations is difficult due to similar soil conditions (predominantly sand).

In the nearshore area, deposits of the Kreftenheye Formation are below the base of the interpreted Naaldwijk Formation.

4.2.5 Unit C

Unit C is present in the northern and central part of the route. The base of the unit is marked by Horizon H20, which typically forms a distinctive nearly flat erosional surface, locally, in the central part of the route it cuts into the underlying unit forming a wide depression(s). In this part of the route, the unit is thickest and several internal erosion surfaces were observed (Figure 4.5).

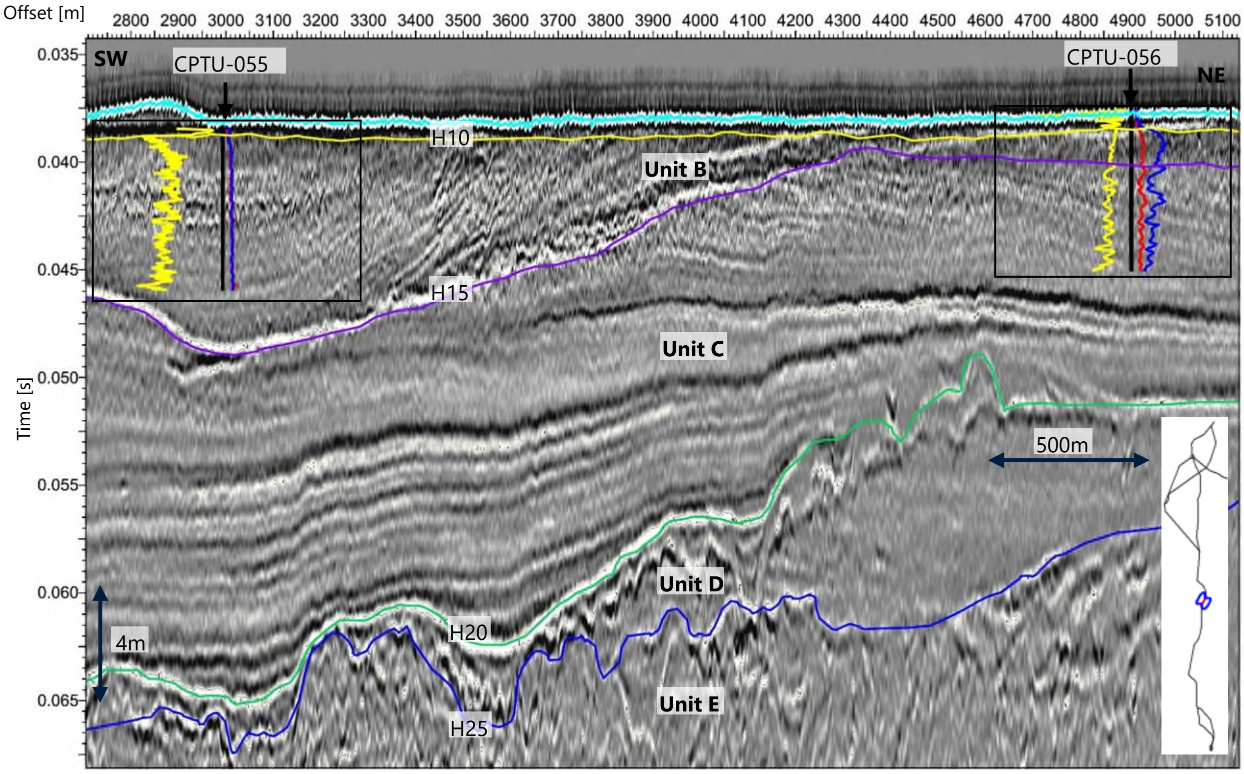


Figure 4.5: 2D-UHRS data example of the internal seismic character of Unit C. (Line 059-TA3A1542P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

The unit for most of the route is characterised by bedded seismic facies, consisting of parallel reflectors. Locally, in the upper part of the unit, structureless, semi-transparent intervals within the unit were observed. In the north-eastern part of the route, the unit is characterised by overall semi-transparent seismic facies with local high amplitude reflectors of various extent. The high amplitude negative (2D-UHRS data) reflectors may indicate layers of pockets of peat and/or organic clay.

The layered nature of the unit is expected to correlate with sand and clay alternations, and local beds of peat. The unit is interpreted to be deposited in a range of coastal (estuarine), tidal flat or lagoonal environments and corresponds to the Brown Bank Member.

4.2.6 Unit D

Unit D is present across the entire route, except small part of the route (approximately 15 km) in the central part, and in the most southern part, where it is interpreted to be absent. In the central part, the area where unit is absent, the base of the overlying Unit C is thickest and forms a wide depression.

The base of the unit is marked by Horizon H25 and generally forms a flat erosional surface, which is occasionally undulating and channelised (Figure 4.6). The base typically forms a medium to high-amplitude negative reflector, although this may vary due to the heterogeneity of the underlying sediments.

The unit has in general a structureless and semi-transparent acoustic character. Locally, layered intervals, internal erosion surfaces marked by strong inclined reflectors or forming broad channel-like features. Internal buried channels are locally present. The infill of these channels is various from chaotic to bedded with inclined parallel reflectors.

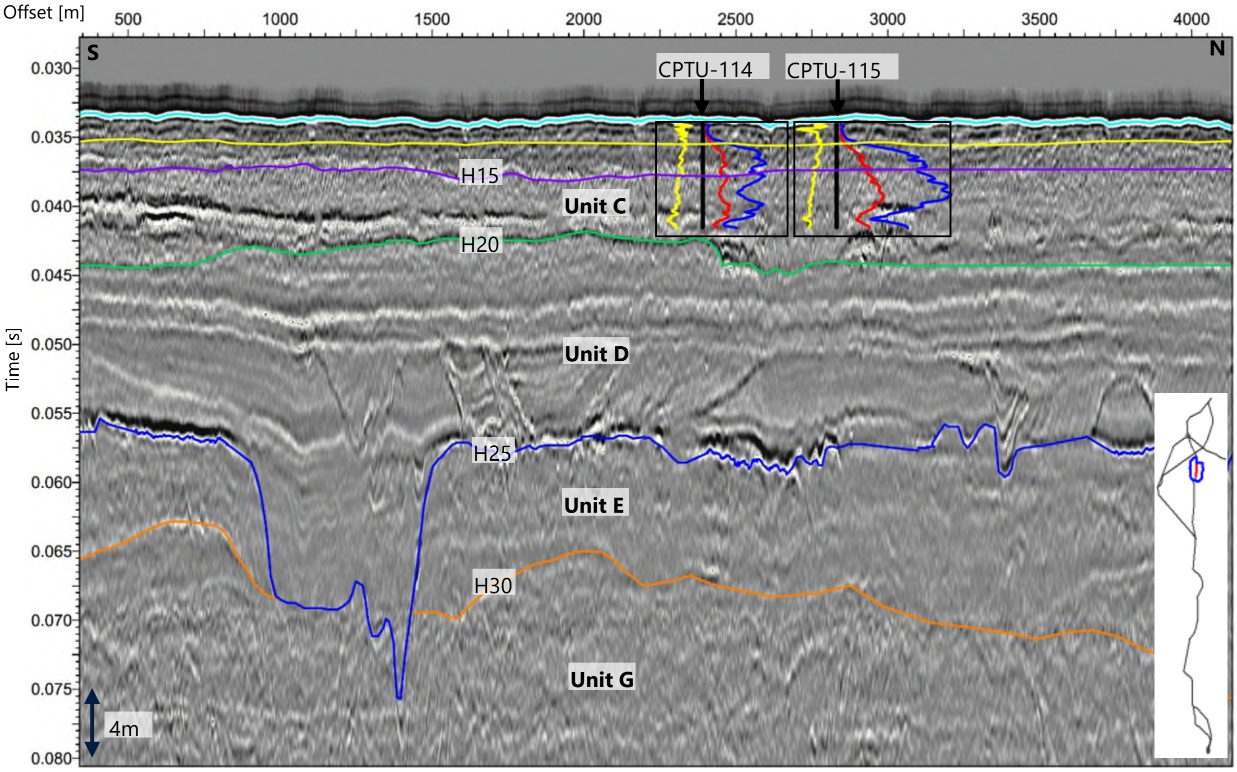


Figure 4.6: 2D-UHRS data example of the internal seismic character of Unit D. (Line 085-TA3A1562P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

Unit D is expected to comprise predominantly sand, with very locally clay or peat alternations, deposited in open marine and tidal environments. The unit is thought to belong to the Eem Formation.

4.2.7 Unit E

Unit E is present in the northern part of the route.

The base of the unit is marked by Horizon H30 and generally forms an undulating erosional surface. The base typically forms a weak low amplitude reflector.

The unit has in general a structureless and semi-transparent acoustic character, to locally chaotic with high amplitude negative point reflections (Figure 4.7). The acoustic facies of this unit are similar to the underlaying unit. As a result, it is very difficult to trace this interface in some parts of the route.

Unit D is expected to comprise predominantly sand, occasionally with thin layers or pockets of clay or peat, deposited in open marine and tidal environments. The unit is thought to belong to the Egmond Ground Formation.

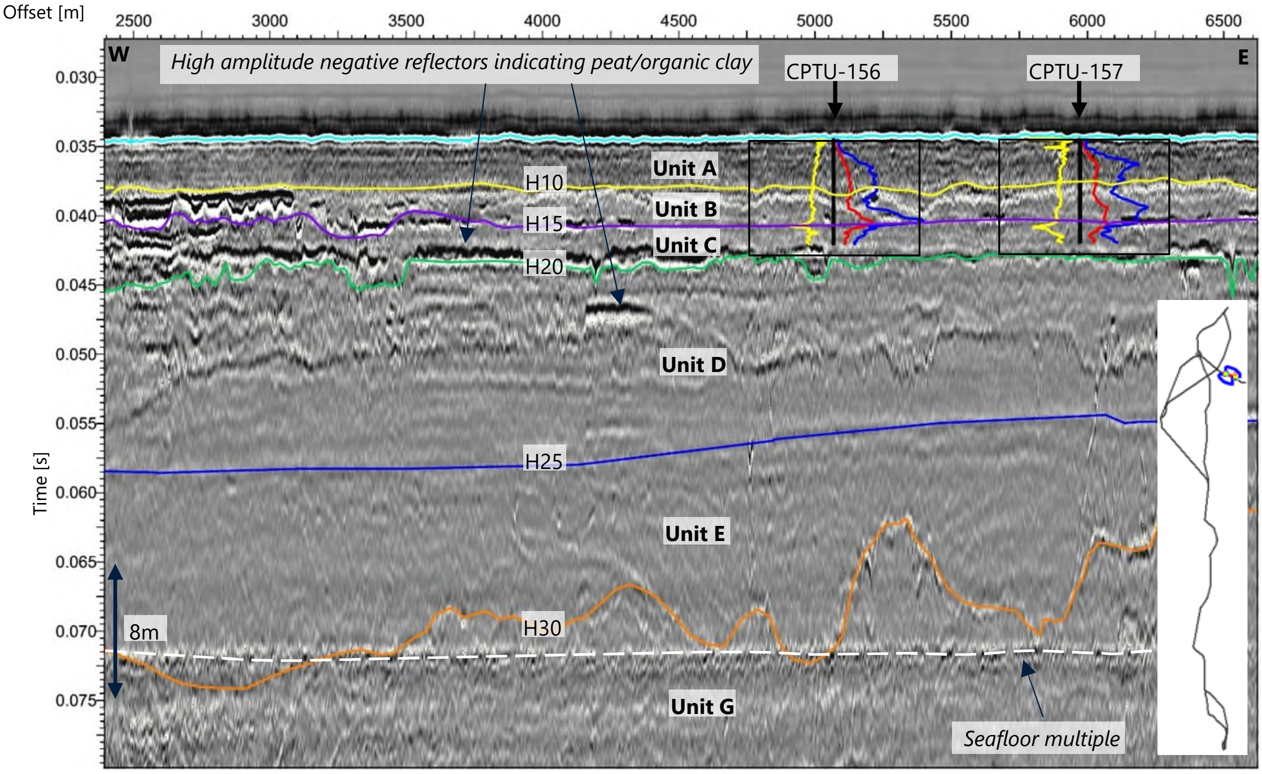


Figure 4.7: 2D-UHRS data example of the internal seismic character of Unit E. (Line 196-TA3A1608P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

4.2.8 Unit F

Unit F is present locally in the northern half of the route. The unit forms the infill of deeply incisive U-shaped channel-like features with steep flanks. They cut into the underlying Unit G, reaching locally depths below the penetration of the 2D-UHRS data. Such features in this part of the North Sea are considered as glacial tunnel valleys.

The base of the unit is marked by Horizon H35, which form a boundary between relatively more acoustically transparent infill (Unit F) and chaotic facies outside (Unit H). Flanks of these glacial valleys are not always clear on seismic data and given the data were acquired on a single line, they are difficult to trace locally. As a result, the extent of this unit is locally uncertain and may be larger than interpreted.

The internal character of Unit F is characterised in general by semi-transparent to chaotic seismic facies. Often, especially in the upper part, discontinuous, irregular, and wavy (folded?) medium to high-amplitude reflectors were observed (Figure 4.8). Occasional amplitude anomalies may be present within the unit.

Intra-formational channels with high-amplitude reflections are observed sometimes near the top of the unit.

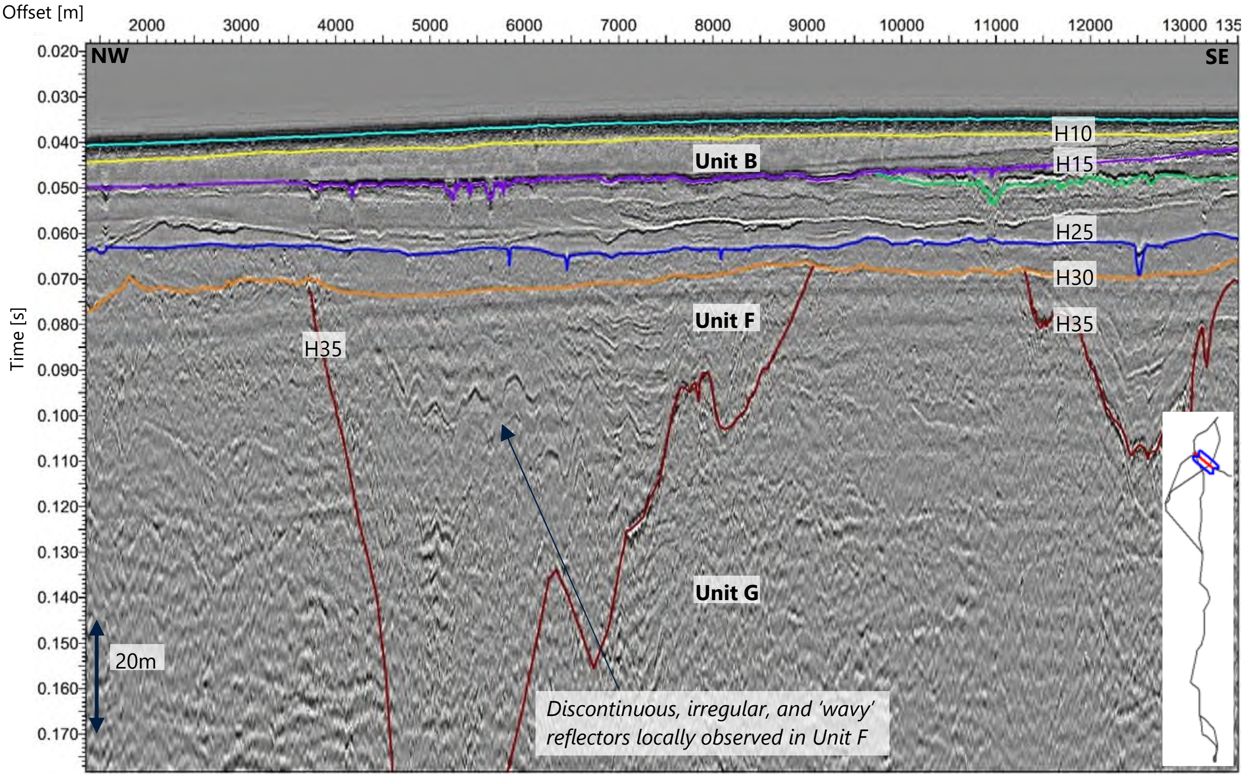


Figure 4.8: 2D-UHRS data example of the internal seismic character of Unit F. (Line 180-TA3A1606P1)

The dimensions and stratigraphic position of the glacial tunnel valleys correspond to the Elsterian age. Based on the public domain data and Fugro database, the unit is expected to consist of mainly clay with frequent (silty) sand interbeds deposited in glacial, glaciofluvial and glaciolacustrine environments. These deposits are interpreted to belong to the Peelo Formation.

4.2.9 Unit G

Unit G is the deepest unit observed in the seismic data within depth of interest and is present across the entire route. The base of this unit is beyond the penetration depth of the 2D-UHRS.

An internal reflector Horizon H40 was interpreted in the southern part of the route. Locally, this reflector shows high amplitude and negative polarity, indicating possible bed or laminae of peat and/or organic clay (Figure 4.9).

The internal acoustic character of the unit is complex, from semi-transparent to chaotic, with locally discontinuous reflectors, internal erosion surfaces and various internal channels. This complexity results from the nature of the depositional setting of this unit (fluvial to deltaic) and post-depositional processes such as glacial activity, including erosion and possibly deformation. Particularly, extensive glacial erosion affected the unit during Elsterian and Saalian glaciations.

The unit is expected to consist of predominantly sand with occasional clay and silt interbeds, and local beds of peat. Unit G is interpreted to be deposited in a fluvio-deltaic to marine environment and corresponds to the Yarmouth Roads Formation.

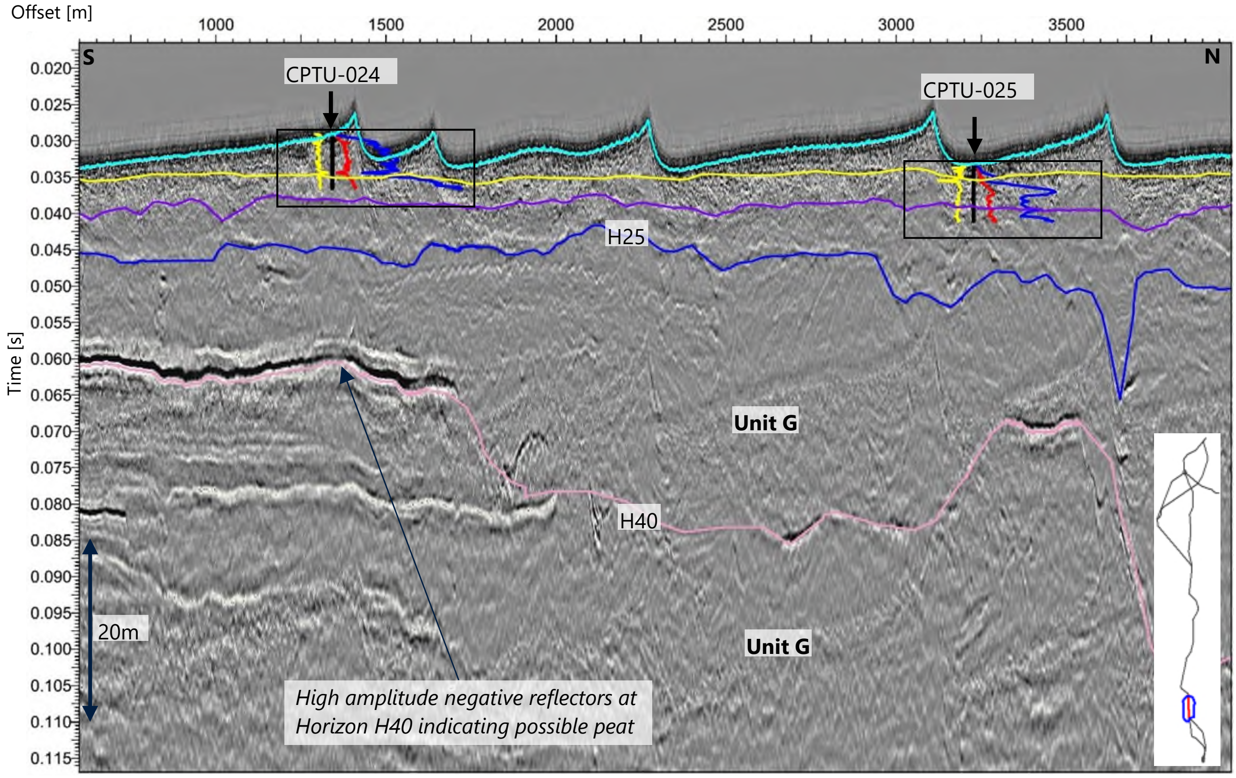


Figure 4.9: 2D-UHRS data example of the internal seismic character of Unit G. (Line 012-TA3A1525R1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 50 MPa, sleeve friction values (red curve) from 0 to 1.25 MPa and friction ratio (yellow curve) from 0 to 4 %.

4.3 Geological Features and Geohazards

4.3.1 Buried Channels

Repeated changes in depositional environment, multiple episodes of subaerial exposure, combined with marine transgression events and glacial and marine erosion during the Pleistocene have caused buried channel to be formed and filled over time.

Internal buried channels and channels at the base were observed in all units except Unit A.

Buried channels in Unit B were mapped based on SBP data. These channels are often located towards the top of the unit, have NW-SE orientation and limited extent (Figure 4.10). They often have a layered infill. The formation of these channels may be related to low-energy, coastal (tidal flat) depositional environments of the Early Holocene.

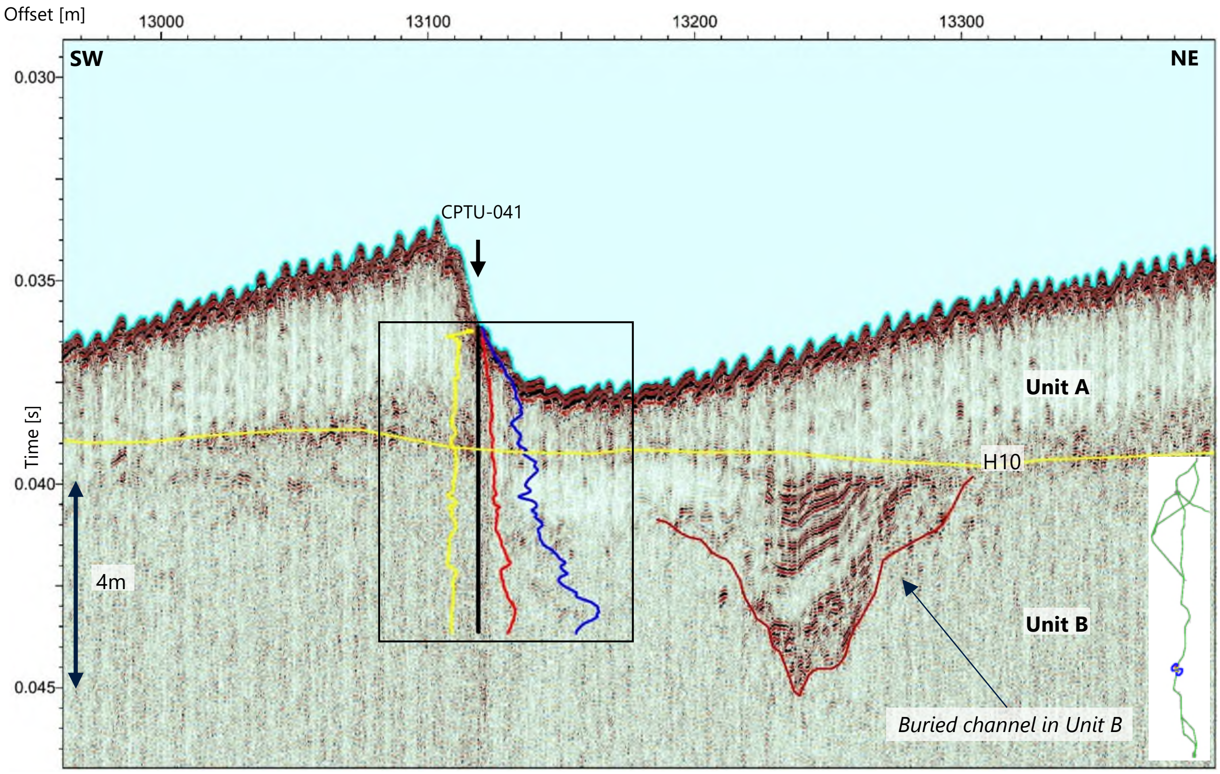


Figure 4.10: SBP data example of buried channels in Unit B. (Line SBP_TA3D2118P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

The base of Unit B, Unit C and Unit D is locally channelised (Figure 4.11). The base of Unit B is mainly channelised in the western part of the northern and central part of the route.

The base of Unit F forms the deeply incised glacial tunnel valleys.

Near the top of Unit F, locally bedded, high-amplitude reflectors forming channel-like shape were observed. These features are associated with the glacial tunnel valleys of Elsterian age and appear to represent a late stage of the infill of these tunnel valleys that may took place in lacustrine environment.

4.3.2 Peat

On the SBP data, the high amplitude reflectors that may indicate peat and/or organic clay were associated with Unit B (Figure 4.11).

High negative amplitude anomalies were observed in the 2D-UHRS seismic data. These negative amplitude events most likely represent peat and/or organic-rich clay. Peat layers were identified at a few stratigraphic levels: *2D-UHR_peat_level 1* – associated with Unit B; *2D-UHR_peat_level 2* – associated with Unit C, Unit D and Unit E; *2D-UHR_peat_level 3* – associated with Unit F and Unit G.

Peat is most common in the northern part of the route, except 2D-UHR_peat level 3, which is present along the entire route, but its distribution is very limited.

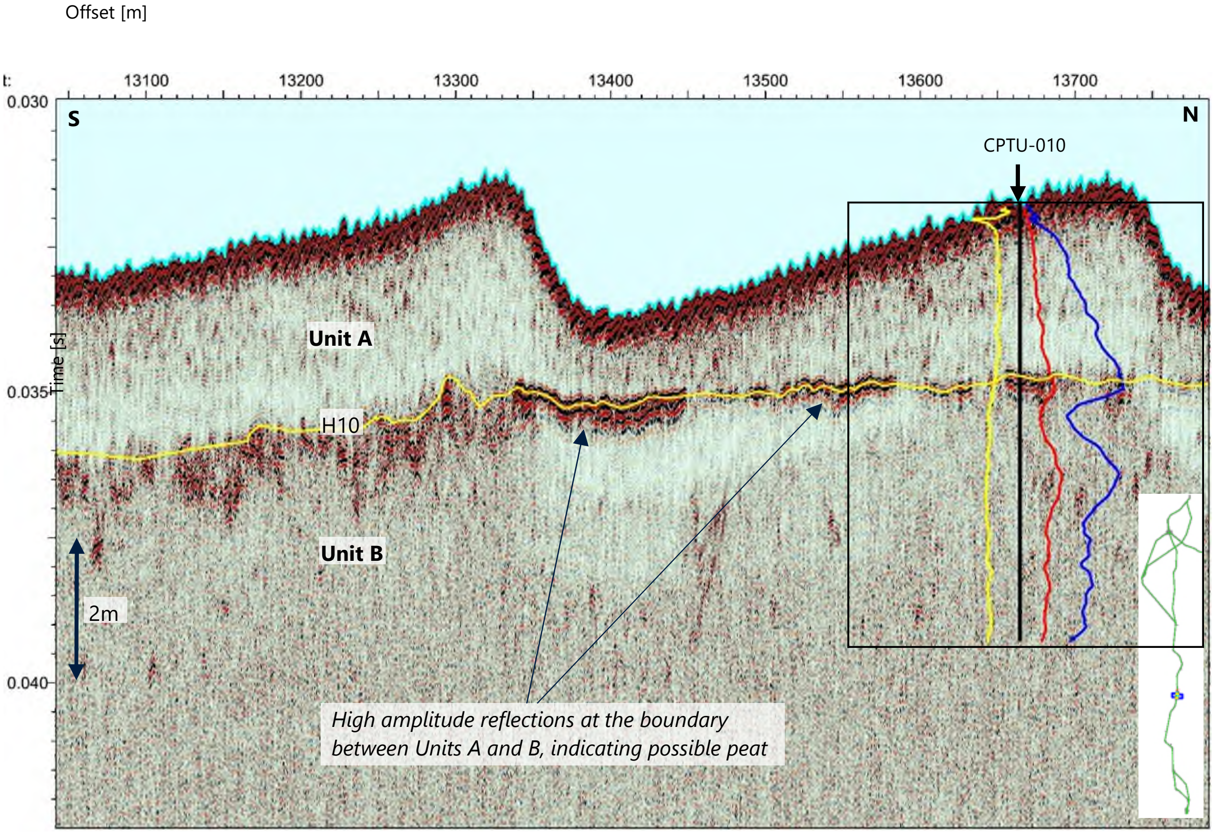


Figure 4.11: SBP data example of anomalies indicating possible peat in Unit B. (Line SBP_TA3E2134P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

4.3.3 Shallow Gas

Acoustic blanking can indicate presence of gas in soil. It was observed locally in the nearshore area. The minor acoustic blanking or signal distortion that was observed below some of the negative amplitude anomalies is thought to be related to the presence of peat (Figure 4.12). However, the presence of gas/fluid-charged sediments cannot be excluded entirely.

Acoustic blanking or signal distortion beneath some channels (mostly in Unit B) may be related to the high acoustic impedance contrast between the channel infill and surrounding sediments, in combination with the flanks of the channels being too steep to be imaged properly.

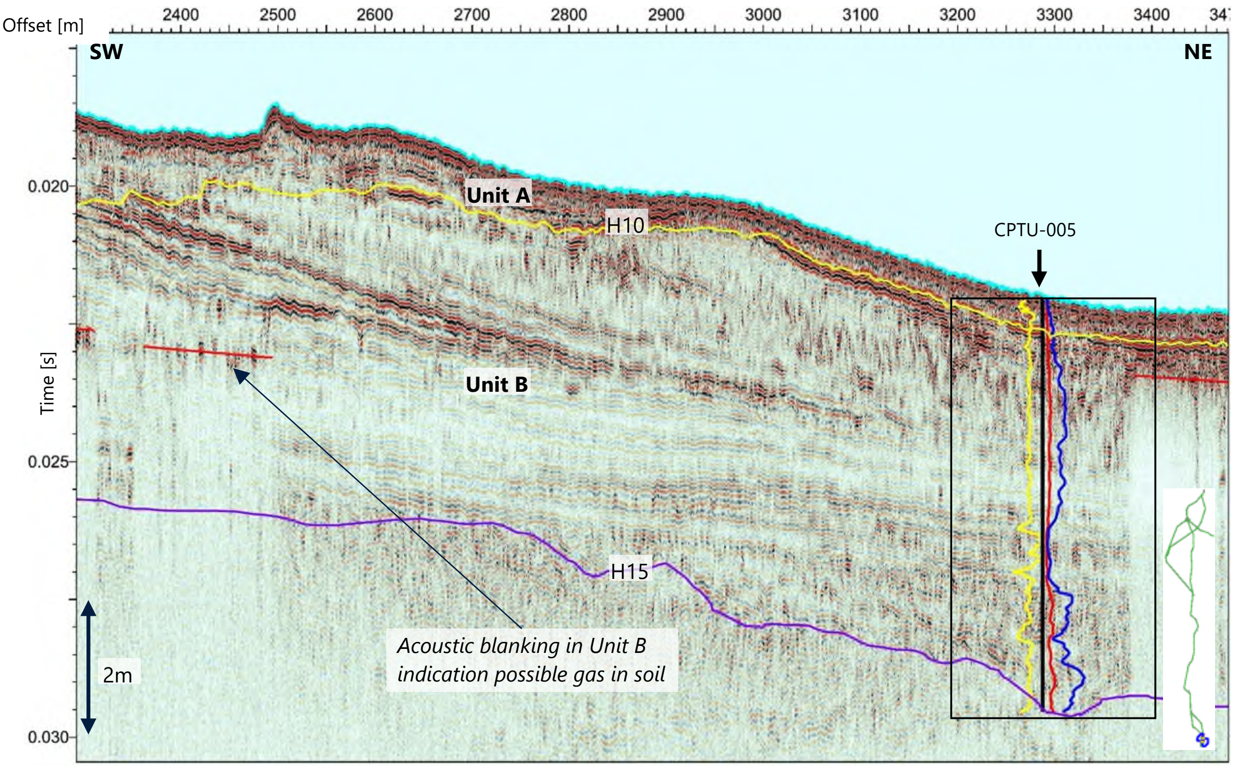


Figure 4.12: SBP data example of acoustic blanking in Unit B. (Line SBP_TA3C2020P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

4.3.4 Boulders, Cobbles and Gravel

A few diffraction hyperbolas were observed in the SBP data and are interpreted to represent possible boulders, cobbles and/or coarse gravel.

It should be noted that interpretation of these features is speculative and diffraction hyperbolas may be the result of factors other than the presence of boulders, cobbles or coarse gravel. Diffraction hyperbolas might be out of plane reflections which represent objects away from the SBP track line. Objects in between track lines may not be imaged in the SBP data and therefore not identified. Data quality influences the ability to image diffraction hyperbolas. Interpreting diffraction hyperbolas is subjective to some extent.

Given the geological setting (i.e. the expected presence of periglacial and glacial sediments), boulders and cobbles can be expected along the Aramis route. Hence, their presence cannot be ruled out.

4.3.5 Glacial Deformation

Glacial deformation is typically expressed in seismic data as chaotic internal reflections, inclined shear planes, deformed and folded strata and disturbance of the original internal structure.

The Aramis trunkline area has been affected by two glaciations, the Saalian and the Elsterian, which may have resulted in thrusting and folding of sediments due to glacial loading and ice sheet advances and retreats. The units that may have been affected are the pre-Saalian units (Unit F and Unit G).

Evidence of possible deformation was observed in Unit G, especially in proximity of glacial tunnel valleys (Unit F). These features are thought to be related to the Elsterian glaciation (Figure 4.13).

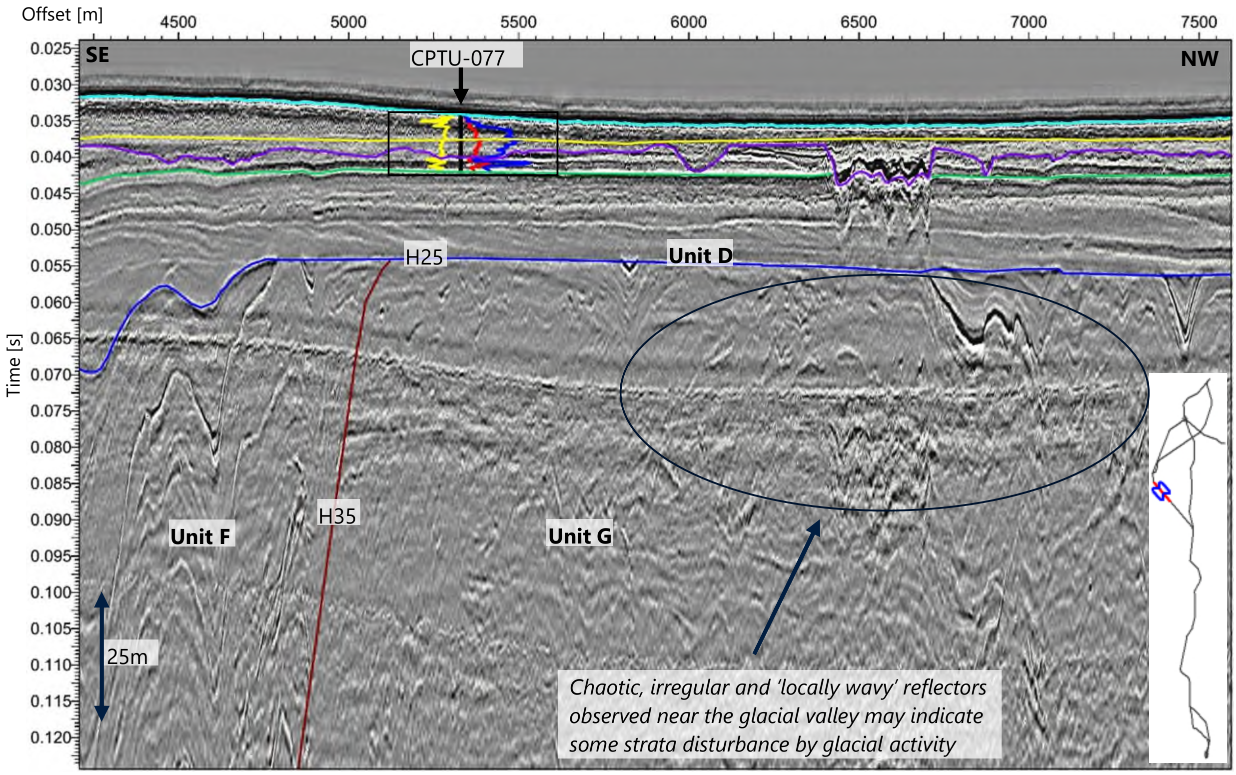


Figure 4.13: 2D-UHRS data example of possible glacial deformation in Unit G. (Line 212-TA3A1547P1) *Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.*

4.3.6 Faults

Due to the structureless seismic aspect that characterises a large part of the sub-seafloor vertically extensive / tectonic faults were not observed in the seismic reflection data. Small-scale faults associated with possible glaciotectonism or dewatering features may be present, as well as faults associated with the steep flanks of the tunnel valleys. The presence of more faults and/or fractures cannot be ruled out.

5. Export Route East MT

5.1 Export Route East MT Location

The location of the route section Export Route East MT is shown in Figure 5.1. This section of the route has a length of 30.5 km.

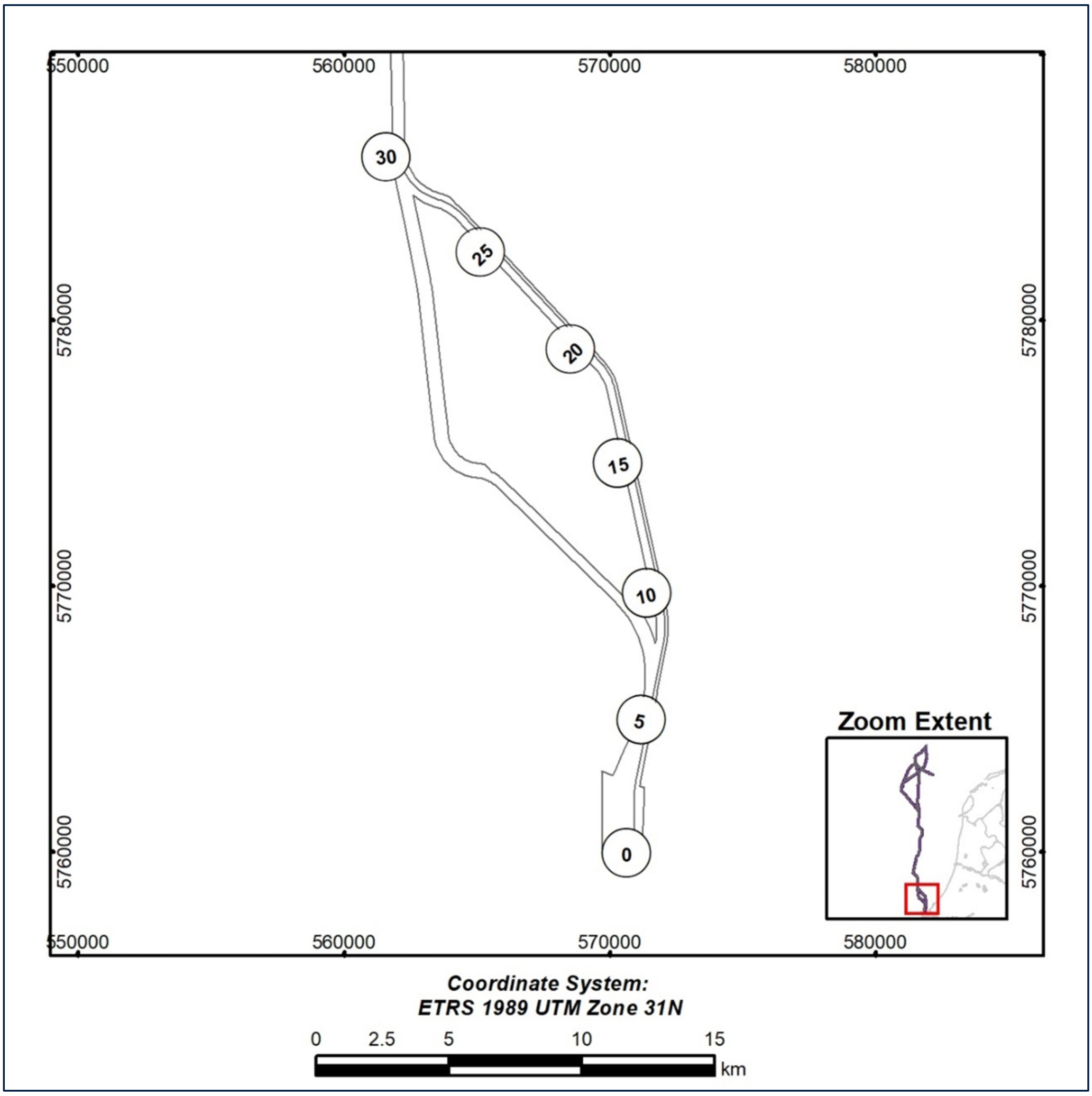


Figure 5.1: Location of the route section Export Route East MT.

5.2 Results

5.2.1 Bathymetry

The water depth within the Export Route East MT section ranges between 3.0 m and 24.0 m. An overview of the bathymetry is given in Figure 5.2.

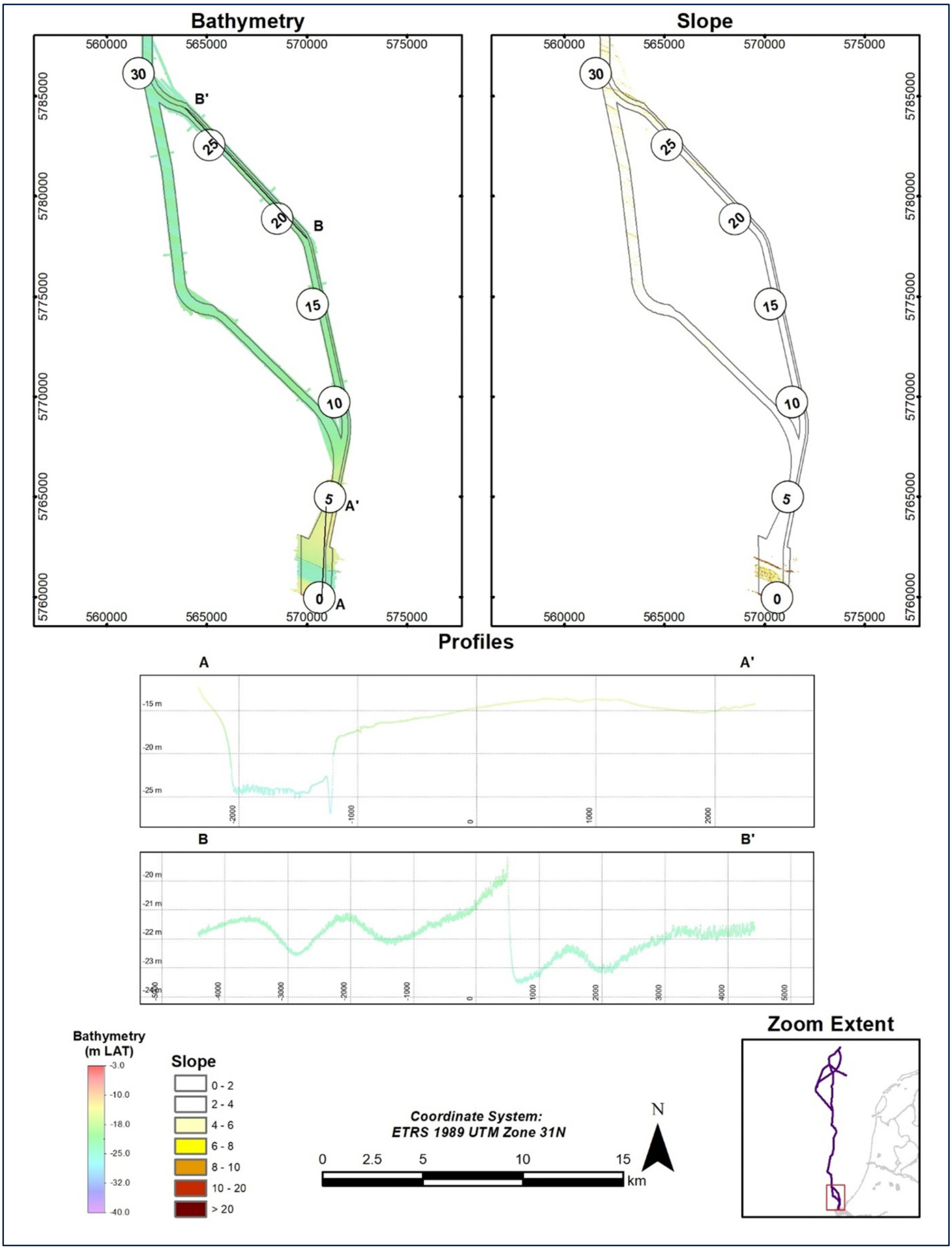


Figure 5.2: Bathymetry along Export Route East MT.

5.2.2 Seafloor Morphology

Overall, a strong correlation between seafloor sediment types and morphological types was observed along the Export Route East MT. An overview of the sediment and features encountered is given in Table 5.1.

Table 31: Sediment type with associated morphology in Export Route East MT

Sediment Type	Morphological Type
Gravelly SAND	Area with numerous boulders/debris Area with occasional boulders/debris Irregular seafloor or featureless
Slightly gravelly SAND	Ripples, megaripples and sand waves Irregular seafloor Cable trench (HKZ)
SAND	Featureless Irregular seafloor Navigation Channel / Maasmond Kanaal
Rock armour	Rock armour

Figure 5.3 to Figure 5.6 show the first 4 KPs of the Export Route East MT section. In the nearshore area, the main bathymetrical feature is the dredged Maasmond Kanaal (navigation channel) with its dredging scour marks.

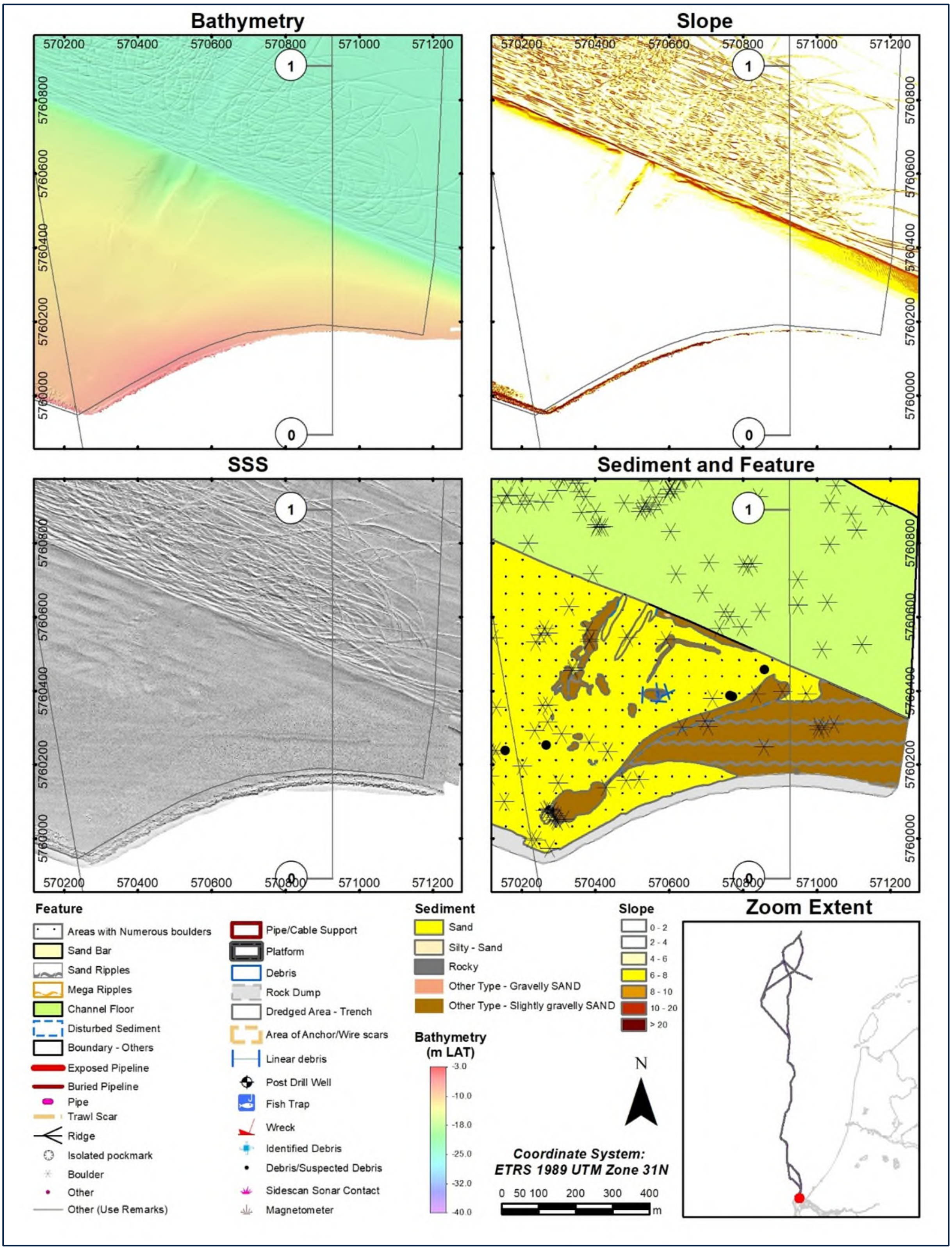


Figure 5.3: Overview of the sediments and morphology in Export Route East MT. : KP 0.0 to KP 1.0. Maasmond Kanaal with dredging scours visible.

Between KP 1.0 and KP 2.0 of the route section (Figure 5.4), trenches of the recently installed cables (Kabel van windgebied HK(Zuid) naar Maasvlakte) are visible.

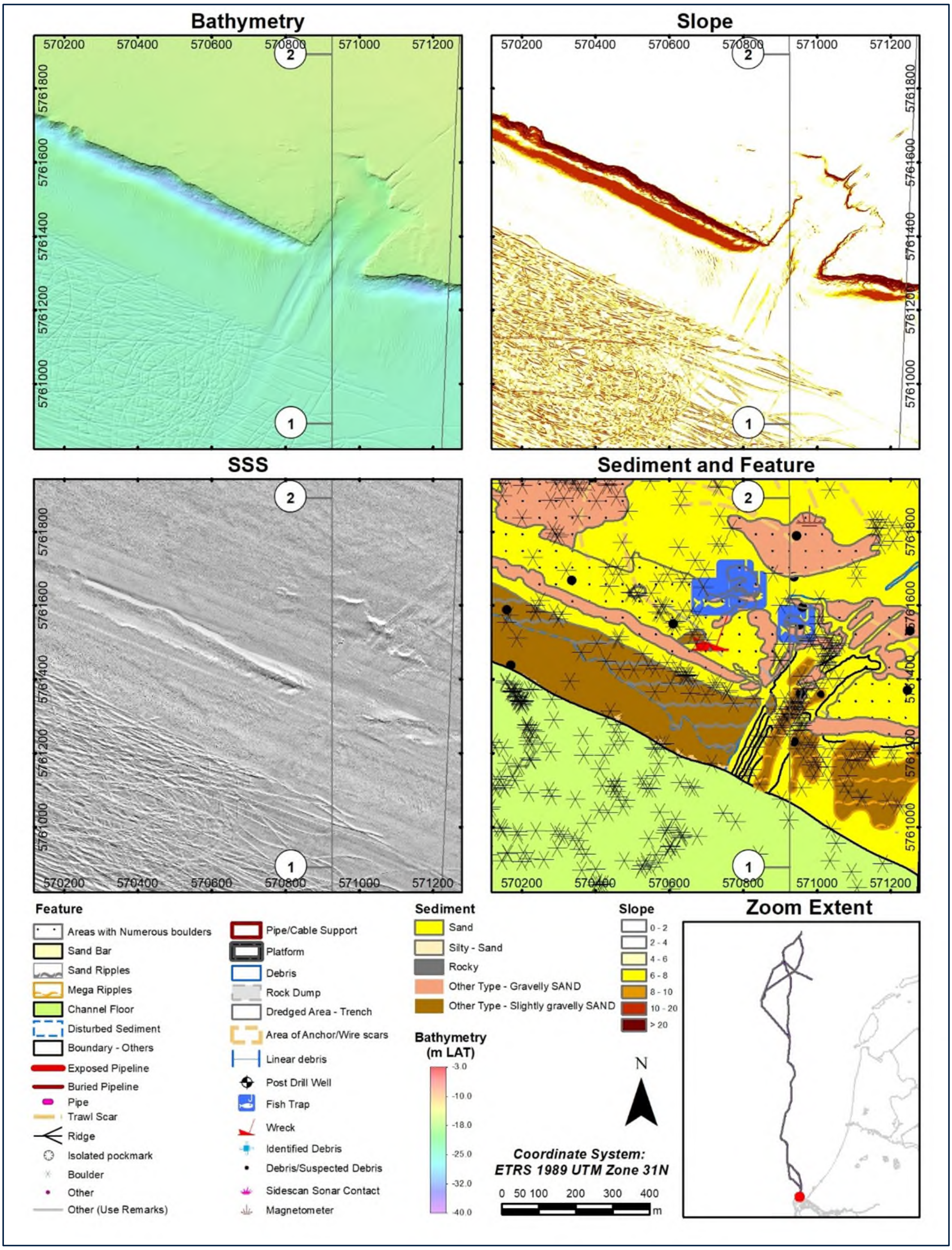


Figure 5.4: Overview of the sediments and morphology in Export Route East MT.: KP 1.0 to KP 2.0. Maasmond Kanaal with dredging scours and HKZ cable trenches visible.

Between KP 2.0 and KP 3.0 (Figure 5.5), an area with numerous boulders/debris and sediment dumping features is visible. At KP 2.5 there is a change in sediment type from SAND with sediment dumping features to slightly gravelly SAND with irregular seafloor.

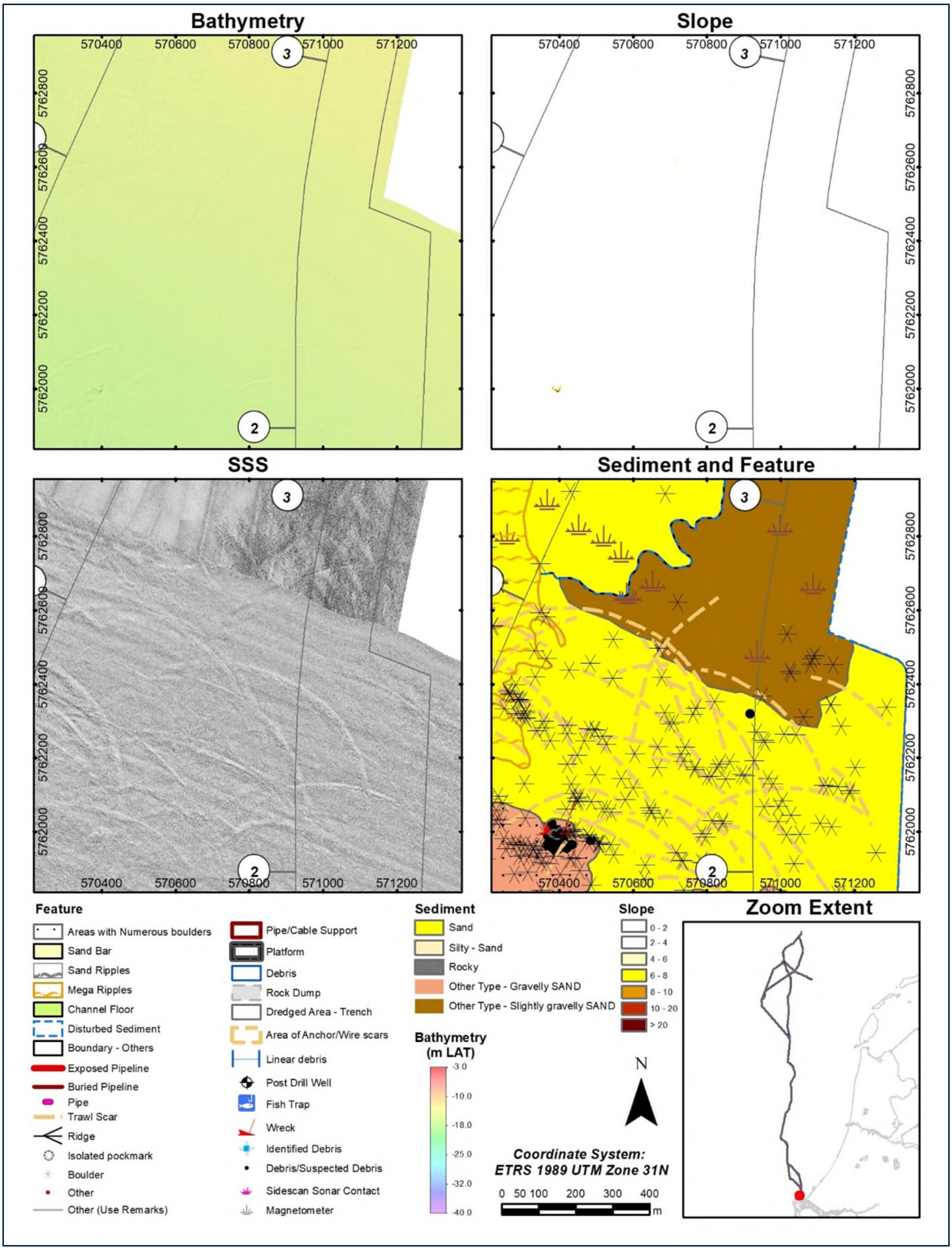


Figure 5.5: Overview of the sediments and morphology in Export Route East MT: KP 2.0 to KP 3.0.

Between KP 3.0 and KP 4.0 (Figure 5.6), an area with various MAG contacts is visible. This part of the section is relatively flat and characterised by various sediment types from featureless SAND to slightly gravelly SAND with irregular seafloor and patchy SSS reflectivity.

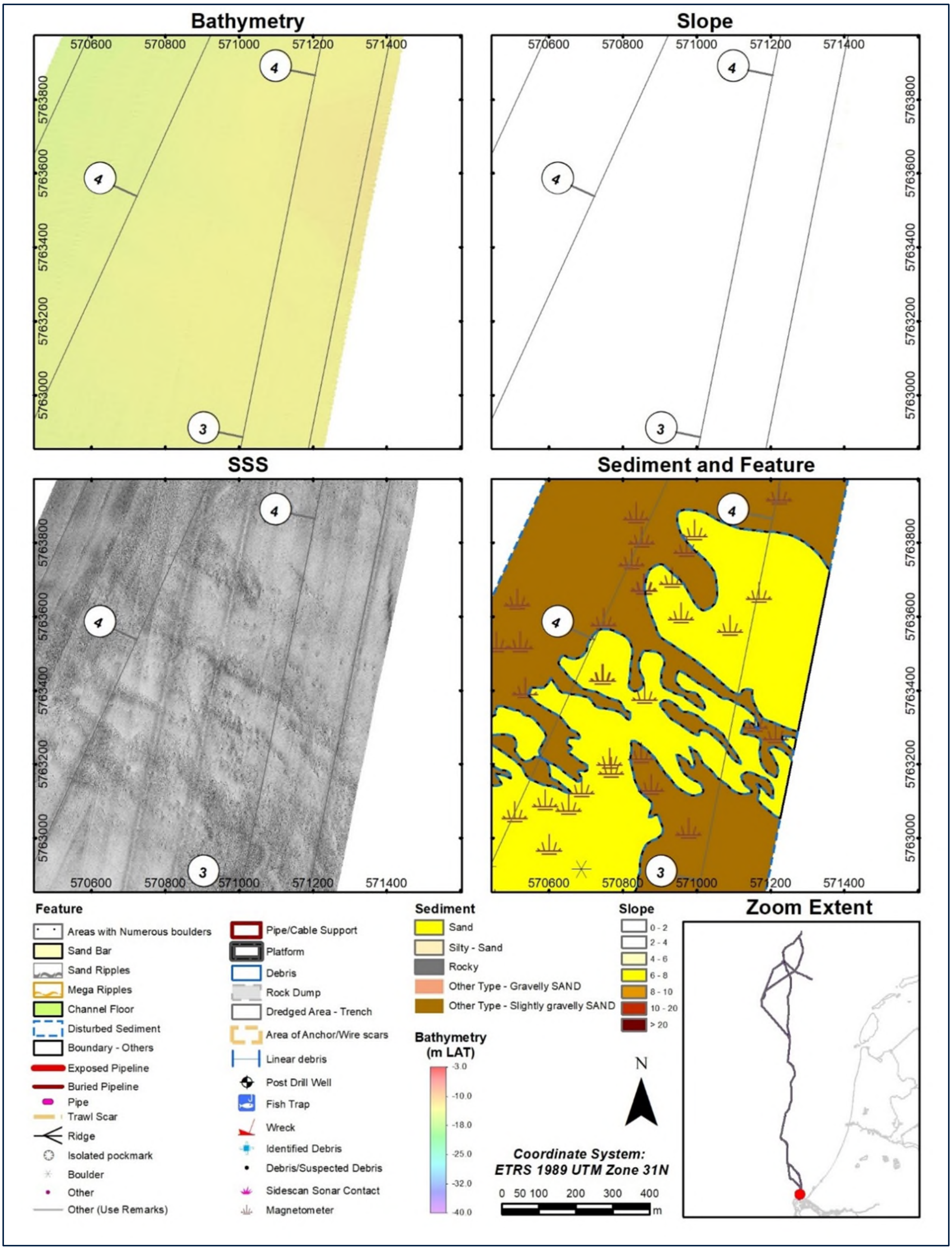


Figure 5.6: Overview of the sediments and morphology in Export Route East MT: KP 3.0 to KP 4.0.

Between KP 14.0 and the end of the section, the sediment type identified as slightly gravelly SAND is present, with the presence of ripples, megaripples and sand waves.

The sand waves are mostly symmetrical, with a northwest – southeast orientation, with an average length of 3.0 km, with the height between 1 m and 4 m.

5.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross correlated where possible.

Table 5.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the section boundary of each sensor and cross-correlated where multiple datasets were available. No targets cross correlate between sensors.

Table 32: Summary of seafloor contacts in Export Route East MT

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	576
	Debris	11
	Fishing gear	5
	Suspected debris	20
	Wreck	1
	Magnetic anomalies	1174
SSS/MBES/MAG Linear Features	Scour	1527
	Unknown linear feature	8
	Buried pipeline	6 segments (2 pipeline in total)
	Magnetic linear feature	7

An area of numerous boulders / debris has been identified between KP 23.5 and KP 26.0 (Figure 5.7).

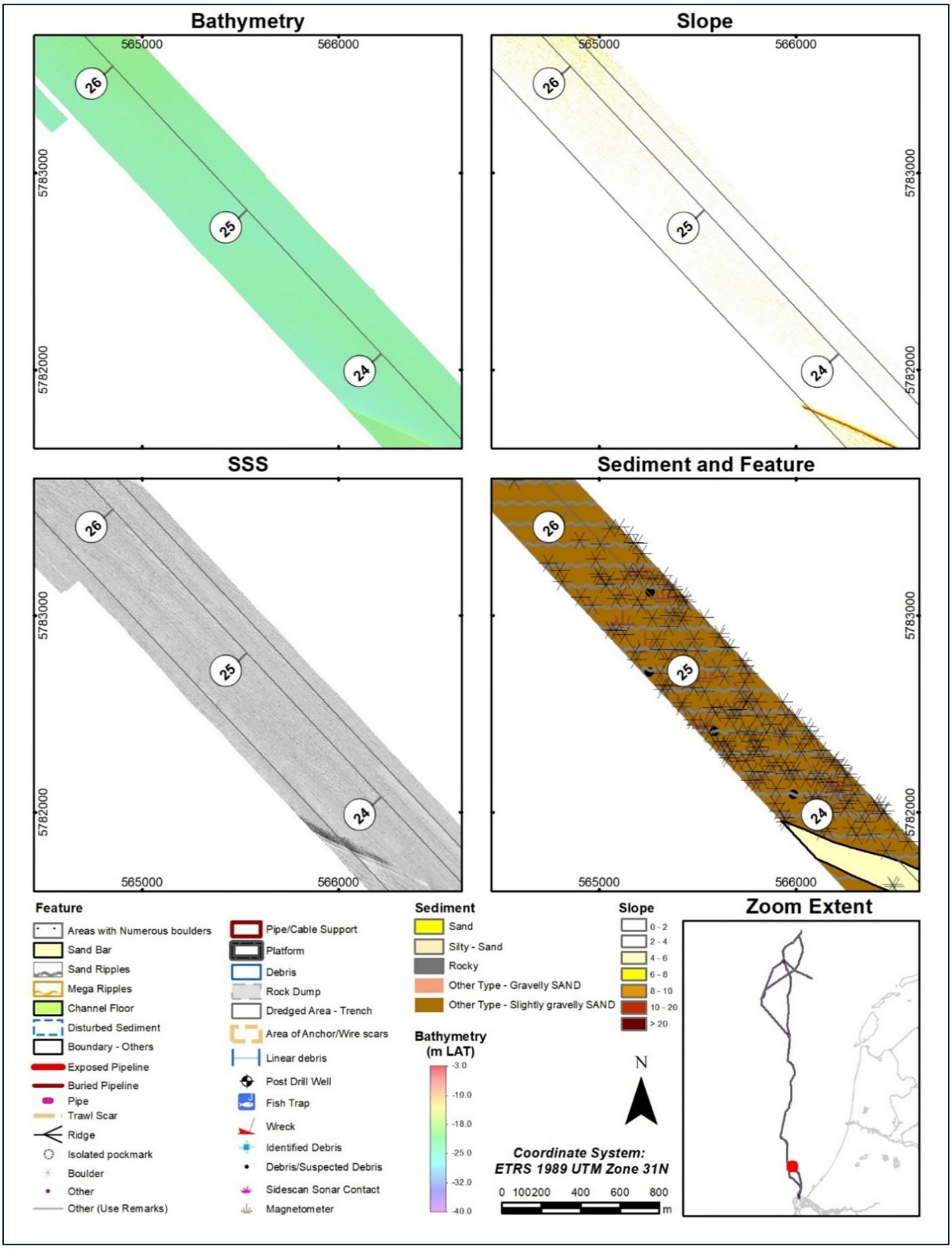


Figure 5.7: Overview of the sediments and morphology in Export Route East MT: KP 24.0 to KP 26.0.

Six (6) segments of two (2) buried pipelines are observed in route section Export Route East MT (Table 5.3 and Figure 5.8). The pipelines also cross the Export Route West HDD and the beginning of section A – Alt.

Table 33: Summary of pipelines in Export Route East MT

Contact ID	Pipeline Name	Comment
Pipeline (PL0039_PR)	P15-C to Hoek van Holland 10-inch oil trunkline	Buried (3 segments)
Pipeline (PL0099_PR)	P15-D to Maasmonding 26-inch gas pipeline	Buried (3 segments)

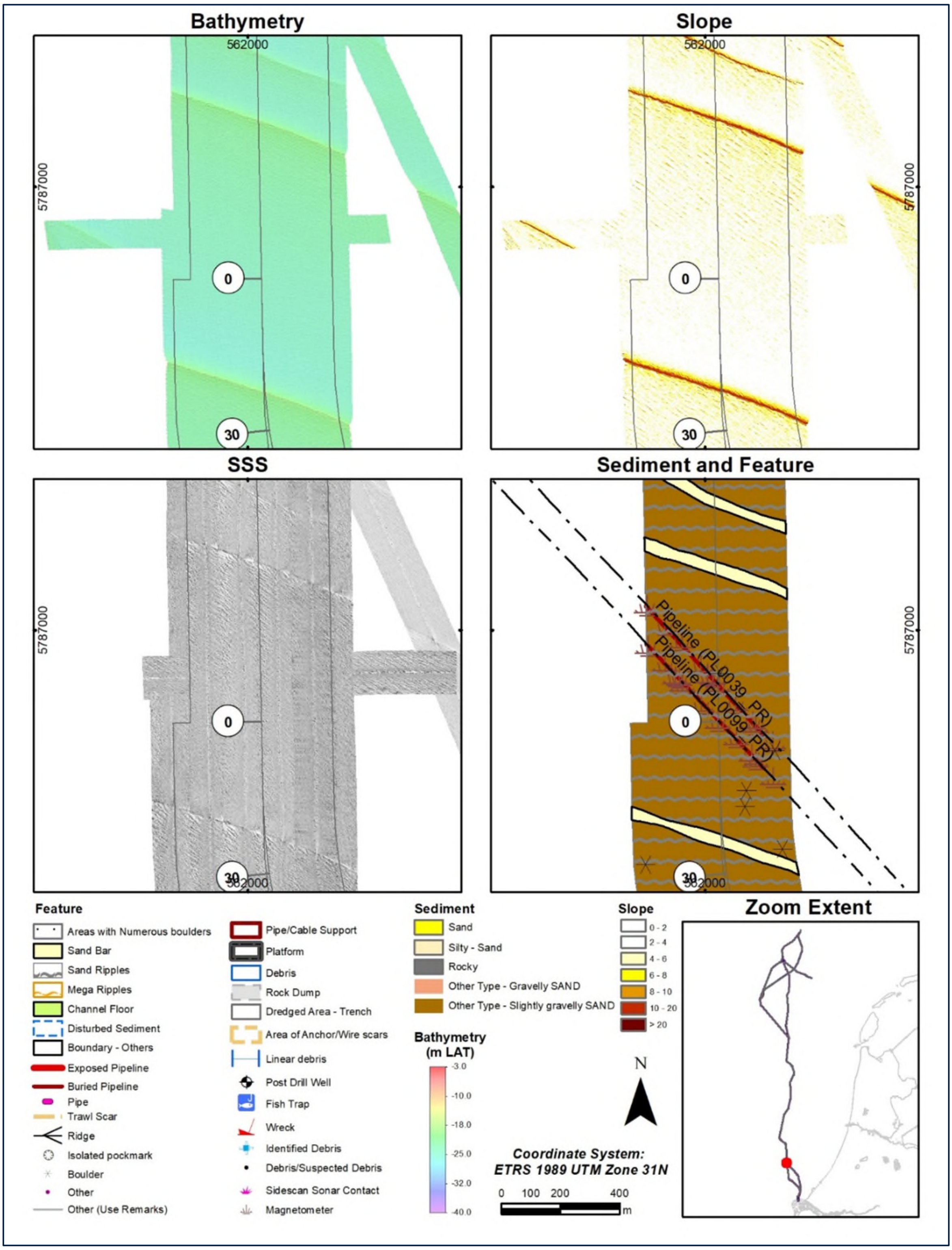


Figure 5.8: Pipelines encountered in Export Route East MT: KP 30.5.

5.2.4 Magnetometer Contacts

1174 magnetic contacts were found at the time the geophysical scope (single MAG survey) in Export Route East MT. The magnetometer anomalies range between 0.9 nT and 3867.1 nT. The highest magnetic amplitude is associated with the encountered pipelines. Most of the magnetic anomalies are located in the nearshore area, between KP 0.5 and KP 2.5, and are probably related to the very anthropogenically altered area close to the Port of Rotterdam.

5.2.5 Sub-seafloor Geology

Units DS, A, B, D and G are present in Export Route East MT (Figure 5.9).

Unit DS is present exclusively in the dredged Maasmond Kanaal. The base of these sediments is uncertain and taken at the base of high amplitude reflections or at the top of structured seismic facies, which were very locally observed. The unit has semi-transparent and chaotic seismic character.

Unit A is present basically in the entire section, except in the Maasmond Kanaal. The top unit in the Maasmond Kanaal consists of disturbed sediments (Unit DS) and deposits of Unit A were removed during dredging activities. Between KP 0.3 and KP 1.8 Unit A was not observed, however in this part of the section acoustic blanking is widespread, what greatly obscure the acoustic signal. Unit A is characterized by chaotic in the nearshore area to semi-transparent seismic facies, with locally point reflections further offshore. High amplitude reflectors of limited extent were observed locally between KP 2.0 and KP 10.0 in this unit. The maximum thickness of Unit A in this section is approximately 4.5 m.

Unit B is present across the entire section. Between KP 0.0 to KP 2.7 it is observed locally (as patches), what can be due to the acoustic blanking that hinder the interpretation. The unit exhibits transparent to semi-transparent seismic character. Between approximately KP 2.5 and KP 7.5 the unit exhibits often layered facies with flat to inclined parallel reflectors. Internal buried channels with layered infill were observed in this unit. The maximum thickness of Unit B in this section is approximately 5 m.

Unit B is underlain by Unit D (interpreted to be present from approximately KP 17.3) and Unit G. Unit D and G exhibit structureless acoustically transparent to semi-transparent seismic character in this section.

High amplitude anomalies in Unit G were interpreted between KP 18.3 to KP 30.0. These negative amplitude events most likely represent laminae or thin bed of peat and/or organic-rich clay (peat level 3).

Table 5.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 34: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
DS	0 to 4.5	Very loose to very dense slightly silty fine and medium SAND
A	0.2 to 4.0	Very loose to very dense slightly silty fine and medium SAND with frequent shells and shell fragments
B	2.0 to 10.5	Medium to very dense slightly silty fine and medium SAND with numerous shells and shell fragments
D	BPD	Dense to very dense slightly silty fine and medium SAND, occasionally slightly gravelly
Notes: BPD = below penetration depth of SBP data		

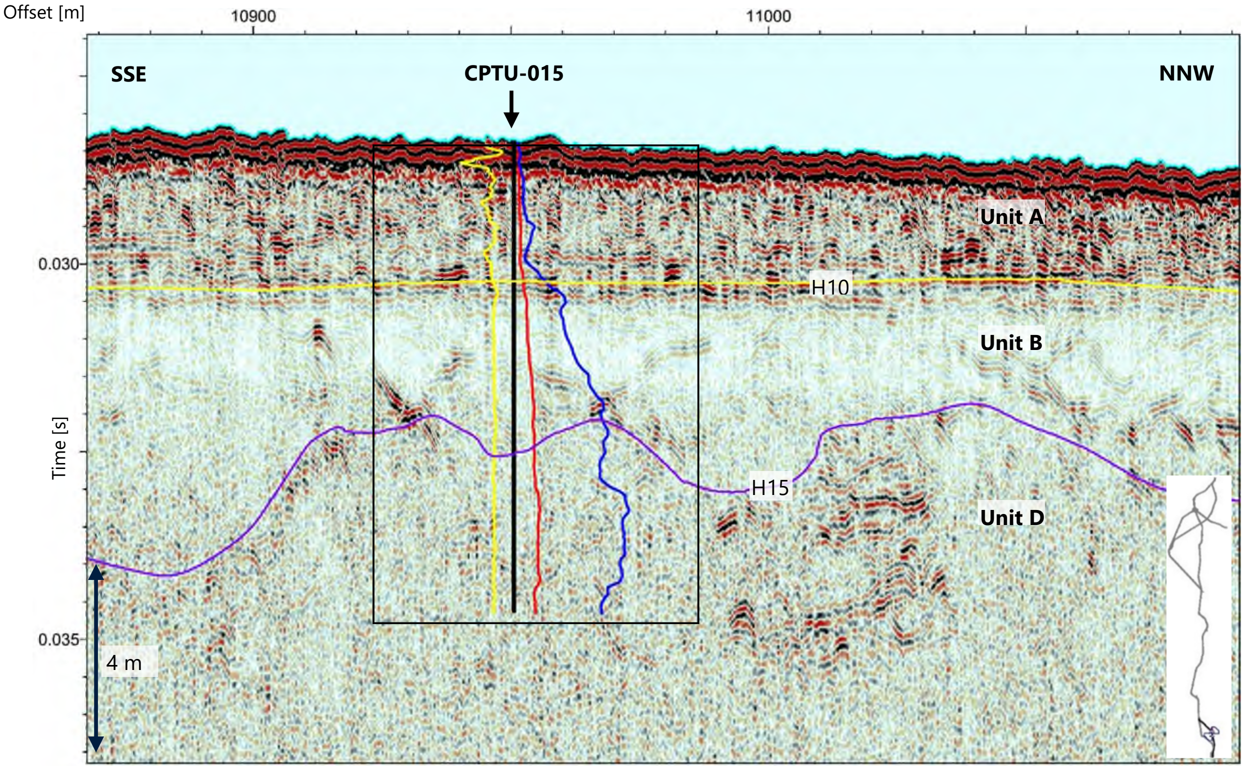


Figure 5.9: SBP data example of route section Export Route East MT. (Line SBP_TA3C2015P1) *Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.*

6. Export Route West HDD

6.1 Export Route West HDD Location

The location of the Export Route West HDD section is shown in Figure 6.1. This section of the route has a length of 31.0 km.

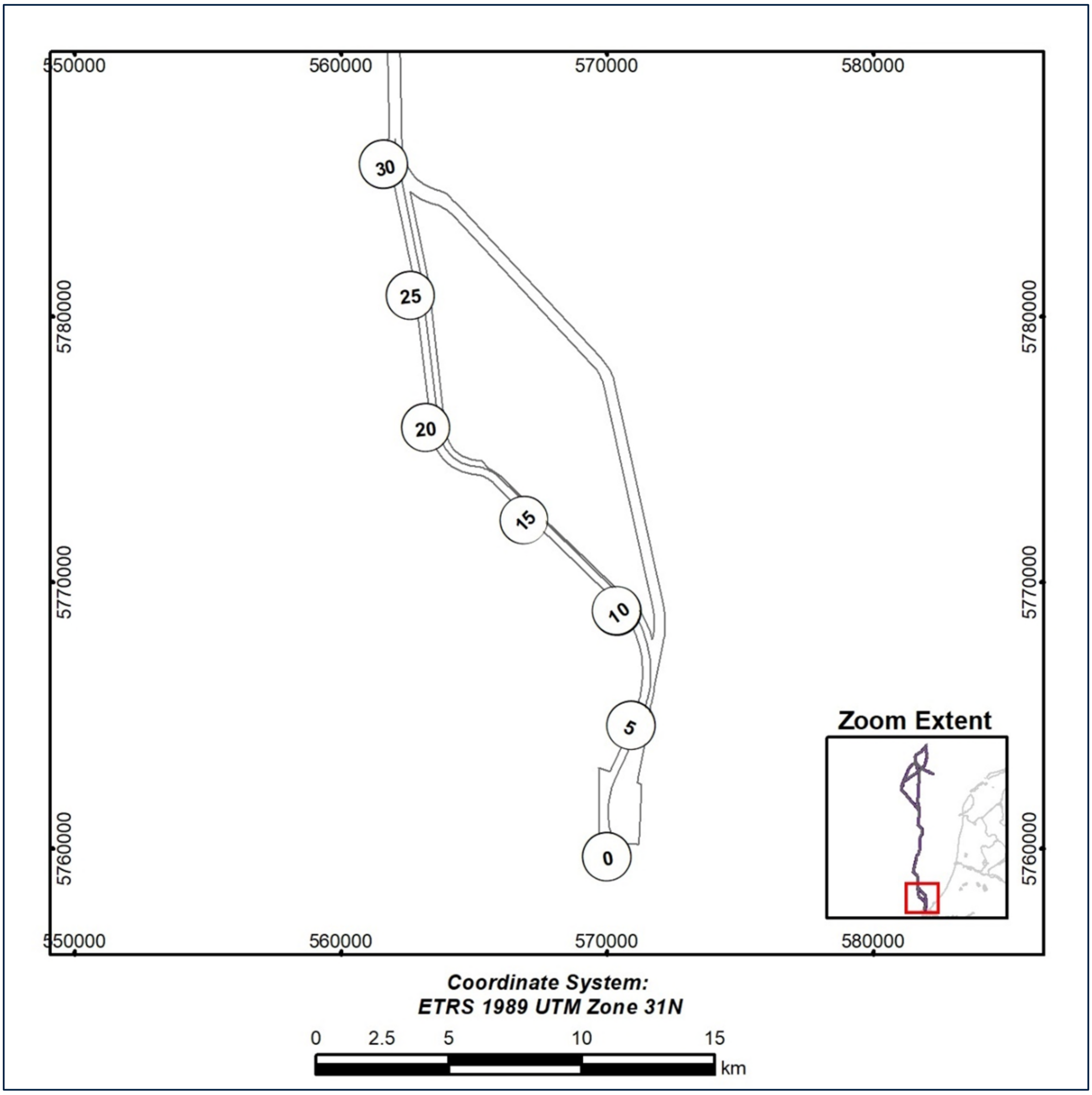


Figure 6.1: Location of the route section Export Route West HDD.

6.2 Results

6.2.1 Bathymetry

The water depth within Section Export Route West HDD ranges between 3.0 m and 24.0 m. An overview of the bathymetry is given in Figure 6.2.

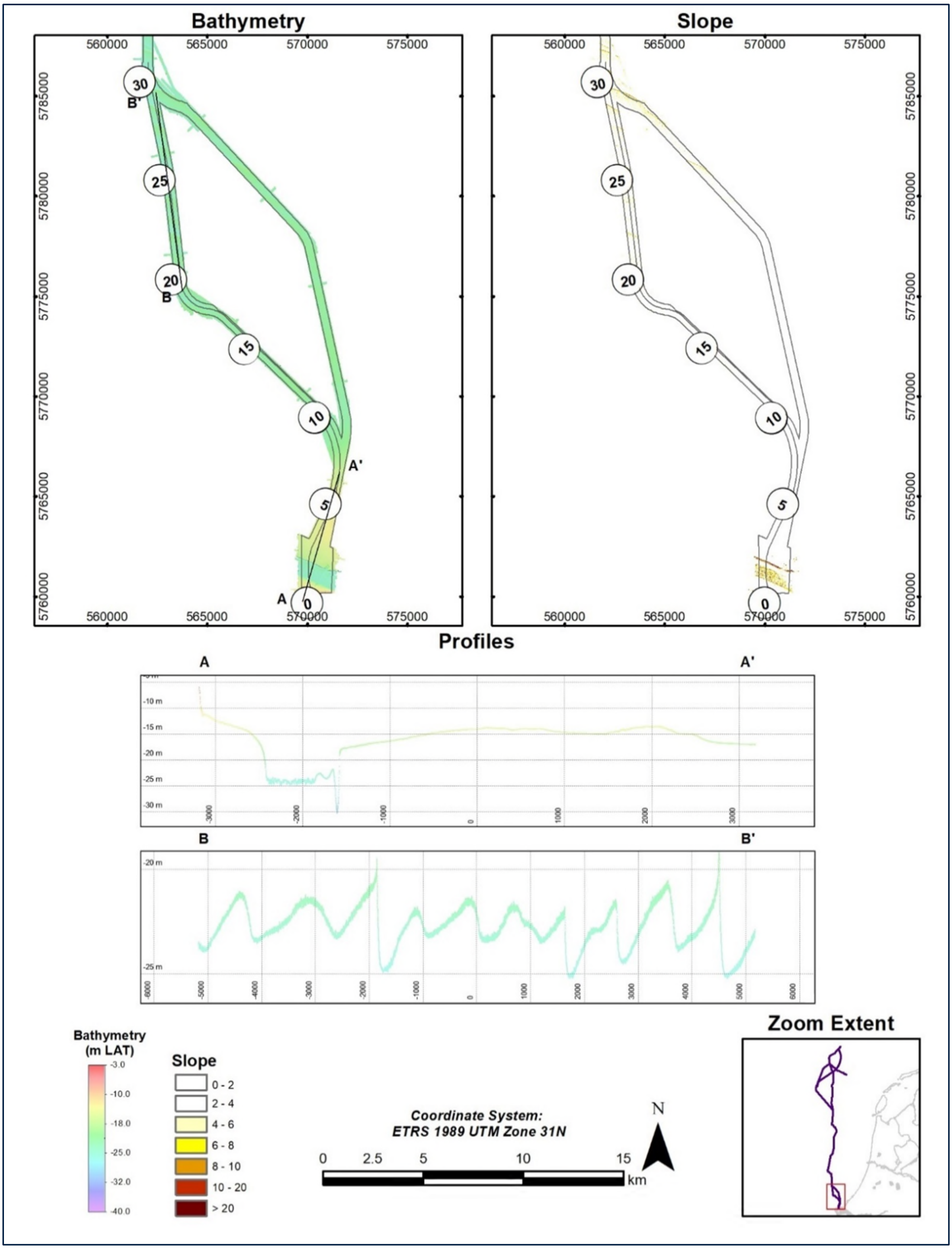


Figure 6.2: Bathymetry along Export Route West HDD.

6.2.2 Seafloor Morphology

A strong correlation between sediment types and morphological type was observed in the Export Route West HDD section, although some small variations are possible. An overview of encountered sediments and seafloor features is given in Table 6.1.

Table 35: Sediment type with associated morphology in Export Route West HDD

Sediment Type	Morphological Type
Gravelly SAND	Area with numerous boulders/debris Area with occasional boulders/debris Irregular seafloor or featureless
Slightly gravelly SAND	Ripples, megaripples and sand waves Irregular seafloor Cable trench (HKZ)
SAND	Featureless Irregular seafloor Navigation Channel / Maasmond Kanaal Wreck area
Rock armour	Rock armour

Figure 6.3 to Figure 6.5 show the first 3 KPs of the route section Export Route East MT.

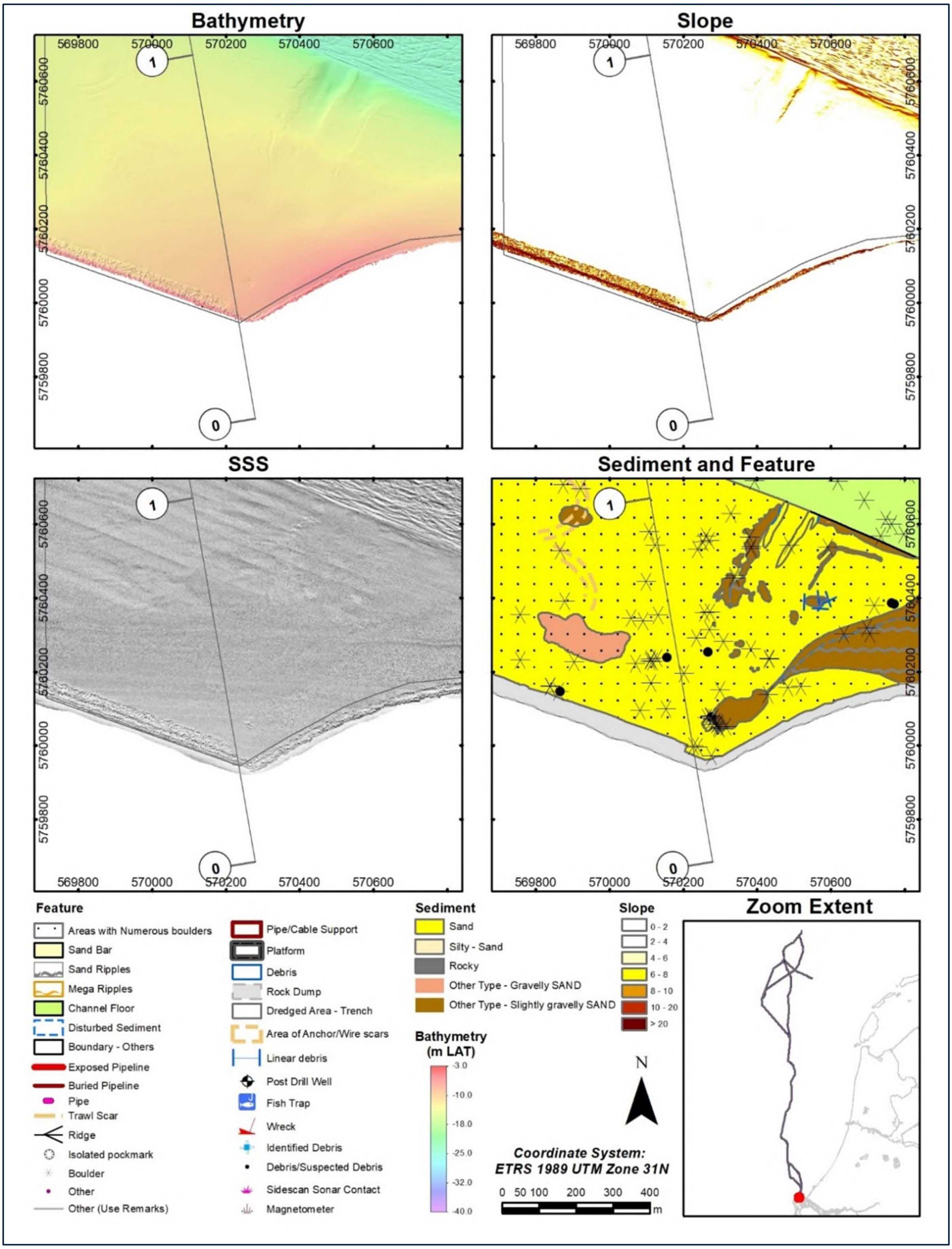


Figure 6.3: Overview of the sediments and morphology in Export Route West HDD: KP 0.0 to KP 1.0.

In the nearshore area, between KP 1.0 and KP 2.0, the main morphological feature is the dredged Maasmond Kanaal (navigation channel) with its dredging scour marks.

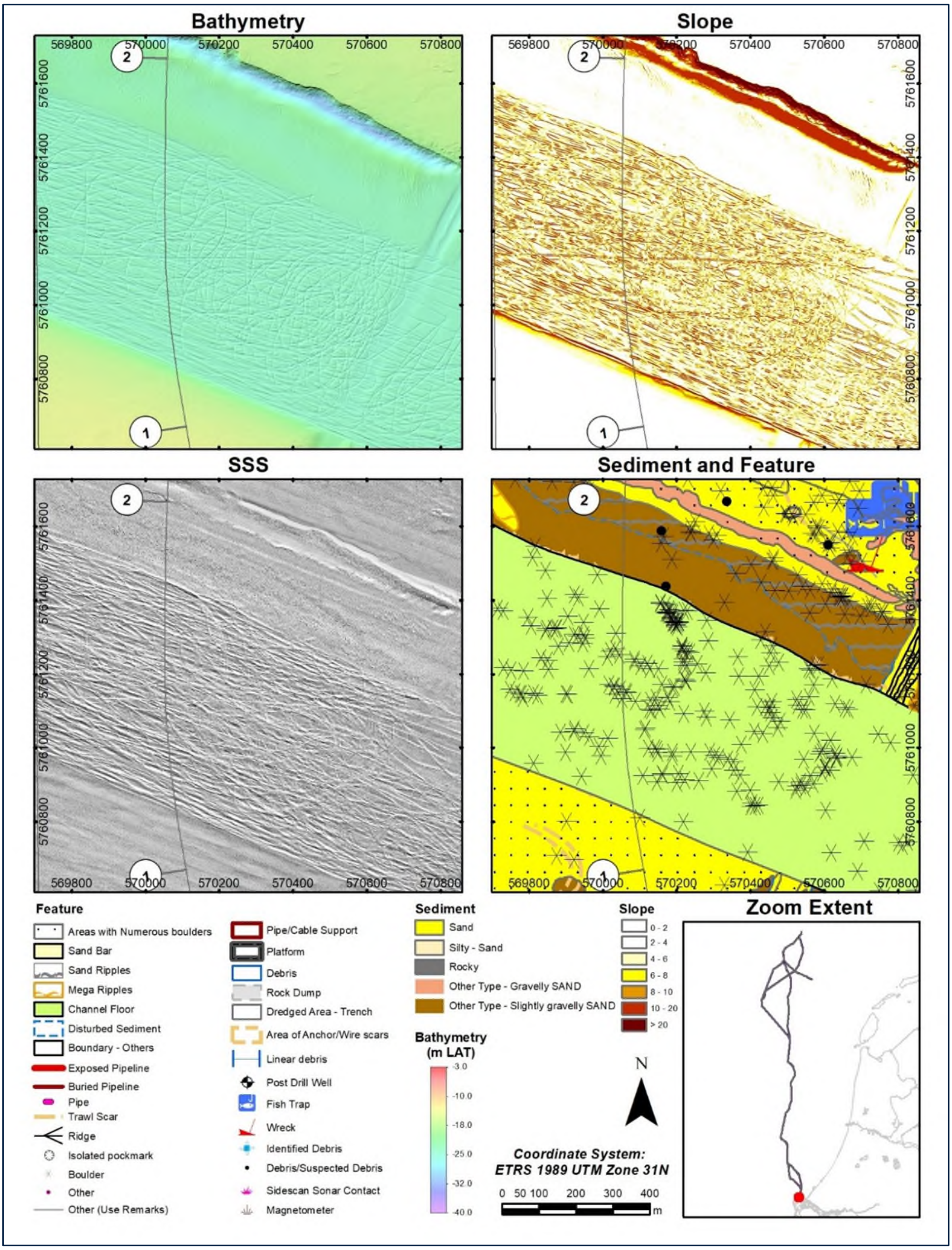


Figure 6.4: Overview of the sediments and morphology in Export Route West HDD: KP 1.0 to KP 2.0.

Between KP 2.0 and KP 3.0, an area with numerous boulders / debris and sediment dumping features is visible (Figure 6.5). At KP 2.4 of the section, and 0.4 km east from the centreline there is a debris wreck area identified.

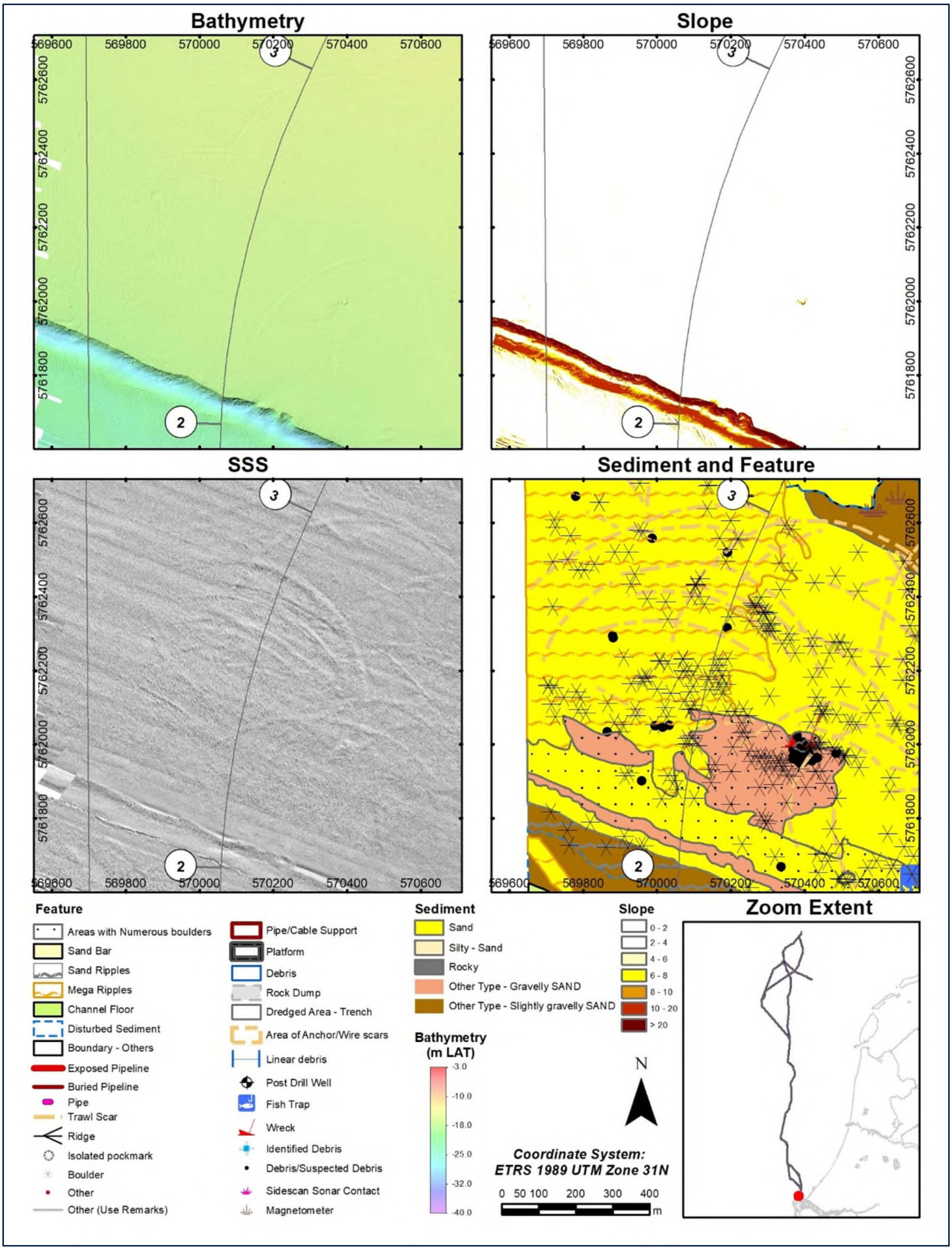


Figure 6.5: Overview of the sediments and morphology in Export Route West HDD: KP 2.0 to KP 3.0.

Between KP 12.0 and KP 13.0, a change of sediment type from a featureless SAND area to slightly gravelly SAND with ripples (Figure 6.6). From KP 12.5 till the end of this section the prevalent sediment is classified as slightly gravelly SAND with bedforms such as ripples, megaripples and sand waves.

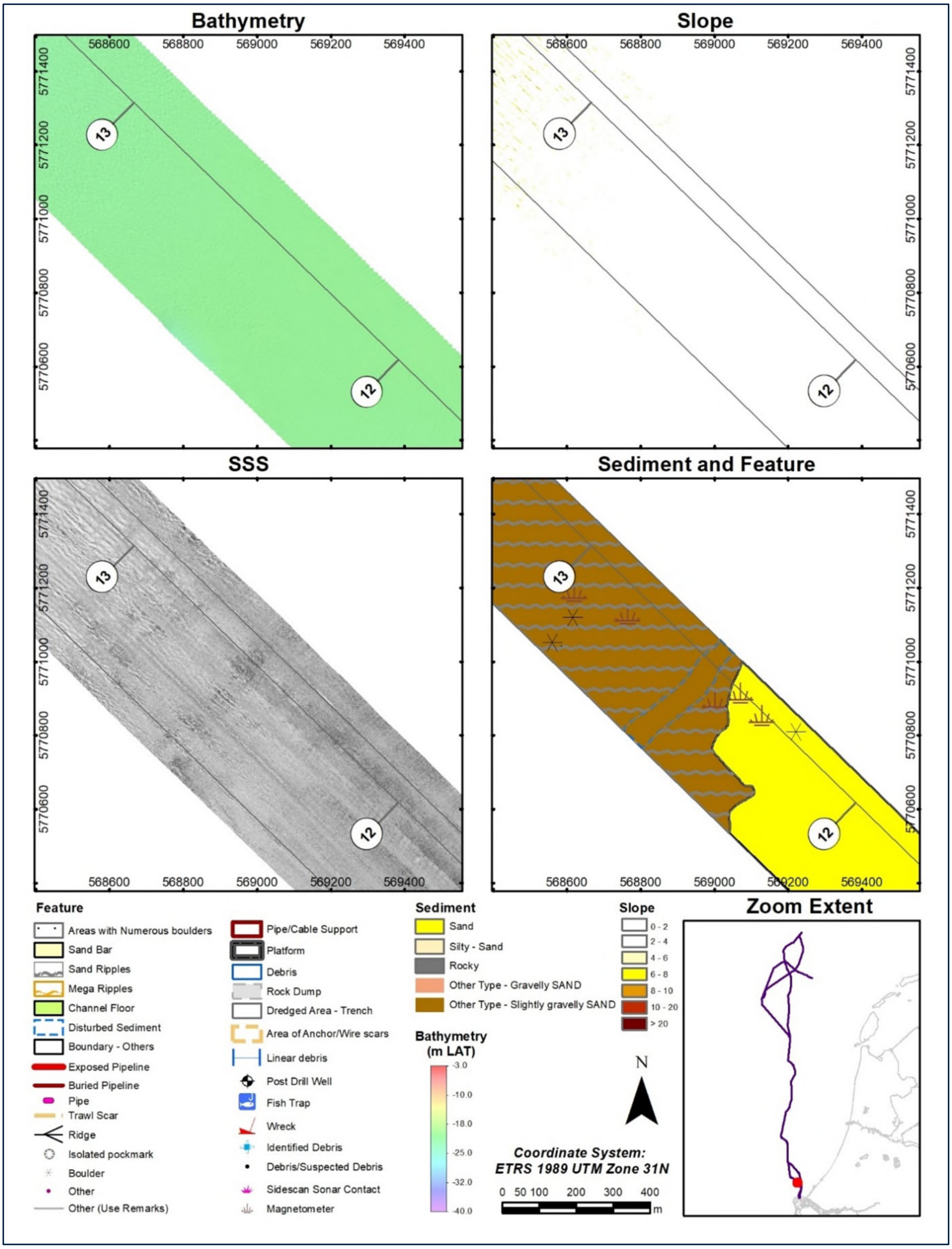


Figure 6.6: Overview of the sediments and morphology in Export Route West HDD: KP 12.0 to KP 13.0.

Between route sections Export Route East MT and Export Route West HDD, approximately 0.5 km from both sections, at KP 2.0, an unknown circular feature has been identified (Figure 6.7). This feature has a length of 47.7 m, a width of 24.8 m and a maximum depth of 0.54 m.

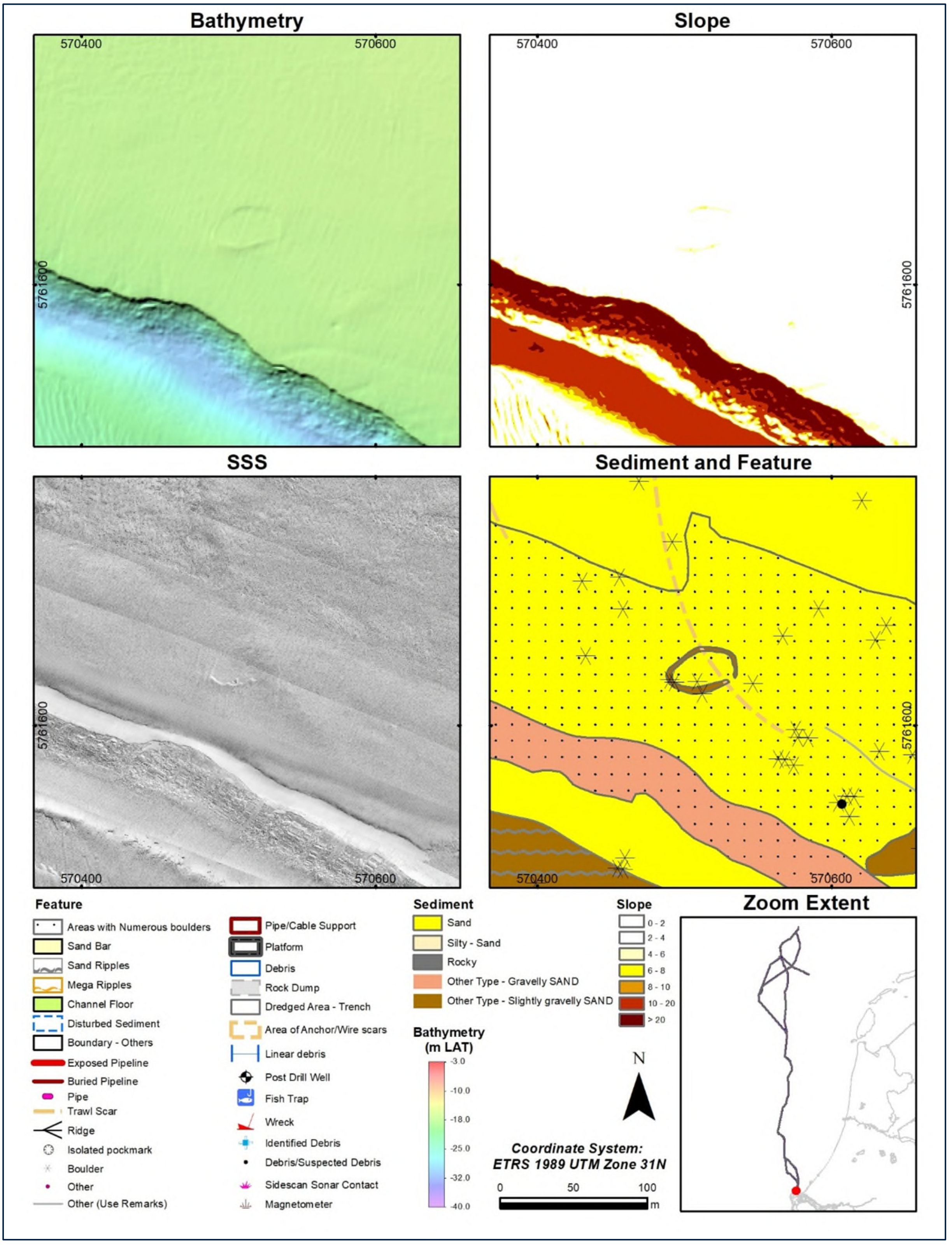


Figure 6.7: Overview of the sediments and morphology in Export Route West HDD: KP 2.0, unknown circular feature.

6.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated, where possible.

Table 6.2 summarizes the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available.

Table 36: Summary of seafloor contacts in Export Route West HDD

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	1885
	Debris	25
	Suspected debris	80
	Wreck	1
	Magnetic anomalies	651
SSS/MBES/MAG Linear Features	Possible fishing gear	3
	Mound ridge	2
	Scour	6460
	Telecommunication cable	1
	Buried pipeline	1
	Magnetic linear feature	4

8 targets cross correlate between sensors in section Export Route West HDD (Table 6.3).

Table 37: Summary of cross correlating seafloor contacts in Export Route West HDD

Section	SSS Target Name	MAG Target Name	Description
Near shore Area (Export Route West HDD)	BB_FS_SSS_0593	BB_FS_MAG_0222	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0607	BB_FS_MAG_0247	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0642	BB_FS_MAG_0274	Suspected debris
Near shore Area (Export Route West HDD)	BB_FS_SSS_0884	BB_FS_MAG_0567	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0916	BB_FS_MAG_0605	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0929	BB_FS_MAG_0691	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0946	BB_FS_MAG_0710	Boulder
Near shore Area (Export Route West HDD)	BB_FS_SSS_0678	BB_FS_MAG_0298	Wreck

An area of numerous boulders / debris was identified between KP 19.0 and KP 28.0 (Figure 6.8).

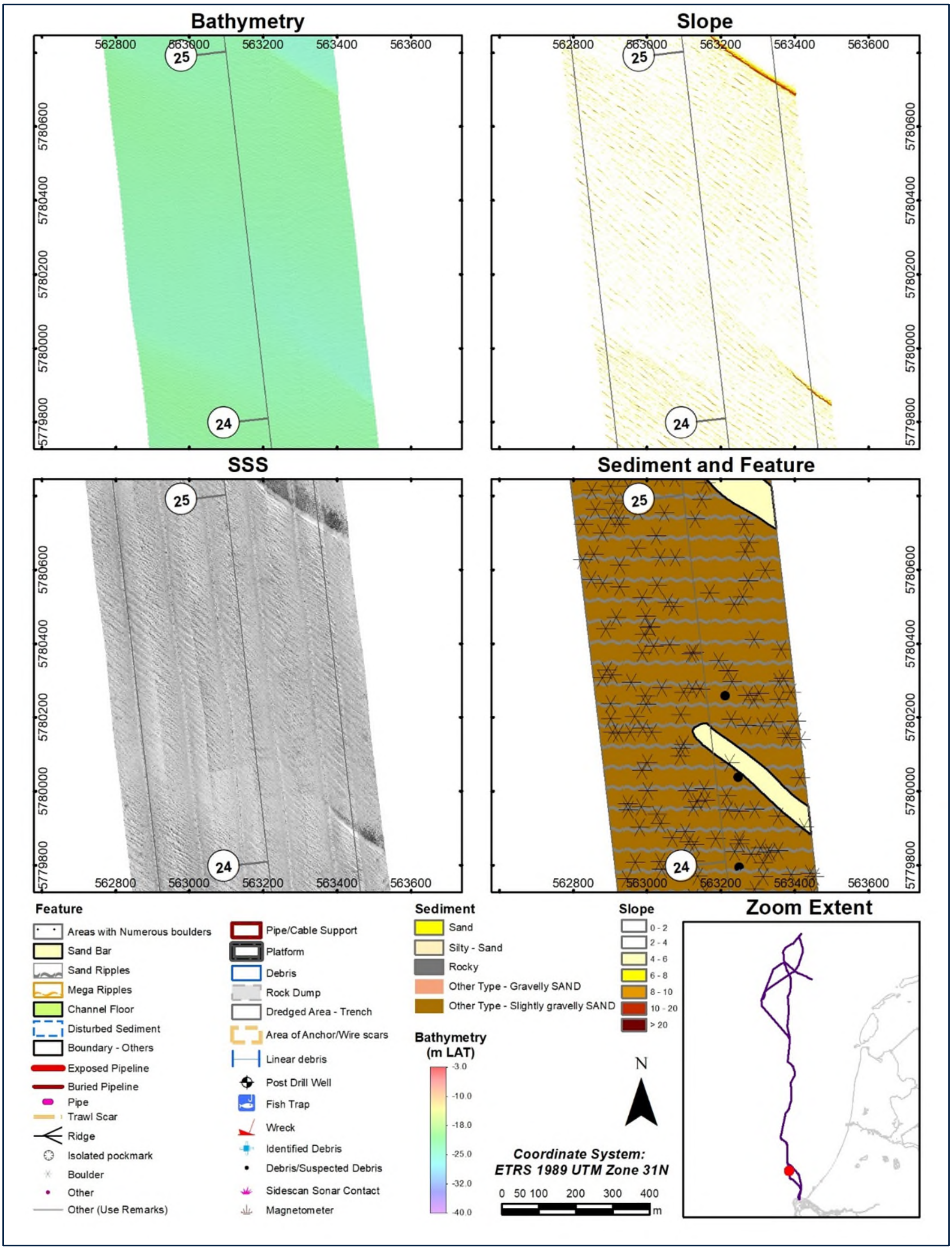


Figure 6.8: Example of area of boulders in Export Route West HDD.

Between KP 20 and KP 21 of the Export Route West HDD, a buried pipeline was identified (Table 5.3 and Figure 6.9).

Table 38: Summary of pipeline and cable in Export Route West HHD

Contact ID	Pipeline Name	Comment
Pipeline (PL0106_PR)	P18-A to P15-D 16-inch gas / 3-inch methanol pipeline bundle	Buried (1 segment)
Telecommunication cable (KB0002)	Concerto 1E	Buried (1 segment) (slightly visible in the magnetometer data)

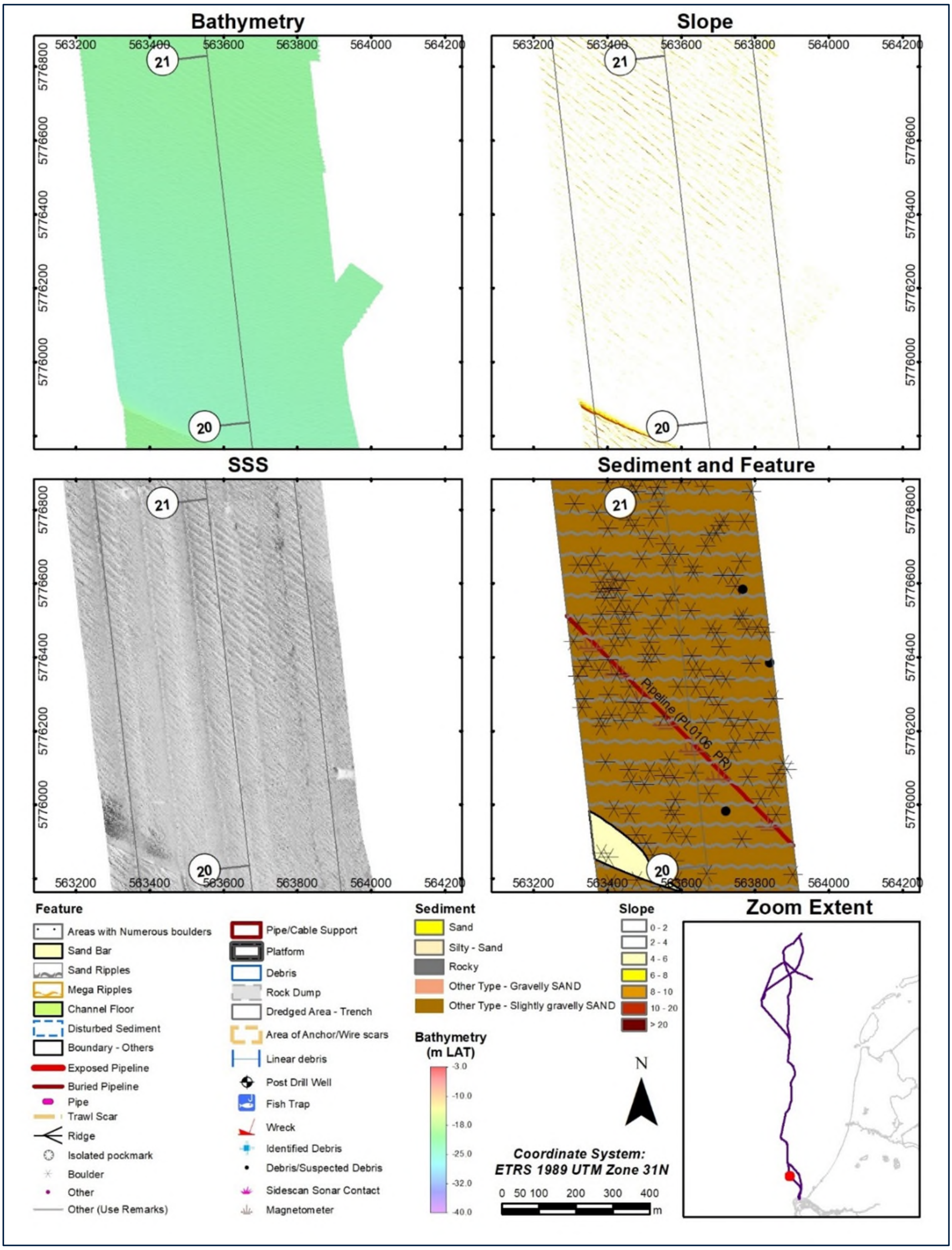


Figure 6.9: Example of area of boulders in Export Route West HDD: KP 20.0 to K9 21.0.

6.2.4 Magnetometer Contacts

651 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in Export Route West HDD. The magnetometer anomalies range between 1.1 nT and 1213.1 nT. The highest magnetic amplitude is associated with the encountered pipeline. Most of the magnetic anomalies are located in the nearshore area, between KP 0.5 and KP 3.0 and are probably related to the anthropogenically altered area close to the port of Rotterdam.

6.2.5 Sub-seafloor Geology

Units DS, A, B, D and G are present in Export Route West HD (Figure 6.10).

Unit A is present basically in the entire section, except in the Maasmond Kanaal, where the top unit consists of disturbed sediments (Unit DS) and Unit A was removed during dredging activities. Between KP 0.3 and KP 1.1 Unit A was not observed, due to the acoustic blanking that hinder the interpretation. Unit A is characterized by chaotic in the nearshore area to semi-transparent seismic facies, with locally point reflections further offshore. The maximum thickness of Unit A in this section is approximately 4 m.

Unit B is present across the entire section. Between KP 0.0 to KP 1.1 it is not observed due to the acoustic blanking that hinder the interpretation. The unit has in general transparent to semi-transparent seismic character. Between approximately KP 2.0 and KP 7.5 the unit exhibits mostly layered facies with flat to inclined parallel reflectors. Internal buried channels with layered infill were observed in this unit locally.

Unit B is underlain by Unit D (interpreted to be present from approximately KP 14.8) and Unit G. Unit D and G exhibit structureless acoustically transparent to semi-transparent seismic character in this section.

High amplitude anomalies in Unit G were interpreted between KP 20.5 and KP 21.0, at approximately KP 23, between KP 25.6 and KP 27.0 and between KP 30.1 and KP 30.8. These negative amplitude events most likely represent laminae or thin bed of peat and/or organic-rich clay (peat level 3).

Table 6.5 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 39: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
DS	0 to 4.5	Very loose to very dense slightly silty fine and medium SAND
A	0.3 to 4.2	Very loose to very dense slightly silty fine and medium SAND with frequent shells and shell fragments Locally low to medium strength slightly sandy CLAY, with closely spaced thin laminae of silt

Unit	Depth to Base [m BSF]	Lithology
B	2.2 to 9.2	Medium to very dense slightly silty fine and medium SAND with numerous shells and shell fragments, occasionally slightly gravelly Locally with medium to thick beds of extremely low to very low strength very dark grey sandy CLAY
Notes: BPD = below penetration depth of SBP data		

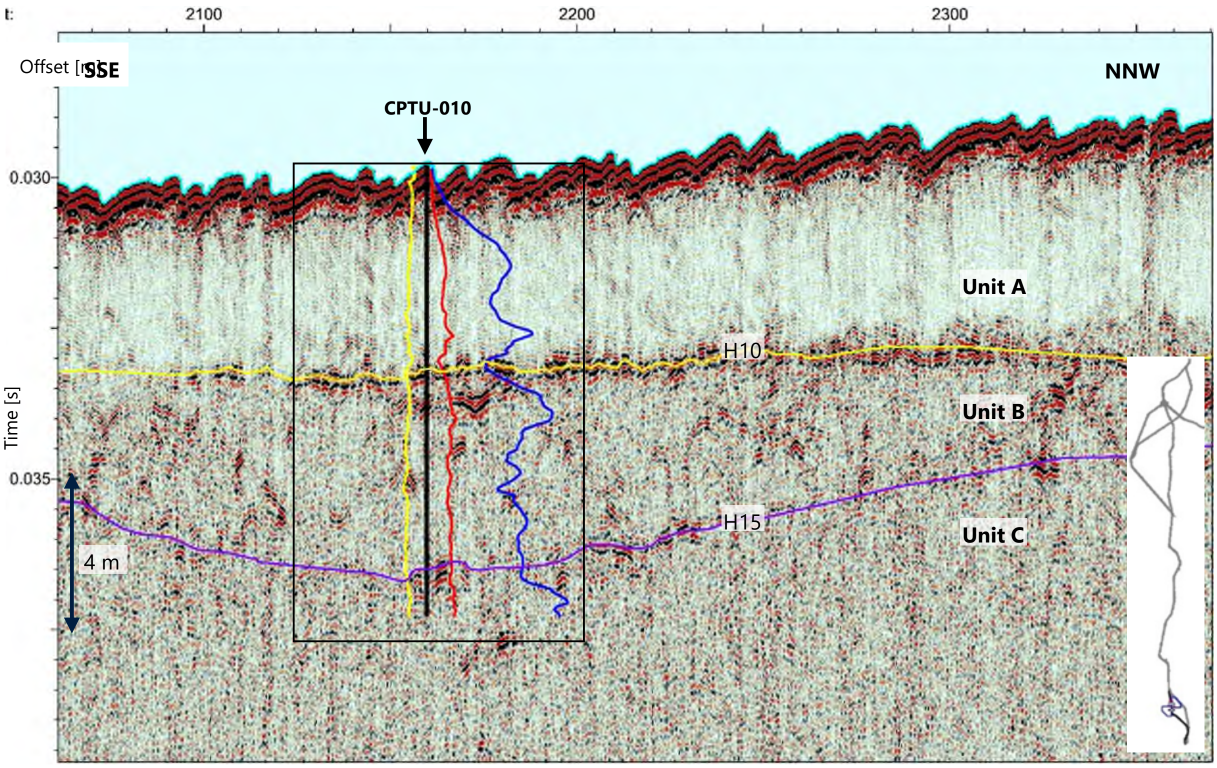


Figure 6.10: SBP data example of route section Export Route West HDD. (Line SBP_TA3D2079P2) *Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.*

7. Section A-Alt

7.1 Section A - Alt Location

The location of the route Section A - Alt is shown in Figure 7.1. This section of the route has a length of 94 km.

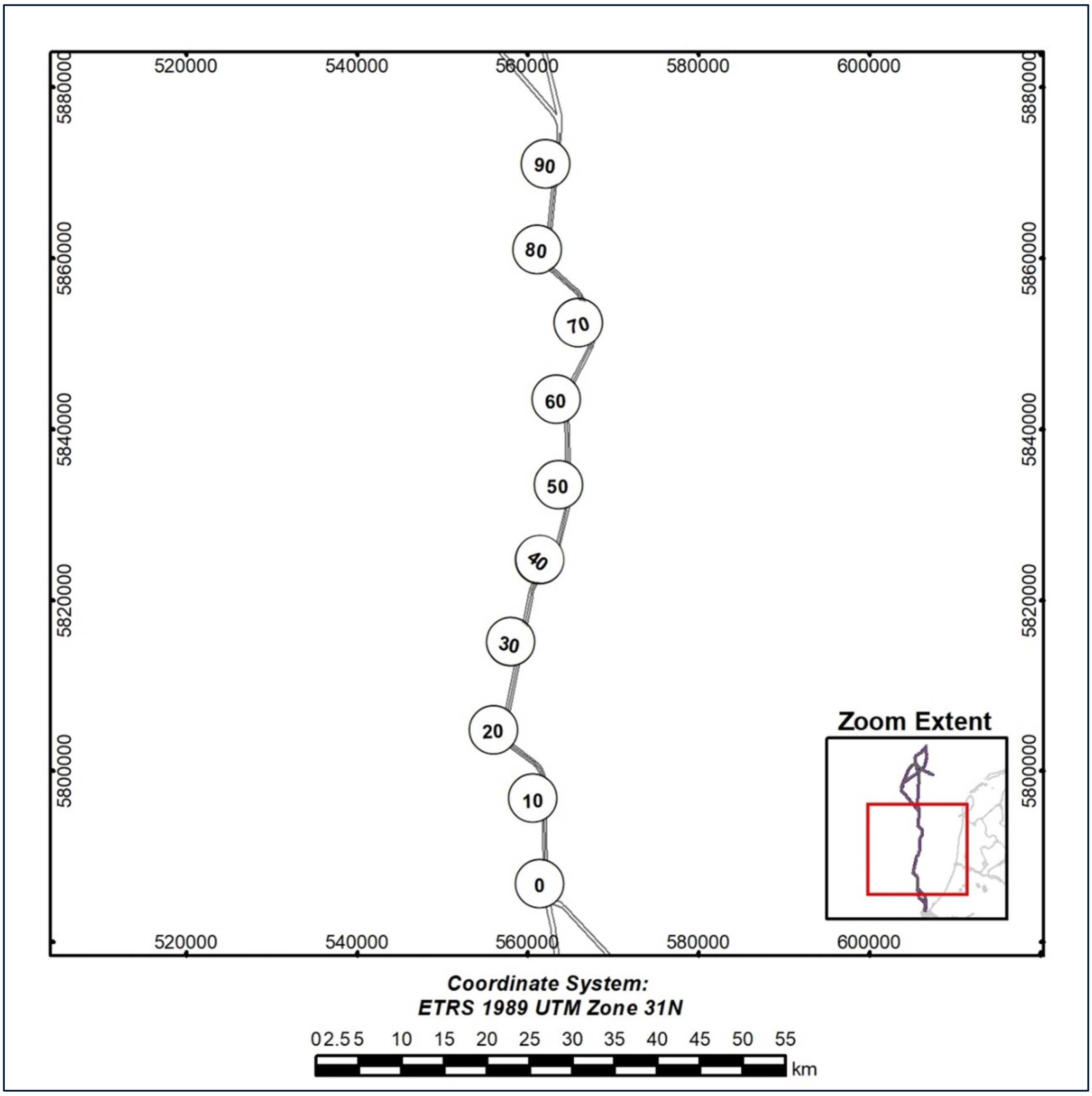


Figure 7.1: Location of the route section A – Alt.

7.2 Results

7.2.1 Bathymetry

The water depth in route Section A-Alt ranges between 24.0 m and 25.0 m. An overview of the bathymetry is given in Figure 7.2.

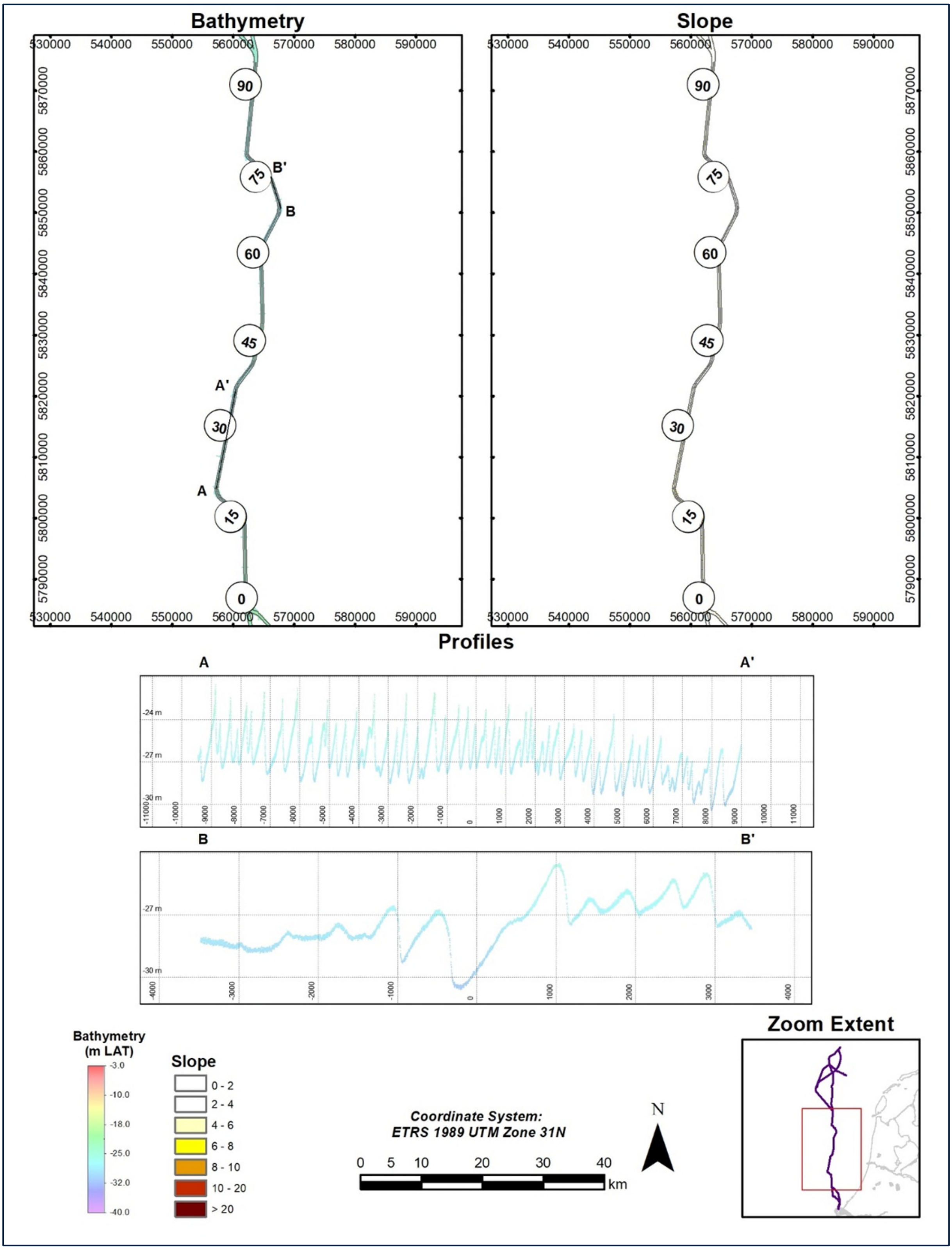


Figure 7.2: Bathymetry along the route Section A-Alt.

7.2.2 Seafloor Morphology

Overall, a strong correlation between sediment type and morphological type was observed, although some small variation is possible. An overview is given in Table 7.1 and Figure 7.3.

Table 40: Sediment type with associated morphology in route section A-Alt

Sediment Type	Morphological Type
Slightly gravelly SAND	Ripples or megaripples and sand waves

Figure 7.3 and Figure 7.4 show data examples of the route Section A – Alt. This area is characterised mostly by ripples, megaripples and sand waves.

The sand waves are symmetrical, with a northwest-southeast orientation, a wavelength ranging between 100 m and 600 m (on average 350 m), and an average height of 4.0 m.

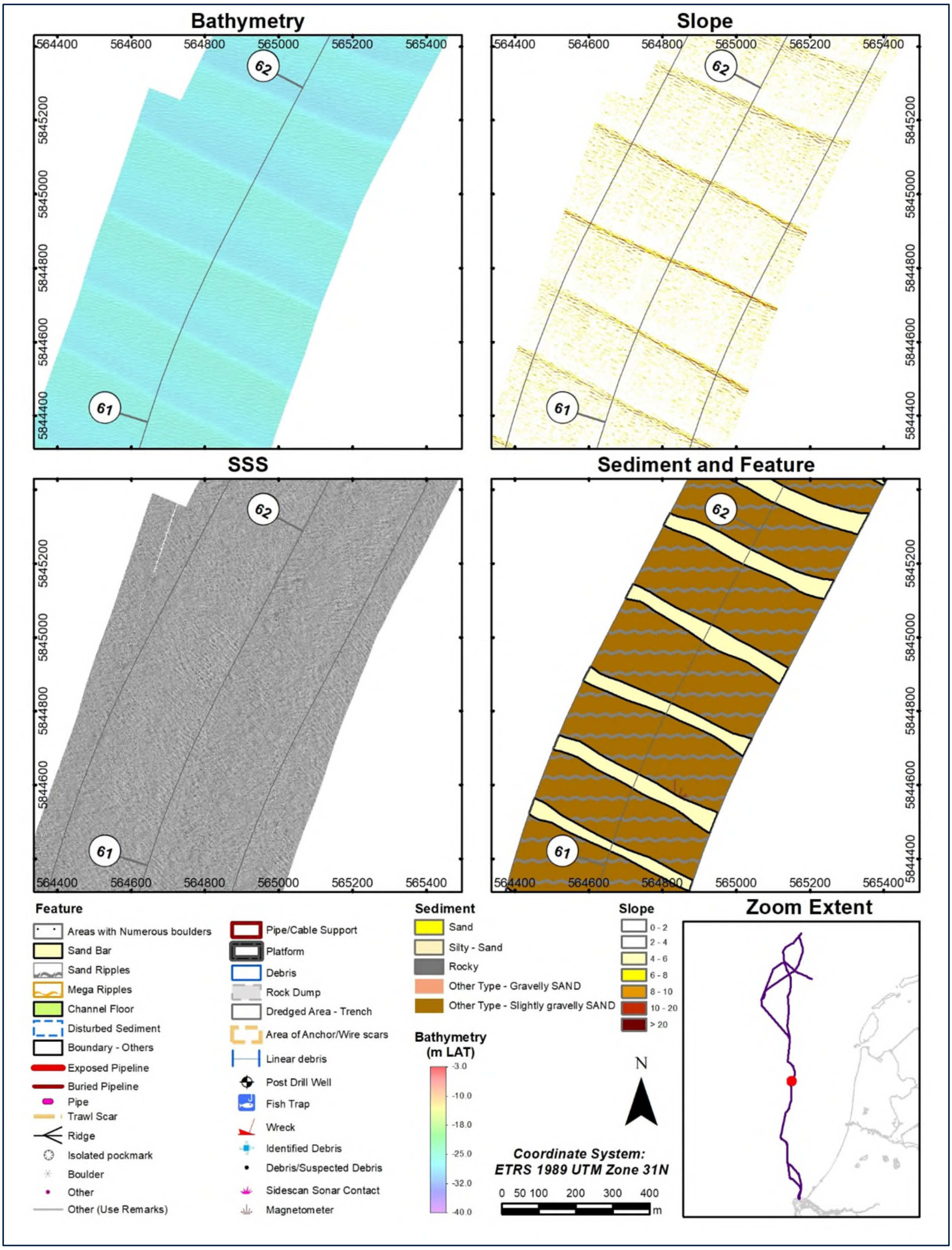


Figure 7.3: Overview of the sediments and morphology in route section A-Alt: KP 61.0 to KP 62.0.

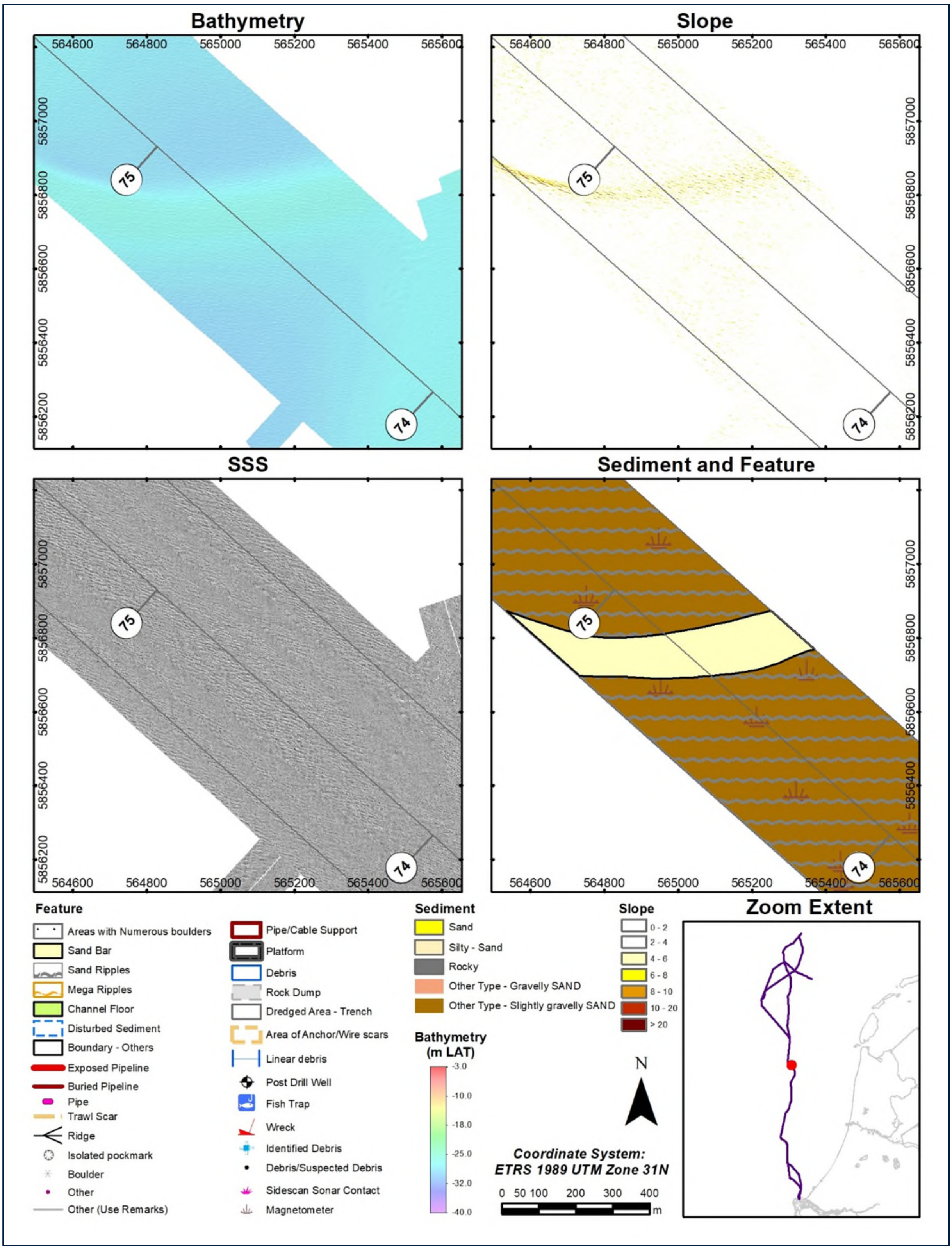


Figure 7.4: Overview of the sediments and morphology in route section A-Alt: KP 74.0 to KP 75.0.

7.2.3 Seafloor Feature and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 7.2 summarises the quantities of contacts picked in Section A - Alt. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 41: Summary of seafloor contacts in route section A-Alt

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	11
	Debris	13
	Suspected debris	37
	Magnetic anomalies	271
SSS/MBES/MAG Linear Features	Fishing gear	1
	Telecommunication cable	4
	Buried pipeline	5
	Magnetic linear feature	14

Five (5) buried pipelines and four (4) telecommunication cables were identified. Table 7.3 provides all the encountered and identified pipeline and cables.

Table 42: Summary of pipeline and telecommunication cables in route section A - Alt

Contact ID	Pipeline/Cable Name	Comment
Pipeline (PL0228_PR)	Q13a-A to P15-C 8-inch oil pipeline	Buried, KP 3.7
Mag Linear Feature	Q10 to P15-D pipeline	Buried, KP 18.0
Telecom Cable (KB0045)	Circe North	Buried, KP 19.6
Telecom Cable (KB0003)	Concerto 1 N	Buried, KP 20.5
Pipeline (PL0084_PR/HS)	P12-C to P12-SW 8-inch gas / 3-inch glycol pipeline bundle (abandoned)	Buried, KP 22.0
Telecom Cable (KB0015)	Rembrandt 1	Buried, KP 45.7
Telecom Cable (KB0067)	UK - Netherlands 14	Buried, KP 55.4
Pipeline (PL0148_PR)	Q4-A to P6-A 14-inch gas pipeline	Buried, KP 66.2
Pipeline (PL0109_PR)	Horizon to Helder-A 10-inch oil pipeline	Buried, KP 69.4
Pipeline (PL0176_PR)	Balgzand to Bacton	Buried, KP 92.5

Figure 7.5, Figure 7.6 and Figure 7.7 show data examples of encountered pipelines in in this section of the route.

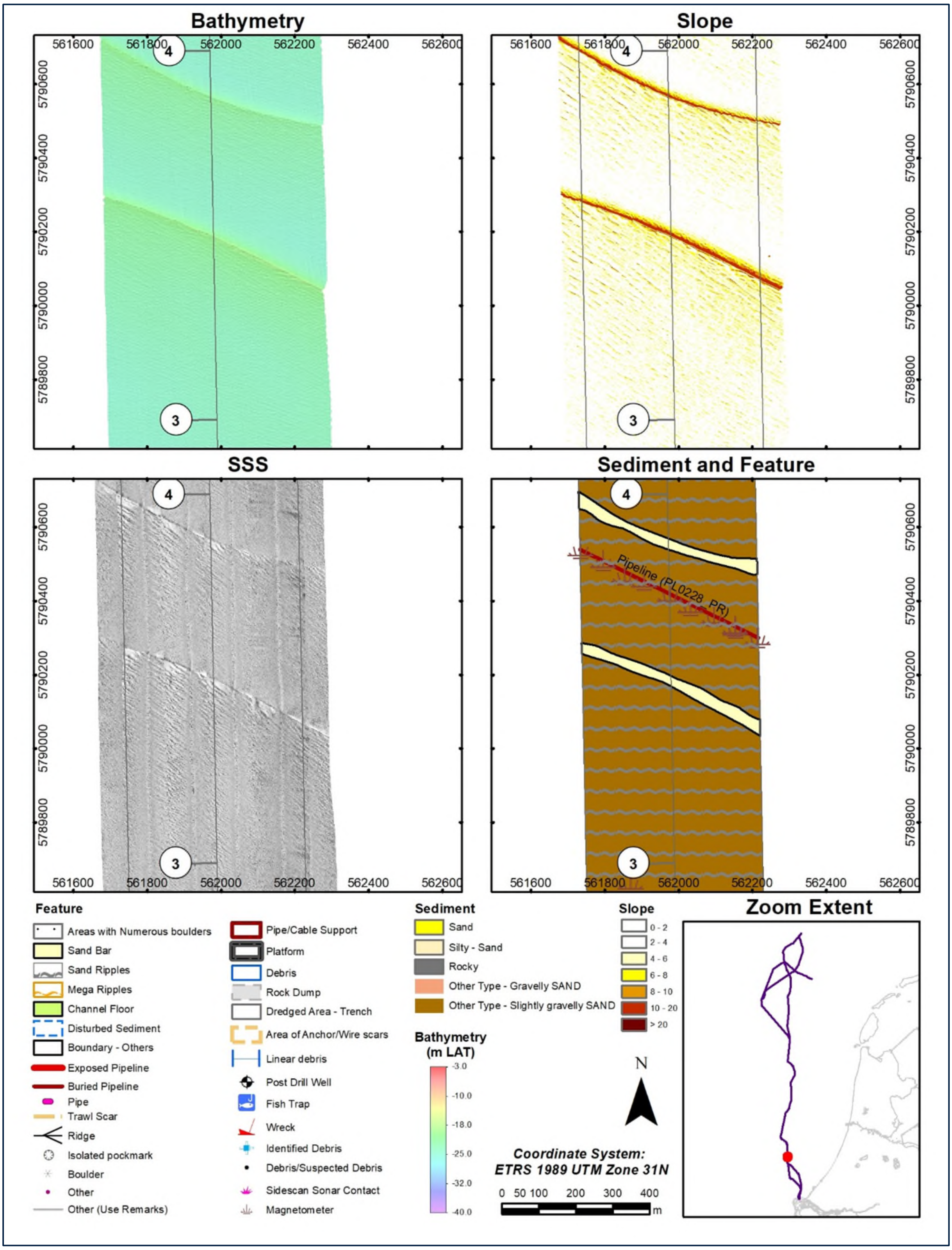


Figure 7.5: Overview of the sediments and morphology in route section A-Alt: KP 3.0 to KP 4.0, buried pipeline.

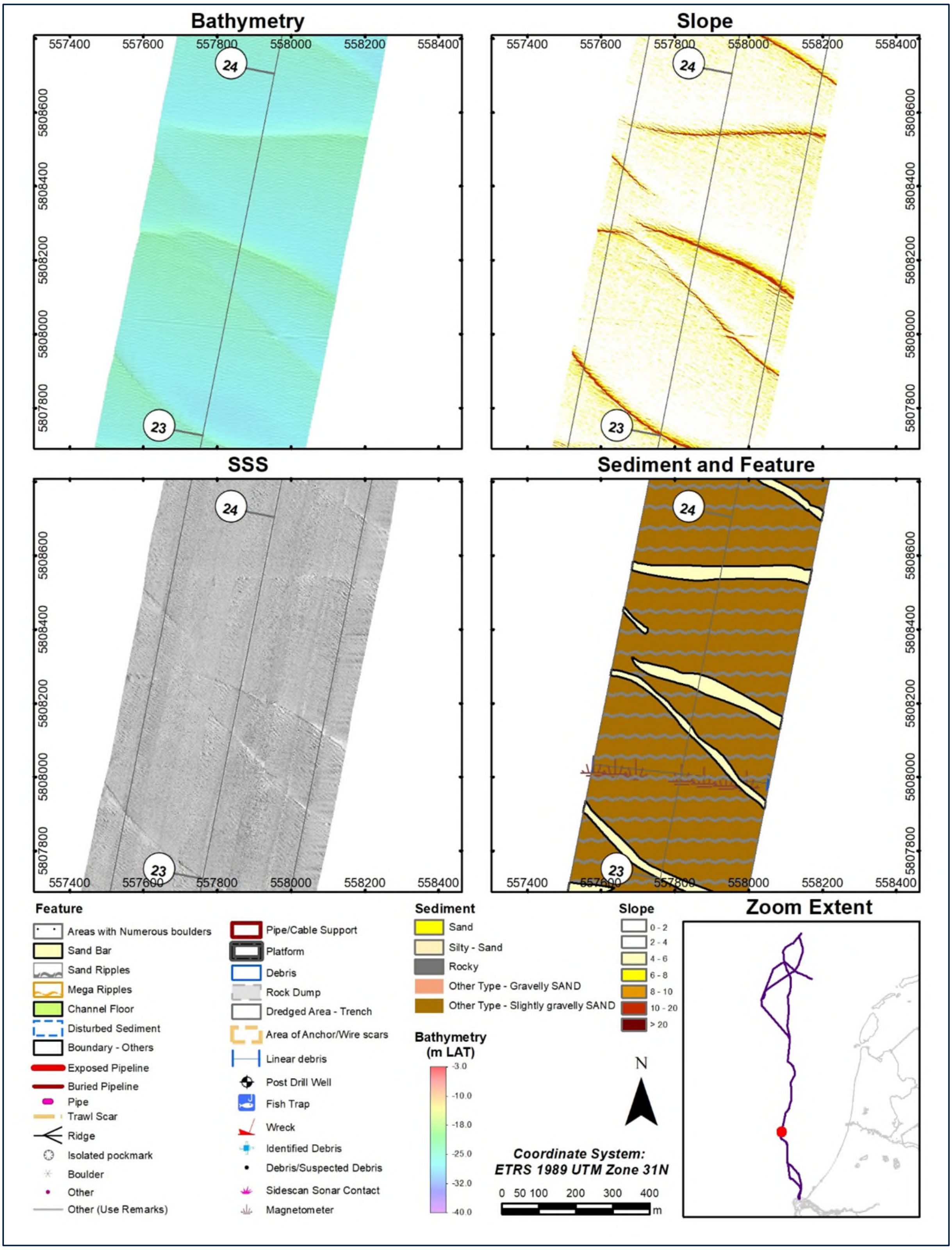


Figure 7.6: Overview of the sediments and morphology in route section A-Alt: KP 23.0 to KP 24.0, buried cable.

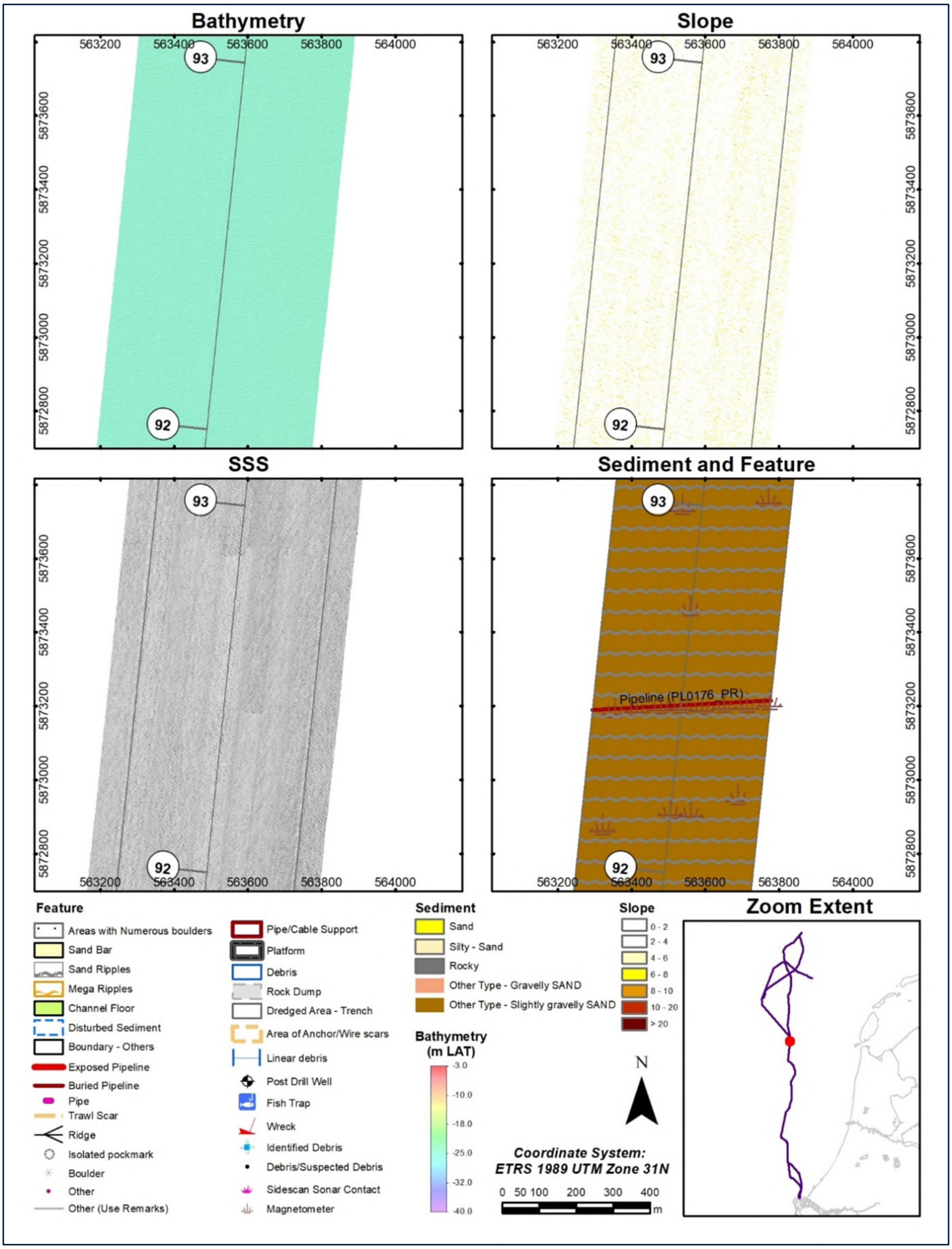


Figure 7.7: Overview of the sediments and morphology in route section A-Alt: KP 92.0 to KP 93.0, buried pipeline.

7.2.4 Magnetometer Contacts

271 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in route Section A – Alt. The magnetometer anomalies range between 5.0 nT and 2966.4 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

7.2.5 Sub-seafloor Geology

Units A, B, C, D, F and G are present in the route Section A-Alt (Figure 7.8).

Unit A is present in the entire section. It is characterized by acoustically transparent and semi-transparent seismic facies. Rarely, high amplitude reflectors of limited extent were observed in this unit. The maximum thickness of Unit A in this section is approximately 7 m.

Unit B is present across the entire section. On the SBP data, between KP 0.0 to KP 59.0 the base of the unit is observed locally and for the large part it is below the penetration depth of the data. The unit exhibits transparent to semi-transparent seismic character. Internal buried channels with layered infill were observed in this unit at approximately KP 23.5 to KP 59. High negative amplitude anomalies were also interpreted in this unit, most likely represent laminae or thin bed of peat and/or organic-rich clay (peat level 1). The maximum thickness of Unit A in this section is approximately 10 m.

Unit C is present between KP 42.0 to KP 94.0. This unit exhibits layered facies with low to high-amplitude parallel reflectors. High negative amplitude anomalies were also interpreted in this unit, most likely represent laminae or thin bed of peat and/or organic-rich clay (peat level 2). Maximum thickness of this unit is approximately 35 m.

Unit D is present across the entire section, but from KP 78.0 to KP 94.0 only in patches. It is acoustically transparent to semi-transparent and structureless. Maximum thickness of this unit in Section A-Alt is approximately 10 m.

Unit F is interpreted between KP 74.5 to KP 78.0. The basal reflector of this unit forms U-shaped channel with seismically transparent infill. Maximum thickness of this unit is approximately 90 m.

Unit G is present across the entire section. It exhibits transparent and semi-transparent seismic character. High negative amplitude anomalies were also interpreted in this unit (peat level 3).

Table 7.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 43: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.5 to 7.0	Very loose to very dense slightly silty fine and medium SAND with frequent shells and shell fragments
B	0.8 to 10.7	Medium to very dense slightly silty fine and medium SAND, occasionally with shells and shell fragments Locally low to high strength slightly sandy CLAY

Unit	Depth to Base [m BSF]	Lithology
C	BPD	Very loose to loose very silty fine and medium SAND with occasional pockets of organic matter Locally low strength to high strength very slightly sandy CLAY with medium spaced very thin beds of sand
Notes: BPD = below penetration depth of SBP data		

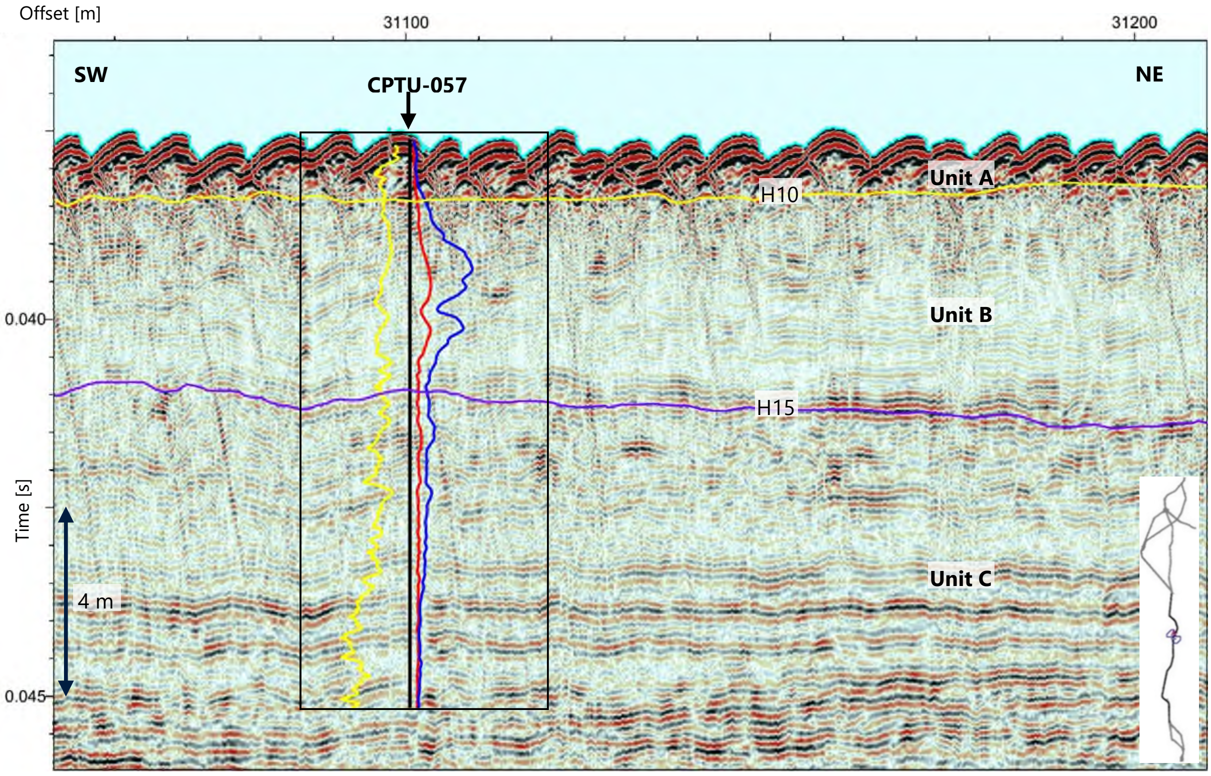


Figure 7.8: SBP data example of route section Alt-A. (Line SBP_TA3E2130P1) *Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.*

8. Section B

8.1 Section B Location

The location of the route Section B is showed in Figure 8.1. This section of the route has a length of 57.8 km.

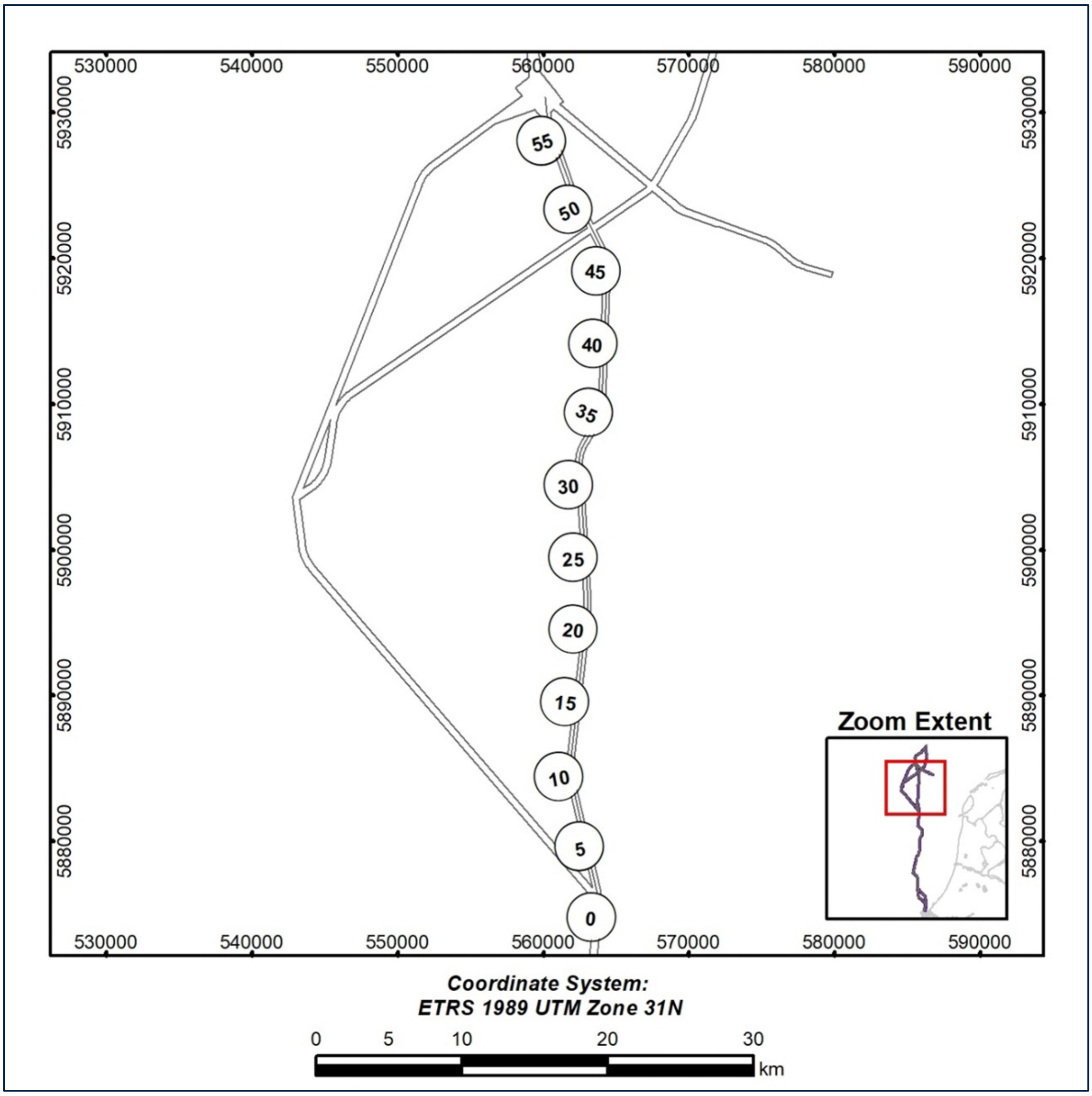


Figure 8.1: Location of the route section B.

8.2 Results

8.2.1 Bathymetry

The water depth in route Section B ranges between 25.0 m and 30.5 m. An overview of the bathymetry is given in Figure 8.2.

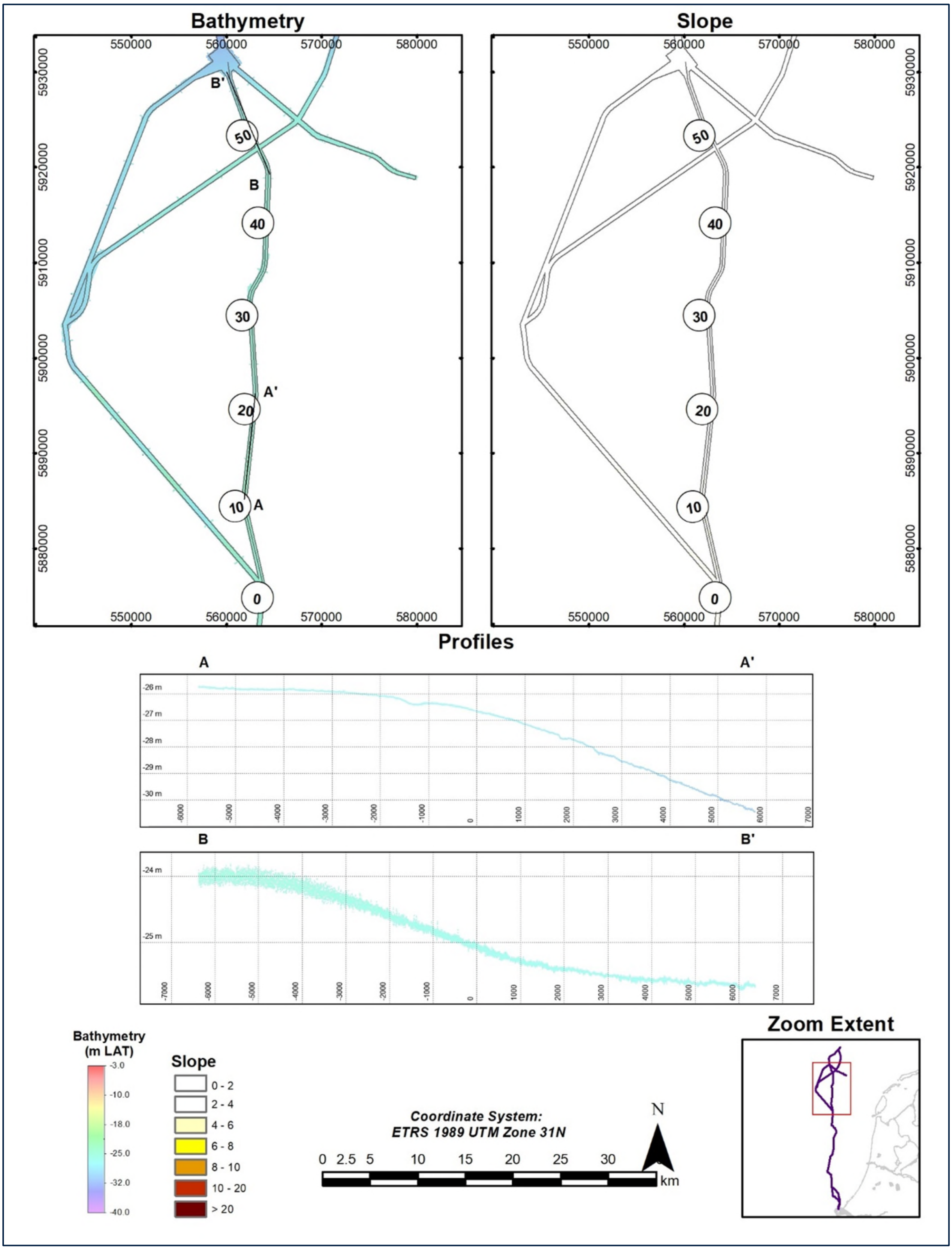


Figure 8.2: Bathymetry along the route section B.

8.2.2 Seafloor Morphology

A strong correlation between sediment type and morphological type was observed, although some small variation is possible. An overview is given in Table 8.1 and Figure 8.7 and Figure 8.8.

Table 44: Sediment type with associated morphology in route section B

Sediment Type	Morphological Type
Slightly gravelly SAND	Ripples, megaripples
SAND	Featureless

Between KP 0.0 and KP 17.5 and between KP 23.5 and KP 28.3, sediment was classified as slightly gravelly SAND with ripples and megaripples. The rest of Section B was classified as featureless SAND.

Figure 8.3 and Figure 8.4 show data examples of the sediment type and seafloor feature found in Section B.

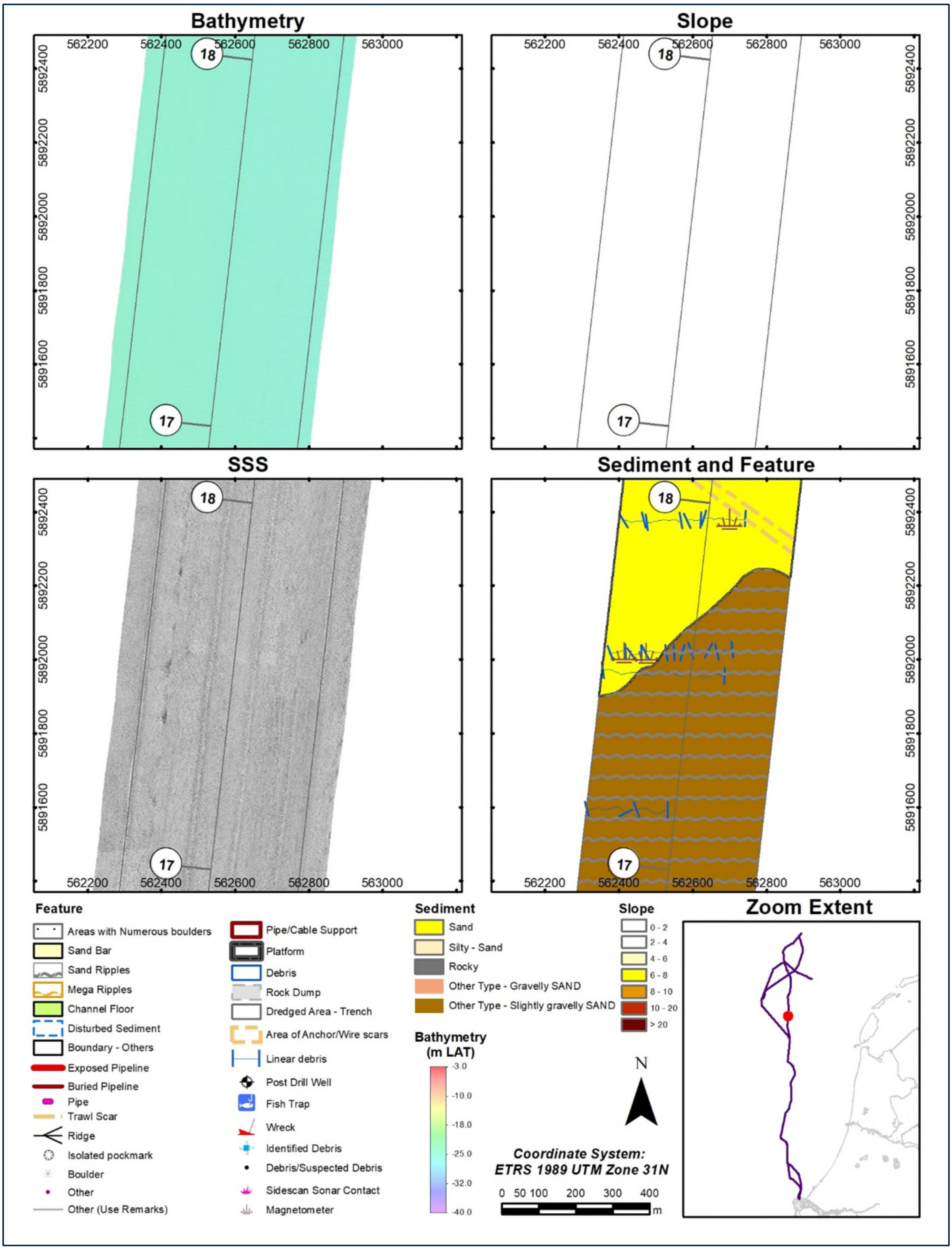


Figure 8.3: Overview of the sediments and morphology in route section B: KP 17.0 to KP 18.0.

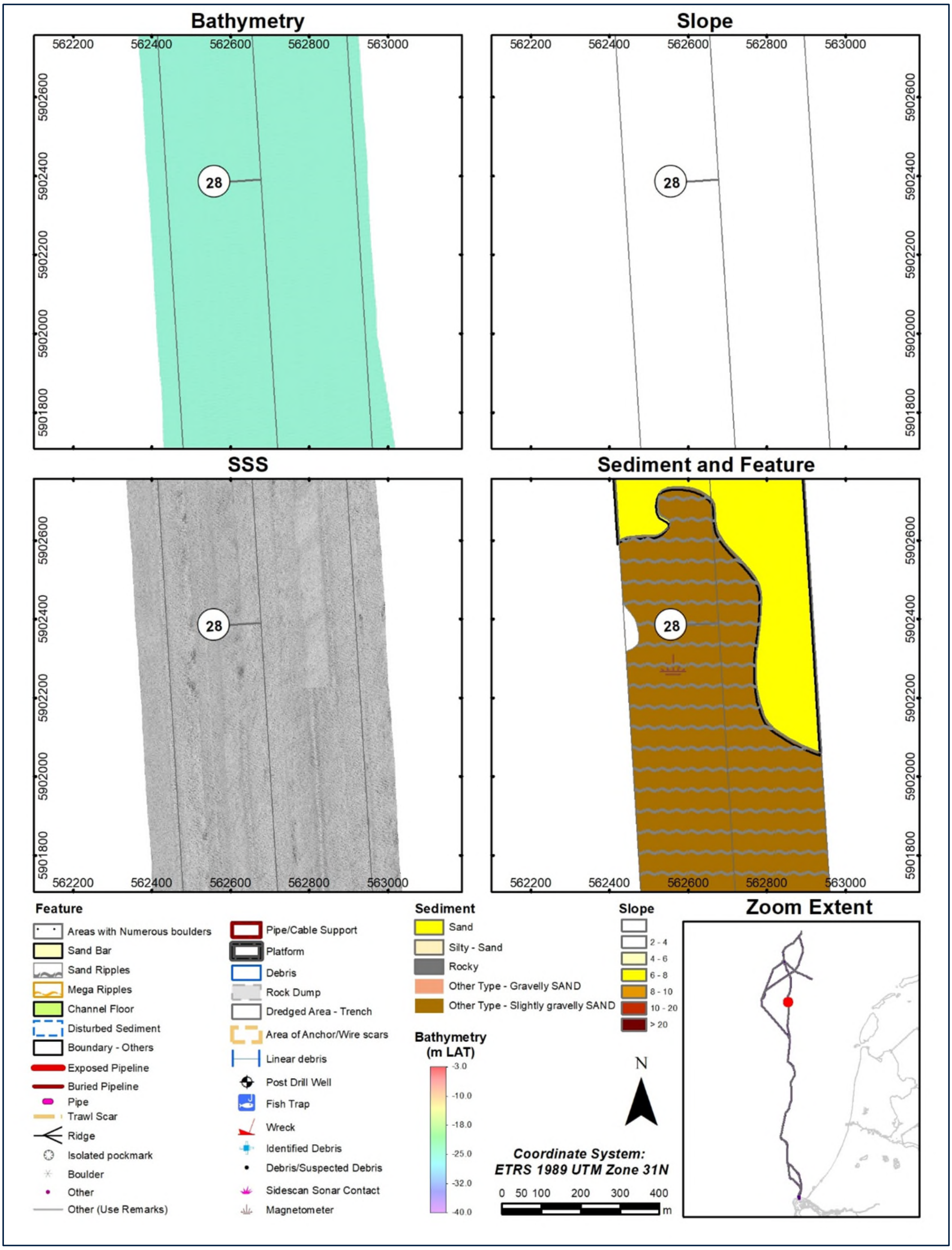


Figure 8.4: Overview of the sediments and morphology in route section B: KP 28.0.

8.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated, where possible.

Table 8.2 summarizes the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 45: Summary of seafloor contacts in route section B

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Debris	34
	Depression pockmark	1
	Fishing gear	2
	Exposed pipe	4
	Seabed mound	39
	Suspected debris	7
	Magnetic anomalies	133
SSS/MBES/MAG Linear Features	Fishing gear	2
	Possible fishing gear	39
	Large trawl scour	24
	Mound ridge	18
	Exposed pipeline	1 (3 segments exposed, 4 segments buried)
	Buried pipeline	7

Figure 8.5 shows two (2) seafloor contacts classified as possible fishing gears were identified at KP 25.0.

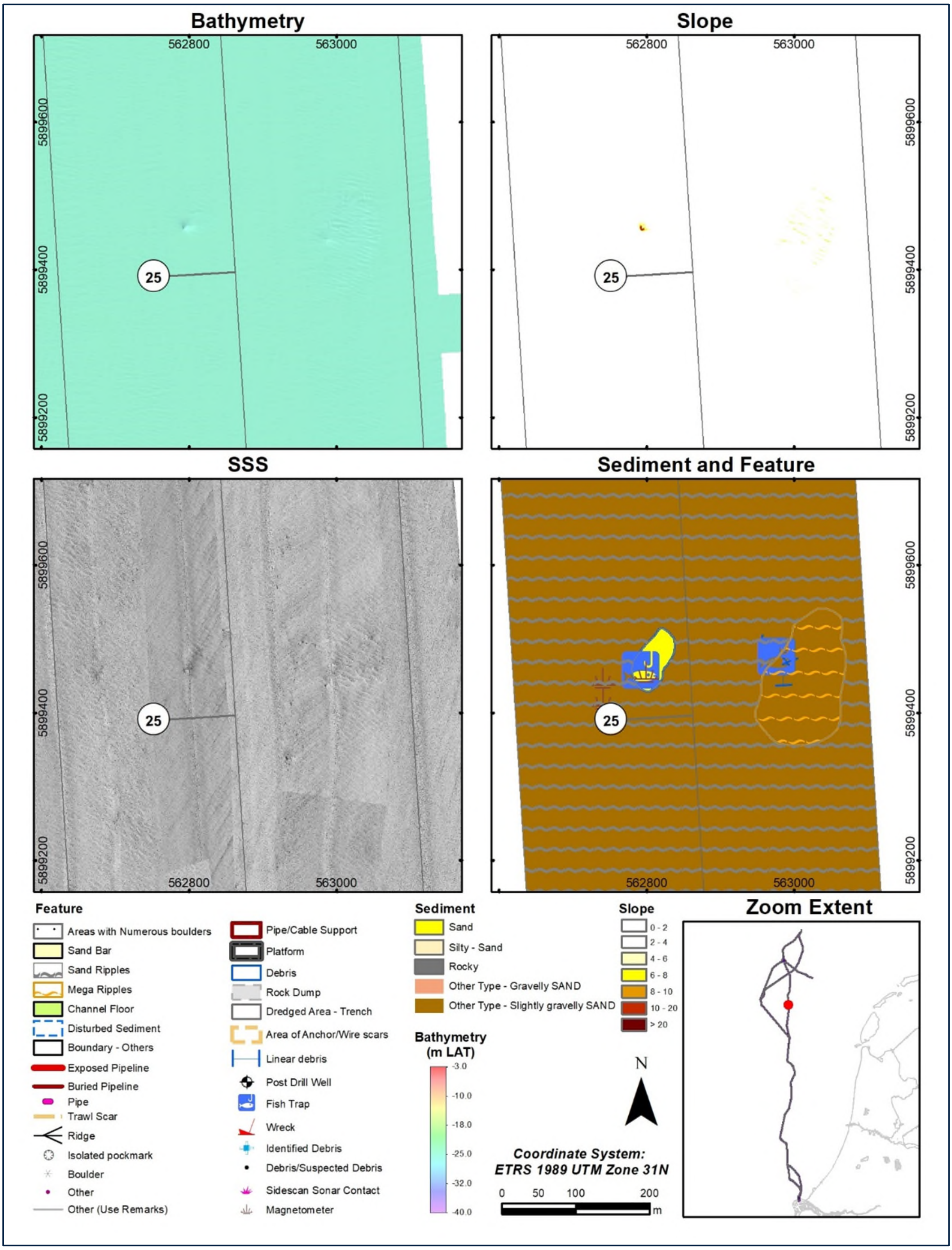


Figure 8.5: Overview of the sediments and morphology in route section B: KP 25.0, possible fishing gears.

Several buried pipelines were observed (Table 8.3 and Figure 8.6, Figure 8.7 and Figure 8.8).

Table 46: Summary of pipelines in route section B

Contact ID	Pipeline Name	Comment
Pipeline (PL0032_PR)	P6-A to L10-AR 20-inch gas pipeline	Buried, KP 8.7
Pipeline (PL0030_PR)	NAM_K15-FB-1 to Den Helder	Buried, KP 20.5
Pipeline (PL0004_PR)	K13-A to Den Helder 36-inch gas pipeline	Buried, KP 26.1
Pipeline (PL0062_PR)	K14-FA-1C TO K15-FA-1 18-inch pipeline	Buried, KP 26.2
Pipeline (PL0063_PR)	K12-BP to L10-AR 18-inch pipeline	Buried, KP 38.0
Pipeline (PL0029_HS)	K12-A to L10-AP 14/2-inch bundle	Buried, KP 48.7
Pipeline (PL0056_PR)	K12-E to K12-C 10-inch pipeline	Buried, KP 50.8
Pipeline (PL0142_PR)	D15-FA to L10-AC 36-inch pipeline	Partially buried and partially exposed, KP 53.4

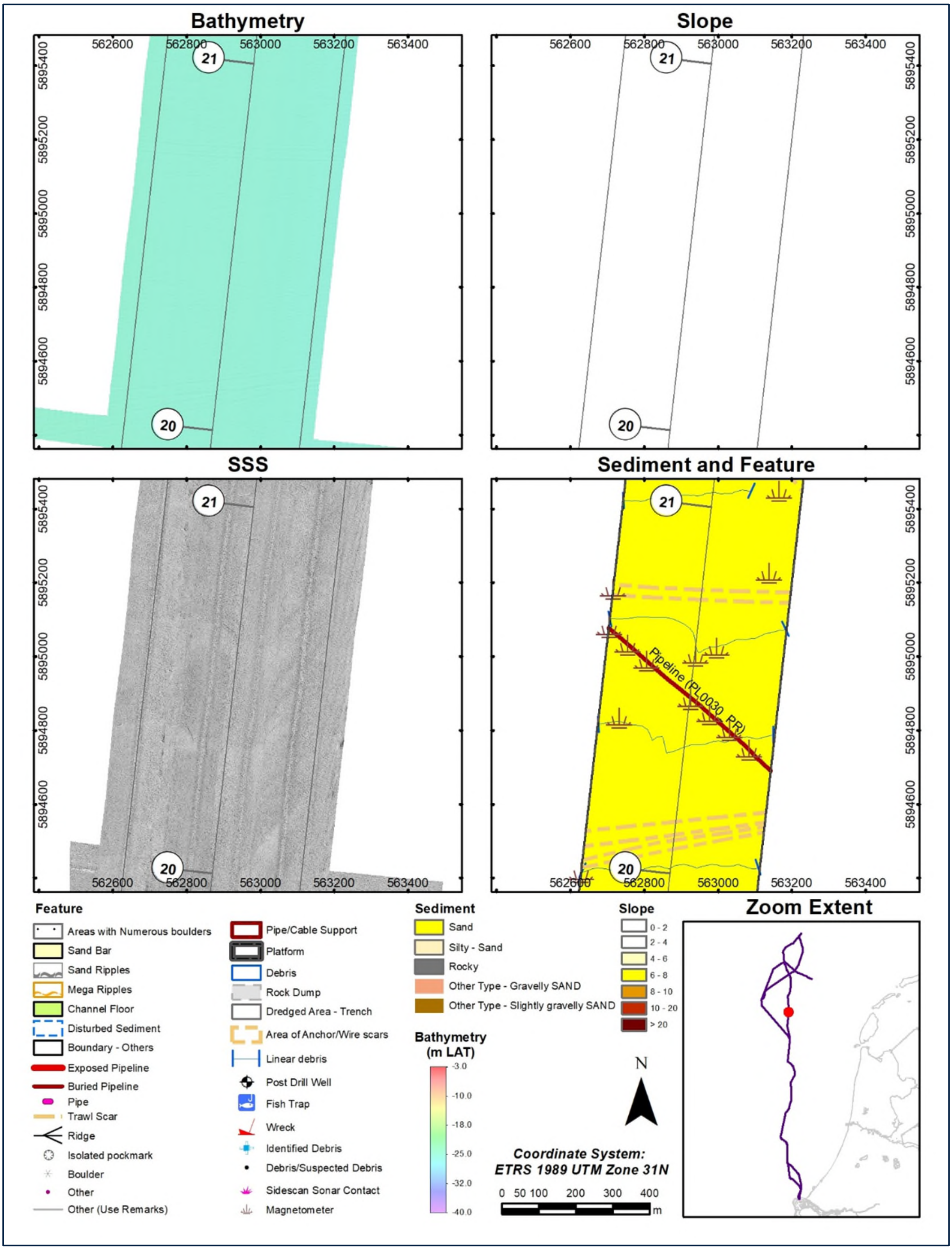


Figure 8.6: Overview of the sediments and morphology in route section B: KP 20.0 to KP 21.0, buried pipeline.

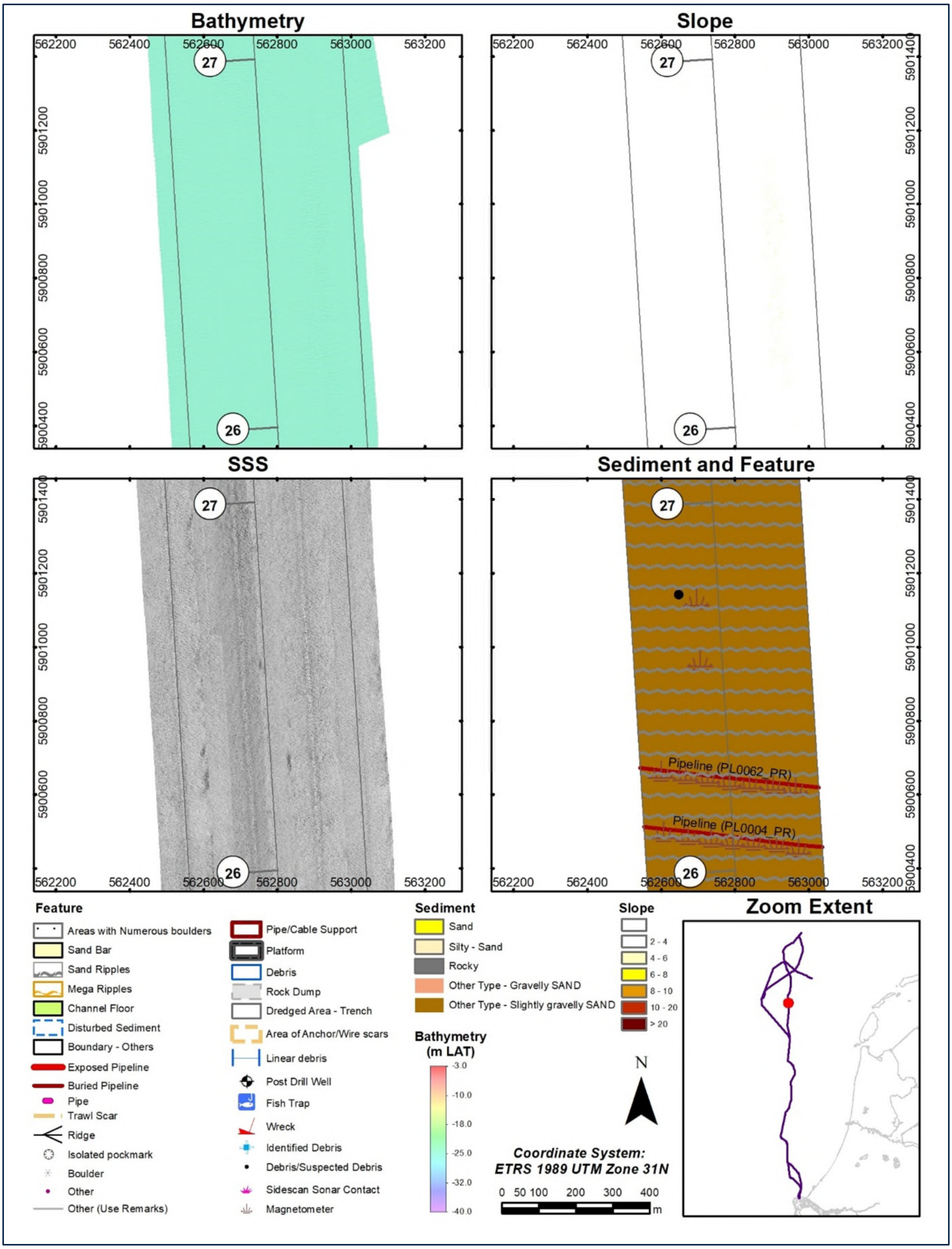


Figure 8.7: Overview of the sediments and morphology in route section B: KP 26.0 to KP 27.0, buried pipelines.

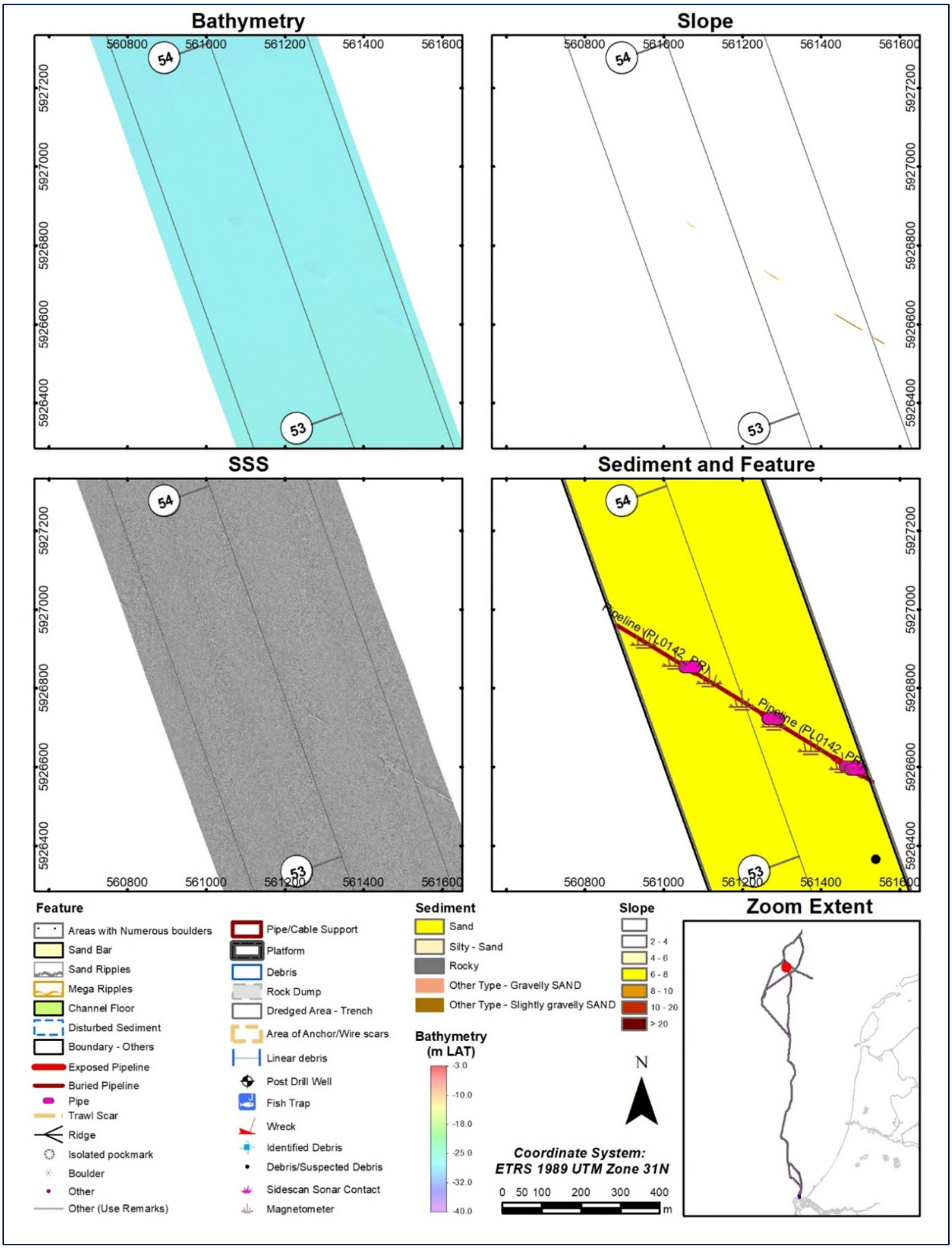


Figure 8.8: Overview of the sediments and morphology in route section B: KP 53.0 to KP 54.0, partially exposed pipeline.

8.2.4 Magnetometer Contacts

In Section B, 133 magnetic contacts were found at the time of the geophysical scope (single MAG survey). The magnetometer anomalies range between 5.2 nT and 7064.6 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

8.2.5 Sub-seafloor Geology

Units A, B, D, E, F and G are present in the route Section B (Figure 8.9).

Unit A is present in the entire section. Between KP 0.0 to KP 40.0 the unit is characterized by a chaotic and semi-transparent seismic character. Between KP 40.0 to KP 57.8 it is acoustically transparent. The maximum thickness of this unit in this section is approximately 3 m.

Unit B is present across the entire section. On the SBP data, the seismic character is semi-transparent and structureless, locally where the base is channelised the infill is structured, with medium-amplitude subparallel reflectors. On the 2D-UHRS, high amplitude negative anomalies were observed at the base of this unit, which represent laminae or thin bed of peat and/or organic-rich clay (peat level 1). The maximum thickness Unit B in this section is approximately 9 m.

Unit C is present across the entire section, except between KP 51.8 and the end of the section, where it is interpreted to be absent. The unit is characterized by locally transparent /structureless to layered facies, with medium to high amplitude parallel reflectors, which are locally irregular, discontinuous, and forming small channels. High negative amplitude reflectors are common in this unit, which most likely represent laminae or thin bed of peat and/or organic-rich clay (peat level 2). The thickness varies, on average it is approximately 5 m, the maximum reaches approximately 10 m.

Unit D is present in the entire section. Its seismic character is transparent to semi-transparent, with locally internal erosion surfaces. The maximum thickness of the Unit D in this section is approximately 15 m.

Unit E is present between KP 31.5 to KP 57.8. The unit is characterised by semi-transparent and structureless facies. The maximum thickness of this unit in this section is approximately 20 m.

Unit F (infill of glacial valley) is present between KP 41.9 to KP 51.7.

Table 8.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 47: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.7 to 3.3	Very loose to very dense slightly silty to silty fine and medium SAND with frequent shells and shell fragments
B	2.4 to 11.1	Medium to very dense slightly silty fine and medium SAND with frequent shells and shell fragments Locally clayey fine and medium SAND

Unit	Depth to Base [m BSF]	Lithology
C	BPD	Thickly Interbedded Low to medium strength sandy clayey SILT and medium strength CLAY Occasionally medium dense to dense slightly silty fine and medium SAND with extremely closely to very closely spaced thin laminae to medium beds of peat and clay
D	BPD	Loose to medium dense slightly silty to silty fine and medium SAND
Notes: BPD = below penetration depth of SBP data		

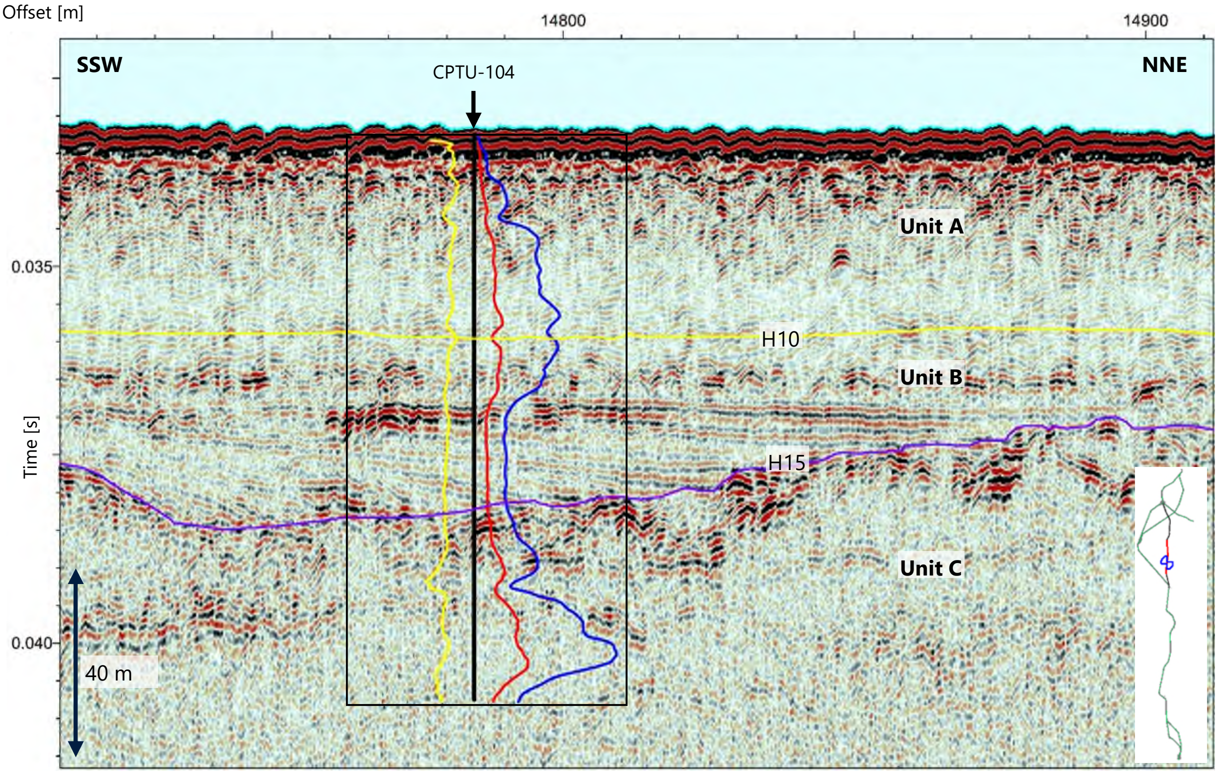


Figure 8.9: SBP data example of route section B. (Line SBP_ TA3F2184P2) ***Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.***

9. Section C

9.1 Section C Location

The location of the Section C is showed in Figure 9.1. This section of the route has a length of 26.8 km and runs from the Hub Area to Platform LA4.

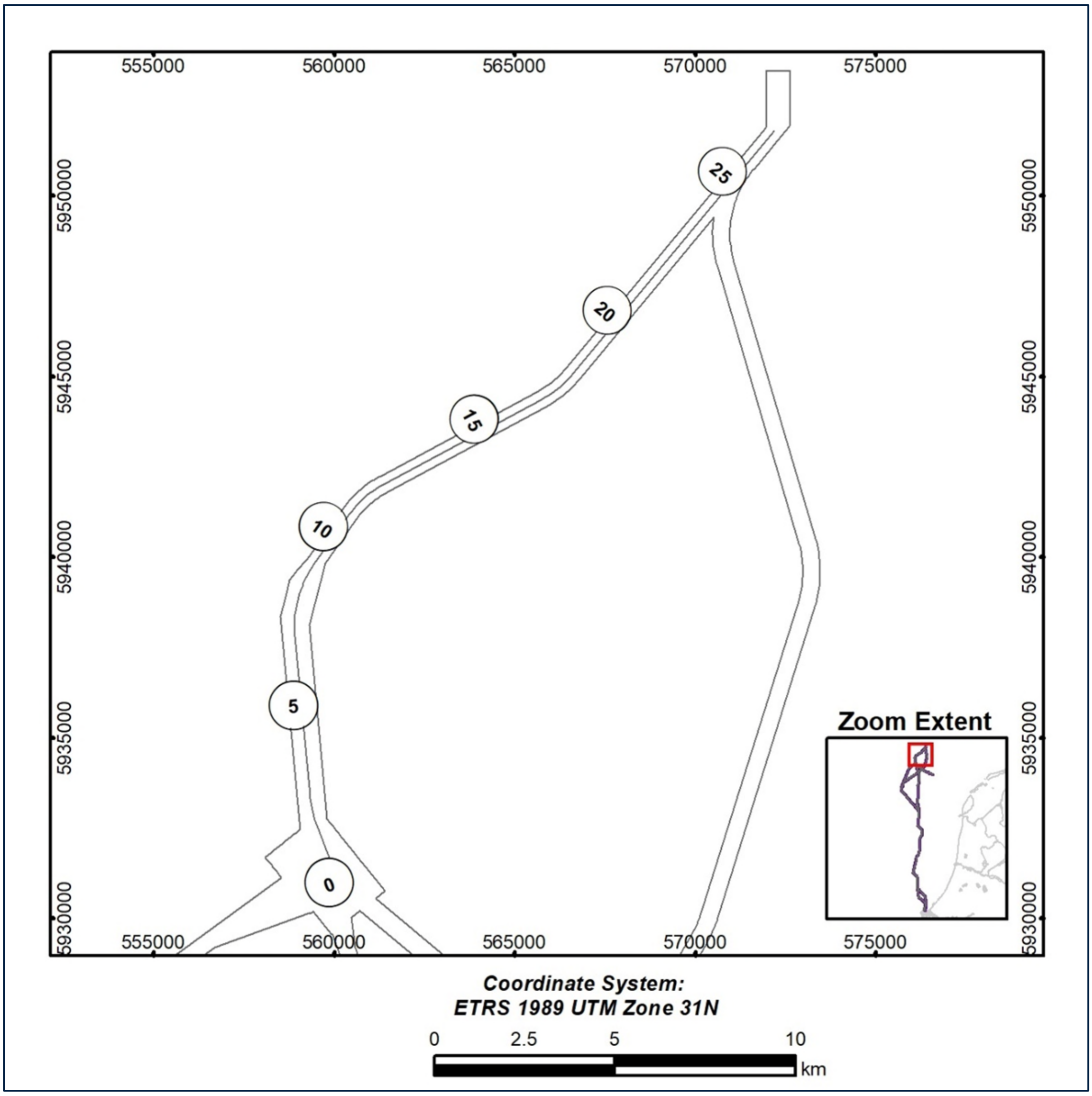


Figure 9.1: Location of the route section C.

9.2 Results

9.2.1 Bathymetry

The water depth in route Section C ranges between 31.0 m and 39.5 m. An overview of the bathymetry is given in Figure 9.2.

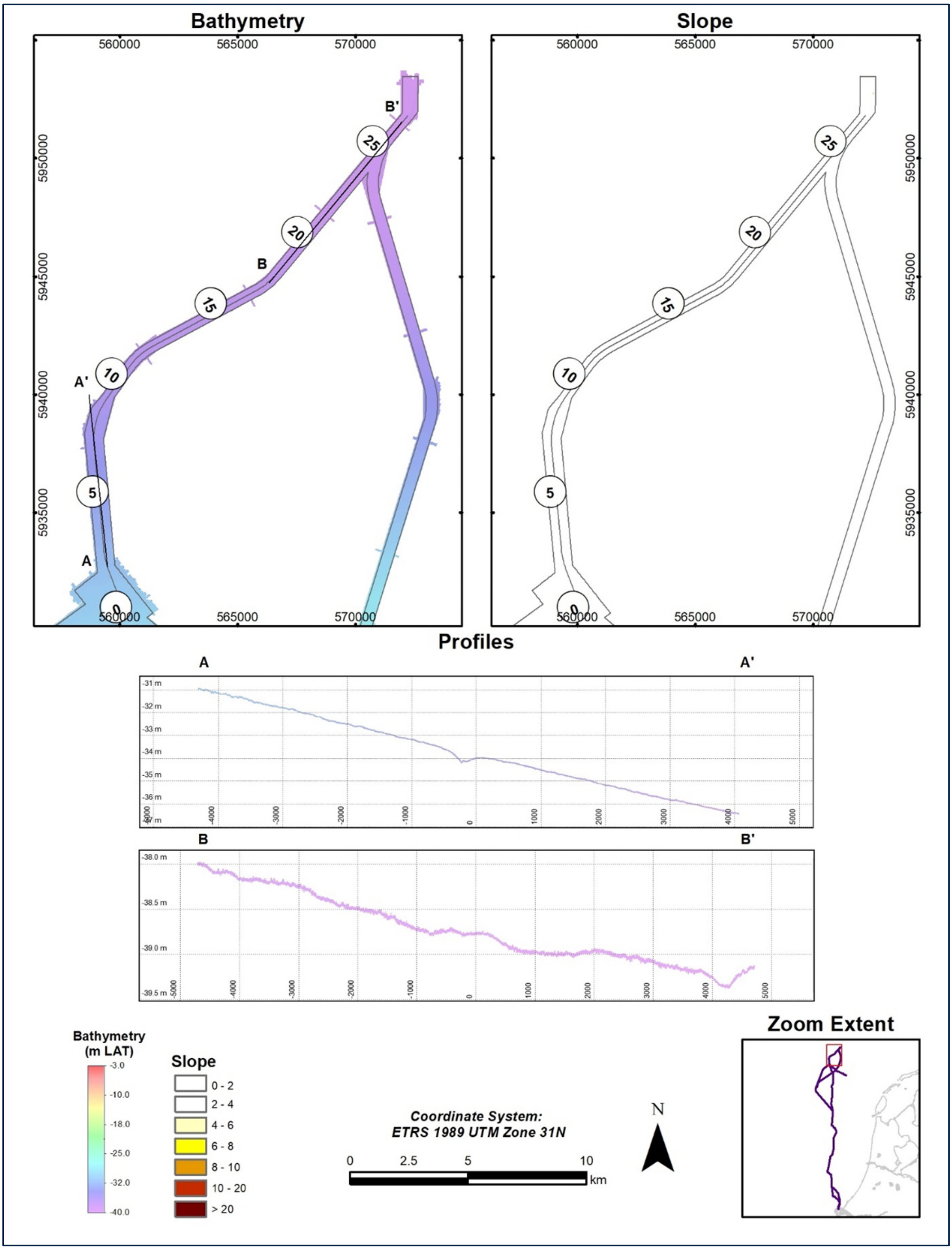


Figure 9.2: Bathymetry along the route section C.

9.2.2 Seafloor Morphology

Overall, a strong correlation between sediment type and morphological type was observed, although some small variation is possible. An overview is given in Table 9.1.

Table 48: Sediment type with associated morphology in route section C

Sediment Type	Morphological Type
Gravelly SAND	Patchy coarse sediments
Silty (muddy) SAND	Patchy fine sediments
SAND	Featureless, trawl marks area

The seafloor in Section C is mostly featureless with SAND as primary sediment. Between KP 2.5 and KP 5.5 two areas of gravelly SAND (patchy coarse sediments) have been identified. Isolated trawl marks have been found as well. From KP 20.0 to the Platform L4A there is a change in sediment type observed, which becomes silty (muddy) SAND (Figure 9.6).

9.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 9.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 49: Summary of seafloor contacts in route section C

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	148
	Depression pockmark	5
	Mattress	2
	Seabed mound	3
	Suspected debris	83
	Wreck	1
	Magnetic anomalies	118
SSS/MBES/MAG Linear Features	Exposed pipeline	3 (2 segments belonging to the same pipeline)
	Buried pipeline	8 (several segments belonging to the same pipelines)
	Magnetic linear feature	1

A wreck was identified at KP 4.5 of this route section (Figure 9.3).

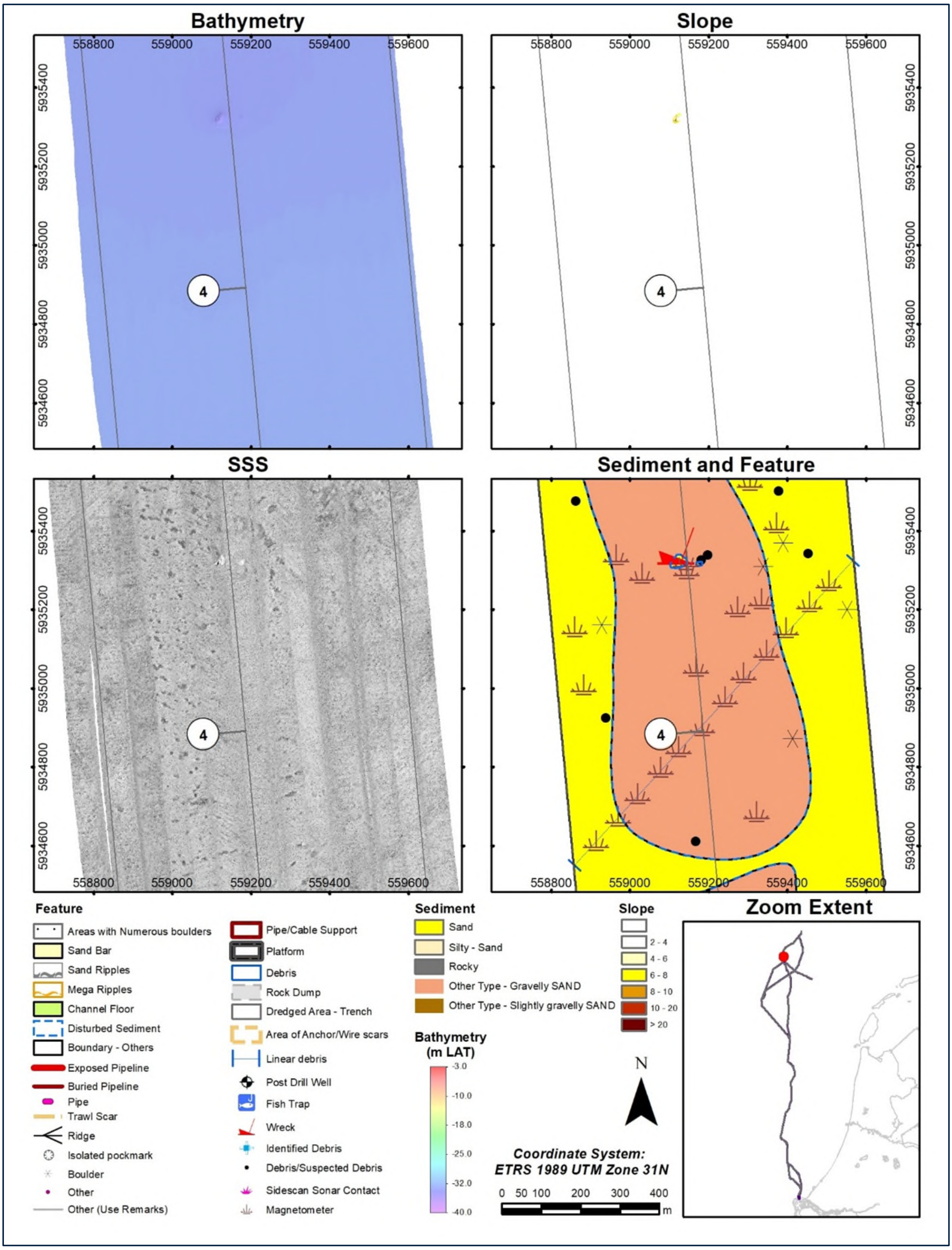


Figure 9.3: Overview of the sediments and morphology in route section C: KP 4.5.

Two (2) exposed segments of a pipeline and two (2) mattresses were identified near Platform L4A (Figure 9.4).

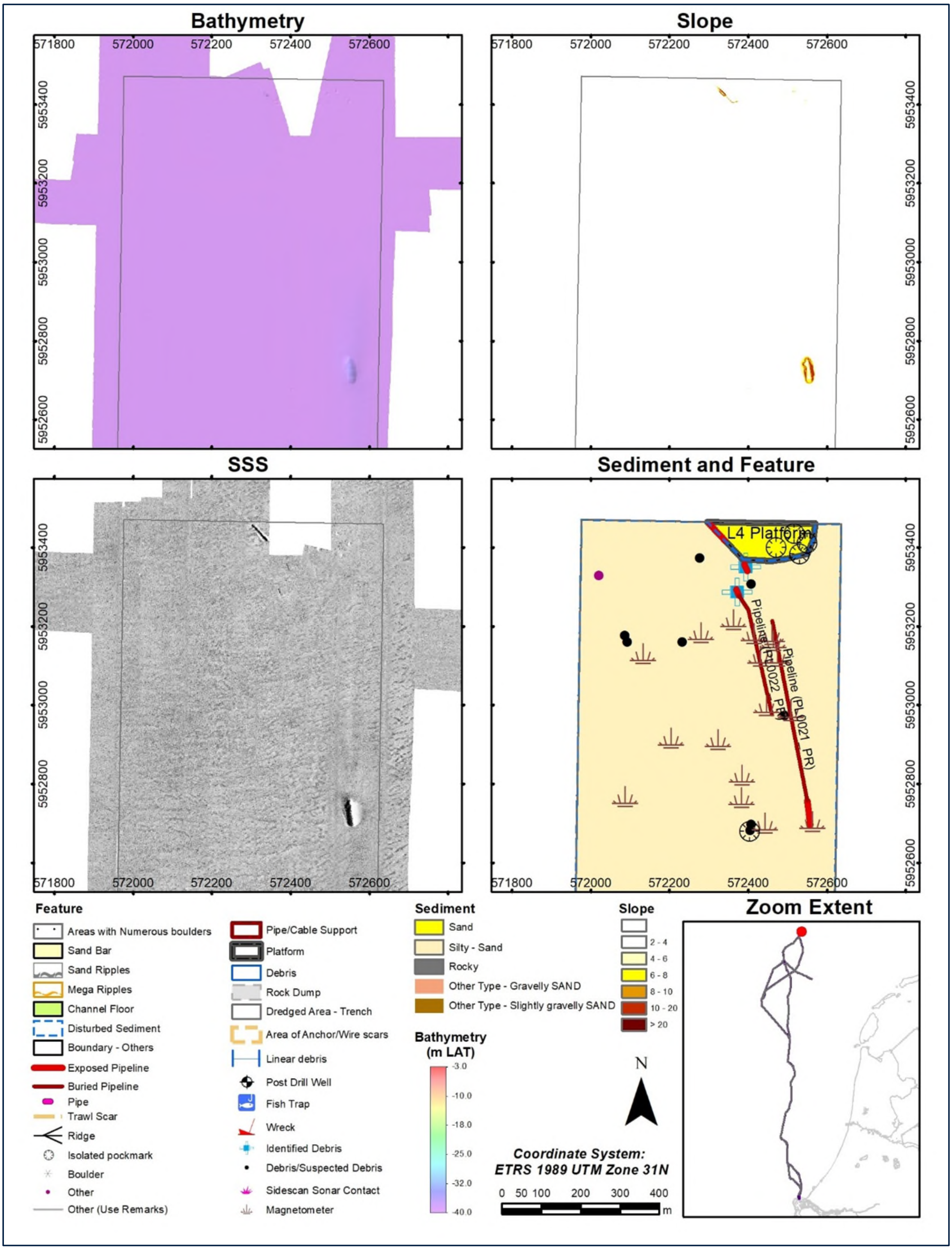


Figure 9.4: Overview of the sediments and morphology in route section C, near Platform L4A.

In Section C, five (5) pipelines and one (1) possible cable have been identified. One of the observed pipelines has two exposed segments in the proximity of the Platform L4A (Table 9.3, Figure 9.5, Figure 9.6 and Figure 9.7).

Table 50: Summary of pipelines in route section C

Contact ID	Pipeline Name	Comment
Pipeline (PL0064_PR)	K9c-A to L10-AR 16-inch pipeline	Buried, KP 9.7
Pipeline (PL0047_PR)	L4-B to L7-A 10.75-inch pipeline	Buried, KP 19.2
Pipeline (PL0048_PR)	L4-B to L7-A 3.5-inch pipeline	Buried, KP 19.3
Pipeline (PL0022_PR)	L4-A TO L7-P 3.5-inch pipeline (abandoned)	Buried (2 segments) (No KP information available)
Pipeline (PL0021_PR)	L4-A to L7-P 12.75-inch pipeline (abandoned)	2 Segments Exposed 1 Segment buried (No KP information available)
Magnetic linear feature (possible cable)	No available background information	Buried, KP 4

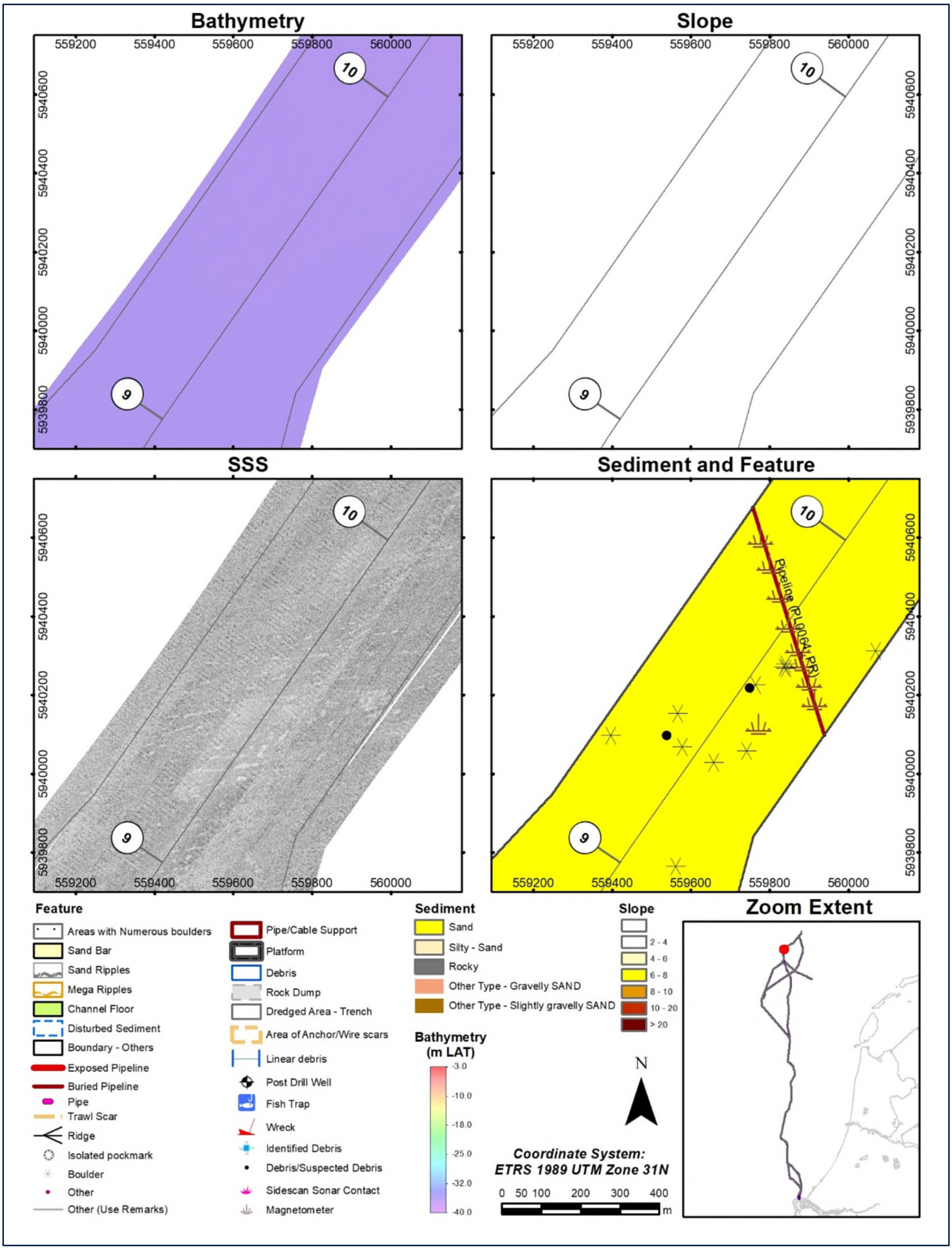


Figure 9.5: Overview of the sediments and morphology in route section C: KP 9.0 to KP 10.0; identified pipeline.

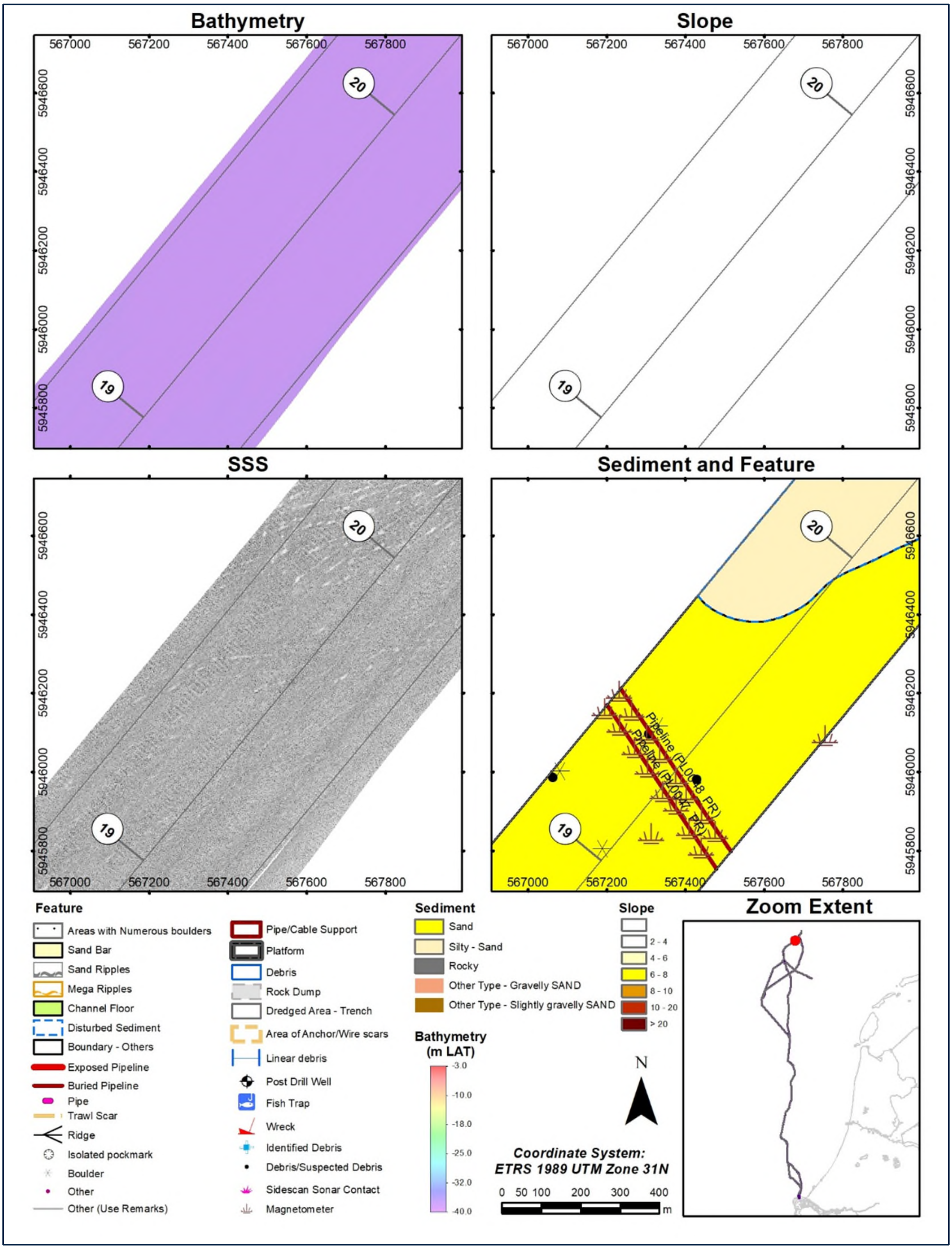


Figure 9.6: Overview of the sediments and morphology in section C: KP 19.0 to KP 20.0, identified pipelines.

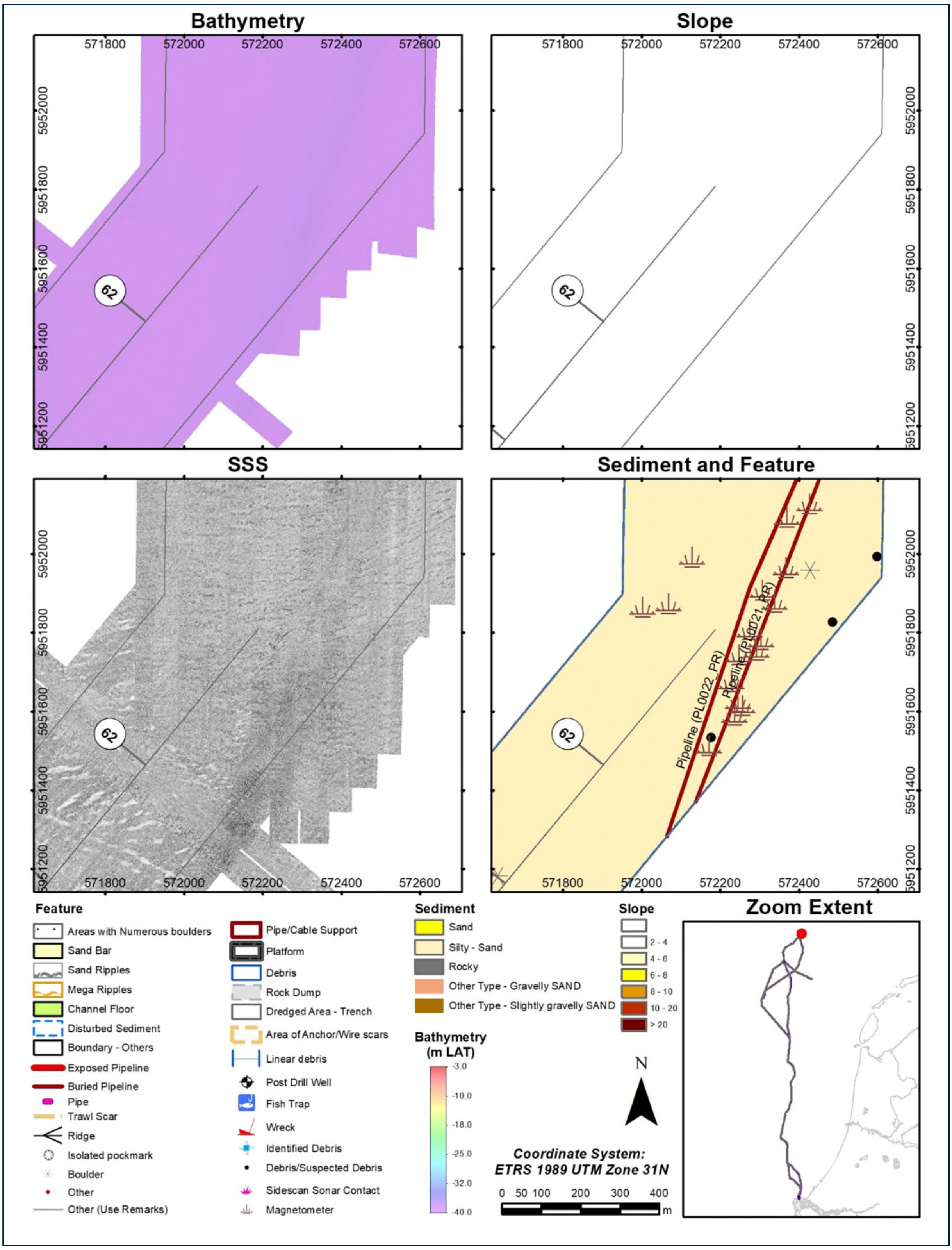


Figure 9.7: Overview of the sediments and morphology in section C: KP 62.0, buried pipelines.

9.2.4 Magnetometer Contacts

118 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in route Section C. The magnetometer anomalies range between 5.1 nT and 3529.9 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

9.2.5 Sub-seafloor Geology

Units A, B, D, E, F and G are present in the route Section C (Figure 9.8).

Unit A is present in the entire section. From KP 0.0 to KP 5.5 this unit is acoustically transparent. This changes between KP 5.5 to KP 26.8 with the upper half of the unit being acoustically semi-transparent with low to medium-amplitude parallel reflectors while the lower half of the unit remains acoustically transparent. The maximum thickness this unit in this section is approximately 3 m.

Unit B is present across the entire section. On the SBP data, the unit is characterized by layered facies, of medium to high amplitude parallel reflectors. In the initial part of this route section, the lower part of the unit is acoustically transparent. The transparent interval thins towards the north and from approximately KP 11.5 the entire unit has layered facies. Locally, the base is channelized. The infill of the channels at the base is structured or chaotic, with high amplitude reflectors. The maximum thickness Unit B in this section is approximately 7 m.

Unit D is present in the entire section. Its seismic character is transparent to semi-transparent, with parallel to sub parallel internal reflectors, marking erosion surfaces. Locally, channels and negative high amplitude anomalies were also interpreted in this unit (peat level 2). The maximum thickness of the Unit D in this section is approximately 15 m.

Unit E is present in the entire section. Acoustically it is semi-transparent and structureless. Locally high negative amplitude anomalies were also interpreted (peat level 3). The maximum thickness of this unit in this section is approximately 20 m.

Unit F (infill of glacial valley) is present between KP 24.6 to KP 26.5.

Table 9.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 51: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.8 to 3.2	Very loose slightly clayey fine SAND with frequent shells and shell fragments Locally silty fine SAND
B	1.2 to 7.5	Medium to very dense slightly silty fine and medium SAND Frequently a very thin to thick bed of very low to high strength slightly sandy CLAY
D	BDP	Medium to very dense slightly silty to silty fine and medium SAND
Notes: BPD = below penetration depth of SBP data		

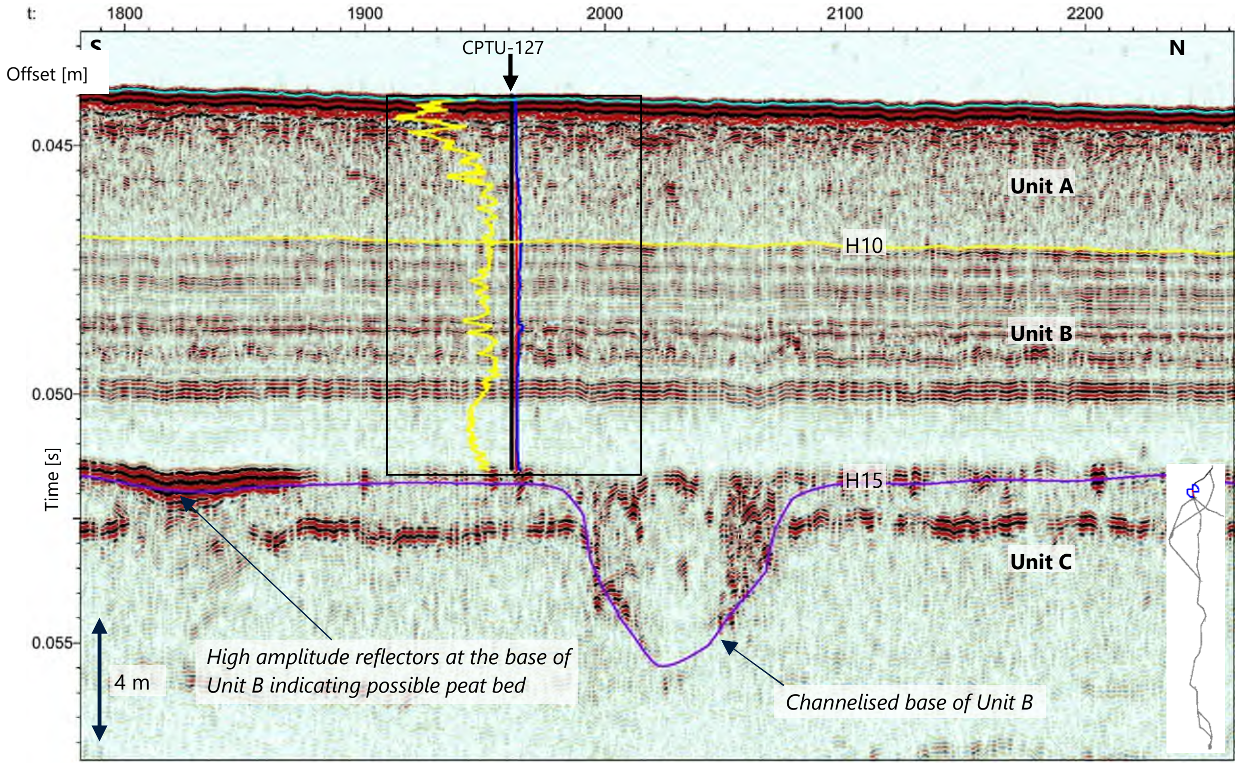


Figure 9.8: SBP data example of route section C. (Line SBP_TA3H23321P1_1) *Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.*

10. Section D

10.1 Section D Location

The location the route Section D is shown in Figure 10.1. This section of the route has a length of 33.8 km.

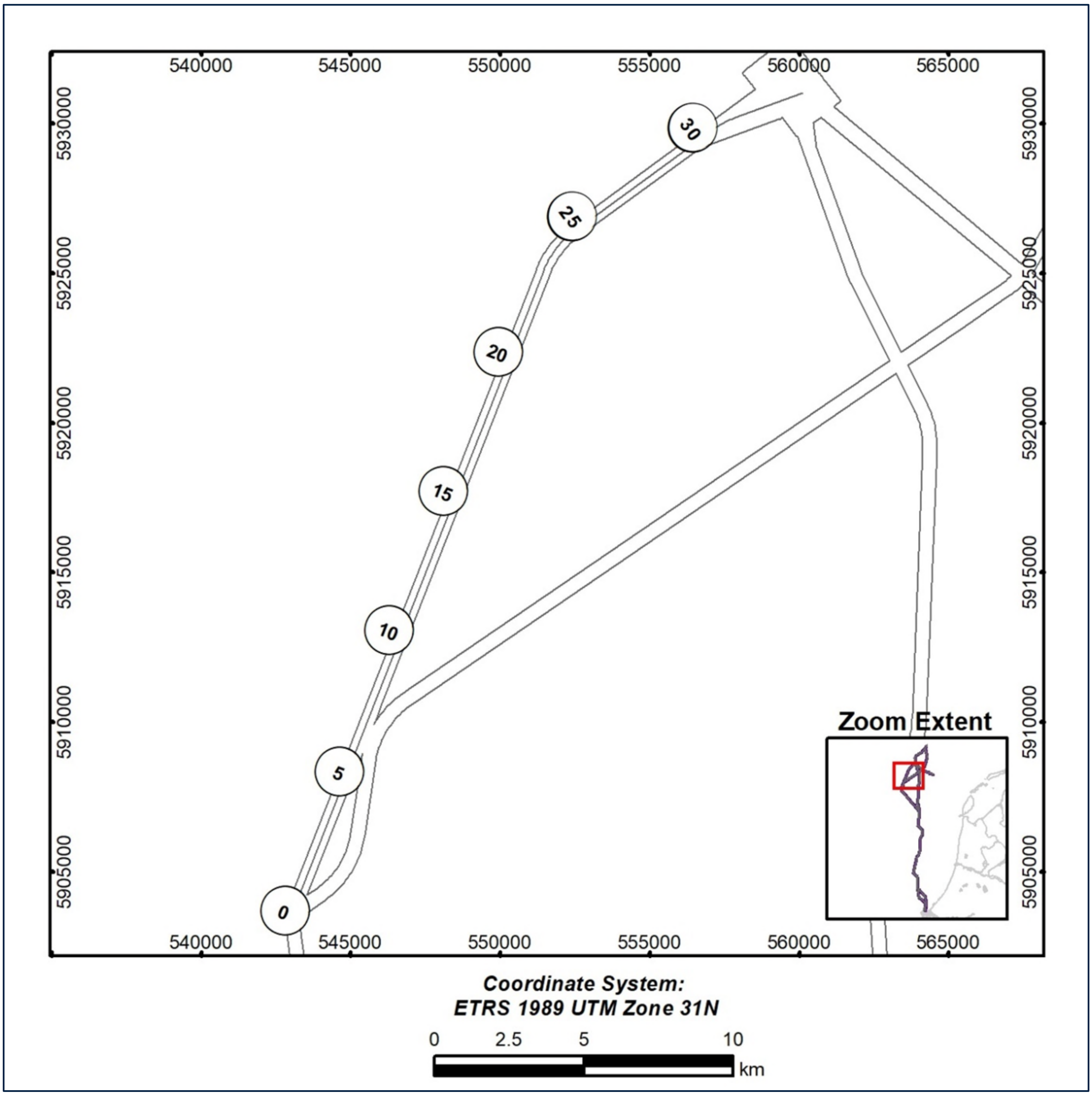


Figure 10.1: Location of the route section D.

10.2 Results

10.2.1 Bathymetry

The water depth in route Section D ranges between 29.5 m and 31.0 m. An overview of the bathymetry is given in Figure 10.2.

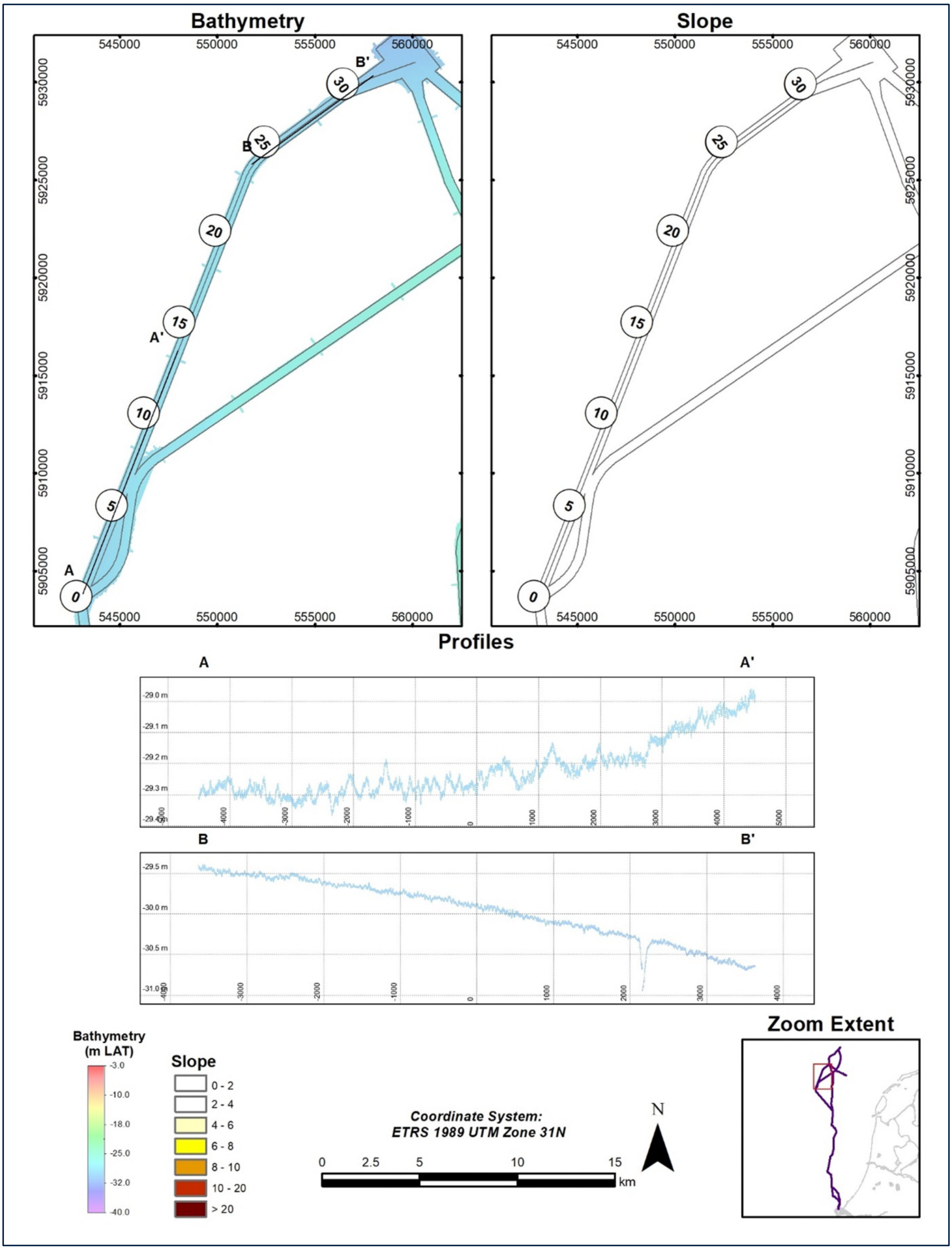


Figure 10.2: Bathymetry along the route section D.

10.2.2 Seafloor Morphology

A strong correlation between sediment types and morphological type was observed, although some small variation is possible. An overview is given in Table 10.1.

Table 52: Sediment type with associated morphology in route section D

Sediment Type	Morphological Type
Silty (muddy) SAND	Patchy fine sediments
SAND	Featureless, trawl marks area

Between KP 0.0 and KP 29, the dominant sediment is SAND, between KP 29.0 and KP 32.5 the sediment is classified as silty (muddy)SAND, between KP 32.5 and the end of the section (Hub Area) the sediment type is mostly SAND with isolated trawl marks.

10.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 10.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available. Three targets cross correlate between sensors.

Table 53: Summary of seafloor contacts in route section D

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	251
	Debris	9
	Magnetic anomalies	117
SSS/MBES/MAG Linear Features	Fishing gear	1
	Exposed pipeline	1 partially exposed (2 segments) and partially buried (1 segment)
	Buried pipeline	1

Table 10.3 shows the 3 targets that were cross correlated between sensors in Section D.

Table 54: Summary of cross correlating seafloor contacts in route section D

Section	SSS Target Name	MAG Target Name	Description
Section D	BK_FSEA_SSS_0084	BK_FSEA_MAG_0090	Debris
Section D	BK_FSEA_SSS_0086	BK_FSEA_MAG_0133	Debris
Section D	BK_FSEA_SSS_0163	BK_FSEA_MAG_0093	Debris

An example of a SSS/MBES target with a length of 2.5 m correlated with a MAG anomaly of 4576.5 nT, found at KP 19.8 of Section D, is shown in Figure 10.3. The distance between the target and the route is 63 m.

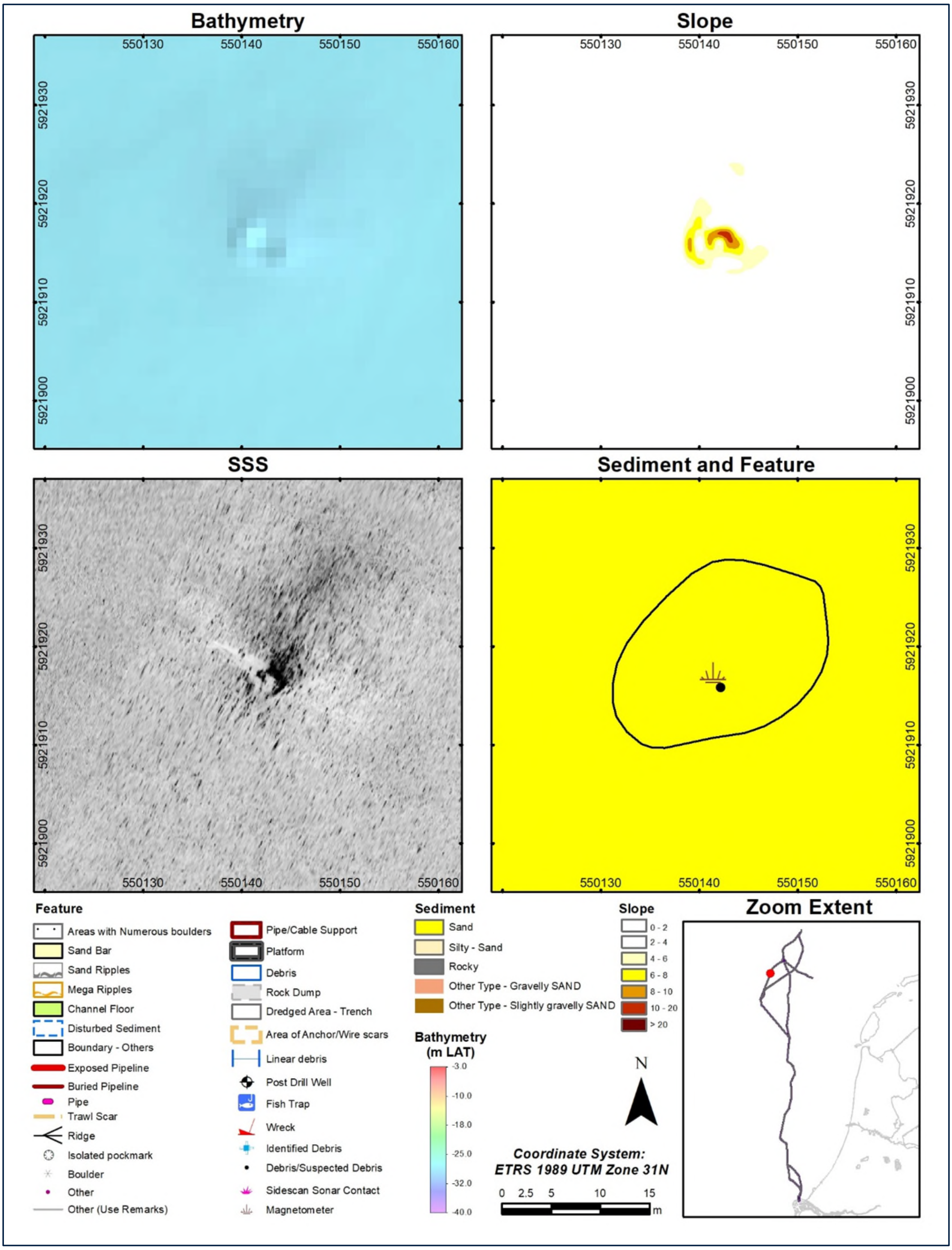


Figure 10.3: Example cross-correlated target found in route section D.

Two (2) pipelines were identified, one (1) buried and one (1) partially buried and partially exposed in this section of the route (Table 10.4 and Figure 10.4).

Table 55: Summary of pipelines in route section D

Contact ID	Pipeline Name	Comment
Pipeline (PL0119_PR)	K11-B to K12-C 14/2-inch pipeline bundle (abandoned 2005)	Buried, KP 21.1
Pipeline (PL0142_PR)	D15-FA to L10-AC 36-inch dry gas pipeline	Partially buried (1 segment), partially exposed (2 segments), KP 30.1

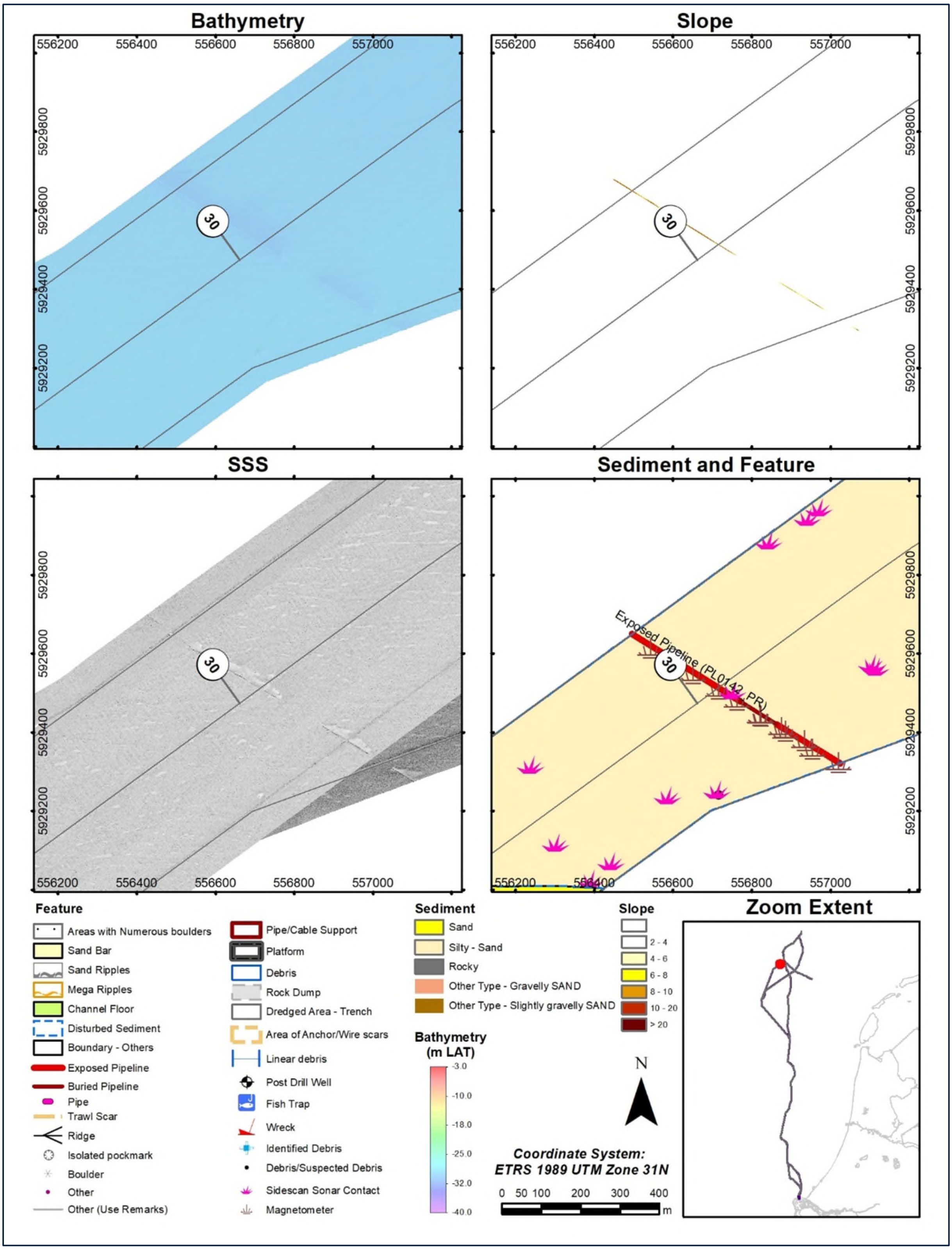


Figure 10.4: Example of partially buried and partially exposed pipeline in route section D.

10.2.4 Magnetometer Contacts

117 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in route Section D. The magnetometer anomalies range between 5.1 nT and 7221.3 nT. The highest magnetic amplitudes are associated with the encountered pipelines

10.2.5 Sub-seafloor Geology

Units A, B, C, D, E, F and G are present in the route Section D (Figure 10.5).

Unit A is present in the entire section. It characterized by acoustically transparent seismic character. The maximum thickness of this unit in this section is approximately 3 m.

Unit B is present across the entire section. On the SBP data, the seismic character is chaotic between KP 0.0 and KP 10.0, acoustically transparent between KP 10.0 and KP 21.0, and from KP 21.0 till the end of the route section layered seismic facies with low to medium-amplitude parallel reflectors. Where the base is channelised, the infill is chaotic or structured, with high amplitude reflectors. At the base of this unit high amplitude anomalies were observed, which may represent laminae or thin bed of peat and/or organic-rich clay (peat level 1). The maximum thickness of this unit in this section is approximately 5 m.

Unit C is present between KP 0.0 and KP 20.4. The unit exhibits mostly transparent/ structureless facies in this section, locally there are internal high amplitude semi-horizontal reflectors observed, especially towards the north. The thickness increases to the north and reaches maximum thickness of approximately 10 m.

Unit D is present between KP 4.0 and KP 28.9, between KP 31.5 and the end of the section. Its seismic character varies from acoustically transparent to bedded, with parallel reflectors. Locally, negative high amplitude anomalies were also interpreted (peat level 2). The maximum thickness of the Unit D in this section is approximately 15 m.

Unit E is present in the entire section. Acoustically it is transparent to semi-transparent and structureless. The maximum thickness of this unit in this section is approximately 20 m.

Unit F (infill of glacial valley) is present between KP 27.9 to KP 29.1.

Table 10.5 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 56: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.8 to 2.9	Very loose to medium dense silty fine and medium SAND, with occasional shells and shell fragments
B	1.3 to 9.0	Medium dense to dense slightly silty to silty fine and medium SAND with occasional shells and shell fragments Locally with thick beds of low to medium strength slightly sandy clayey SILT with closely spaced thin to thick laminae of sand, with closely spaced thin laminae of peat
C	BPD	Medium dense to dense silty to very silty fine and medium SAND
D	BPD	Low strength to high strength CLAY

Unit	Depth to Base [m BSF]	Lithology
Notes: BPD = below penetration depth of SBP data		

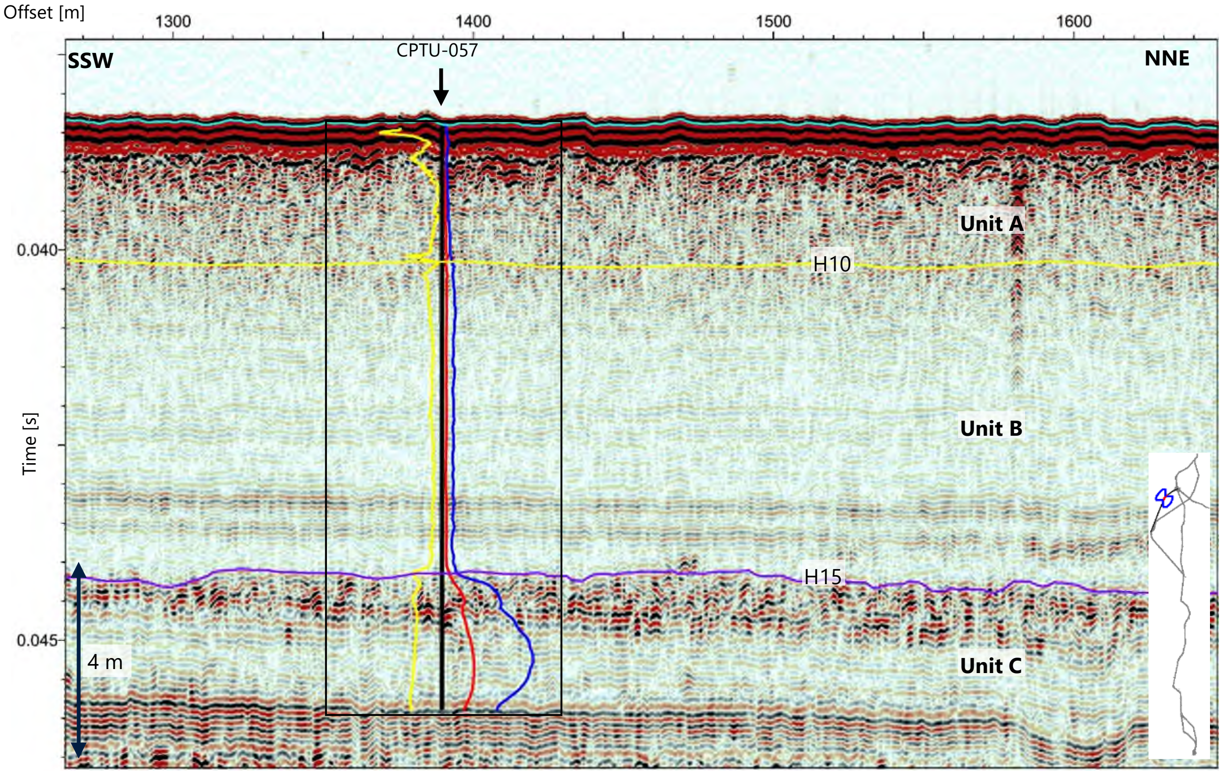


Figure 10.5: SBP data example of route section D. (Line SBP_TA3K2305P1_5) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

11. Section E Alternative

11.1 Section E Alternative Location

The location of the route Section E Alternative is shown in Figure 11.1. This section of the route has a length of 23.5 km.

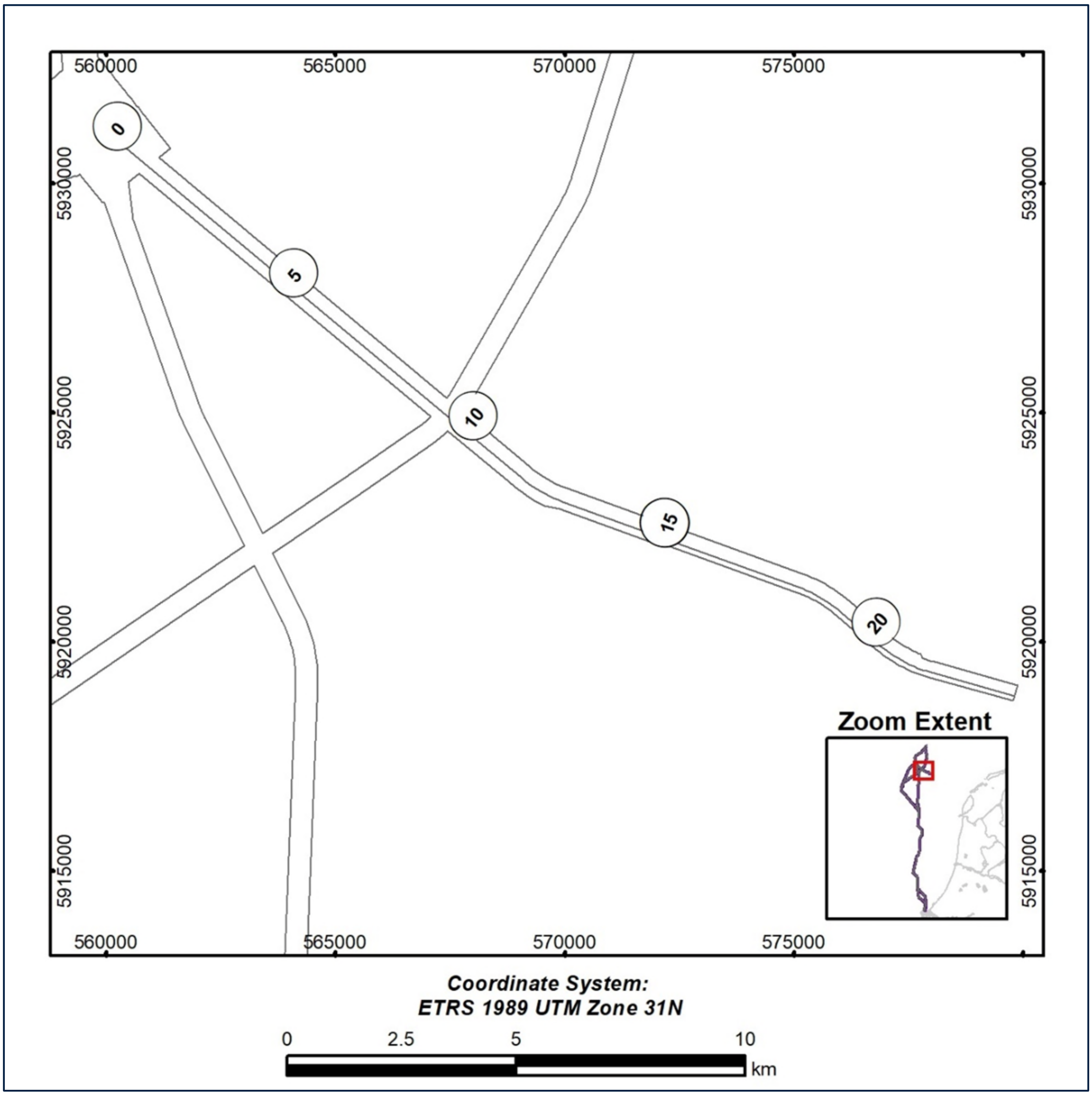


Figure 11.1: Location of the route section E Alternative.

11.2 Results

11.2.1 Bathymetry

The water depth in route Section E Alternative ranges between 26.0 m and 30.5 m. An overview of the bathymetry is given in Figure 11.2.

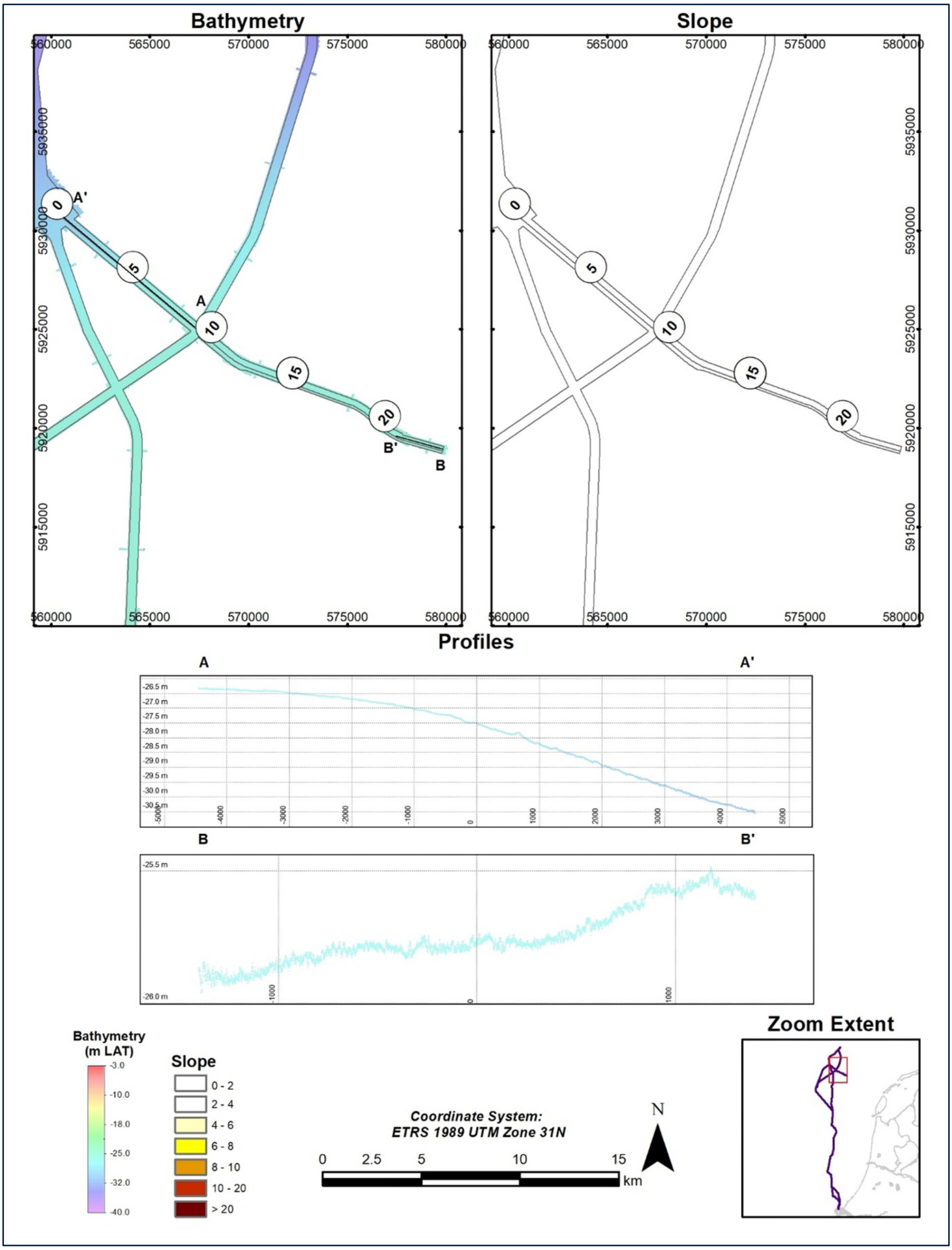


Figure 11.2: Bathymetry along the route section E Alternative.

11.2.2 Seafloor Morphology

A strong correlation between sediment types and morphological type was observed, although some small variation is possible. An overview is given in Table 11.1.

Table 57: Sediment type with associated morphology in route section E Alternative

Sediment Type	Morphological Type
Slightly gravelly SAND	Ripples
SAND	Featureless

From KP 0.0 to KP 22.0 the dominant sediment has been classified as SAND mostly featureless, from KP 22.0 till the end of Section E Alternative an area of sightly gravelly SAND with ripples has been identified.

11.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 11.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross correlated where multiple datasets were available. No targets cross-correlate in this section of the route.

Table 58: Summary of seafloor contacts in route section E Alternative

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Debris	34
	Suspected debris	2
	Wreck	1
	Magnetic anomalies	41
SSS/MBES/MAG Linear Features	Exposed pipeline	1 partially exposed and partially buried pipeline
	Buried pipeline	4
	Magnetic linear feature	1

A wreck was found at KP 20.0 of the route Section E Alternative (Figure 11.3). The wreck is located approximately 220 m from the route.

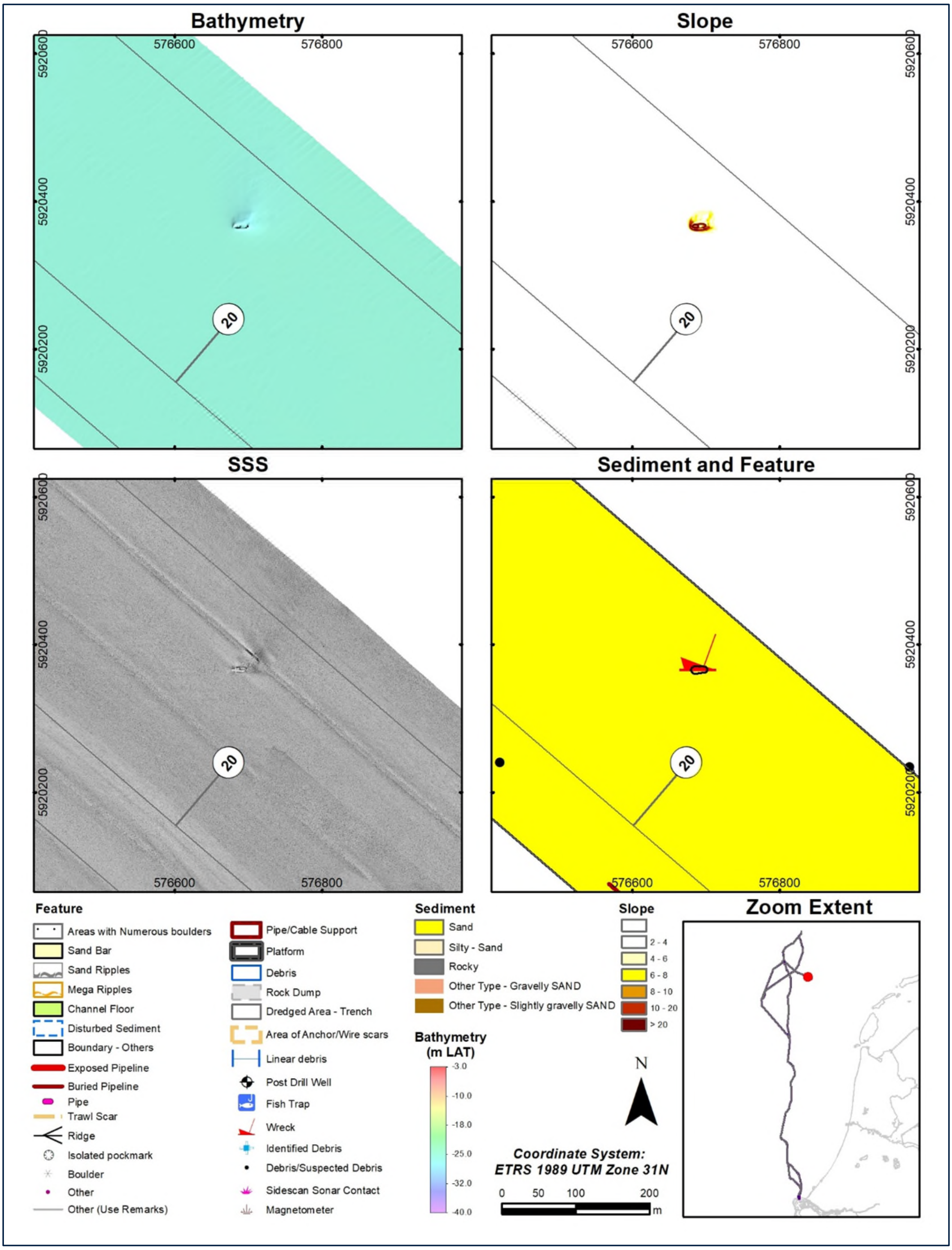


Figure 11.3: Example of wreck found in route section E Alternative.

Five (5) pipelines and one (1) possible cable were identified in route Section E Alternative (Table 11.3). One of the identified pipelines is partially exposed.

Table 59: Summary of pipeline in route section E Alternative

Contact ID	Pipeline Name	Comment
Pipeline (PL0064_PR)	K9c-A to L10-AR 16-inch dry gas pipeline	Buried, KP 18
Pipeline (PL0068_PR)	L10-S3 to L10-AP 6/2-inch pipeline bundle (abandoned 2005)	Buried KP 20, 21
Pipeline (PL0067_HS)	L10-L to L10-AP 10-inch gas / 2-inch methanol pipeline bundle	Partially buried (2 Segments) and partially exposed (1 segment), KP 22.5
Pipeline (PL0012_PR)	L7-P to L10-A 16-inch dry gas pipeline	Buried, KP 22.5
Pipeline (PL0002_HS)	L10-B to L10-AD 10-inch gas / 2-inch methanol pipeline bundle	Buried, KP 22.8
Mag Linear Feature (Possible cable)	Not present in the background database	Buried, KP 23.4

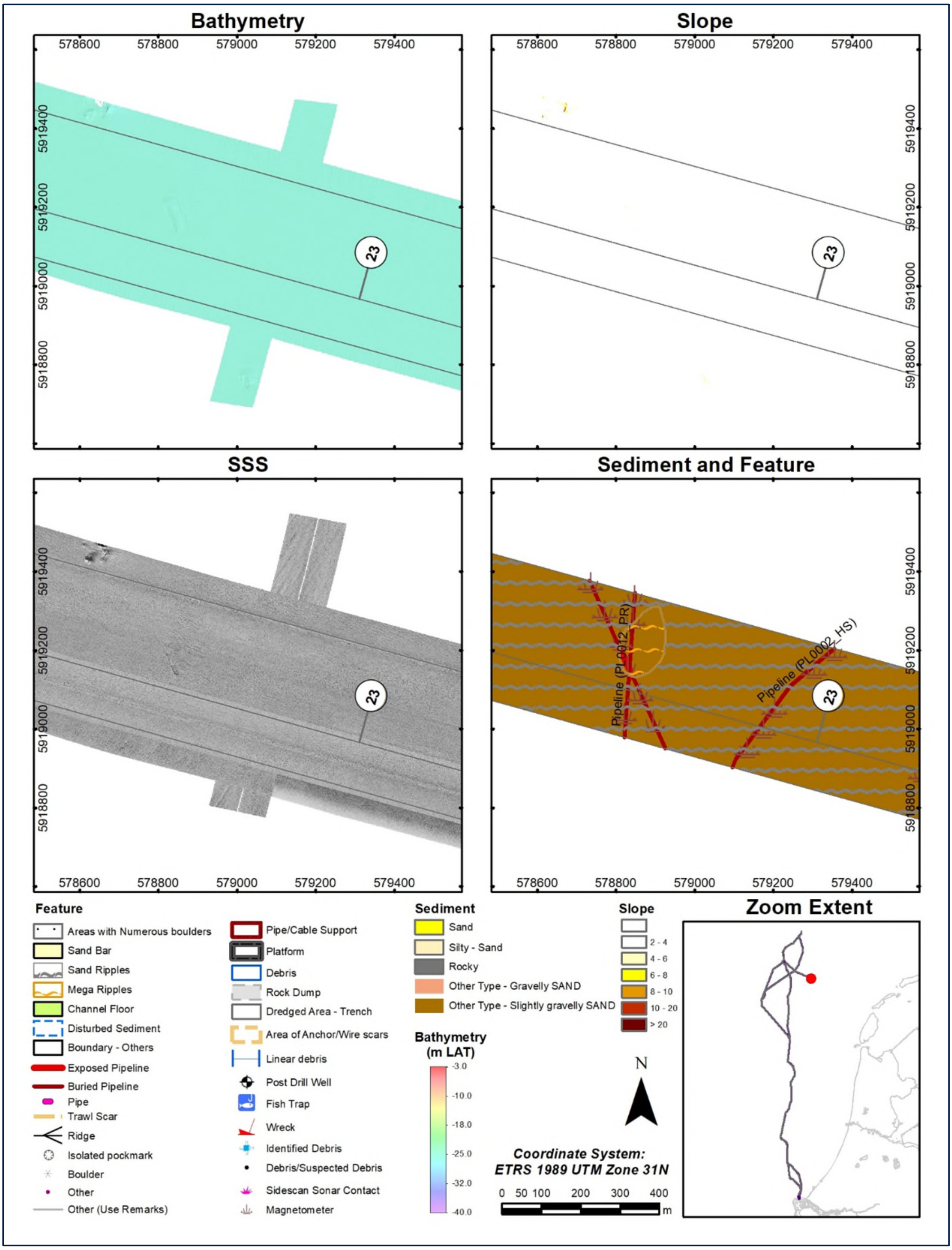


Figure 11.4: Example of pipelines found in route section E Alternative.

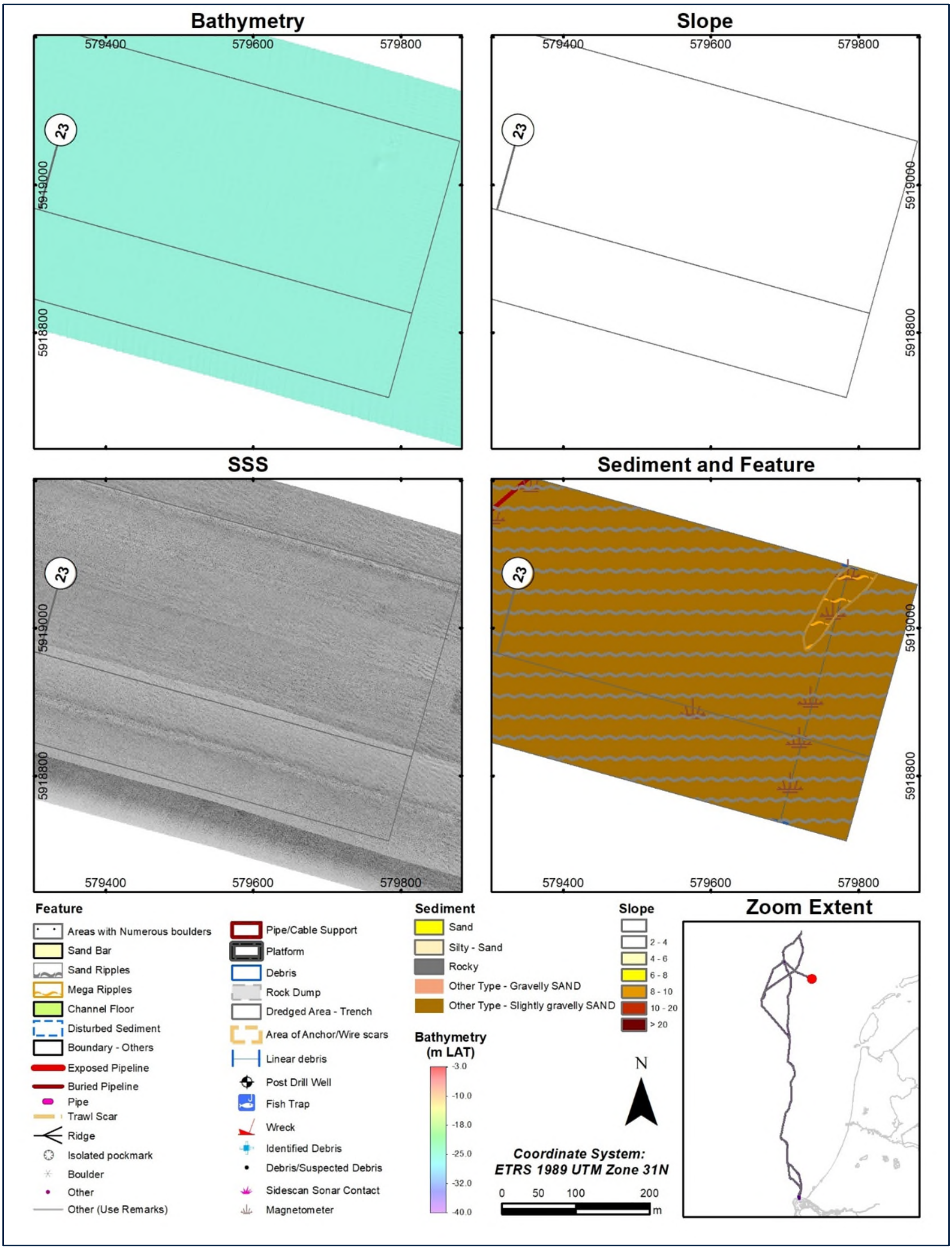


Figure 11.5: Example of possible cable found in route section E Alternative: KP 23.4.

11.2.4 Magnetometer Contacts

41 magnetic contacts were found at the time of the geophysical scope (single MAG survey). in route section E Alternative. The magnetometer anomalies range between 7.4 nT and 3424.2 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

11.2.5 Sub-seafloor Geology

Units A, B, C, D, E and F are present in route Section E Alternative (Figure 11.6).

Unit A is present in the entire section. It has transparent seismic character. From approximately KP 12.0 the unit shows locally chaotic intervals and undulating internal erosion surfaces marked by medium amplitude reflectors. The maximum thickness of this unit in this section is approximately 3 m.

Unit B is present across the entire section. The unit has predominantly acoustically transparent seismic character. Between KP 11.0 and KP 15.5, locally intervals with chaotic facies with high amplitude reflections are present. The base is locally channelised. Their infill is structured, with medium to high amplitude sub parallel reflectors. The maximum thickness of this unit in this section is approximately 6 m.

Unit C is present between KP 8.5 to KP 23.5. It exhibits semi-transparent seismic character, with locally internal high amplitude negative reflectors of various extent. These reflectors represent laminae or thin bed of peat and/or organic-rich clay. The maximum thickness of this unit in this section is approximately 4 m.

Unit D is present in the entire section. Its seismic character is semi-transparent with internal erosion surfaces marked by undulating medium to high amplitude reflectors. Locally, internal channels and negative high amplitude anomalies indicating peat were observed in this unit. The maximum thickness of the Unit D in this section is approximately 20 m.

Unit E is present in the entire section. Acoustically it is transparent to semi-transparent and structureless.

Unit F (glacial valley infill) is present locally between KP 2.5 and KP 22.7.

Table 11.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 60: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	2.3 to 2.8	Very loose to loose silty fine and medium SAND with occasional shells and shell fragments
B	3.9 to 10.9	Loose to dense slightly silty to very silty fine and medium SAND with occasional shells and shell fragments
C	BPD	Medium dense slightly silty to very silty fine and medium SAND Locally with a medium bed of sandy SILT Locally with a medium bed of medium strength CLAY
Notes: BPD = below penetration depth of SBP data		

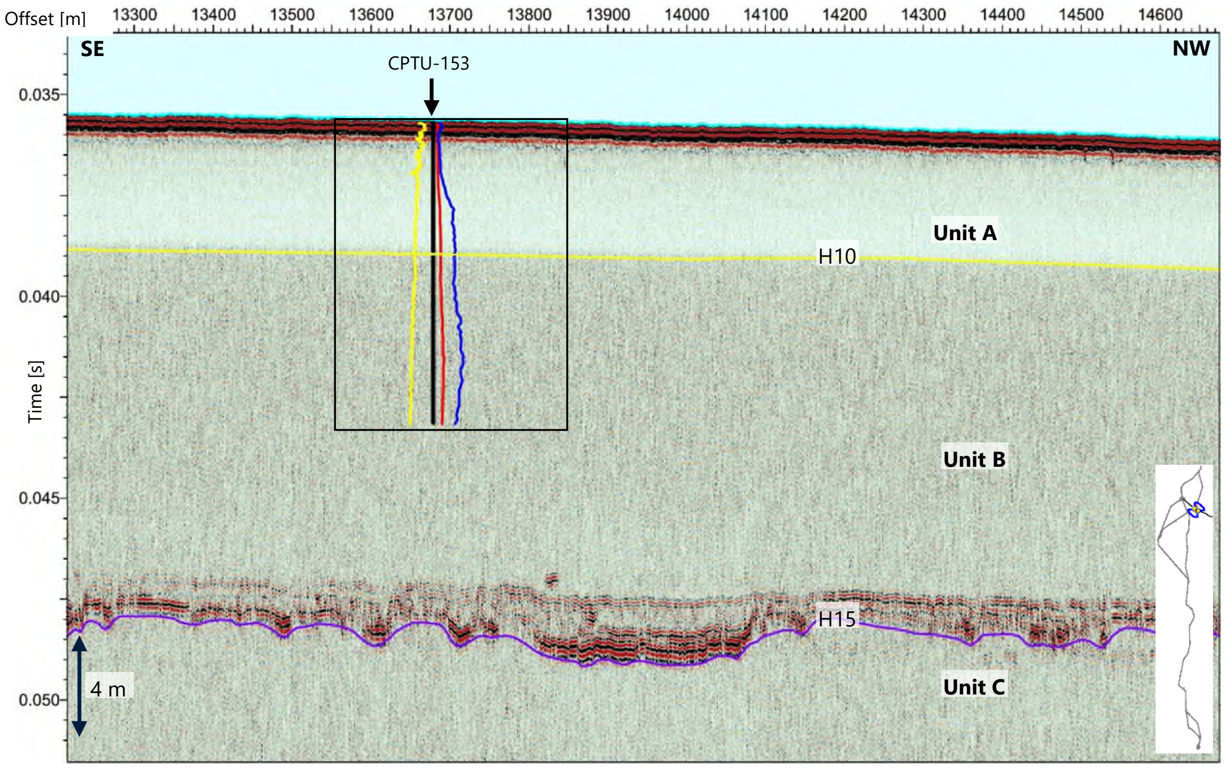


Figure 11.6: SBP data example of route section E Alternative. (Line SBP_TA3N2365P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

12. Section F

12.1 Section F Location

The location of in route Section F is shown in Figure 12.1. This section of the route has a length of 36.3 km.

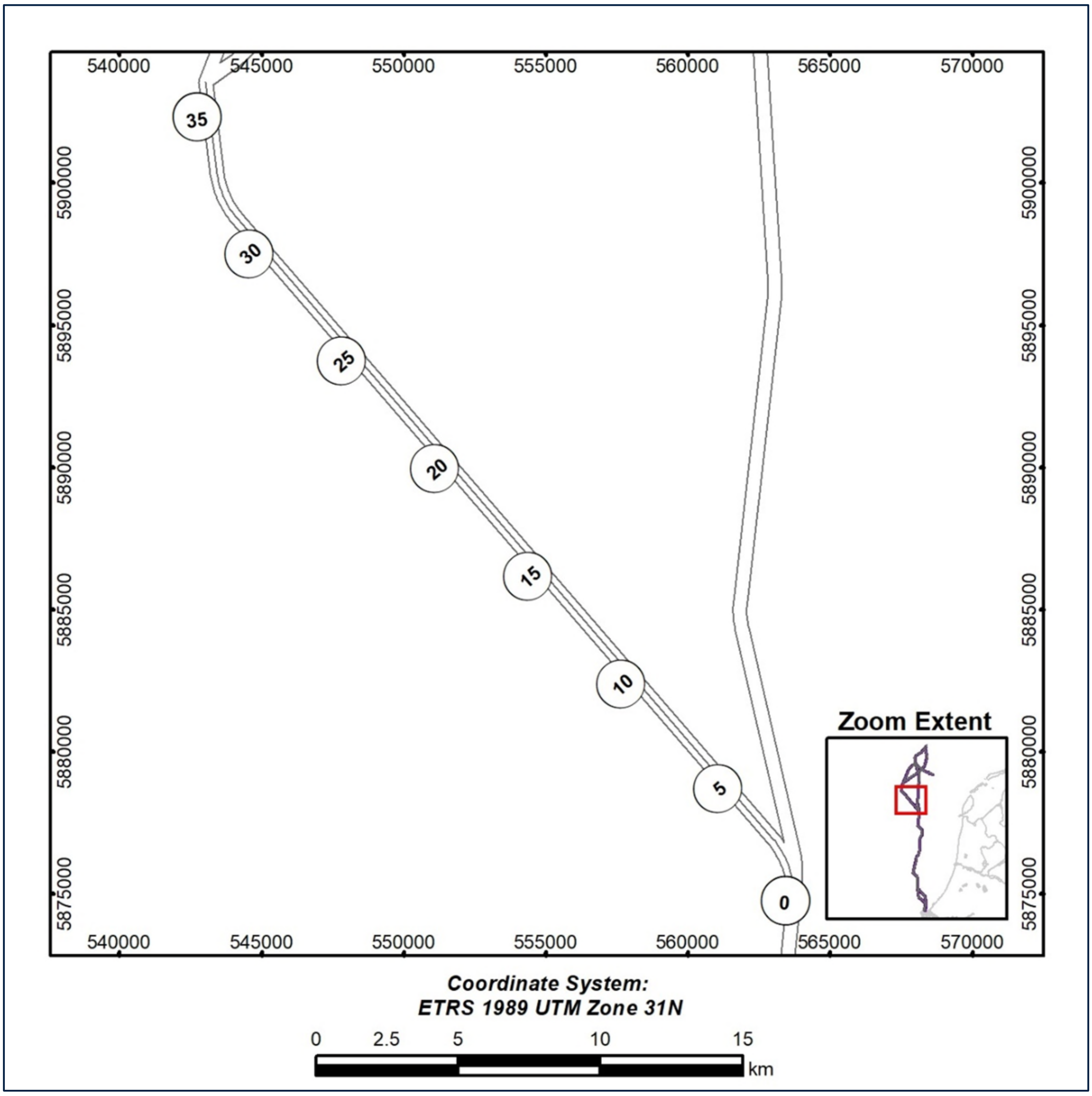


Figure 12.1: Location of the route section F.

12.2 Results

12.2.1 Bathymetry

The water depth in route Section F ranges between 24.0 m and 30.0 m. An overview of the bathymetry is given in Figure 12.2.

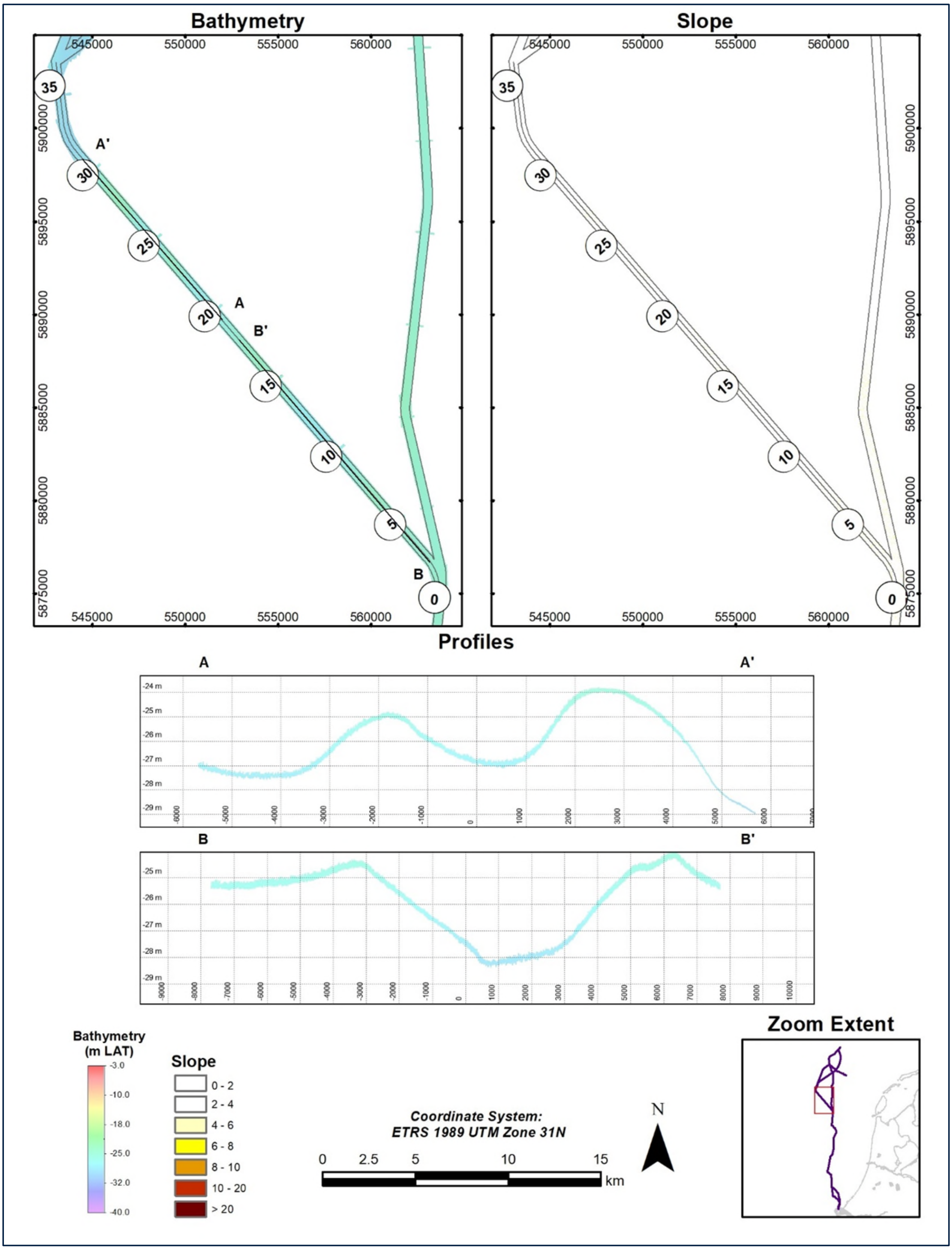


Figure 12.2: Bathymetry along the route section F.

12.2.2 Seafloor Morphology

A strong relation between sediment type and morphological type was observed, although some small variation is possible. An overview is given in Table 12.1.

Table 61: Sediment type with associated morphology in route section F

Sediment Type	Morphological Type
Slightly gravelly SAND	Ripples or megaripples and sand waves
SAND	Featureless

From KP 0.0 to KP 29.7 the dominant sediment was classified as slightly gravelly SAND with ripples, megaripples and sand waves. From KP 29.7 till the end of the section the sediments were classified as SAND mostly featureless. Figure 12.3 shows the sediment and morphology transition at KP 29.7.

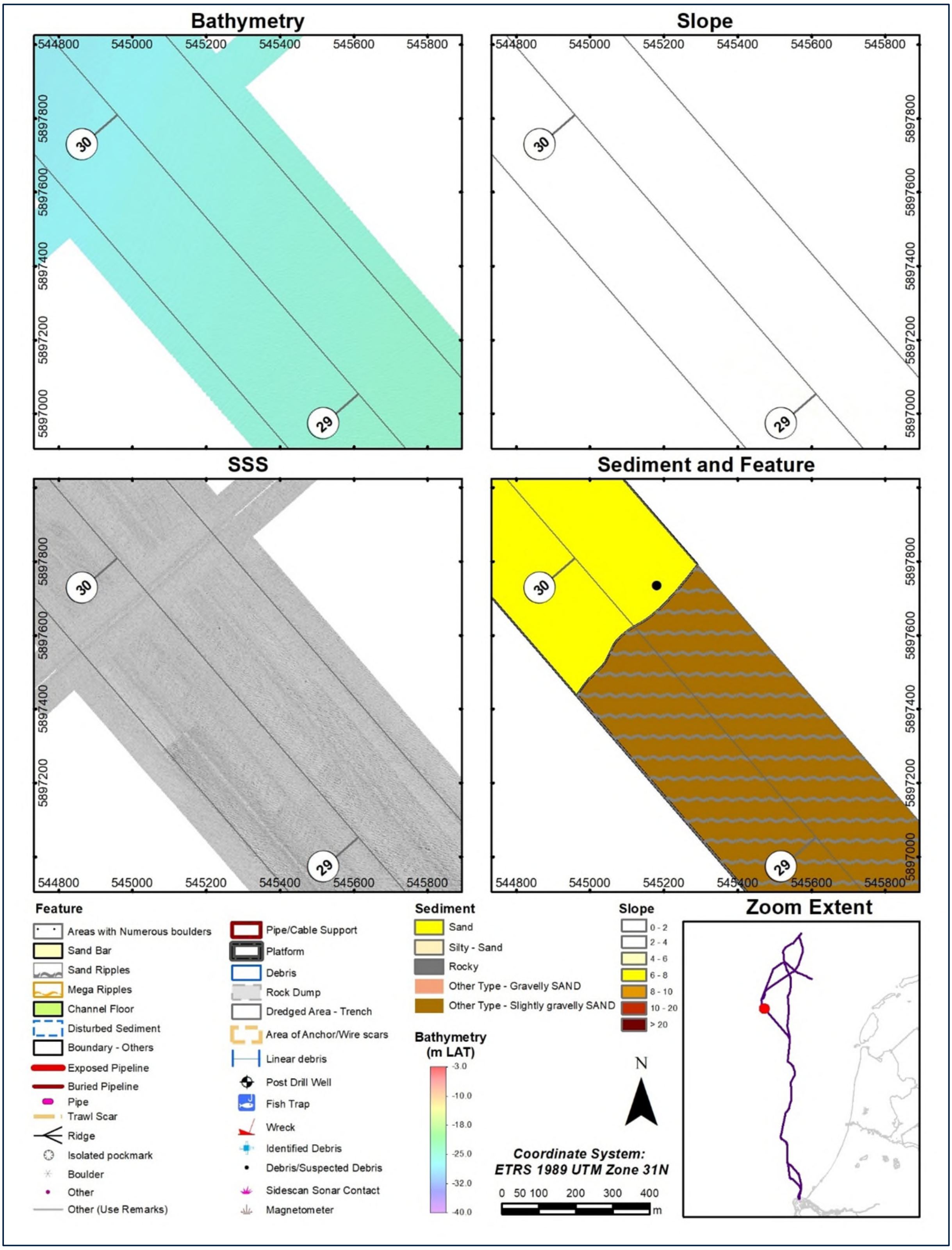


Figure 12.3: Overview of the sediments and morphology transition in rote section F: KP 29.0 to KP 30.0.

12.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross correlated where possible.

Table 12.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 62: Summary of seafloor contacts in route section F

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	10
	Debris	12
	Magnetic anomalies	70
SSS/MBES/MAG Linear Features	Debris	1
	Large trawl scour	16
	Buried pipeline	4

Four (4) buried pipelines were identified in route Section F (Table 12.3, Figure 12.4 and Figure 12.5).

Table 63: Summary of pipeline in route section F

Contact ID	Pipeline Name	Comment
Pipeline (PL0032_PR)	P6-A to L10-AR 20-inch gas pipeline	Buried, KP 5.8
Pipeline (PL0004_PR)	K13-A to Den Helder 36-inch gas pipeline	Buried, KP 36.2
Pipeline (PL0062_PR)	K14-FA-1C to K15-FA-1 18-inch pipeline	Buried, KP 36.3
Pipeline (PL0130_PR)	K14-FA-1 to K15-FB-1 pipeline	Buried, KP 36.35

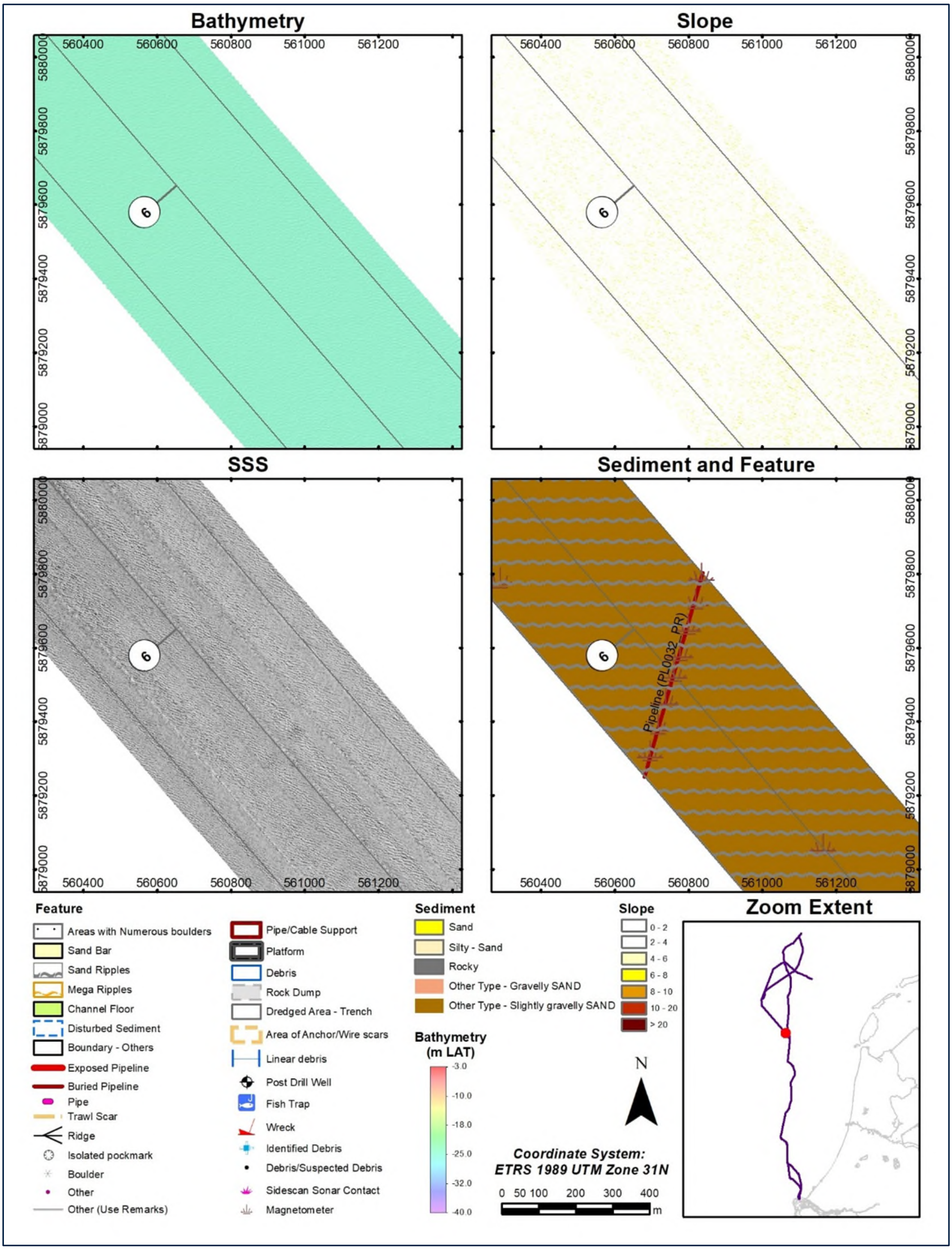


Figure 12.4: Example of pipeline crossing in route section F: KP 6.0.

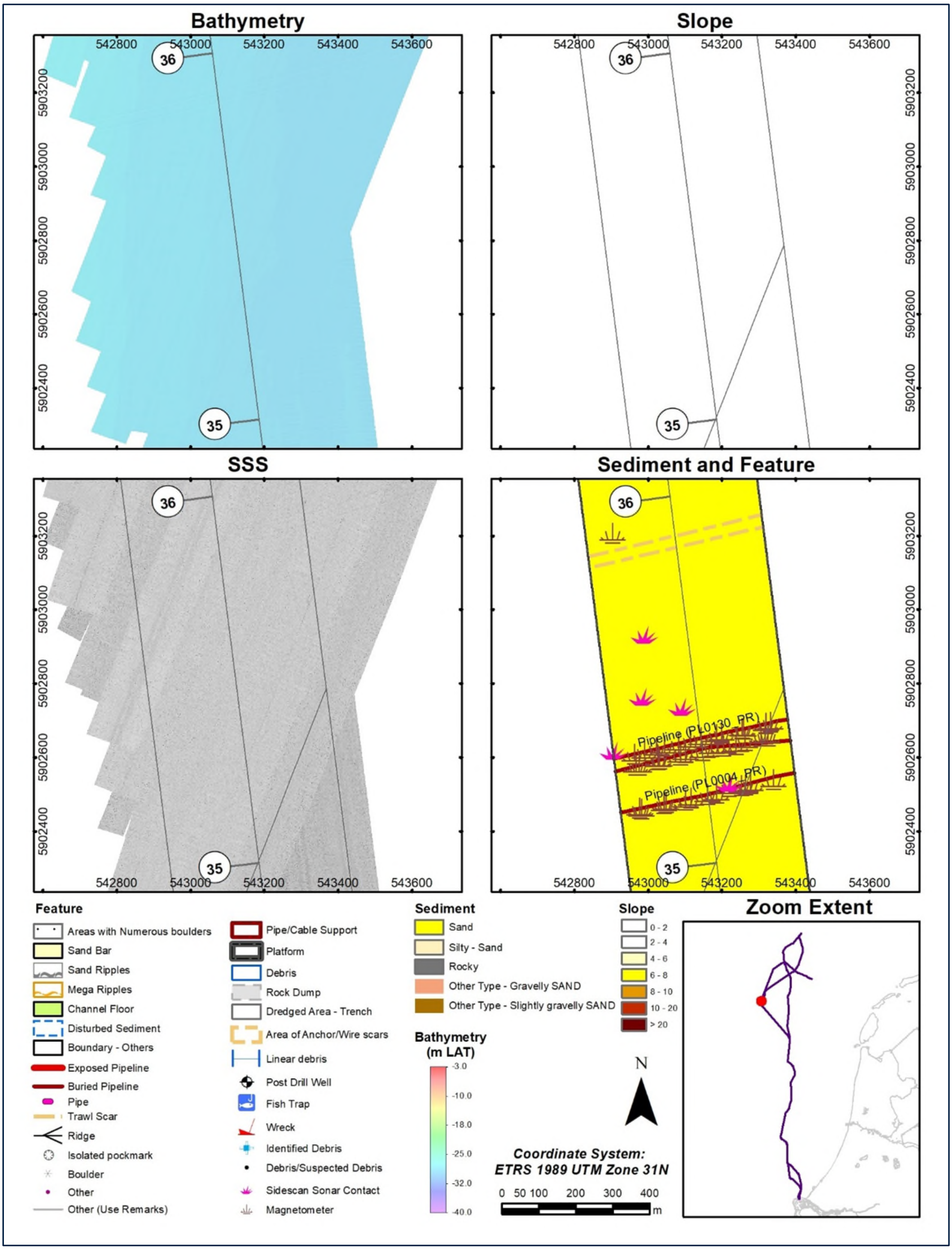


Figure 12.5: Example of pipelines crossing the route section F: KP 35.0 to KP 36.0.

12.2.4 Magnetometer Contacts

70 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in route section F. The magnetometer anomalies range between 13.7 nT and 3983.8 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

12.2.5 Sub-seafloor Geology

Units A, B, C, D, F and G are present in route Section F (Figure 12.6).

Unit A is present in the entire section. It has transparent seismic character. The maximum thickness of this unit in this section is approximately 5 m.

Unit B is present across the entire section. The unit is predominantly acoustically transparent. The base is locally channelised, with the infill characterised by layered character with high amplitude reflectors. At the base, locally high amplitude reflectors were observed, which represent laminae or thin bed of peat and/or organic-rich clay (peat level 1). The maximum thickness of this unit in this section is approximately 5 m.

Unit C is present in the entire section. It exhibits semi-transparent to chaotic seismic character, with local high amplitude negative reflectors, indicating laminae or thin bed of peat and/or organic-rich clay (peat level 2). The maximum thickness of this unit in this section is approximately 4 m.

Unit D is present in the entire section. Its seismic character changes along the route. Between KP 0.0 to KP 11.0 it is mainly acoustically transparent, between KP 11.0 and KP 27.0 it is bedded in the upper part and from approximately KP 27.0 the entire unit shows bedded facies with medium amplitude parallel reflectors. Locally, the base is channelised and high amplitude negative short reflectors were observed (peat level 2). The maximum thickness of the Unit D in this section is approximately 20 m.

Unit F (glacial valley infill) is present between KP 2.7 and KP 6.4, between KP 8.4 and KP 10.0, between KP 26.9 and KP 27.3 and between KP 28.4 and KP 31.7.

Table 12.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 64: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.7 to 4.7	Very loose to medium dense slightly silty fine and medium SAND
B	1.6 to 6.5	Medium to very dense slightly silty to very silty fine and medium SAND with occasional shells and shell fragments Locally with a medium to high strength slightly sandy clayey SILT
C	BPD	Very loose to very dense silty fine SAND with Locally with very closely to closely spaced thin laminae of peat Locally with a medium bed of medium to high strength CLAY
D	BPD	Low to high strength silty CLAY

Notes:
BPD = below penetration depth of SBP data

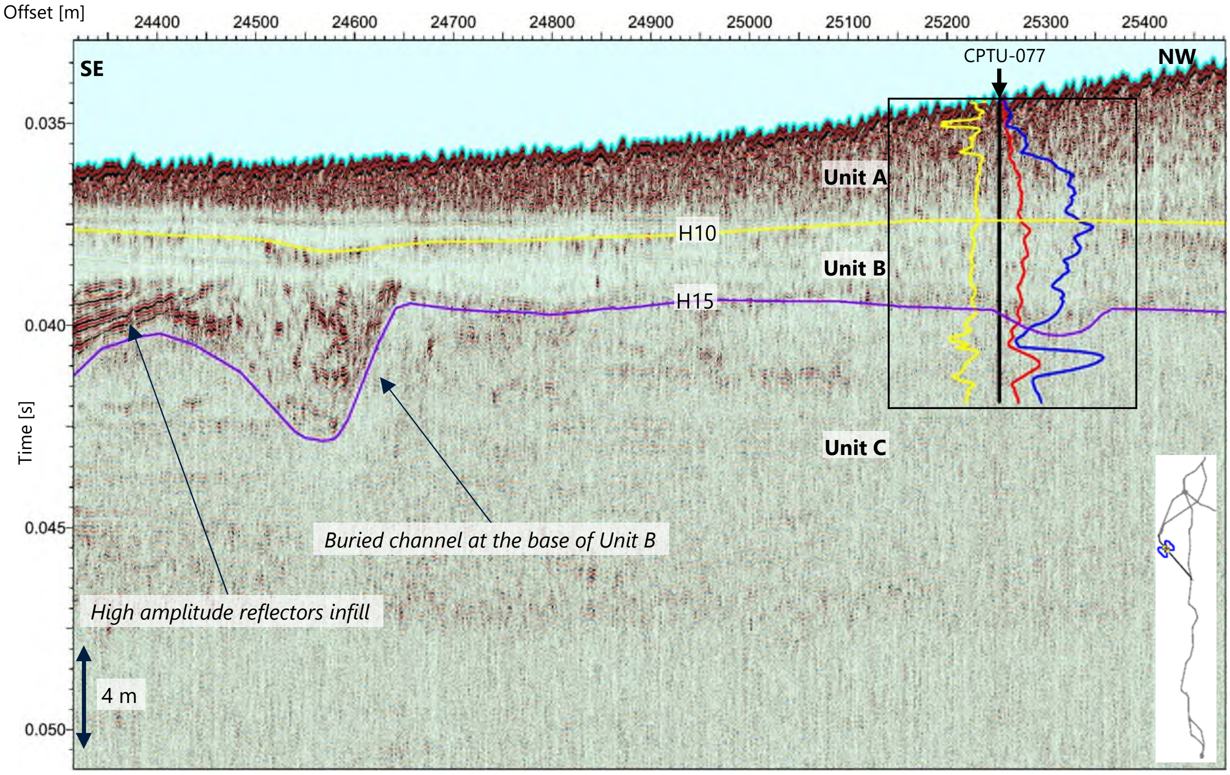


Figure 12.6: SBP data example of route section F. (Line SBP_TA3J2262P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 4 %.

13. Section K14-L4A

13.1 Section K14-L4A Locations

The location of in route Section K14-L4A is shown in Figure 13.1. This section of the route has a length of 62.4 km.

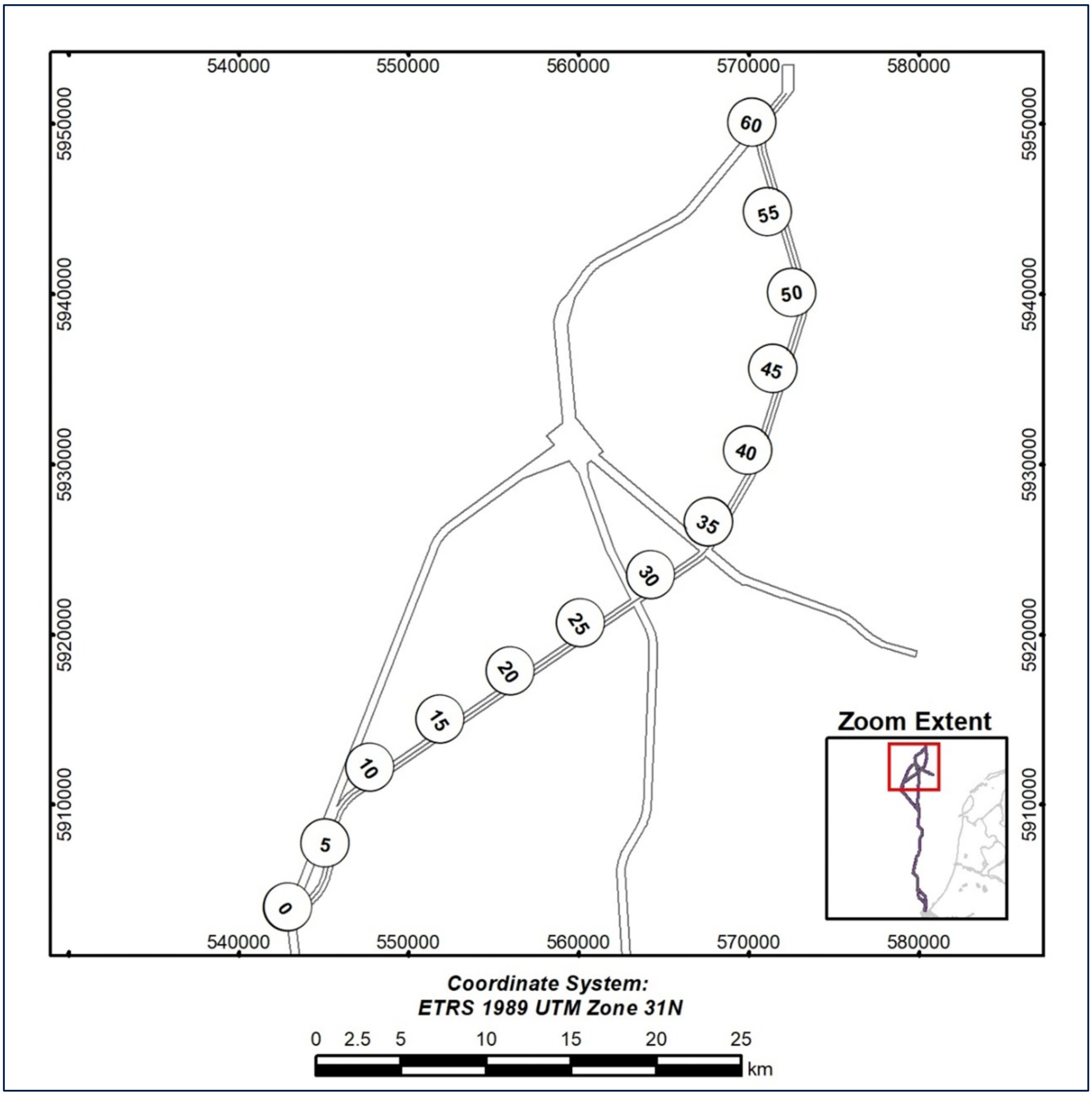


Figure 13.1: Location of the route section K14-L4A.

13.2 Results

13.2.1 Bathymetry

The water depth in route Section K14-L4A ranges between 26.0 m and 39.5 m. An overview of the bathymetry is given in Figure 13.2.

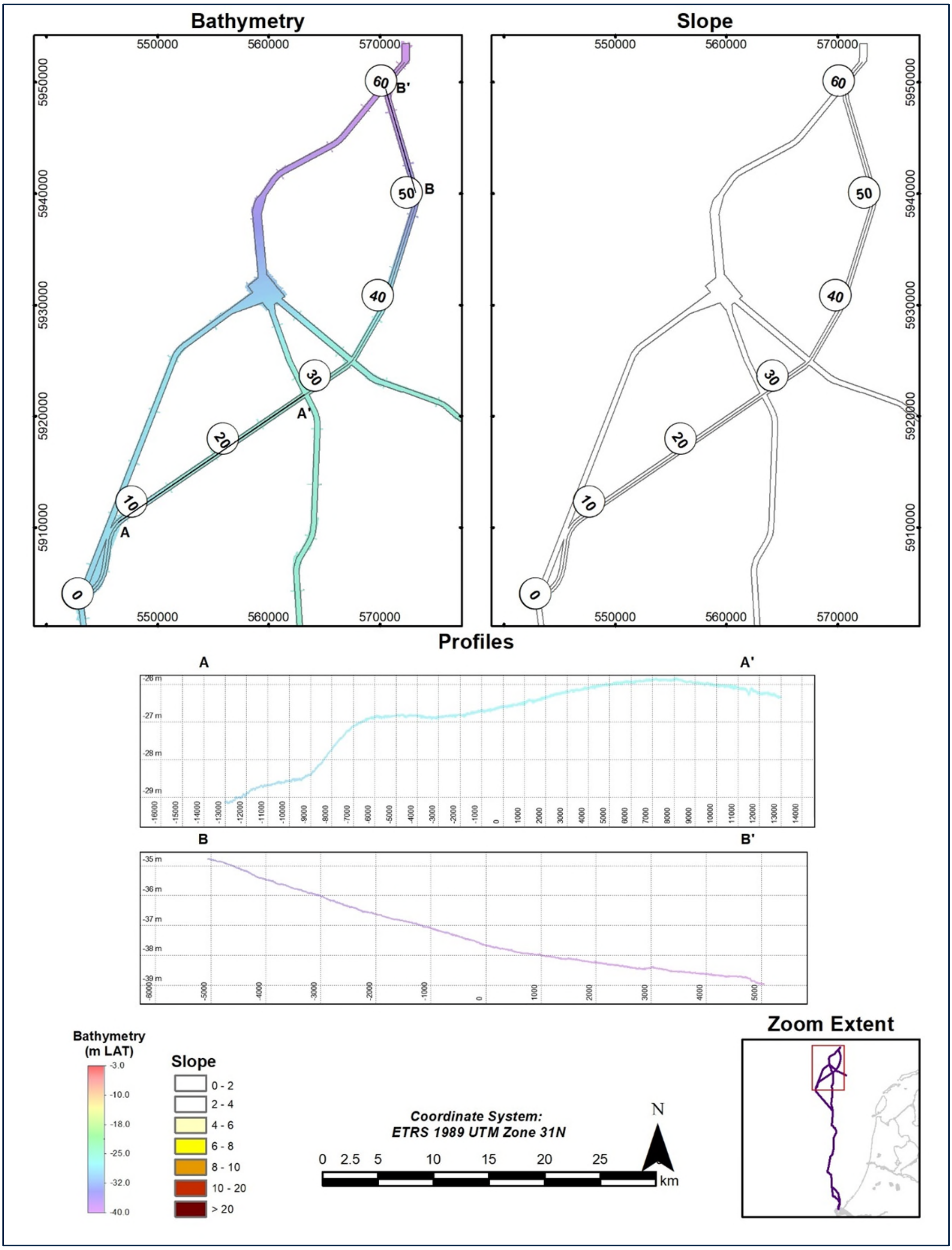


Figure 13.2: Bathymetry along the route section K14-L4A.

13.2.2 Seafloor Morphology

A strong correlation between seafloor sediment types and morphological type was observed, although some small variation is possible. An overview of the encountered sediment and features is given in Table 13.1.

Table 65: Sediment type with associated morphology in route section K14-L4A

Sediment Type	Morphological Type
Gravelly SAND	Patchy coarse sediments
Silty (muddy) SAND	Patchy fine sediments
SAND	Featureless, area with trawl marks

From KP 0.0 to KP 50.0 the route is characterised by sandy sediments with trawl marks. Between KP 50.0 and KP 58.0 there are sandy sediments with occasional patchy (fine and coarse) sediments. Figure 13.3 shows an example of sediments transition in this section of the route.

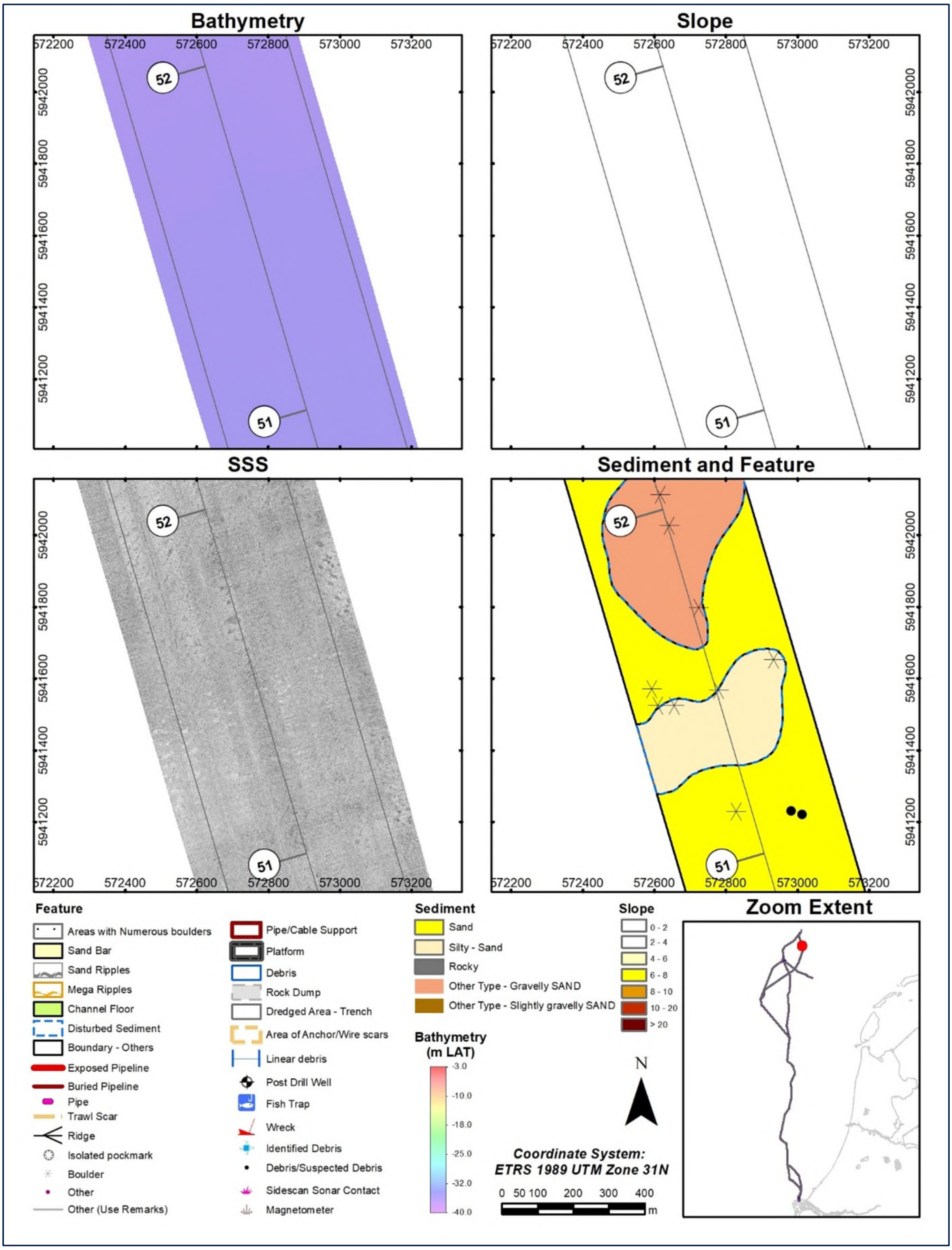


Figure 13.3: Overview of the sediments and morphology in route section K14-L4A: KP 51 to KP 52.

13.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 13.2 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 66: Summary of seafloor contacts in route section K14-L4A

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Boulder	129
	Debris	2
	Seabed mound	56
	Suspected debris	285
	Magnetic anomalies	132
SSS/MBES/MAG Linear Features	Possible debris	1
	Mound Ridge	1
	Unknown linear feature	1
	Buried pipeline	6
	Magnetic linear feature	1

Figure 13.4 shows the interpreted magnetic linear feature at KP 52.6.

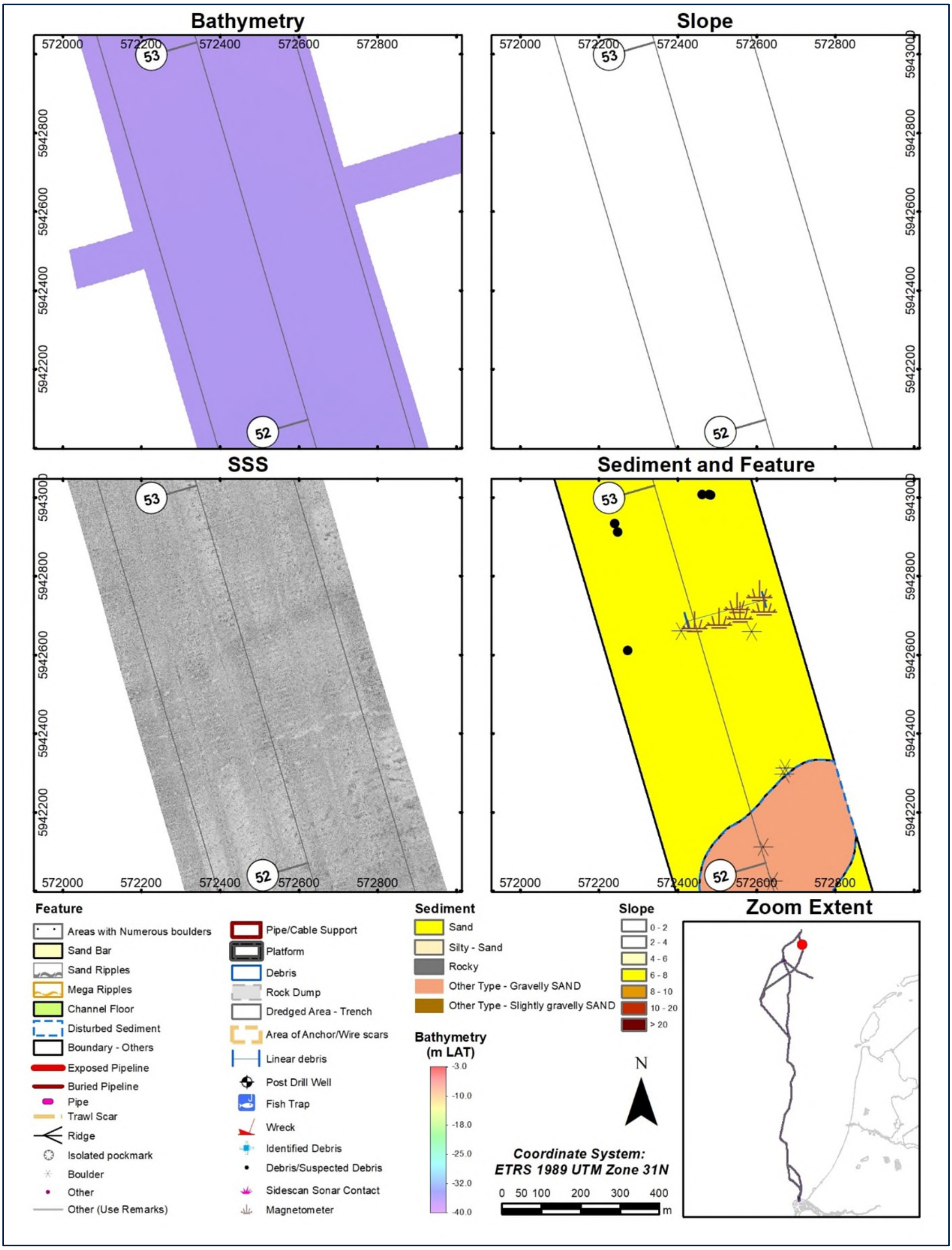


Figure 13.4: Overview of the magnetic linear feature interpreted in route section K14-L4A: KP 52.6.

Six (6) buried pipelines were identified in route Section K14-L4A (Table 13.3, Figure 13.5 and Figure 13.6).

Table 67: Summary of pipelines in route section K14-L4A

Contact ID	Pipeline name	Comment
Pipeline (PL0029_HS)	K12-A to L10-AP 14/2-inch bundle	Buried, KP 29.0
Pipeline (PL0055_HS)	SIDE-TAP KP 12.4 to K12-E 2-inch pipeline	Buried, KP 29.0
Pipeline (PL0142_PR)	D15-FA to L10-AC 36-inch pipeline	Buried, KP 31.7
Pipeline (PL0064_PR)	K9c-A to L10-AR 16-inch pipeline	Buried, KP 36.2
Pipeline (PL0049_PR)	L7-A to L7-P 10.75-inch pipeline	Buried, KP 48.0
Pipeline (PL0050_HS)	L7-A to L7-P 3.5-inch pipeline	Buried, KP 48.1

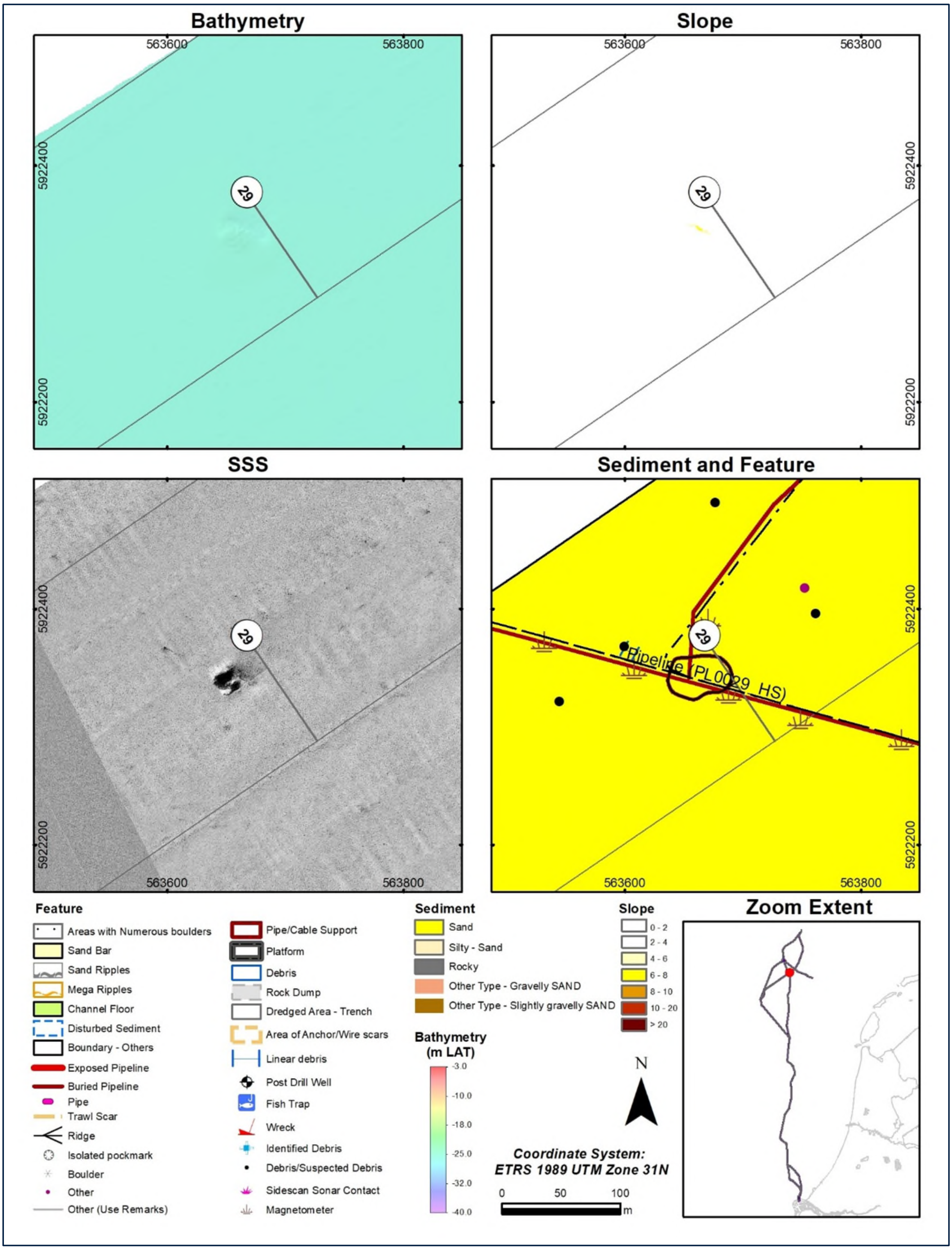


Figure 13.5: Pipelines conjunction encountered in route section K14-L4A: KP 29.0.

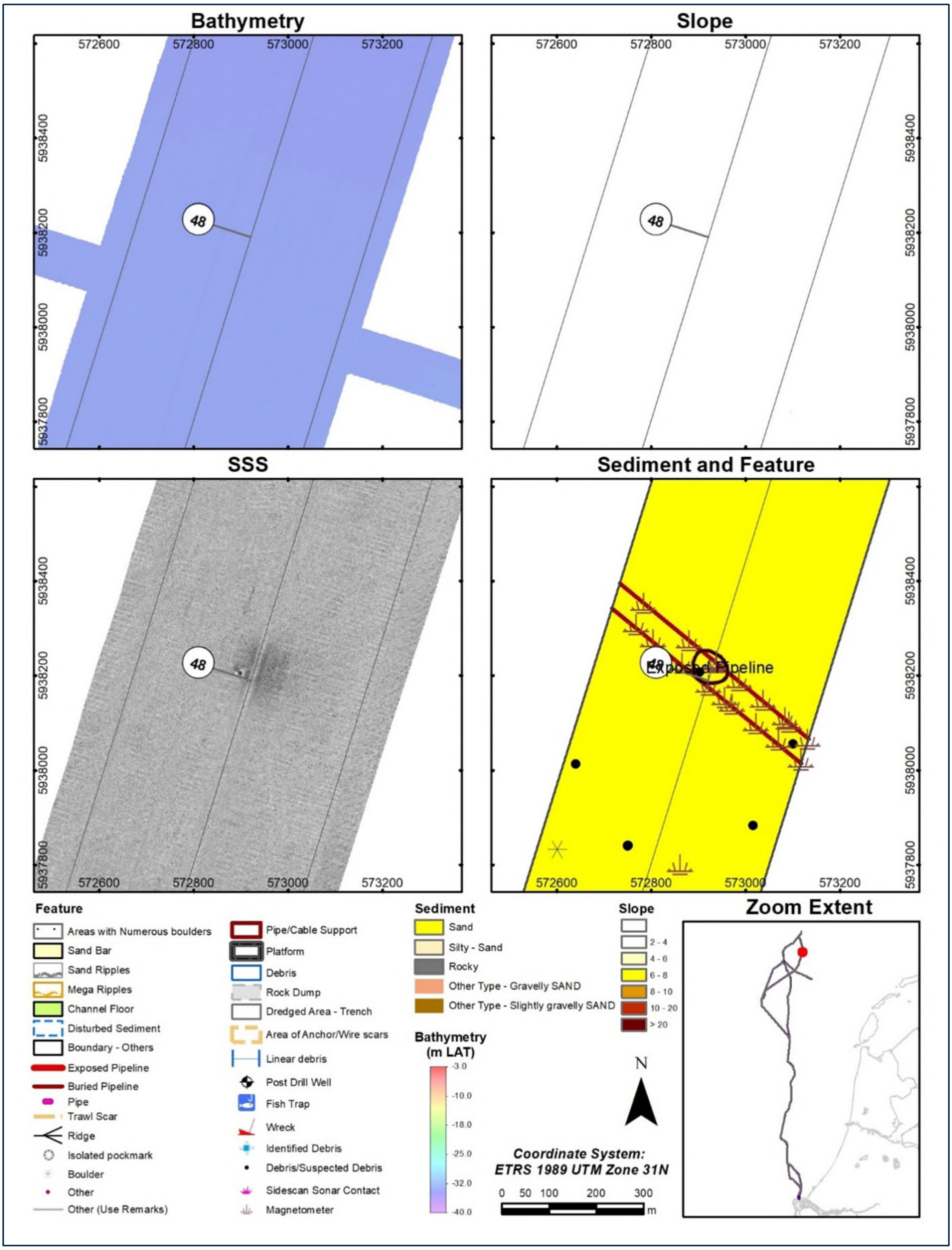


Figure 13.6: Pipelines encountered in route section K14-L4A: KP 48.0.

13.2.4 Magnetometer Contacts

132 magnetic contacts were found at the time of the geophysical scope (single MAG survey) in route Section K14-L4A. The magnetometer anomalies range between 5.1 nT and 2892.0 nT. The highest magnetic amplitudes are associated with the encountered pipelines.

13.2.5 Sub-seafloor Geology

Units A, B, C, D, E and G are present in the route Section K14-L4A (Figure 13.7).

Unit A is present in the entire section, characterized by homogenous acoustically semi-transparent seismic facies. The average thickness is 1.2 m between KP 0.0 and KP 21.0, between KP 21.0 and KP 52.0 it is approximately 2.5 m and further it gradually decreases towards the north.

Unit B is present across the entire section. On the SBP data, the unit is in general characterized by layered seismic facies, with low to high amplitude semi-horizontal to inclined reflectors. Between KP 0.0 and KP 9.0, the unit is relatively thin with chaotic seismic facies. From approximately KP 9.0, internal erosion surfaces are present. The upper part is in general more acoustically transparent with vague reflectors and the lower part with medium to high amplitude reflectors. Between KP 23.0 and KP 32.0, the lower part of the unit is structureless (chaotic) with point reflections. From KP 44.5 the unit exhibits entirely high amplitude parallel reflectors.

Unit C is present between approximately KP 0.0 and KP 38.5. The unit exhibits structureless and semi-transparent internal seismic facies in this section. Between KP 16.0 and KP 22.0, common local high amplitude negative reflectors are observed, pointing to possible pockets or beds of peat. The base is marked mostly by positive amplitude reflector.

Unit D is present in the entire route section and exhibits layered facies with low to high-amplitude parallel reflectors and locally transparent intervals. The base is locally channelised, also negative high amplitude short reflectors were observed at the base pointing to possible peat.

Unit E is absent between KP 0.0 and KP 3.1 and between KP 43.6 and KP 49.2. Unit G is present in the entire route section. Both units show similar chaotic seismic facies.

Unit F (glacial valley infill) is present between KP 28.3 and KP 31.4, between KP 33.9 and KP 35.5, between KP 36.9 and KP 37.8, between KP 43.3 and KP 46.1, between KP 60.4 and KP 62.1.

Table 13.4 provides lithology in the shallow sub-seafloor (within penetration depth of the SBP data), which is based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 68: Soil conditions in shallow sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	0.4 to 2.8	Very loose to loose slightly silty to silty fine and medium SAND with occasional shells and shell fragments Locally very loose clayey fine SAND

Unit	Depth to Base [m BSF]	Lithology
B	1.2 o 10.7	Medium to very dense slightly silty to very silty fine and medium SAND with occasional shells and shell fragments Locally with a thin bed of firm PEAT Locally with a thin to very thick bed of low strength sandy CLAY

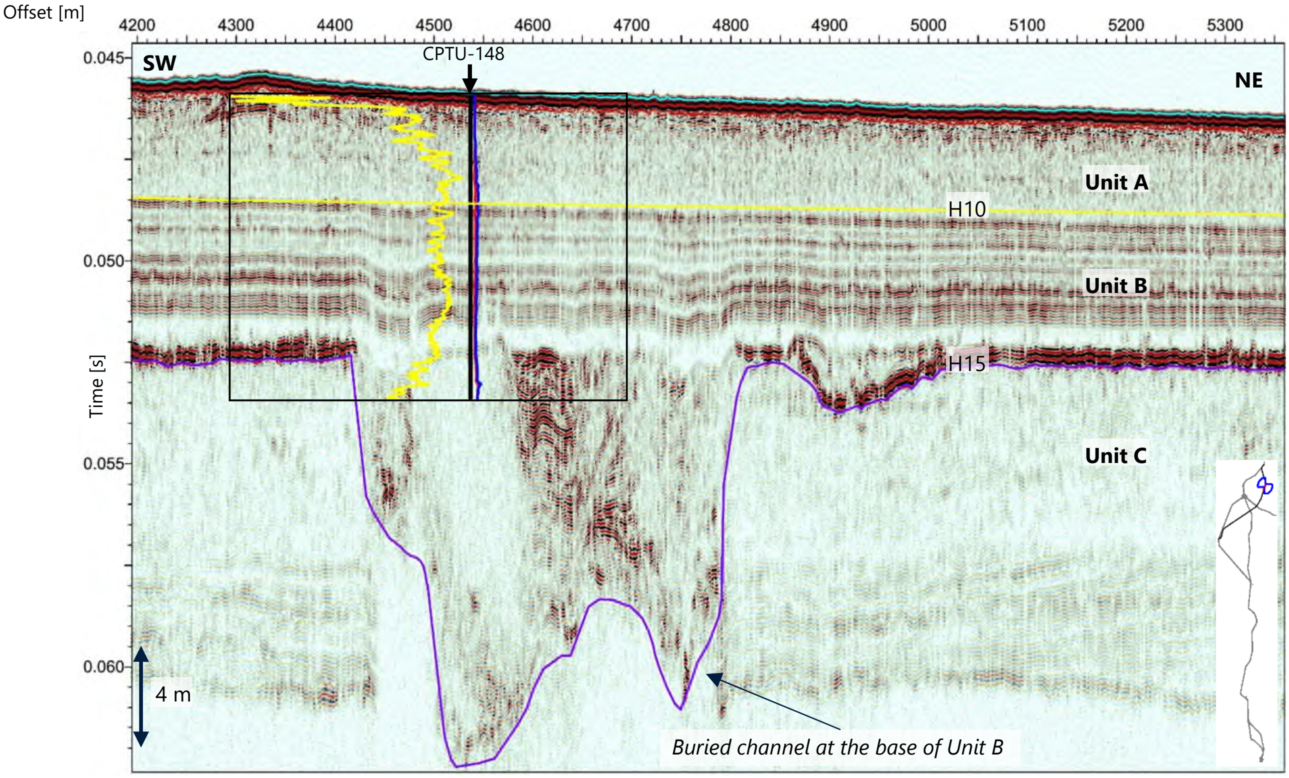


Figure 13.7: SBP data example of route section K14-L4A. (Line SBP_TA3M2320P1_3) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 8 %.

14. Hub Area

14.1 Hub Area Locations

The location of the Hub Area is shown in Figure 14.1.

The Hub Area is approximately 5.3 km^2 in size, situated in the crossing between route Section B, Section C, Section D and Section E Alternative.

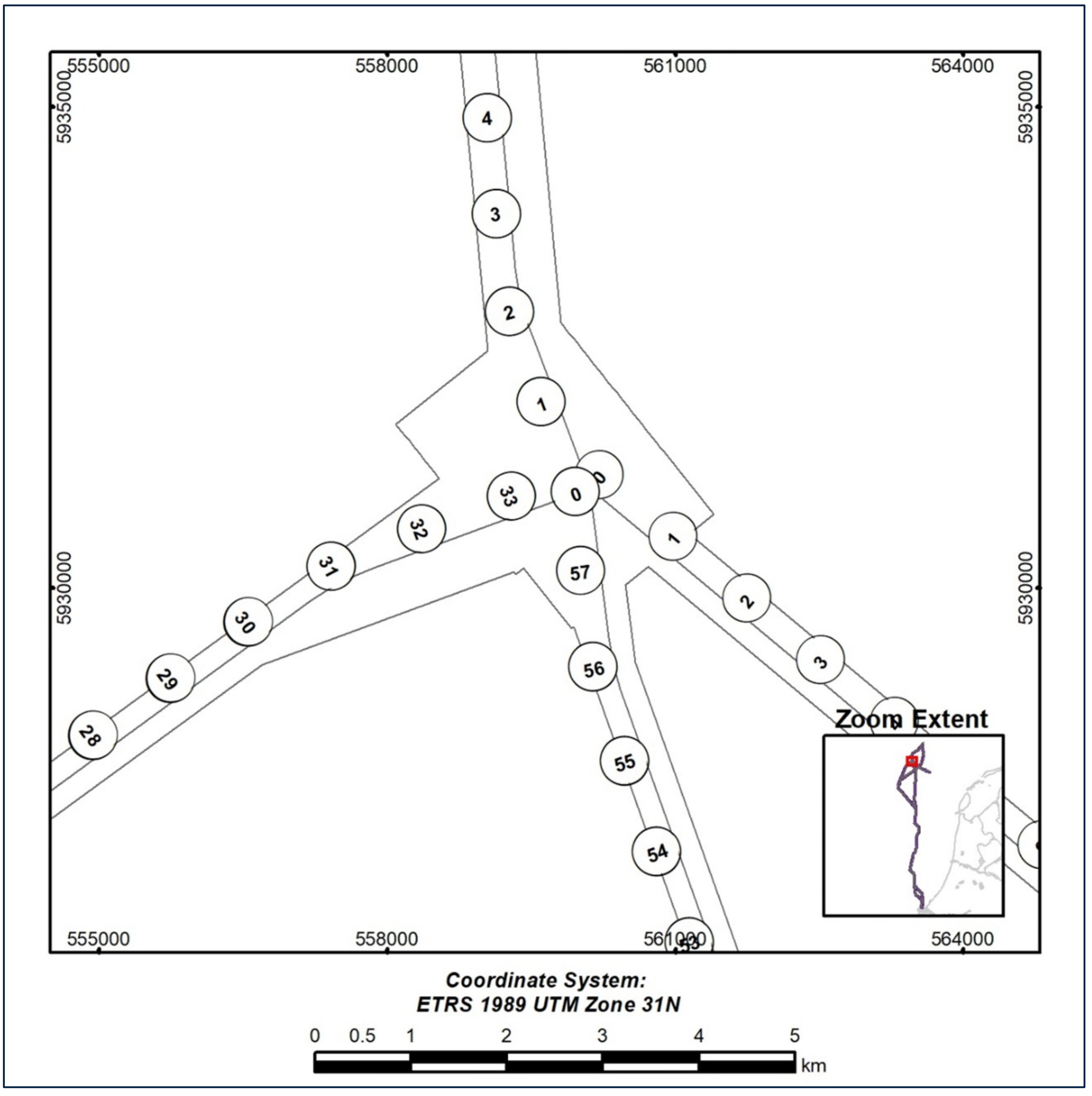


Figure 14.1: Location of the Hub Area.

14.2 Results

14.2.1 Bathymetry

The water depth within Hub Area ranges between 30.0 m and 31.5 m. An overview of the bathymetry is given in Figure 14.2

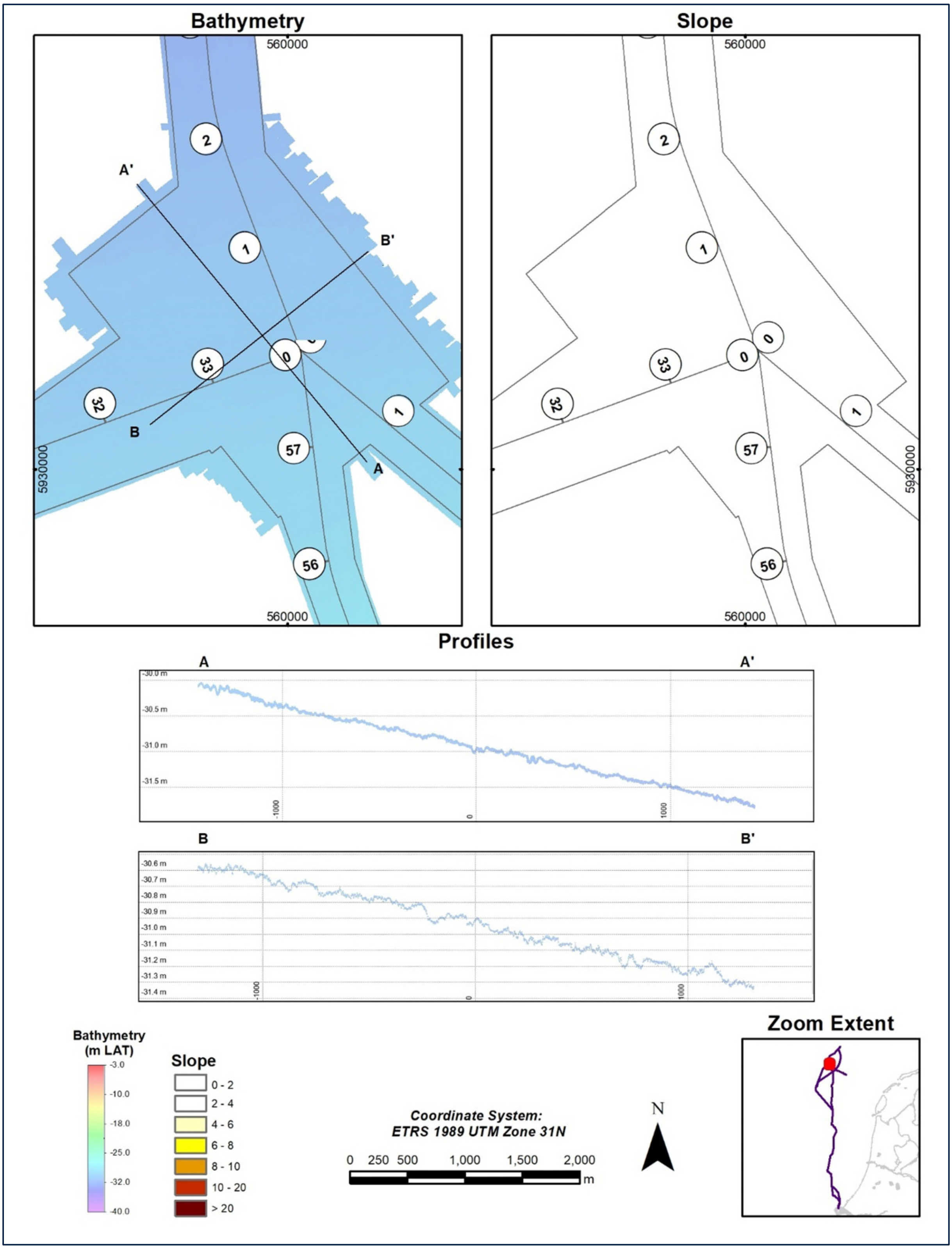


Figure 14.2: Bathymetry in the Hub Area.

14.2.2 Seafloor Morphology

No morphological features were identified in the Hub Area. The main sediment type has been classified as SAND with trawl marks. An overview of the sediment and the morphology in the Hub Area is given in Figure 14.3.

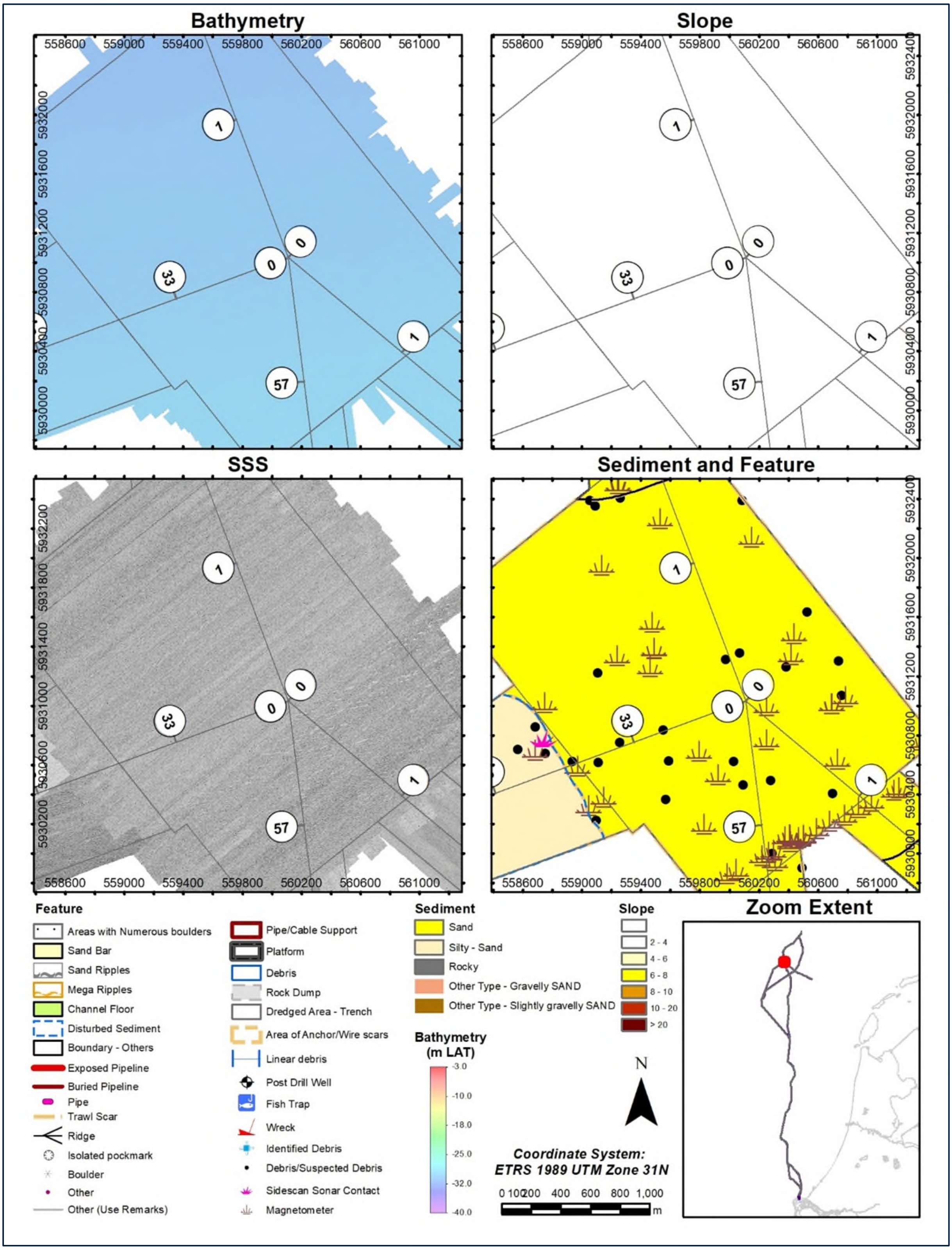


Figure 14.3: Overview of the sediments and morphology in the Hub Area.

14.2.3 Seafloor Features and Contacts

Seafloor features and contacts were identified from one or more of the SSS, MBES, MAG and SBP sensors and cross-correlated where possible.

Table 14.1 summarises the quantities of contacts picked. The survey extent for each sensor varied and contacts were picked within the survey boundary of each sensor and cross-correlated where multiple datasets were available. No targets cross correlate between sensors in this section of the route.

Table 69: Summary of seafloor contacts in the Hub Area

Sensor	Contact Classification	Quantity
SSS/MBES/MAG Point Features	Debris	19
	Suspected debris	3
	Magnetic anomalies	38

No linear features and no pipelines are crossing the Hub Area.

14.2.4 Magnetometer Contacts

In the Hub Area, 38 magnetic contacts were found at the time of the geophysical scope (single MAG survey). The magnetometer anomalies range between 6.0 nT and 591.0 nT. The highest magnetic amplitudes are associated with buried suspected debris (Figure 14.4)

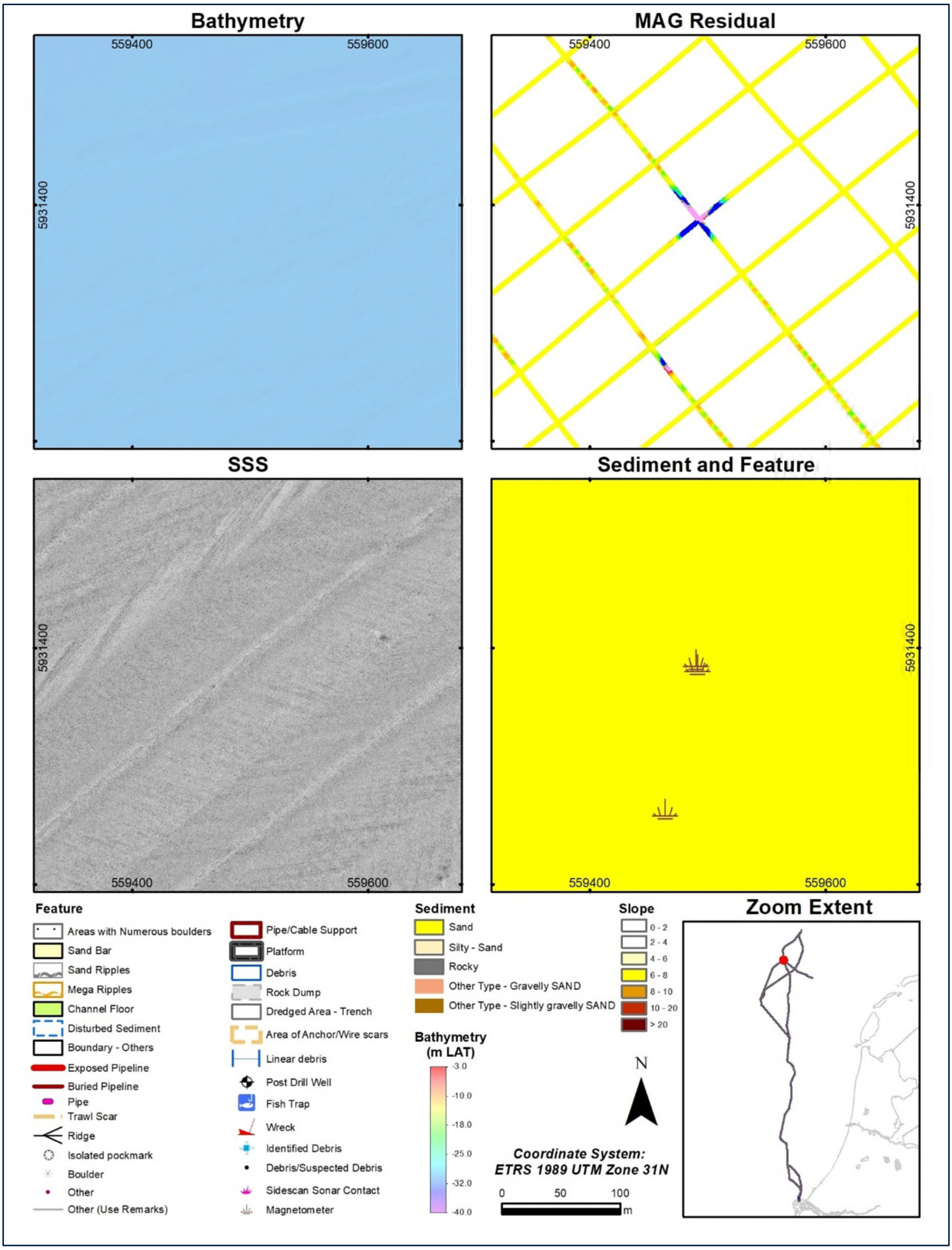


Figure 14.4: Position of the largest MAG contact in the Hub Area (MAG residual scale +/- 5 nT).

14.2.5 Sub-seafloor Stratigraphy

Units A, B, D, E and G are present in the Hub Area (Figure 14.5).

Unit A is present in the entire section. It has transparent seismic character. The average thickness of this unit in this route section is approximately 2.5 m.

Unit B is present across the entire section. This unit has a semi-transparent seismic character with low to medium-amplitude parallel to sub parallel reflectors. The base of this unit is locally channelised. Their infill is structured, with medium to high amplitude reflectors. Locally at the base, high amplitude short reflectors were observed, which represent laminae or thin bed of peat and/or organic-rich clay (peat level 1). The maximum thickness of this unit in this section is approximately 5 m.

Unit D is present in the entire section. Its seismic character is transparent to semi-transparent, with internal erosion surfaces, marked by inclined reflectors. Locally, channels and high negative amplitude anomalies were also interpreted (peat level 2). The maximum thickness of the Unit D in this section is approximately 20 m.

Unit E and G is present in the entire section. Both units show similar chaotic seismic facies.

Table 14.2 provides Lithology for the HUB Area based on the seafloor CPT and VC geotechnical data acquired as part of this geophysical survey. Details of the geotechnical data can be found in report F197217-REP-006.

Table 70: Soil conditions in sub-seafloor

Unit	Depth to Base [m BSF]	Lithology
A	1.5 to 3.3	Very loose clayey fine and medium SAND with occasional shells and shell fragments
B	5.8 to 9.6	Very loose clayey fine and medium SAND with occasional shells and shell fragments Locally with medium bed of very low to low strength sandy CLAY
D	17.3 to 19.0	Dense to very dense SAND
E	27.5 to 31.6	Dense to very dense SAND Locally with medium spaced thin to medium beds of CLAY

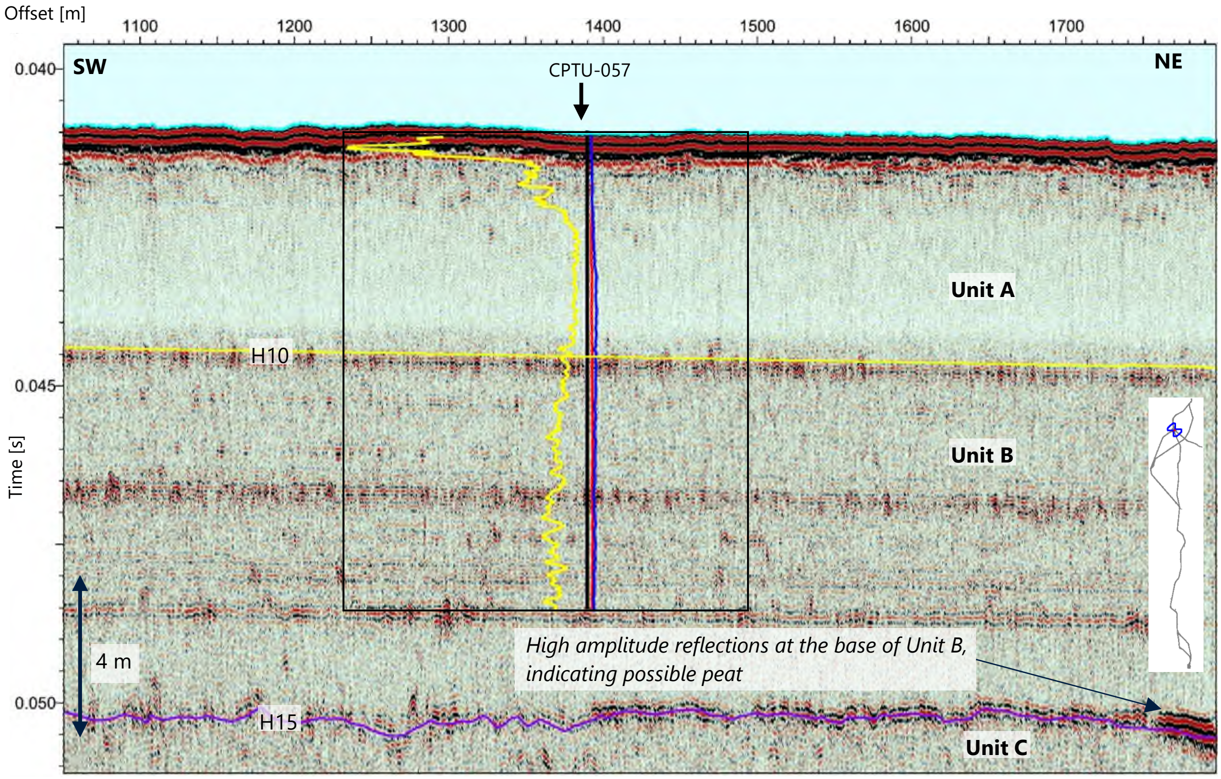


Figure 14.5: SBP data example of the Hub Area. (Line SBP_TA3P2428P1) Width of the CPT boxes show cone resistance values (blue curve) within range of 0 to 25 MPa, sleeve friction values (red curve) from 0 to 0.625 MPa and friction ratio (yellow curve) from 0 to 8 %.

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Appendix A

Guidelines on the Use of the Report

Appendix B

Alignment charts

B.1 Export Route

B.2 Section A-Alt

B.3 Section B

B.4 Section C

B.5 Section D

B.6 Section E Alternative

B.7 Section F

B.8 Section K14-L4A

B.9 Hub Area

Appendix C

2DUHR processing report

Appendix D

Operation Reports

D.1 Field Operations and Preliminary Results report from the Kommandor Orca and the Normand Mermaid

D.2 Field Operations from the Fugro Discovery

D.3 Field Operations from the Fugro Searcher

D.4 Field Operations from the Fugro Seeker

Appendix E

Nearshore Geophysical Survey Report (preliminary results)

Appendix F

Environmental Reports and Tests Results

F.1 Environmental Field Report

F.2 Biodiversity Observation Report

F.3 EBS Report

F.4 eDNA Report

Appendix G

Measured and Derived Geotechnical Parameters and Final Results Report

Appendix H

ISB Interpretation

Nearshore Geophysical Survey Results – Seeker

Nearshore Geophysical Survey Results – Seeker | Netherlands

F197217-REP-RES 02 | 9 November 2022

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Nearshore Geophysical Survey Results – Seeker

Nearshore Geophysical Survey Results – Seeker | Netherlands

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Document Control

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9 November 2022

Dear Sir/Madam,

We have the pleasure of submitting the 'Nearshore Geophysical Survey Results –Seeker' for the Nearshore Work Package for the Aramis Project.

This report presents the results of the surveys conducted on the proposed offshore pipeline corridor, running from the Maasvlakte to offshore blocks L4/K6.

We hope that you find this report to your satisfaction; should you have any queries, please do not hesitate to contact us.

Yours faithfully,

Alexia Darbo

Alexia Darbo
Geophysical Reporting Coordinator

Document Arrangement

R201644 (03) Consultancy Report

F197217-REP-MOB-SK (04) Mobilisation and Calibration Report – Seeker

F197217-REP-SIT-SK (01) SIT Report – Seeker

F197217-REP-RES 02 Processing and Results Report – Seeker

Executive Summary

This report provides information relating to the results and interpretation of data acquired onboard the survey vessel Seeker, within the Nearshore Work Package - Client's Work Package 2 (WP2) - for the TotalEnergies Aramis Project.

Fugro performed an offshore geophysical and geotechnical site investigation of the proposed offshore pipeline corridor, running from the Maasvlakte to offshore blocks L4/K6. The aim of the pipeline was the transportation of captured CO2 from a compressor station at Maasvlakte to offshore gas fields, for injection into the depleted gas fields.

The Aramis nearshore geophysical survey was divided into the following four Work Elements:

- Geophysical (multibeam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP) and single magnetometer (MAG));
- Unexploded ordnance (UXO) (Magnetic Gradiometer);
- 2D ultra high resolution seismic (UHRS);
- Refraction Seismic and multi-channel analysis of surface waves (MASW)

The main findings from the geophysical surveys carried out were:

- Water depths ranged from 1.8 to 32.0 m below Lowest Astronomical Tide (LAT);
- Seafloor substrates were characterised primarily from an assessment of reflectivity from the low frequency SSS and multibeam backscatter (MBBS) data, cross-correlated to the sub-seafloor interpretation;
- A total of three substrate classifications were identified, corresponding to the following;
  - Type 1 – Sand
  - Type 2 – Slightly Gravelly Sand
  - Type 3 – Gravelly Sand
- A total of 1012 side scan sonar contacts were identified within the survey area.
- A total of 863 magnetic targets were identified from the single magnetometer dataset.
- A total of 1644 buried contacts were identified from the SBP dataset.
- One confirmed and one potential wreck were identified within the survey area from both the SSS and MBES datasets;
- Three main geological horizons were interpreted from the SBP dataset, corresponding to the following:
  - Seafloor
  - Top of Naaldwijk
  - Top of Kreftenheye
- A total of four units were identified from the SBP dataset:
  - Disturbed Soils
  - Southern Bight
  - Naaldwijk
  - Kreftenheye

- Acoustic blanking was visible and spatially interpreted from the SBP dataset. The acoustic blanking was prevalent across much of the survey area.

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Abbreviations

AGC	Automatic gain control
CCS	Carbon capture storage
COVID	Coronavirus disease
DTM	Digital terrain model
EGN	Empirical gain normalisation
FMGT	Fledermaus Geocoder Toolbox
GNSS	Global Navigation Satellite System
ISO	International Standards Organisation
ka	Kilo annum
Kts	Knots
LAT	Lowest Astronomical Tide
MASW	Multichannel analysis of surface waves
MBES	Multibeam echosounder
QA	Quality assurance
QC	Quality control
SBP	Sub-bottom profiler
SSS	Side scan sonar
SVP	Sound velocity probe
THU	Total horizontal uncertainty
TVU	Total vertical uncertainty
UHRS	Ultra-high resolution seismic
USBL	Ultra short baseline
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
WGS84	World Geodetic System 1984

1. Introduction

1.1 Survey Aims and Overview

1.1.1 Survey Aims

TotalEnergies contracted Fugro to perform a geophysical site investigation in support of the Carbon Capture and Storage (CCS) Aramis Project. The proposed offshore pipeline corridor runs from the Maasvlakte to offshore blocks L4/K6. This report provides information relating to the operations onboard the survey vessel Seeker, working on the nearshore scope of the project.

The nearshore geophysical survey was divided into the following four Work Elements:

- Geophysical (multibeam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP) and single magnetometer (MAG));
- Unexploded ordnance (UXO) (Magnetic Gradiometer);
- 2D ultra high resolution seismic (UHRS);
- Refraction seismic and multi-channel analysis of surface waves (MASW).

1.1.2 Location

A project location map of the TotalEnergies geophysical site investigation including the proposed pipeline route to the North of Rotterdam is shown in Figure 1.1. The Aramis nearshore geophysical survey area is located in the vicinity of Maasmond channel which is the main access for the Rotterdam Europoort and industrial facilities.

Water depths at the site varied between 0 and 25 meters for the nearshore section. Strong currents and extremely busy shipping conditions were experienced throughout the survey area.

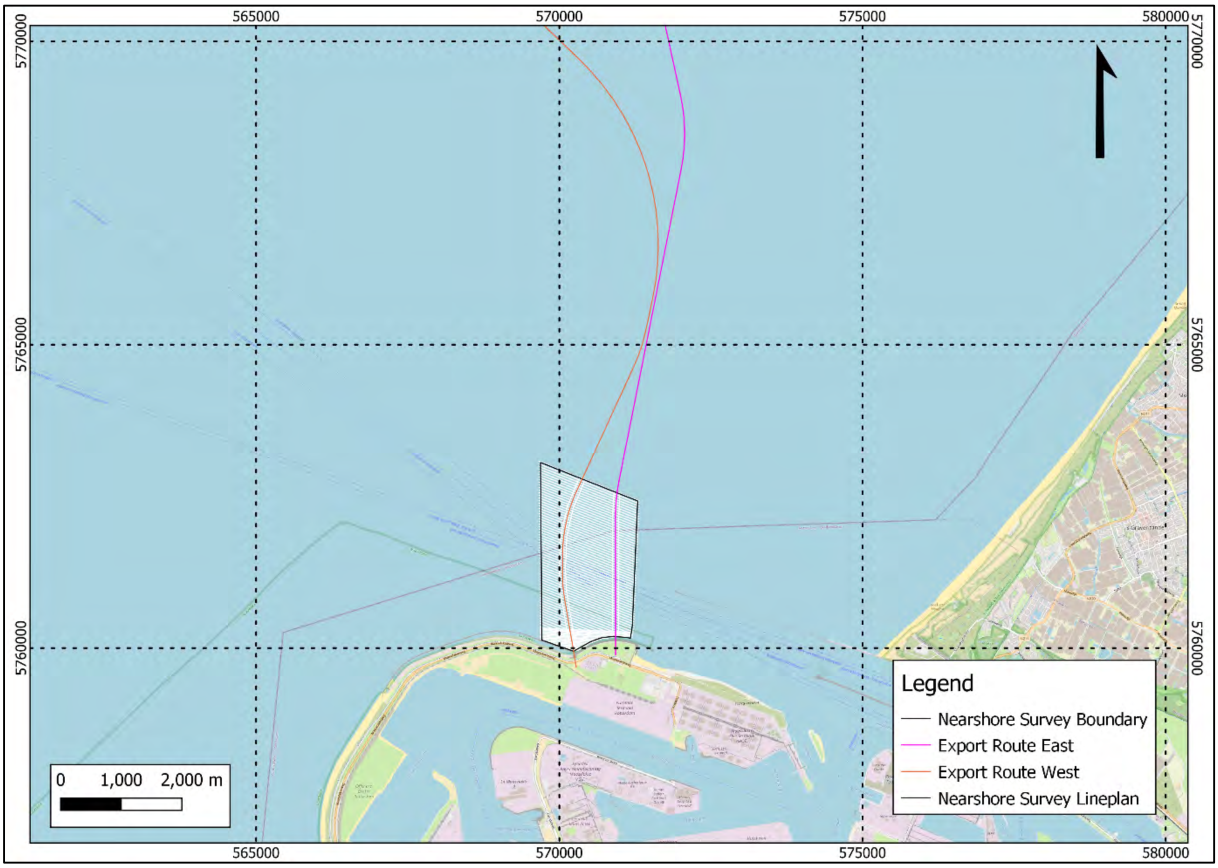

Figure 1.1: Overview of nearshore survey area.

1.1.3 Survey Requirements

Table 1.1: Survey requirements overview

Equipment method	Survey requirements
Vessels	■ Seeker
Proposed Pipeline Survey Line Spacing	■ Line spacing varied between blocks A & B: ■ Block A line spacing was 20 m ■ Block B line spacing was 40 m. ■ Crosslines were set along the two potential cable routes with parallel wing lines offset 50 m either side of the main crosslines.
Survey Priority	■ Where sufficient overlap was not created infill lines were collected;
Target Vessel Speed	■ 4.0 Kts
Surface Positioning	■ Two independent positioning systems with full quality control amenities ■ Positioning accuracy ± 2 m
USBL	■ <10s gaps; ■ Positioning accuracy ± 2 m;
Multibeam Echosounder	■ As per Section 4.4 of the Scope of Work and tender deviations ■ THU < 1.0 m (1.141σ), TVU < 30 cm (1σ) ■ Acquisition of high-resolution swath bathymetry data within the planned survey area. ■ Minimum hit count of 16 soundings per 1 m DTM cell size. 200 m^2 of continuous area with <16 soundings per 1 m bin require infill. ■ 20 % overlap of MBES

Equipment method	Survey requirements
Multibeam Backscatter	■ To be recorded and processed at 0.5 m resolution.
Sidescan Sonar	■ As per section 4.5 of the Scope of Work. ■ Dual operating frequency fish: minimum 300 kHz (low frequency) & minimum 600 kHz (high frequency). ■ 200 % coverage across the site, 100 % in the SSS nadir ■ Target resolution ≥ 0.5 m with high frequency (HF). ■ Mosaic resolution at 0.1 m
Innomar SBP	■ As per section 4.6 of the Scope of Work. ■ System resolution of up to 0.2 m penetration through unconsolidated sediments to a target depth of up to 10 m depending on water depth, geological and environmental conditions. ■ Output > 8 Kw ■ Beamwidth at 3 dBD ± 1º ■ Primary frequency 85 kHz to 115 kHz ■ Low frequency 2 kHz to 222 kHz ■ Soft start required
Magnetometer	■ As per section 4.7 in the Scope of Work ■ Single magnetometer with high sensitivity (0.01 nT) ■ Positioning known to within ± 2 m
SVP	■ Speed of sound in water measured in the survey area at the start of each day (as a minimum) and whenever deemed necessary (i.e. beginning to have MBES refraction artefact); ■ SVP sensor should have an accuracy of ± 0.05 m/s
UHRS	■ As per section 4.9 in the Scope of Work.
Refraction Seismic and MASW	■ As per section 4.10 in the Scope of Work ■ 48 hydrophone streamer plus one spare; ■ Source (air gun) and trigger together with spare parts; ■ PC's in sufficient quantity to cover data acquisition and QC needs; ■ Software sufficient to cover data acquisition and QC/computing needs (refraction software); ■ Relevant Geodetic instrumentation for positioning/grid setting.

1.1.4 Survey Overview

The Seeker conducted a geophysical survey for WP2. The objective of the survey was to identify and delineate any possible constraints and hazards from man-made, natural and geological features which may affect the integrity of the exploration site/development area. The scope of work for Seeker was divided into the five Work Elements shown in Table 1.2.

Table 1.2: Scope of work of Seeker.

Area of Operation	Vessel	No. Lines	Line km	Scope Requirements
Nearshore area – Work Element 1	Seeker	N/A	N/A	
Nearshore area – Work Element 2	Seeker	91	141.4	MBES, SSS, SBP and MAG collected on all survey lines.

Area of Operation	Vessel	No. Lines	Line km	Scope Requirements
Nearshore area – Work Element 3	Seeker	225	58.1	UXO - Miniwing
Nearshore area – Work Element 4	Seeker	41	71.9	2D UHRS
Nearshore area – Work Element 5	Seeker	32	31.7	Refraction Seismic and MASW

Initial Quality Assurance (QA) and processing of data acquired by all sensors was carried out onboard the vessel. Multibeam backscatter (MBBS), multibeam echosounder (MBES), side scan sonar (SSS) and sub-bottom profiler (SBP) data were sent to the Fugro office in Portchester, UK for full quality control (QC), final processing, and interpretation. UHRS data were sent to the Geo Surveys office for full QC, final processing, and interpretation. Refraction Seismic and MASW data were sent to the Fugro France officer for full QC, final processing, and interpretations.

The survey comprised a total of 303.1 line kilometres.

1.2 Geodetic Parameters

The project geodetic and projection parameters are summarised in Table 1.3. The test coordinate is provided in Table 1.4.

Table 1.3: Geodetic parameters

Global Navigation Satellite System (GNSS) Geodetic Parameters (Note 1)		
Datum:	International Terrestrial Reference Frame 2014	EPSG: 1165
Spheroid:	GRS 1980	
Semi major axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257222101	
ETRS89 Geodetic Parameters		
Datum:	ETRS89	EPSG: 6258
Spheroid:	GRS 1980	
Semi major axis:	a = 6 378 137.00 m	
Inverse Flattening:	1/f = 298.257 222 101	
Datum Transformation Parameters from ITRF2014 to ETRS89 (Note 2, Note 3)		
X-axis translation 0.05595 m	X-axis rotation –0.0027132″	Scale difference 0.003495455 ppm
Y-axis translation 0.05345 m	Y-axis rotation –0.016413″	
Z-axis translation –0.09784 m	Z-axis rotation 0.0265287″	
Project Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 31N	EPSG: 16031
Latitude origin:	00° 00′ 00.000″ N	
Central meridian:	003° 00′ 00.000″ E	

Scale factor on central meridian:	0.9996
False easting:	500 000 m
False northing:	0 m
Notes: 1) Fugro Starfix navigation software uses ITRF14 geodetic parameters as a primary datum; 2) The seven datum transformation parameters are calculated at epoch 2022.496 (01/07/2022). These are generated from reference epoch 2000.0 using the 14 parameter transformation version ETRF2000-ITRF2014 as defined by Zuheir Altamimi, Key results of ITRF2014 and implication to ETRS89 realisation. EUREF2016 Symposium; 3) The rotation parameters use Coordinate Frame rotation convention as defined by UKOOA.	
Vertical Datum	
Vertical coordinate reference system	ETRS89 to LAT height using NLLAT2018

Table 1.4: Test point

ITRF2014	Test Point Position
Latitude	53° 32′ 37.50000″ N
Longitude	004° 16′ 30.00000″ E
Ellipsoidal height	0.000 m Ell.
ETRS89	
Latitude	53° 32′ 37.48043″ N
Longitude	004° 16′ 29.97086″ E
Ellipsoidal height	-0.023 m Ell.
UTM zone 31N	
Easting	584 484.290 m
Northing	5 933 516.515 m
Chart Datum Height	-40.248

1.3 Vertical Datum

All vertical data for the survey were reduced to Lowest Astronomical Tide (LAT).

2. Mobilisation and Operations

2.1 Mobilisations – Seeker

Initial vessel mobilisation and calibrations were undertaken between 3 and 12 July 2022 in the port of Scheveningen, The Netherlands and offshore near the survey site. Subsequent mobilisation and demobilisation for mode changes was conducted as per paragraph 2.2 below.

All equipment was subject to rigorous testing, and verifications and calibration (where necessary) in following with Fugro procedures. The verification and calibration procedures were conducted in order to demonstrate effective functionality of equipment and satisfy the requirements of TotalEnergies and the survey specification.

Details of this are outlined in the Fugro Seeker Mobilisation and Calibration report (Fugro Document No. F197217-REP-MOB-SK(04) provided in Appendix B.

2.2 Summary of Events

Geophysical operations on the Nearshore Geophysical Survey Results –Seeker commenced on 12 July 2022. Survey operations were run on a 12 hour operational basis with daily data uploads for onshore data processing.

A summary of key events has been provided in Table 2.1. A break-down of operational time (days) for Fugro Seeker is provided in Figure 2.1: Fugro Seeker Project Break-Down. This break-down does not include 12 hours of port call per day.

Table 2.1: Summary of Key Events

Event	Dates
Mobilisation of Fugro Seeker (Scheveningen, The Netherlands)	3-12 July 2022
Alongside calibrations conducted	3-9 July 2022
Offshore calibrations conducted	9-12 June 2022
Geophysical survey operations commence	12 July 2022
Geophysical survey operations complete	30 July 2022
Demobilisation of SSS and magnetometer	1 August 2022
Mobilisation of UXO (Miniwing gradiometer)	2-4 August 2022
UXO survey operations commence	5 August 2022
UXO survey operations complete	3 September 2022
Demobilisation of UXO equipment	4 September 2022
Mobilisation and calibration of 2D UHRS equipment	4 – 6 September 2022
2D UHRS survey operations commence	7 September 2022
2D UHRS survey operations complete	22 September 2022
Demobilisation of 2D URHS equipment	23 – 24 September 2022

Event	Dates
Mobilisation of refraction seismic / MASW equipment	24 – 29 September 2022
Refraction seismic survey commence	29 September 2022
Refraction seismic survey complete	14 October 2022
Demobilisation of refraction seismic equipment	14 – 15 October 2022

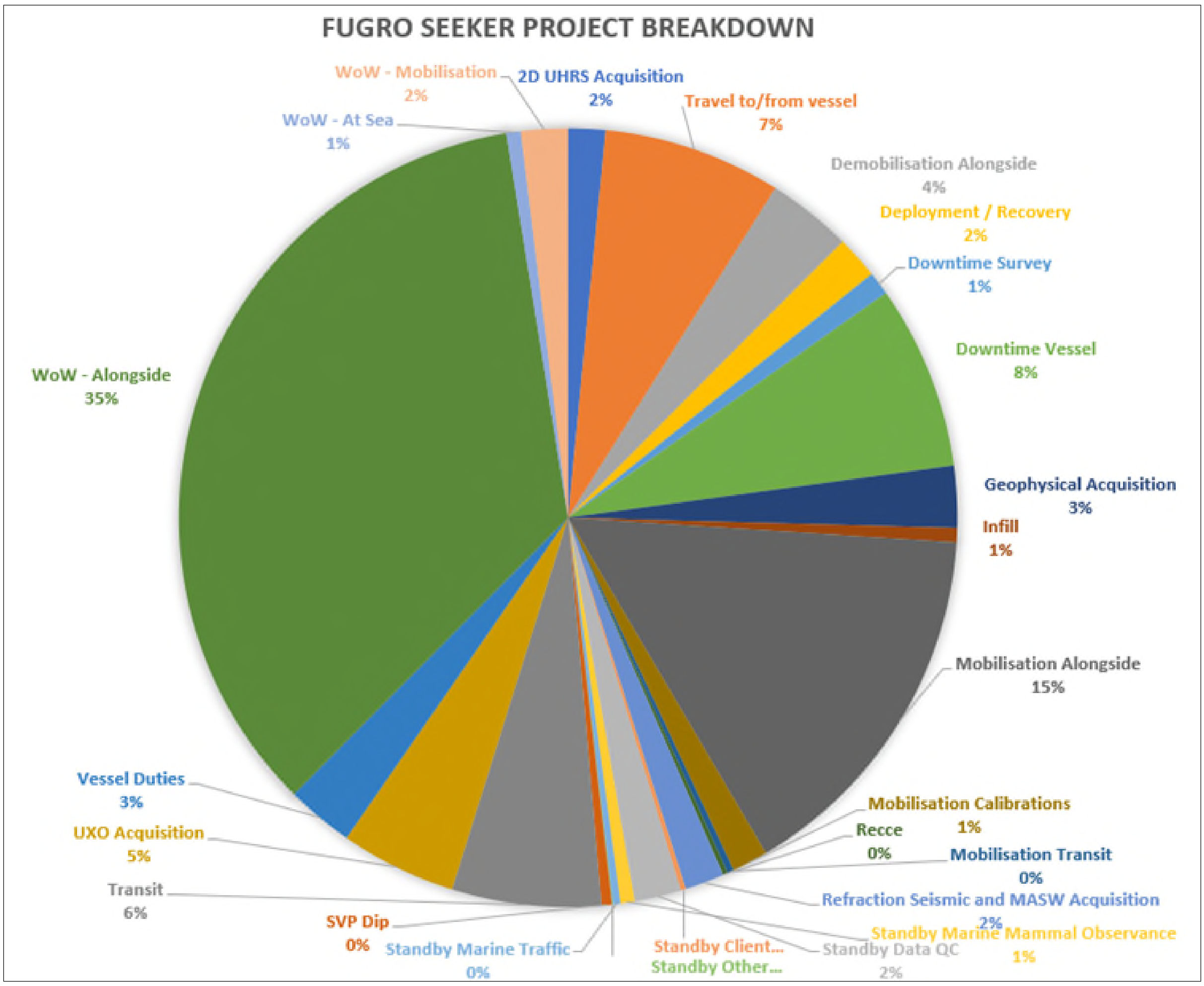

Figure 2.1: Fugro Seeker Project Break-Down

2.2.1 Key Personnel

The key survey, management and processing personnel involved in the surveys onboard Fugro Seeker are outlined in Table 2.2.

Table 2.2: Key Personnel

Position	Name	Dates on Project
Package Manager	Helen Abbey	3 July 2022 - Present
Party Chief	Ryan Taylor Roger Pewsey Reuben Mace Peter Horobin	3 – 26 July 2022 27 July – 18 August 2022 19 August – 16 September 2022 17 September 2022 – 15 October 2022
Surveyor/Engineer	Peter Ridley	3 – 26 July 2022

Position	Name	Dates on Project
	Gareth Davies Alexander Eckl	26 July 2022 – 23 August 2022 24 August – 6 September 2022
Project Geophysicist	Matthew Wetton	3 July 2022 – 30 October 2022
Project Hydrographer	David Baker	3 July 2022 - 30 October 2022
Geophysicist	Rebecca Walker	3 July 2022 – 30 October 2022
	Cameron Berry	3 July 2022 - 30 October 2022
	Jaimun Nayee	1 August 2022 - 30 October 2022
OCR	Roger Deutz Martin Pendleton Lindsay Millington	3 – 13 July 2022 15 July 2022 – 6 August 2022 7 August 2022 – 15 October 2022
UHRS Processor	Gil Moreira	4 – 22 September 2022
UHRS Operator	Robert-Jan Joosten	4 – 22 September 2022
Geophysicist	Jhonny Miranda	22 September – 3 November 2022
Senior Geophysicist	Thomas Chauveau	14 October 2022 – 4 November 2022
GAMBAS Operator	Clément Hassini	24 September 2022 – 14 October 2022
	Romain Kermarrec	24 September 2022 – 14 October 2022

2.2.2 Vessel Details

The Fugro Seeker (Figure 1.1) is a purpose-built hydrographic and geophysical survey vessel, commissioned, owned, maintained, and operated by Fugro. The vessel has been fully mobilised in accordance with Fugro standard procedures. The vessel is equipped for 12-hour operations up to 60 nm from haven and is operated under MCA workboat category 2.

Figure 2.2: Fugro Seeker

The operational capabilities for Fugro Seeker are in Table 2.3 below.

Table 2.3: Fugro Seeker Operating Capabilities

Vessel	Fugro Seeker
Length	12.0 m
Beam	4.88 m
Gross Tonnage	17 ton
Draught	1.20 m
Endurance	12 hours
Survey speed	4 knots
Transit speed	15/18 knots

2.3 Acquisition

The survey strategy for each Work Element is outlined below.

2.3.1 Analogue Geophysical Scope

For the geophysical scope the survey scope was broken into to line plans comprising of 20 m spaced lines in Block A and 40 m spaced lines within Block B. The survey lines were orientated in the direction of the shipping channel. This was to ensure that coverage meets project specifications whilst minimising the impact of currents and the risk of infill. Survey data and subsequent infills were acquired where required

2.3.2 UXO Scope

For the UXO scope, the survey was divided into two blocks centred on the three areas of geotechnical investigation. A line plan comprised of 3 m spaced lines for both blocks. The survey lines were oriented parallel to the lines of the geophysical scope. This was to ensure that coverage met project specifications whilst minimising the risk of infill. Survey data and subsequent infills were acquired where necessary.

2.3.3 UHRS Scope

Survey strategy for the UHRS scope is included in Appendix D.

2.3.4 Refraction Seismic and MASW Scope

For the Refraction Seismic and GAMBAS scope, the line plan consisted of 39 lines in two parts. Within the shallow parts of the site, to the north and south of the channel, a 150m refraction and MASW stream was used. Within the deeper area of the channel, a 90m MASW streamer was used. The lines in the main channel, and some lines to the South, were parallel to the channel. The lines to the North of the channel were oriented North – South.

During acquisition, the Client requested Seeker concentrated on a set of priority lines due to the prospect of unworkable weather impacting progress. This reduced the number of remaining lines by half and involved acquiring every second line. Following the completion of priority lines, a further two non-priority lines were acquired whilst awaiting Client confirmation to cease acquisition. A total of 32 lines covering 31.7km were acquired.

2.4 Infill Requirements

Survey data were reviewed and infills and re-runs acquired for areas where data quality or coverage was outside of the required specification as described in the document *Geophysical Survey Requirements*.

2.4.1 Analogue Geophysical Scope

During the geophysics scope re-runs were acquired for the following specific reasons:

- Magnetometer
  - Gaps in coverage assessed by the processing geophysicist due to USBL positioning dropouts greater than 10 seconds;
  - Data spikes masking the true signal.
- Sub-bottom Profiler
  - A missing section of data at the start of a line;
  - Aeration within the water column from the wake of a passing ship;
- Sidescan Sonar
  - Gaps in coverage assessed by the processing geophysicist due to USBL positioning dropouts greater than 10 seconds;
  - Insufficient data quality to interpret possible contacts and seabed features caused by a confused sea state in Maas entrance due to a combination of factors including marginal weather, marine and river currents, and passing ship wash.
- Multibeam Echosounder
  - Aeration over the sensor due to large vessel wakes and marginal weather conditions;
  - Low data density in an area of steep bathymetry.

2.4.2 UXO Scope

During the UXO scope re-runs were acquired for the following specific reasons:

- UXO Miniwing
  - Periods of strong tidal and fluvial currents;
    - Drops in signal strength below the specification and subsequent degradation of the quality and reliability of the total field.
    - Gaps in coverage due to the Miniwing being off-line.
  - Escarpment in the south of the easternmost UXO survey area;
    - Altitude above the upper limit of the specification when crossing the steep inclines of the escarpment bounding a submarine channel.

2.4.3 UHRS Scope

During the UHRS scope re-runs were acquired for the following specific reasons:

- Effects of passing vessel traffic:
  - Excessive movement of vessel and UHRS equipment from wash from passing large and/or fast vessels reducing quality of data to unacceptable levels.

  - Vessel had to abandon lines due to shipping situations and risk of collision in the channel.
- Software crash:
  - Starfix crashes causing no data to be acquired until it had been properly restarted.
  - GeoMarine Acquisition software did not trigger pulse when recording started so no UHRS data acquired on survey line until started.
- Line not acquired:

Line TA902P1 was not acquired as outlined in Nearshore Concession included in Appendix D.

2.4.4 Refraction Seismic and MASW

During the Refraction Seismic and MASW scope, no re-runs were required. The shallow water lines were acquired first, with the 150m streamer. The vessel then mobilized the 90m streamer for acquisition in the deeper channel area.

- Four priority lines were acquired in the channel; online data QC showed that velocities recorded in the channel were significantly different to velocities recorded in shallow areas of the site. The line TA2BR36P1 was rerun with the 90m streamer. The purpose of the comparison was to provide confidence that the velocity differences were a result of external factors, such as geological site conditions, and not the result of the streamer change. Online data QC showed that the results from the 90m streamer were consistent with results from the 150m streamer; the vessel then continued with acquisition of priority lines in the channel.

3. Processing

The methodology used for data processing is outlined for each sensor in Table 3.1 - Table 3.6 below.

3.1 Multibeam Echosounder

Table 3.1: Multibeam echosounder

Multibeam Echosounder	
Requirement	■ 0.25 m grid resolution ■ Minimum density 16 valid pings per 1 m^2 ■ Simultaneous recording of backscatter
Equipment	■ Two hull mounted Teledyne RESON 7125 multibeam echosounders with full rate dual head functionality.
Data Collection	■ Multibeam data were collected in accordance with Fugro's standard work instructions, a component of Fugro's quality management system, which complies with the requirements of ISO 9001:2015, ensuring that data is collected in accordance with the scope of work and Fugro's work instructions WI351,352,356,362,110-402. ■ On Seeker a dual-head Teledyne RESON 7125 multibeam echosounder system was pre-mobilised and consists of two transmit and receive arrays, one mounted on each hull. ■ A Valeport Mini SVP was deployed by hand to measure the sound velocity of the water column, prior to the start of survey operations and at least once during each 6 to12 hour period. ■ A RESON SVP-70 was mounted near the transmit array to determine the speed of sound at the transducer face and account for ray bending at the acoustic source. Continuous speed of sound measurements was provided by the SVS to the multibeam system. ■ A real-time comparison was set up between the SVS and SVP readings as an indication of MBES refraction errors. If the comparison was greater than 2 m/s, the online surveyor assessed the raw data for refraction artefact. If an unresolvable refraction error existed, another SVP cast was taken and input to Starfix NG. ■ Fugro used best industry practice to achieve the required 16 hits per 1 m bin requirement in the first instance by operating the multibeam echosounder at full rate dual head mode. During survey operations multibeam settings were constantly monitored to ensure optimal performance. Swath angle and vessel speed was monitored and reduced in deeper waters to focus the same number of receive beams over a smaller seabed area to ensure hit count was maintained. The effect of reducing swath width was reduced seabed coverage and therefore reduced line spacing. ■ Prior to commencement of the survey a verification was undertaken for the following variables: i) latency, ii) pitch, iii) roll, iv) yaw. The verification data were processed before the start of the survey as described in Fugro's work instruction WI-207 and WI-229. At intervals throughout the survey this was repeated to ensure there has been no change to the calibration parameters. Calibrations were described in a mobilisation report. ■ During vessel calibrations, a comparison of all SVP's was carried out with a simultaneous cast in a water depth similar to that expected during the survey. ■ Survey data were collected to the required survey specification and monitored using Starfix.NG online sounding grid and Caris HIPS&SIPS offline sounding grid QC statistics.
Processing	■ The data were processed according to Fugro's standard procedures. • CARIS HIPS files were corrected for any sound velocity refraction errors.

Multibeam Echosounder	
	• When required, data point cleaning was conducted in CARIS using the CUBE algorithm, which used site specific parameters to ensure no valid data were removed (noise was flagged only and remained within the raw data set). ■ The CUBE algorithm search radius did not exceed the specified bin size. Data were finally quality controlled again to ensure compliance to the specification.
Data Outputs	■ Gridded soundings at 0.25 m (.XYZ ASCII / .tif); ■ Gridded hill shaded map (.tif) ■ Gridded THU at 1 m (XYTHU ASCII) ■ Gridded TVU at 1 m (XYTVU ASCII) ■ Gridded Slope at 1 m (XYS ASCII) ■ Vessel tracks (.shp)

3.2 Backscatter

Table 3.2: Backscatter methodology.

Item	Description
Equipment	As per the Multibeam
Data Collection	A dual-head Teledyne RESON SeaBat 7125 SV2 FP3 multibeam echo sounder system was pre-mobilised and mounted onto the hull of the vessel. To minimise intensity variations of the backscatter mosaic, power and gain changes were kept to a minimum during the survey. Any setting changes were done during line turns if possible. Survey data were collected to the required survey specification.
Processing and Interpretation	Following acquisition, data were returned to Fugro's Portchester office and copied to a dedicated project network with replication between the Portchester office and an on-site location. Backscatter data contained in the files were imported to the Fledermaus Geocoder toolbox (FMGT) in order to generate a georeferenced mosaic at suitable resolution. The software package was processed by taking the backscatter intensity of each survey line and applying corrections in an attempt to normalise the backscatter intensities. Corrections applied allowed for the differing intensity due to beam angle gain power, beam pattern and radiometric correction due to signal attenuation. Once the corrections were applied the final mosaicked intensity values represented the actual reflectivity of the seafloor. Manual normalisation was carried out where necessary, within FMGT to apply a brightness bias to individual survey lines to further improve the mosaic.
Data Outputs	Multibeam backscatter data grid at 0.5 m resolution (.XYA ASCII / .tif)

3.3 Subsea Positioning

Table 3.3: Subsea positioning.

Subsea Positioning	
Requirement	■ Provide positioning information to towed seabed sensors; ■ Update rate of 0.5 Hz or better (preferred is 1 Hz); ■ Consistent dropouts of duration > 5 seconds not accepted; ■ Following calibration of the USBL system, 95% (2 sigma) of beacon positions within ± 1 m.
Equipment	■ Sonardyne Mini Ranger 2 USBL system ■ Sonardyne WSM6+ transponders.

<table>
<tr><th colspan="2">Subsea Positioning</th></tr>
<tr><td>Data Collection</td><td>

- Underwater positioning data were collected in accordance with Fugro's quality management system, which complies with the requirements of ISO 9001:2015 with specific reference to work instruction WI-212;
- The USBL transceiver was pole mounted. The USBL system received the following data corrected for the USBL transceiver location from the Fugro Starfix.NG navigation system:
  - Position (from Fugro StarPack GNSS);
  - Heading (from Applanix POSMV);
  - Motion (from Applanix POSMV).
- Additionally, SVP cast information was uploaded to the USBL system after each SVP was undertaken;
- The Fugro Starfix.NG navigation software was setup with a visual alert to highlight consistent and/or long-duration beacon dropouts to the online surveyor;
- Prior to the start of the survey the system was calibrated, and the calibration verified by "boxing in" a seabed transponder. During calibration a transponder beacon was deployed in an area where seabed depth was appropriate for the survey site and expected towing distance. An SVP cast was conducted and entered into the system, to ensure scale errors and errors due to refraction are minimised. A series of calibration lines were recorded while the USBL interrogated the transponder. After the calibration lines were recorded, the data were processed, and a calibration report generated. Data had to be filtered to ensure accurate calibration values. The calibration values were entered into Starfix and verified by confirmation lines recorded over the seabed transponder. Once the calibration was completed, the seabed transponder was recovered by use of an acoustic release system.

</td></tr>
</table>

3.4 Side Scan Sonar

Table 3.4: Side scan sonar.

<table>
<tr><th colspan="2">Side Scan Sonar</th></tr>
<tr><td>Requirement</td><td>

- Minimum 200% coverage (100% nadir coverage is required);
- Data resolution sufficient for detection of seabed objects/features ≥ 0.5 m (height, width or length);
- XY precision and accuracy of ≤ ±2.0 m;
- Survey speed of 4.0 knots ±10%, dependent on currents and acceptability of the data;
- Infill required where USBL gaps of more than 10 seconds along the survey line;
- Altitude of approximately 10% of operational range, dependant on water depth and operational safety considerations such as the height of the piggybacked MAG.

</td></tr>
<tr><td>Equipment</td><td>

- EdgeTech 4200 side scan sonar (300/600 kHz);
- USBL sub-sea positioning;
- EdgeTech Discover data acquisition software;
- Chesapeake SonarWiz data processing software.

</td></tr>
<tr><td>Data Collection</td><td>

- Side scan sonar data were collected in accordance with Fugro's Standard Procedures WI02_351, WI02_353 and WI02_354;
- The dual channel, dual frequency side scan sonar operated at a 50-75 m range to achieve the project requirements for coverage and resolution;
- Throughout the survey, both the high and low frequencies were recorded. Data were recorded as both XTF and JSF formats. Survey logs listing the data collection parameters were maintained throughout the survey;
- The SSS was positioned using USBL, with a beacon mounted on the aft handle of the instrument itself with no additional offset to the transceiver required. The system was set up, and data recorded in adherence to WI02_120 and WI02_220;

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</table>

Side Scan Sonar	
	■ Comprehensive survey logs listing the data collection parameters were maintained throughout the survey. Quality was continuously monitored by the online geophysicist using the online displays; further details regarding quality, possible re-runs and equipment performance were noted in the online log.
Processing	■ Data QC, data processing and contact picking were completed by geophysicists at Fugro's Portchester office; ■ The high frequency data were processed in SonarWiz from the JSF files (processing of low frequency data were not required, as stipulated in the scope of work); ■ Data files were imported into SonarWiz processing software. The navigation was checked on import with corrections applied where required. The files were then bottom-tracked before the data files were gain adjusted. As a standard the Empirical Gain Normalisation (EGN) function was used to preserve changes in reflectivity from seabed sediment variations. Where required, additional Automatic Gain Control (AGC) was used to minimise the effects of motion on the data. ■ The processor undertook QC of the positioning quality by using contacts or seabed features on lines run in opposite directions. The bathymetry data were also checked to ensure the data positioning was within expected tolerances; ■ Contacts over 0.5 m in any dimension were picked and classified. Where required, contacts were rationalised to the MBES position or to their position within sonar files.

3.5 Parametric Sub-bottom Profiler

Table 3.5: Parametric sub-bottom profiler.

Parametric Sub-bottom Profiler	
Requirement	■ 10 m penetration; ■ Vertical resolution: 0.2 metres; ■ Total horizontal uncertainty 2 m or better.
Equipment	■ System: Innomar SES-2000 Medium Parametric sub-bottom profiler; ■ Acquisition system: SESWIN; ■ Conversion Software: SES Convert; ■ Processing Software: RadExPro.
Data Collection	■ Sub-bottom profiler data were collected in accordance with Fugro's standard procedures, a component of Fugro's Quality Management System, which complies with the requirements of ISO 9001:2015, ensuring that data is collected in accordance with the scope of work and Fugro's procedures; ■ A test was undertaken at the start of the survey to determine the optimum settings to achieve the best records with the system. As the survey progressed the system was adjusted to obtain the best records. Each change was entered into the survey logs; ■ The data were acquired in a raw format and converted into SEGY. The data were frequency filtered online for the purposes of QA, although this filter was not applied to the recorded SES3 files. The optimum settings were determined as appropriate to the site; ■ All data were recorded digitally in the SESWIN acquisition system along with positional data from the positioning system provided by Fugro Starfix. Any duplicates in source coordinates caused by shot interval and navigation point separation were corrected using an interpolation method; ■ Comprehensive survey logs listing the data collection parameters were maintained throughout the survey. Quality was continuously monitored by the online geophysicist using the online displays; further details regarding quality, possible re-runs and equipment performance were noted in the online log.
Processing	■ All data were quality checked and processed according to Fugro's standard procedures;

Parametric Sub-bottom Profiler	
	■ Initial data QC, data processing and deliverables were completed at Fugro's offices in Portchester: • Heave compensation. • Amplitude Correction: Time raised to the power: 2.0; • Bandpass filtering Low cut frequency 2,200 Hz and High cut frequency 14,000 Hz; • Burst Noise Removal: Window size: 7 traces, Rejection percentage of alpha trimmed average: 50%, Exclude amplitudes lower than 5% of average. ■ Data and navigation QC.

3.6 Single Magnetometer

Table 3.6: Magnetometer

Single Magnetometer	
Requirement	■ 10 m maximum flying altitude; ■ Magnetometer sampling frequency: 10 Hz; ■ Maximum noise level: ±1.5 nT; ■ Lateral blanking distance shall be 2.5 m and cell size of 0.5 m for grids; ■ Data rejected for any USBL gap or altitude out of spec for more than 10 seconds.
Equipment	■ 1x Geometrics G882 magnetometer fitted with a depth sensor and altimeter; ■ USBL subsea positioning; ■ Starfix data acquisition software; ■ Oasis Montaj data processing software.
Data Collection	■ Magnetometer data were collected and processed in accordance with Fugro's standard procedures, a component of Fugro's Quality Management System, which complies with the requirements of BS EN ISO 9001:2008. ■ The magnetometer was positioned using the USBL. Real-time positions for the sensor was then output to the acquisition software and recorded along with the magnetometer readings and altitude data. Magnetometers were towed at less than 10 metres altitude, as close to the seafloor as possible. ■ Magnetometer values in nT, depth and altimeter readings were collected at an update rate of 10 Hz. The data were logged in Starfix acquisition software together with navigation information and a time stamp. ■ Additional required fields such as USBL sensor to vessel range were output from the navigation software and were logged as a separate text file. The data were sampled into the raw Oasis Montaj database on import. ■ Magnetometer data were continuously QC'ed by personnel in Fugro's office in Portchester, UK. Re-runs and infills were acquired based on out of specification cases for magnetometer data.
Processing	■ All data were processed and reported according to Fugro's standard procedures; ■ All magnetometer data were QC'ed for data quality and processed at Fugro's offices in Portchester, UK. Processing was followed by gridding, picking and preparation of final deliverables; ■ Magnetometer gaps / reruns and infill sections were finalized from onboard Seeker when required; ■ Fugro's magnetometer processing and interpretation procedure can be broadly separated into the following stages: • Data import; • Navigation processing and QC of all data; • Export of all data for processing in Oasis Montaj;

Single Magnetometer	
	• Import into Oasis Montaj; • QC all data channels and double check for navigational errors; • De-spiking and QC of total field and altitude data; • Removal of data where the signal strength <100; • Removal of data set sections exhibiting greater than ±1.5 nT noise tolerance; • QC of total field data, signal strength and altitude; • Filtering and calculating residual. • Gridding of the total field data, magnetic residual, signal strength and altitude; ■ Data were reviewed on a line-by-line basis and any sections exceeding system noise parameters (typically ±1.5 nT), altitude > 10 m and signal strength <100 were removed before gridding. Any data gaps resulting from such a process were infilled as required; ■ Filtering and calculating the residual values involved the selection of suitable parameters to ensure that background variations in the magnetic field were removed, without affecting any potential anomalies. Data were subject to a beta-spline filter, followed by a series of non-linear filters with decreasing width and tolerance; ■ The calculated background field was subtracted from the measured field to produce the magnetic residual; ■ Data were interpreted as gridded datasets and profiles.

3.7 UHRS

Details on the mobilisation of the 2D UHRS equipment and processing of the 2D UHRS data can be found in the respective reports provided by Geomarine and Geosurveys and found in Appendix D.

3.8 Refraction Seismic and MASW

Table 3.7: GAMBAS

Refraction Seismic and MASW	
Requirement	■ Vessel speed <2.2knots ■ Sledge and streamer on the seabed
Equipment	■ Access channel: 48 hydrophones variable spacing, total length 90m, for MASW and Refraction acquisition ■ Shallowest water: Combination of 1 x 24 low frequency hydrophones (MASW+refrac) 45m and 1x24 standard hydrophones (refrac only) 115m long. Total streamer length of approximately 150m allowing deeper penetration. ■ USBL subsea positioning for the sledge
	■
Data Collection	■ Streamer and sledge were lowered down on the seabed 300m before the start of a line and brought back at the surface when a line was completed. ■ Acquisition started when the USBL showed that the sledge was at the beginning of the line and stopped when the sledge was after the end of the line to maximise coverage. ■ Buffer zones were decided onboard, for example when we had to deviate from the line because a buoy was there and equipment could get tangled in it. ■ The control panel on deck that fires the airgun gave the instruction to both the seismic recording system and the navigation system to log the data. ■ Recording parameters: length of 2sec and sampling rate of 0.250ms.

Refraction Seismic and MASW	
	■ Air gun pressure between 95 and 110bars. ■ On-line QC was done for refraction and MASW data. It consisted of a check of individual hydrophone validity, validation of signal to noise ratio, checking that we could pick the first arrivals on the whole streamer for refraction and checking that we could see a dispersion curve for MASW. The position of the sledge was also checked in real time.
Processing	■ The processing involves 3 main steps: • Merge of positioning, bathymetric and seismic data; • Picking of regression curves for refraction; Picking of dispersion curves for MASW; • QC and exports of bar charts and maps. ■ The seismic refraction processing itself includes starts with the picking of the first arrival of the compressional wave recorded at each hydrophone. Picked times measured for each trace feed a Time-Distance curve for each shot point. Regression of Time-Distance curve allows to extract a series of compressional wave velocities (Vp) and corresponding thicknesses are identified. Each pair of values Vp - thickness is representative of a layer of constant average velocity. ■ The MASW processing starts with the picking and extraction of the dispersion curve of the fundamental mode for every shot. After inversion of every dispersion curve, data are merged and kriged to produce a 2D section of shear waves velocities (Vs).
Data Outputs	■ Refraction: Gridded bar charts which is the raw VP profile, meaning no smoothing, filtering or kriging has been applied. ■ MASW: Gridded 2D sections with kriging applied.

4. Quality

The survey was planned and carried out in conformance with Fugro's quality management system, which complies with the requirements of ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007. More detailed descriptions of specific survey techniques and procedures are contained within Fugro standard procedures (a component of Fugro's QHSE Manual - details of which can be inspected at the Fugro offices on request).

Prior to the commencement of survey operations, a project execution plan (PEP) consisting of Project Overview, Operations Plan, Quality Plan, Health, Safety, Security and Environment Plan (HSSE) and Emergency Response Plan (ERP) were submitted to TotalEnergies as per Table 4.1. These documents formed the basis for all planning in relation to this project.

Table 4.1: Project Execution Plan Documents

Fugro Document	Revision	Revision Date
F197217-PEP-Vol1	2	1 July 2022
F197217-PEP-Vol2A	4	8 July 2022
F197217-PEP-Vol3	2	1 July 2022
F197217-PEP-Vol4	2	1 July 2022
F197217-PEP-Vol5A-ERP	4	7 September 2022

A digital online survey log was completed during online operations and provided a detailed record of all activities and events that occurred onboard the survey vessel. Detailed information relating to each surveyed line was recorded. This included date, time, line name, instrument setup parameters and highlighted any events or data quality issues.

The performance of the survey instrumentation was constantly monitored by the online surveyor and online geophysicist. Any data quality issues were immediately highlighted and logged in the online logs. Upon review, remedial action could be performed, and a decision made as to whether any reruns were required. Data quality was also monitored by the offline processors soon after data acquisition.

Data storage, control and archiving of the data were undertaken in compliance with the PEP and Fugro's data management policy.

4.1 Quality Control

Information has been provided below on the quality control checks carried out during the operational phase of this project.

Table 4.2: Summary of Analogue Geophysical Quality Control Checks

Stage of Survey	Check
Mobilisation	■ GNSS Health Check of primary navigation system using third party processing;

Stage of Survey	Check
	■ Node offset check and position comparison of primary and secondary navigation systems to a Leica 1200 PPK system; ■ Vessel draught check for MBES and navigation software; ■ Datum transformation verification from WGS84 to ETRS89 UTM31N; ■ Validation of heading sensor using RTK derived baseline; ■ Conduct USBL verification; ■ Beacon battery interrogation to prove battery life; ■ Undertake patch test to calibrate the alignment of the multibeam transducer and conduct latency check; ■ SVP and SVS comparison; ■ SSS rub test, wet test and I/O test; ■ Verification of SSS positioning; ■ MAG sensor alignment check, 'spanner' test and wet test (single MAG and UXO); ■ Verification of MAG positioning; ■ Verification of UXO system positioning; ■ Conduct a Surrogate Item Trial (SIT) for verification of the UXO system positioning, sensitivity, and workflows; ■ Check all instruments logging correctly.
On survey	■ Check MBES for data quality (power/gain/range, motion/weather artefacts, SVP vs SVS accuracy, feature resolution coverage, sounding density, noise interference, THU, TVU); ■ Check MBES files are being recorded (Starfix.NG) populating the correct folders; ■ Check GNSS navigation quality; ■ Check SSS data quality (snatch/weather artefacts, resolution, survey speed, layback); ■ Check SSS files are being recorded (both low and high frequency, XTF and JSF); ■ Check SSS data consistency, USBL navigation quality, correct range being recorded, towfish altitude. ■ Check MAG/UXO system data quality (snatch/weather artefacts, total field noise, signal strength); ■ Check MAG/UXO system files are being recorded correctly (update rate, populated channels, time jumps/spikes); ■ Check MAG/UXO USBL navigation quality and towfish altitude.
In Dock	■ Vessel draught check for MBES and navigation software; ■ Cross check quality and coverage to ensure specification has been met; ■ Back up data onto vessel server and hard drive; ■ Send back data to Fugro Portchester office.
Offline Processing	■ Visual inspection of final sounding grid; ■ Comparison of data from different sensors for validation of picked contacts; ■ Review of SSS data for coverage and data for contact picking; ■ Review of MAG/UXO residual data for coverage and quality of the grid for contact picking; ■ SBP processing and tide correction; ■ Review of SSS, MAG, UXO system and SBP positional accuracy compared to MBES and correction if required; ■ Creation of required QC and final deliverables; ■ Final QC of report and all charted deliverables.
	■ Confirm coverage and survey requirements have been met;

Stage of Survey	Check
	■ Confirm data backed up onto vessel server and hard drive.

Table 4.3: Summary of GAMBAS Quality Control Checks

Stage of Survey	Check
Mobilisation	■ All pieces of equipment were tested before shipment in Fugro warehouses in Nanterre (France) ■ The streamers of hydrophones were all tested in resistivity and isolation. Such "match" test and a "noise" test allow detecting hydrophones or cable break and also bad or noisy sensors. ■ Umbilicals were tested in resistivity, isolation and air pressure. ■ Air gun disassembled, checked, cleaned with freshwater and then reassembled. Solenoid is dry tested by controlling the click made at the time of the trig. ■ The seismic recording units, the Geodes running through Seismodule Controller software, were tested by using its included auto-control test: a voltage pulse is triggered towards each hydrophone to evaluate their performance. The resulting waveform is captured and standard deviation analysed several times by the software so that the operator can accurately control reliability of signal to noise ratio without any external triggered acoustic noise (not documented). ■ Air cylinders certifications are controlled and renewed if necessary. ■ A series of equipment were tested once installed onboard: • The geodes and streamers were tested again with the auto-control function of the geode. Hydrophones spacing was measured again to check. • Air gun Solenoid was dry tested by controlling the click made at the time of the trig. • Dry test of the operation sequence. • The alarm system that triggers the air panel purge in case of emergency was tested. ■ Test of the navigation and refraction computer interfaces.
On survey	■ Check that seismic data are recorded and of good quality. ■ Check that USBL gives a good position of the sledge for every shotpoint and that it doesn't deviate too far from the line.
In Dock	■ Backup data on a hard drive ■ Send data to the office in France for processing
Offline Processing	■ Creation of required QC and final deliverables; ■ Final QC of report and all charted deliverables.
Demobilisation	■ Confirm coverage and survey requirements have been met.

5. Health, Safety and Environment

Fugro performed the survey operations with high regard for health and safety and the environment. A health, safety and environmental plan was completed prior to the start of the survey (refer to Table 4.1). This was produced in accordance with the company's Health Safety and Environmental Management System manual. All survey and crew members were required to read and sign this plan, to ensure they understood the work to be performed and the mitigating measures employed to minimise the identified risks.

During mobilisation and at regular intervals thereafter, safety briefings and toolbox talks were conducted to reiterate the risks relating to survey operations and steps taken to minimise these risks. A full safety briefing was also undertaken after each crew change. Further details have been provided in Table 5.1.

Table 5.1: Summary of HSE Meetings Conducted

Total	Meeting
13	Vessel Drills
11	Cross Department Tours
2	Audit/Inspection
243	Toolbox Talks
84	Daily Meetings
2	Crew Led Kick-Off Meetings
13	Safety Meeting
2	Two Part HIRA
5	Soundbite Training
11	Vessel Induction
1	Workpack Review

Upon joining the vessels all members of crew were given a vessel safety induction tour by the vessel master. All crew were required to wear lifejackets, hardhats, safety boots, safety glasses, and gloves for all back-deck operations.

During operations a hazard observation card (HOC) system was operated on board allowing crew to report unsafe acts, unsafe conditions, safe acts, or make HSE suggestions. In total 24 HOCs were submitted.

One near miss was reported during the geophysical scope of the survey. This was recorded in the submitted Incident 15308 documentation.

7. Results

7.1 Vessel Navigation

Position quality for the primary and secondary GNSS receivers was continually monitored throughout the project and all positioning criteria were met. A navigation comparison check was performed prior to the start of the survey and confirmed that both the primary and secondary StarPack antennas on the vessel were providing consistent position information. Vessel navigation was consistently maintained at an accuracy better than 0.1 m horizontally and vertically, through the StarPack primary and secondary systems.

7.2 Multibeam Echosounder

The multibeam bathymetry data collected were of good quality. Any noise present in the data were removed and the remaining data were corrected for residual tide and sound velocity errors. Density, THU and TVU of MBES footprints were monitored during acquisition. This ensured all data met the requirements as set out in the technical specifications.

The multibeam backscatter data collected were of good quality. Optimum power and gain settings were utilised during data acquisition to ensure high quality acquisition. During the survey multibeam range changes were minimised to maintain the quality of the MBES data.

7.2.1 Multibeam Echosounder (Limitations)

There was some nadir noise present, primarily on the lines in the shallowest areas. Examples of noise can be seen in the deep and shallow surfaces in Figure 7.1. To counter this, noise filters have been applied over these areas and manual cleaning has been performed to remove the remaining worst affected areas. An example surface after filtering can be seen in the swathe angle (SA) depth layer in Figure 7.1. The hypothesis strength layer from CUBE was used filter to avoid removing valid data where there were steep features. An example of hypothesis strength layer is presented in Figure 7.1.

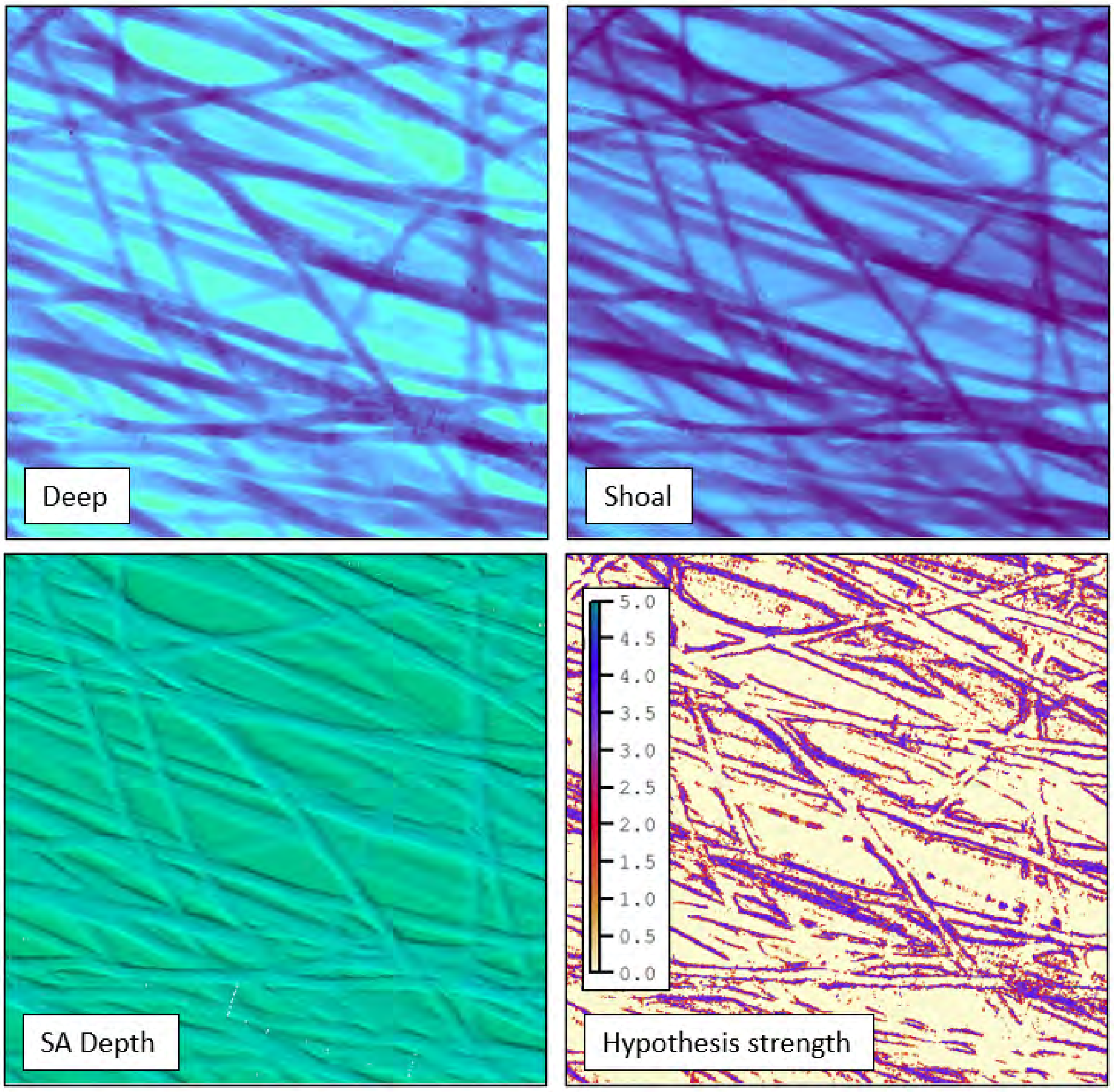


Figure 7.1: Example of MBES data and layers used in CUBE filter

7.3 Subsea Positioning

The subsea positioning was generally good throughout the survey. At mobilisation, unprocessed SSS data were found to have an average target position deviating less than < 2.0 m from the position of the same target derived from MBES. Reference is made to the Mobilisation Report (*F193457-REP-MOB-SK 04*). Data required a very minimal amount of de-spiking, positioning was generally good throughout the survey.

7.4 Side Scan Sonar

SSS data quality was generally good across the site. Areas of data observed to experience excessive snatch were removed and subsequently infilled with acceptable data, whilst artefacts were always minor they were easily trimmed due to the high data density.

Positioning of the SSS data was generally very good across the site and was continually checked throughout the survey to ensure that it remained within the project specification of ± 2.0 m. Features present at the survey site were used to check the SSS positioning against the MBES data.

7.4.1 Side Scan Sonar (Limitations)

During acquisition two factors resulted in limitations within the SSS data. Limitations were mitigated through processing or data were recollected where required. The limitations were:

- Snatch in SSS data during confused sea states
- Far-range interference from the MBES
- Sea defences in south of the survey area
- Steep escarpment resulting in shadowing

On numerous SSS lines, snatch was observed in varying degrees of severity, from only minor intensity differences requiring additional automatic gain control (AGC) to strong distortion of contacts and features resulting in infill or re-runs. This was attributed to a combination of marginal weather, marine and river currents, and passing ship wakes, and was therefore unpredictable and difficult to mitigate.

The data were reviewed on a line-by-line basis with EGN applied to ensure quality was always sufficient to meet the interpretation requirements. After the data were deemed acceptable, high-resolution low-intensity AGC filters were applied to the final mosaic which greatly enhanced the interpretability of the data. Figure 7.2 demonstrates an example of accepted data from the final mosaic, that contains residual artefact caused by snatch.

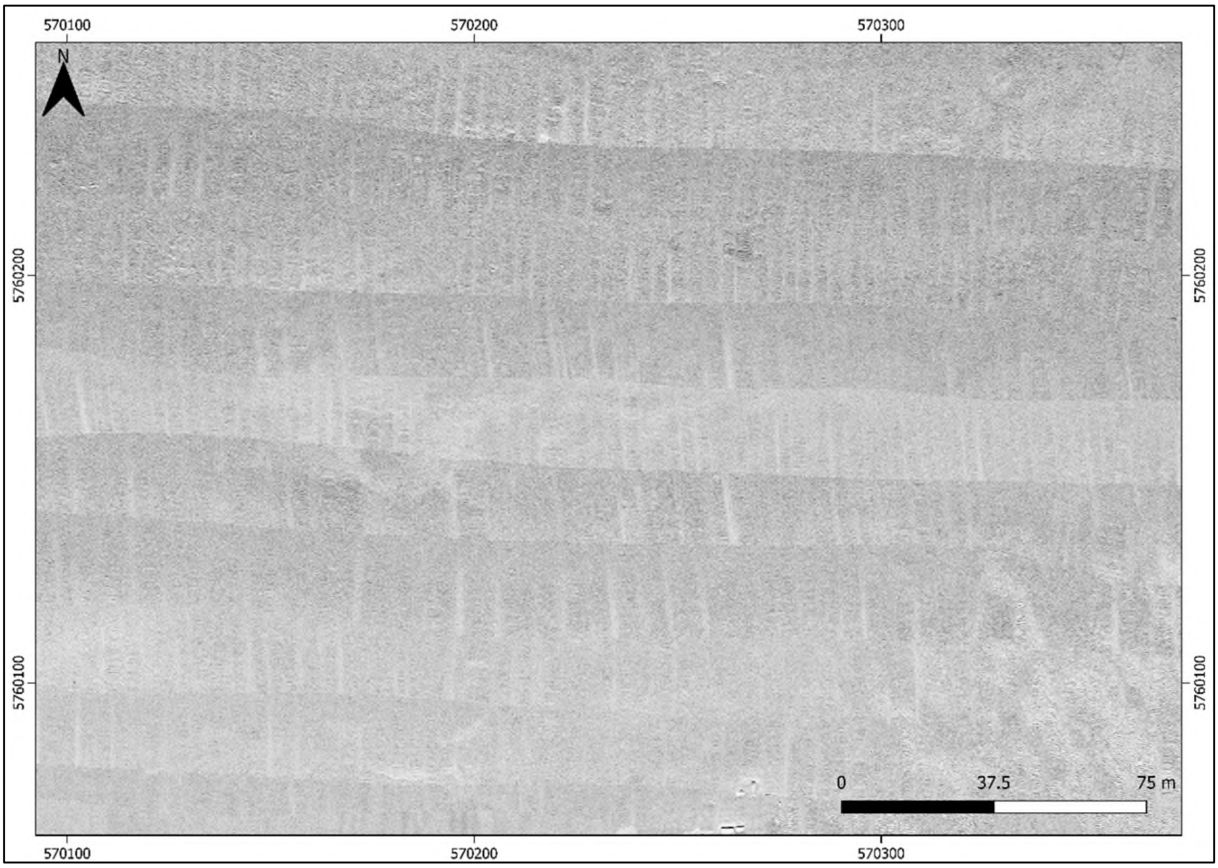


Figure 7.2: SSS example in Block A of snatch in the SSS data, caused by confused sea states

On the majority of the SSS data acquired with 75 m range, noise in the outer ranges was observed in both channels. Due to sufficient data coverage and overlap it was determined that there was no significant impact on the interpretability of the data. All lines had their displayed ranges limited to 60 m in the final mosaic which removed this noise. Figure 7.3 demonstrates the changing nature of the noise along a single line, and shows how the noise is limited to the outer ranges of both channels.

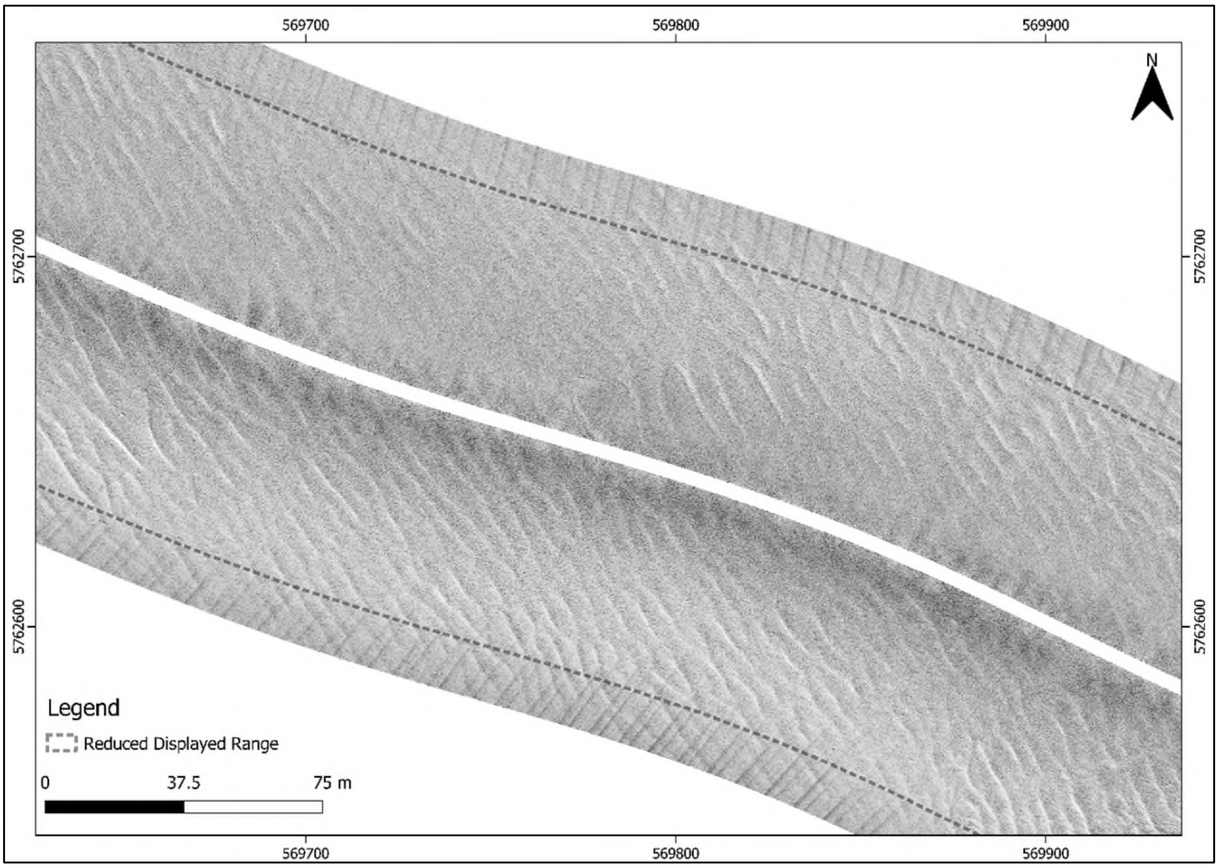


Figure 7.3: SSS example in Block B of noise in the outer range of both channels, line TA2B073P1

The western half of the southern boundary of the survey area was characterised by an extensive sea defence related to the port of Rotterdam. This extends approximately 50 m from the boundary and consists of regularly shaped rock armour for 10-15 m from the boundary, becoming irregular rock dump for the final 35-40 m of the slope, Figure 7.4.

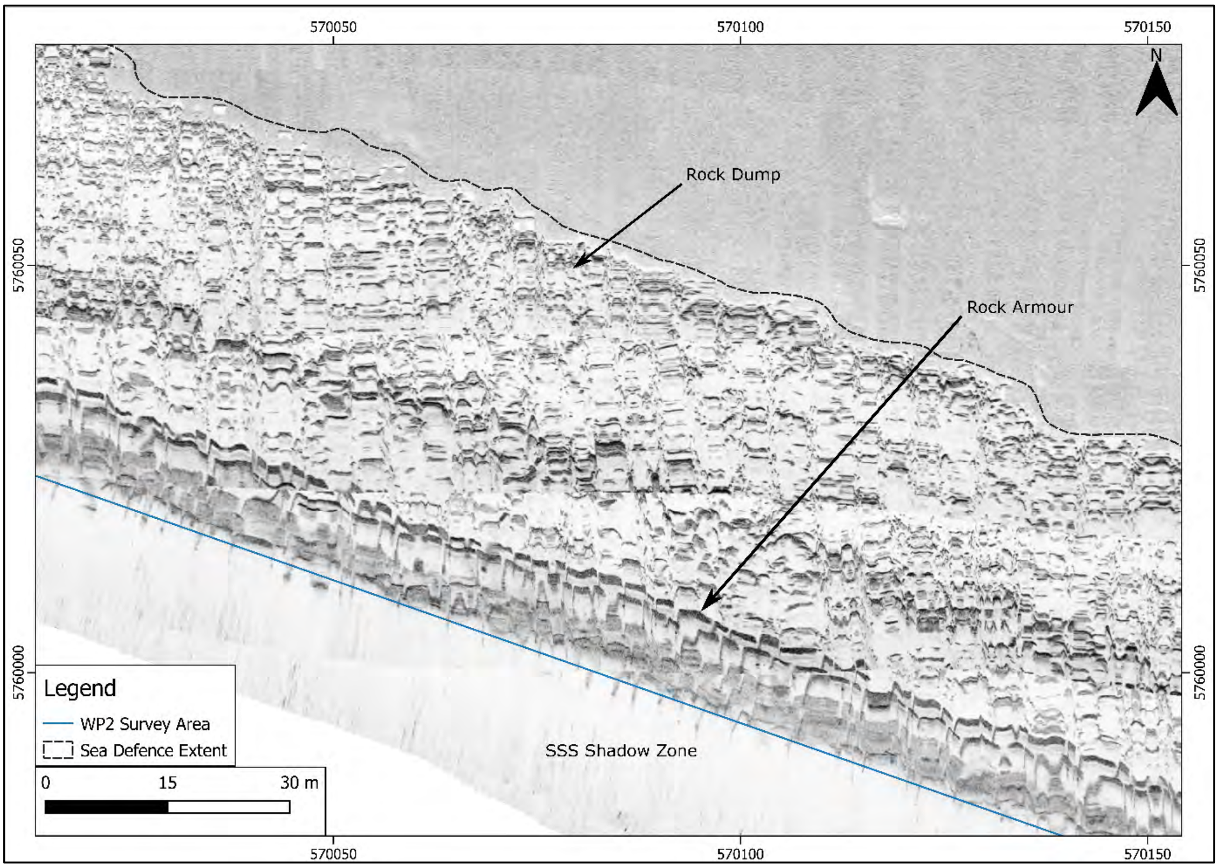


Figure 7.4: SSS example showing rock armour and rock dump sections of the sea defence structure

Shadowing was observed in the centre of the site following a general trend of WNW-ESE. This represented an escarpment along the northern edge of the actively dredged channel. As lines were run near-parallel with this feature, many of the shadow zones were subsequently ensonified by adjacent lines, enabling identification of contacts. However, in regions where the gradient became very steep, the SSS was unable to ensonify these regions regardless of heading direction. An example of shadowing on different lines as they traversed the escarpment are presented in Figure 7.5.

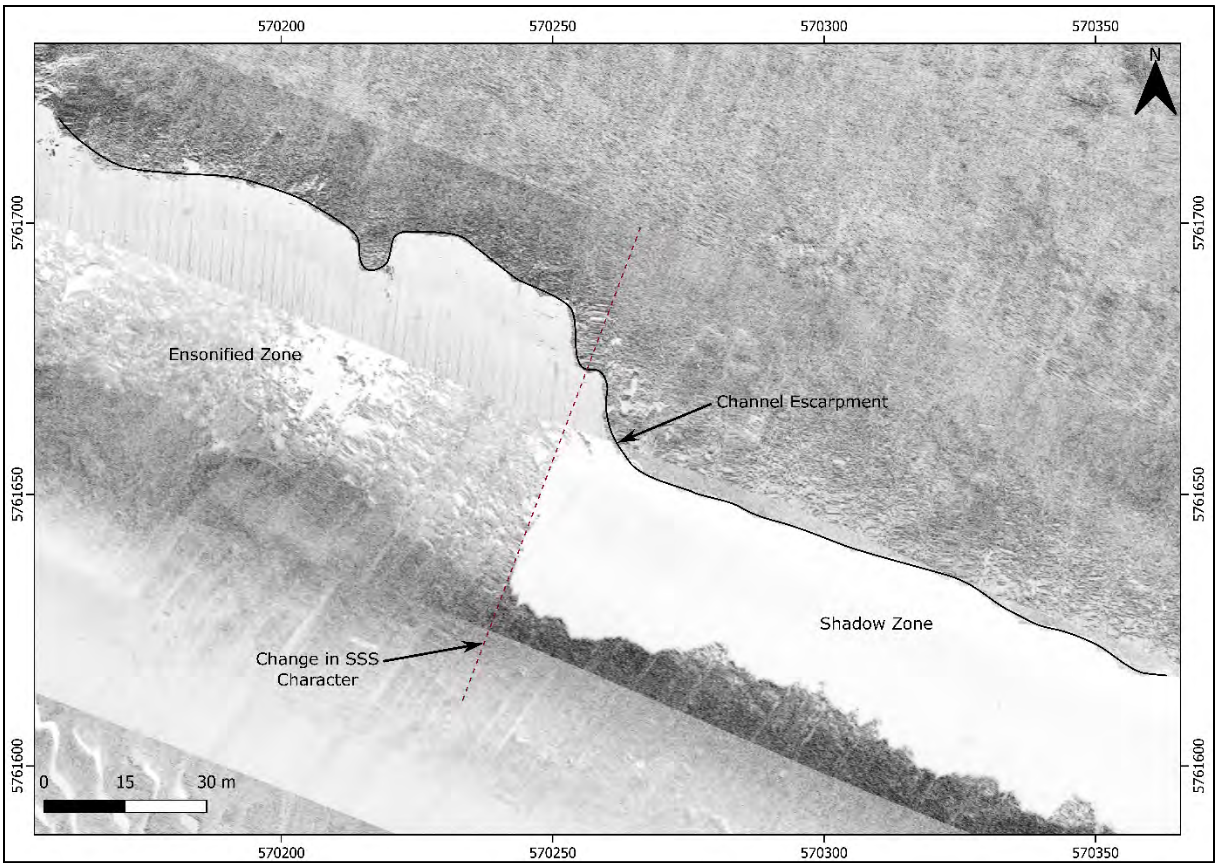


Figure 7.5: SSS example demonstrating a change in SSS character as the tow fish passed over the escarpment

7.4.2 Side Scan Sonar (Data Examples)

SSS data were imported into SonarWiz 7 (V7.09.04) with the recorded samples per channel and a 300-ping smoothing filter applied to the raw navigation. Spatial accuracy within 2 m was achieved with the USBL positioning beacon placed on the towed fish. The heading values were smoothed, and bottom tracking performed on a line-by-line basis. Empirical Gain Normalization (EGN) tables were used to average all amplitude values found at discrete range and sonar altitude to aid with offshore QC and interpretation. Further Automatic Gain Control (AGC) was also employed to compensate for the motion of the towfish. The data were mosaicked at a resolution of 0.1 m and the ordering of the lines was organised to cover nadirs and provide a best representation of the data.

Figure 7.6 shows the good quality of SSS data for the Seeker data in Block A. Positioning was generally good, within 2 m of the MBES. All lines showed light snatch resulting from the confused sea states, however this did not affect the interpretability of the data.

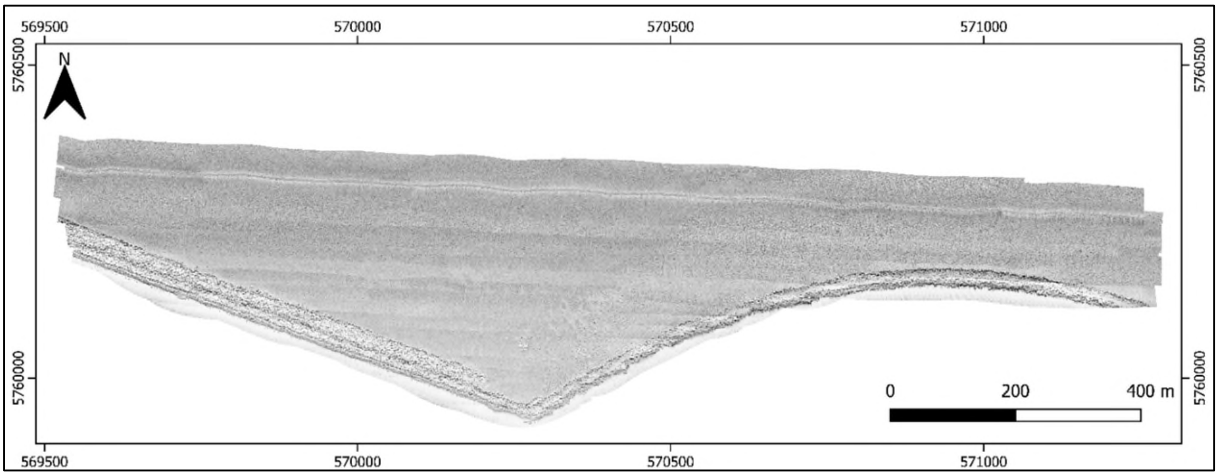


Figure 7.6: Final SSS mosaic for Block A

Figure 7.7 shows the good quality of SSS data for the Seeker data in Block A and Block B combined. Positioning was generally good, within 2 m of the MBES. Lines in the central section, north of the dredge scars, were acquired in good weather yet there were confused sea states due to the factors described in section 7.4.1. This led to some infill and re-run lines being acquired, however all accepted data were determined to be of sufficient quality to meet the interpretation requirements.

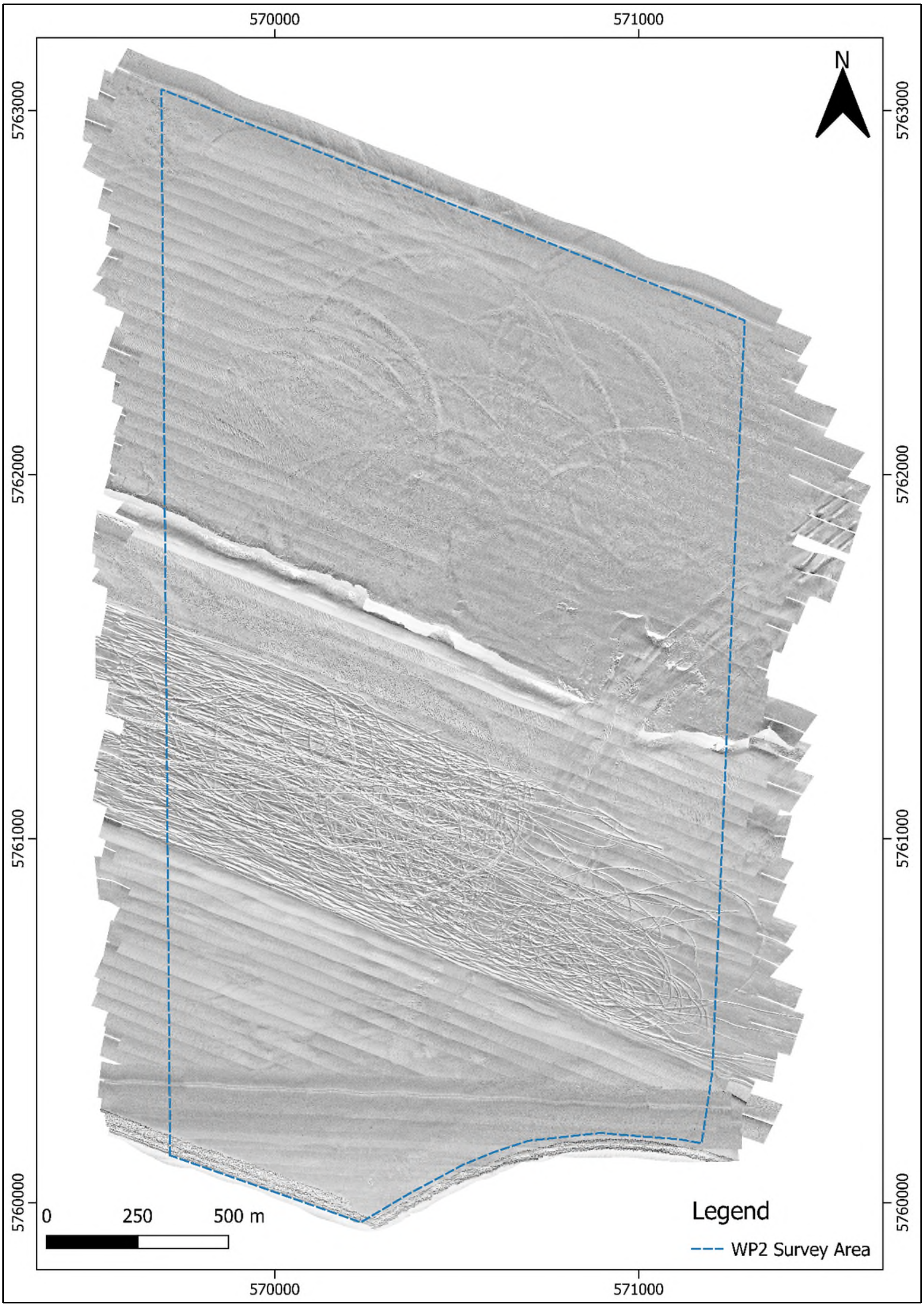


Figure 7.7: Final SSS mosaic

An example of the data quality for the SSS can be seen in Figure 7.8. Seafloor contacts and feature examples are highlighted, as well as demonstrating small-scale changes in sediment type.

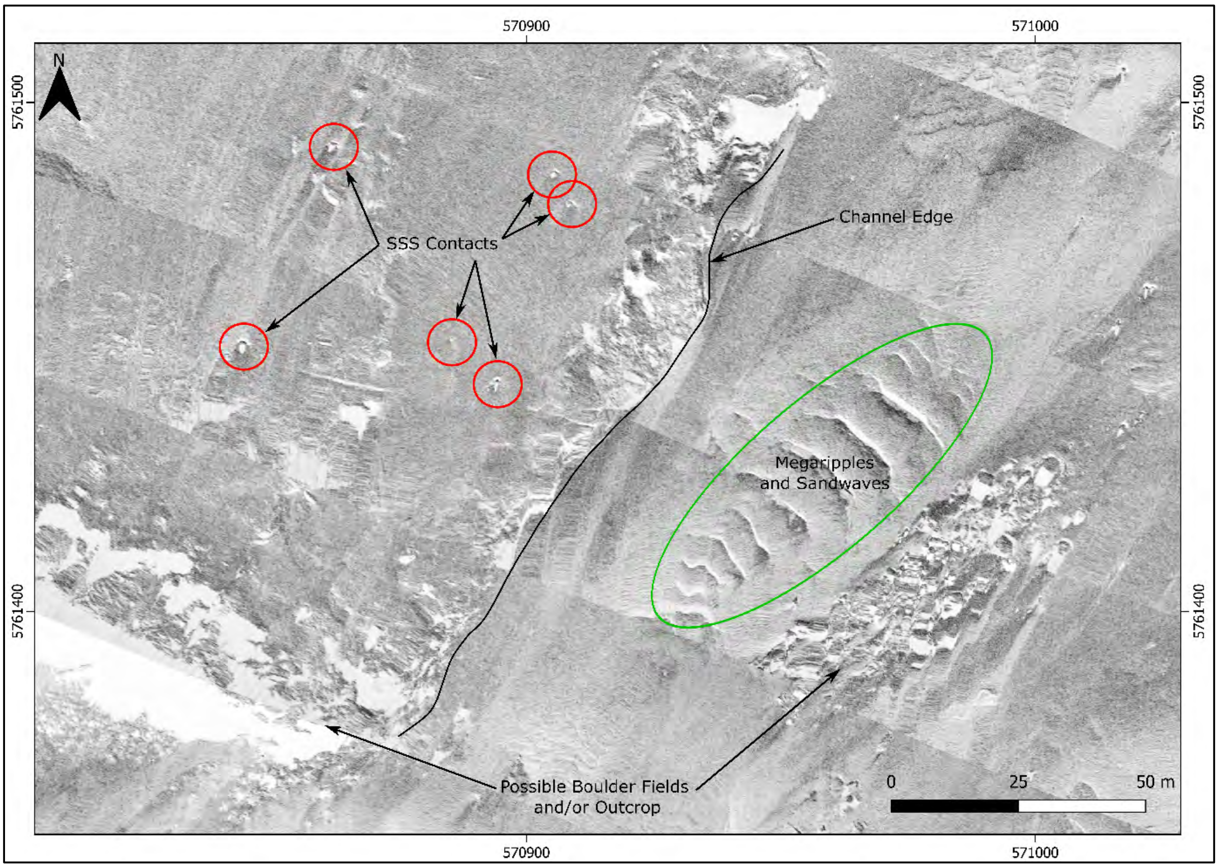


Figure 7.8: SSS data example showing contacts, features and sediment changes in Block B

A further SSS data example can be seen in Figure 7.9, demonstrating a seafloor characterised by human activity in the form of dredge scars in juxtaposition with natural features including irregular seafloor and megaripples and sandwaves.

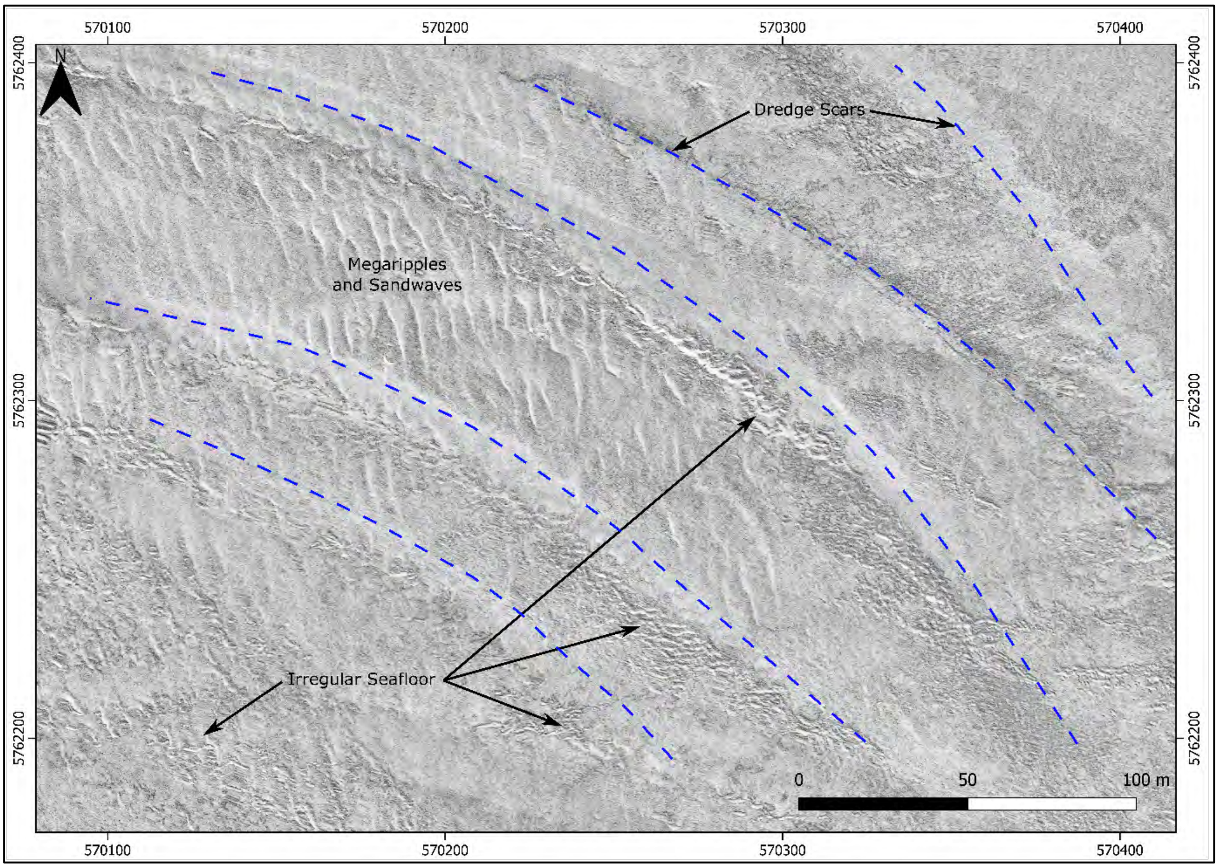


Figure 7.9: SSS data example showing a mixture of seafloor features in Block B

7.5 Sub-Bottom Profiler

SBP data quality was monitored throughout the survey and generally deemed to be high. The acquisition frequency was kept constant (6 kHz) throughout the project to maximise penetration. Across the site average depth penetration of the SBP data ranged between 5 – 10 m.

Positioning of the SBP data was verified to ensure that it remained within the project specification of ± 2 m. Features present within the survey site were used to check the SBP positioning against the MBES data.

7.5.1 Sub-Bottom Profiler (Limitations)

During acquisition several factors resulted in limitations within the SBP data. Limitations were mitigated or data were recollected where possible. Limitations included:

- Anthropogenic features impacting data penetration and quality.
- Regions of seismic data transparency
- Masking of data due to acoustic blanking
- Unfit data quality due to aeration of water column
- Weather effects
-

Anthropogenic features were observed across multiple parts of the survey area. Most of the features were infrastructure related to the port of Rotterdam including sea defences and the dredged shipping channel. An example of the rock armour sea defences and the impact on the seismic data is shown in Figure 7.10. An example of the impact of dredging in the shipping channel on the seismic data is shown in Figure 7.11.

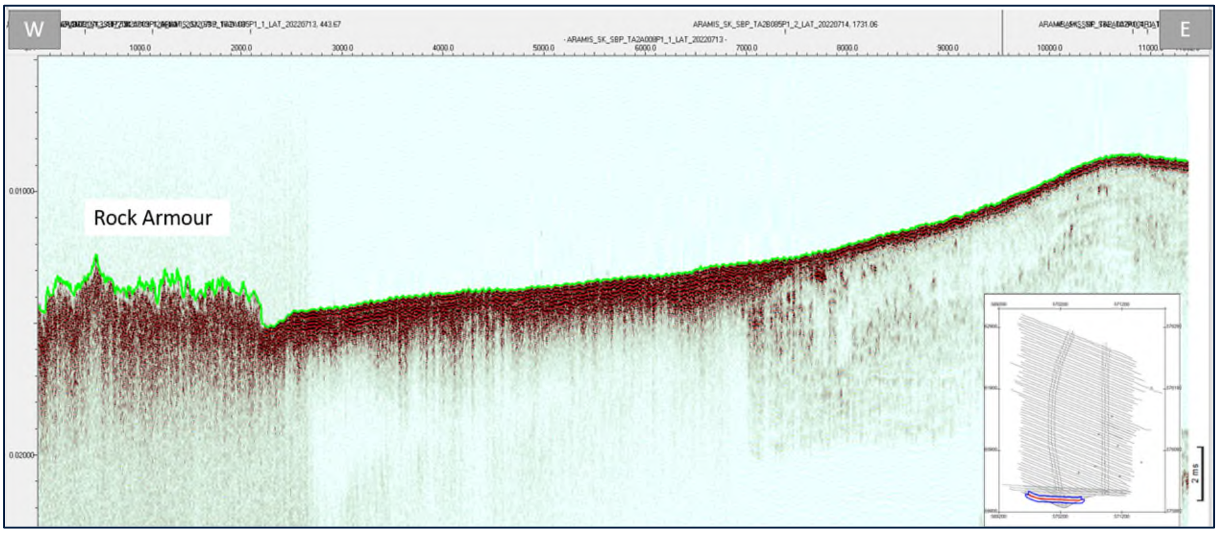


Figure 7.10: Line TA2B008, Impact of rock armour on data penetration.

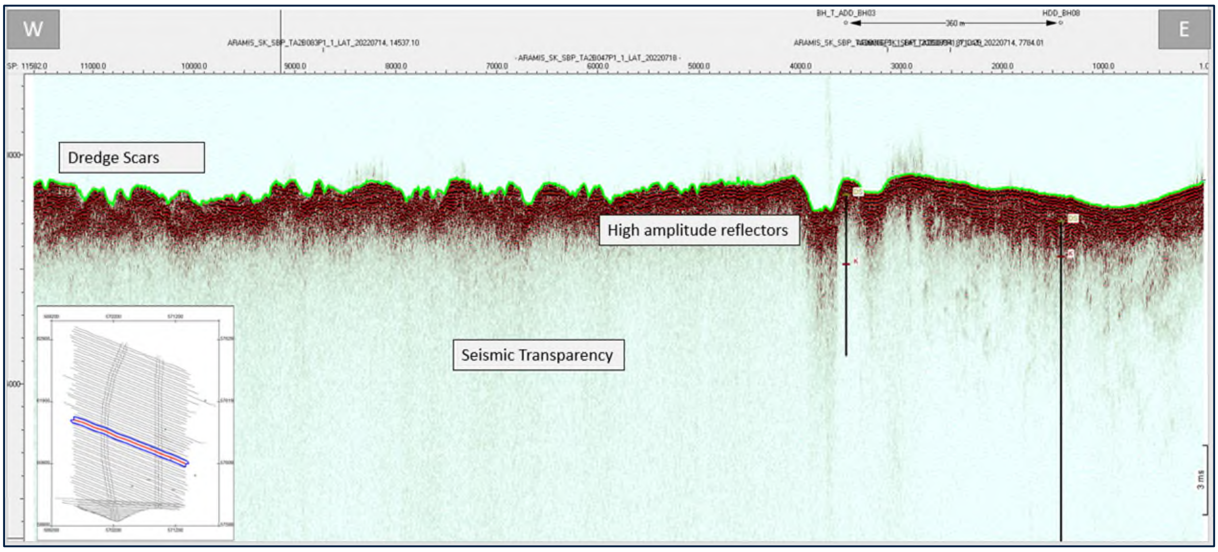


Figure 7.11: Line TA2B047, Impact of dredging and seismic transparency on data penetration.

Alongside the anthropogenic features, the local geology impacted the depth penetration of the SBP data. Primarily seen in the northern half of the site, north of the shipping channel, high reflectivity layers of probably clay or peat, within the Naaldwijk formation caused acoustic blanking of the data below. In these locations the ability to interpret horizons below the acoustic blanking was reduced. An example of this is shown in Figure 7.12.

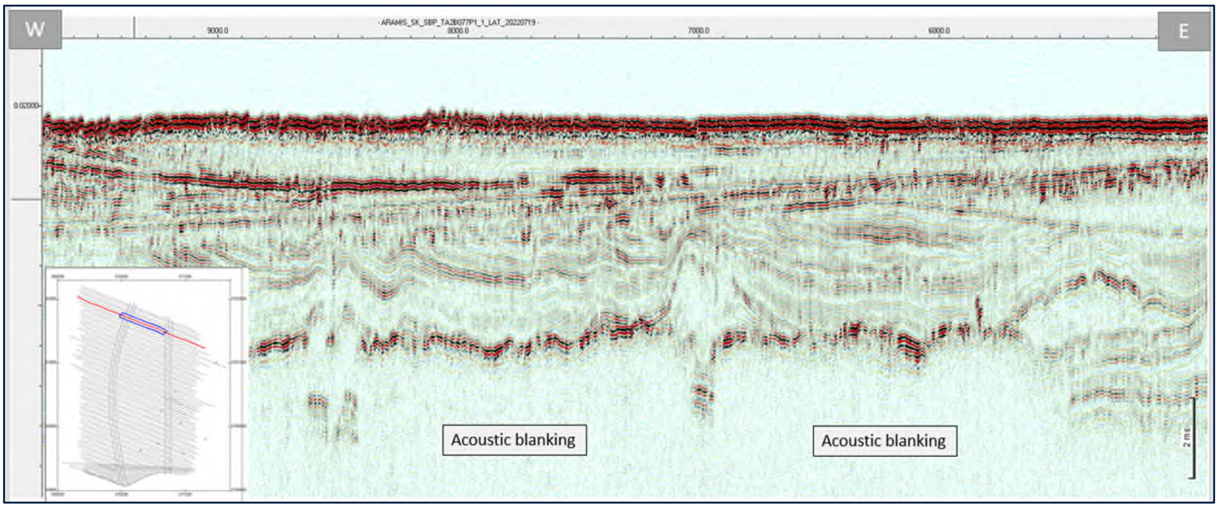


Figure 7.12: Line TA2B077, the impact of acoustic blanking caused by clay and peat horizons.

Due to the location of the site at the mouth of the port of Rotterdam, the operations of other vessels occasionally impacted the quality of the data. In the example shown in Figure 7.13 below, aeration of the water column caused by the passing of a large commercial vessel had an impact on the data quality. In such cases data were recollected.

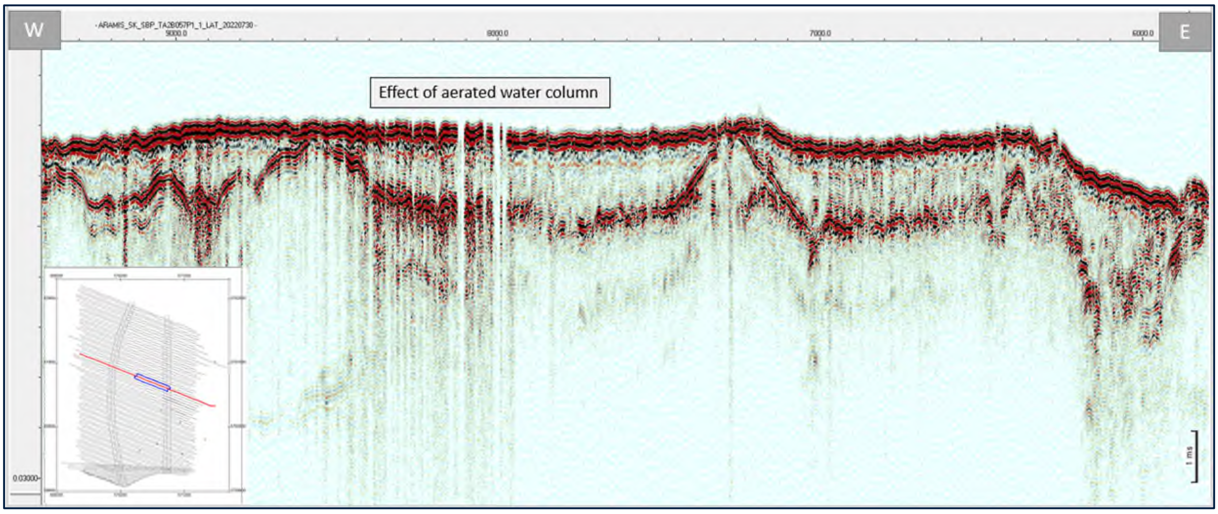


Figure 7.13: Line TA2B057, the impact of the aerated water column of the data. Data was recollected.

Due to marginal weather conditions on 23 July 2022 the SBP data were affected by severe swell noise. To correct this swell filter was applied to the data. The effect of the swell noise is shown in Figure 7.14 and the filtered data in Figure 7.15.

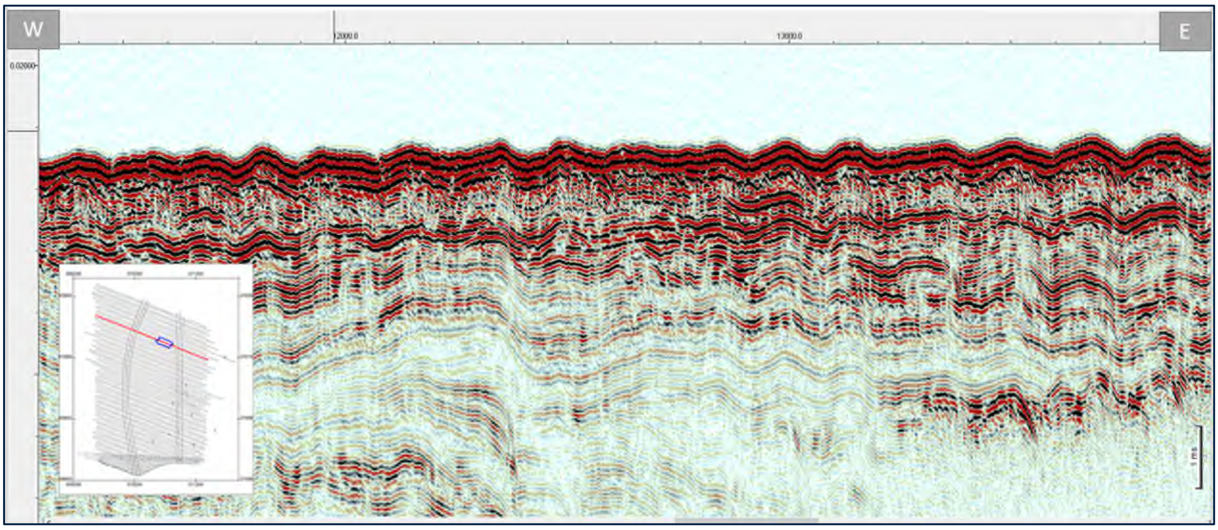


Figure 7.14: Line TA2B070 processed without swell filtering

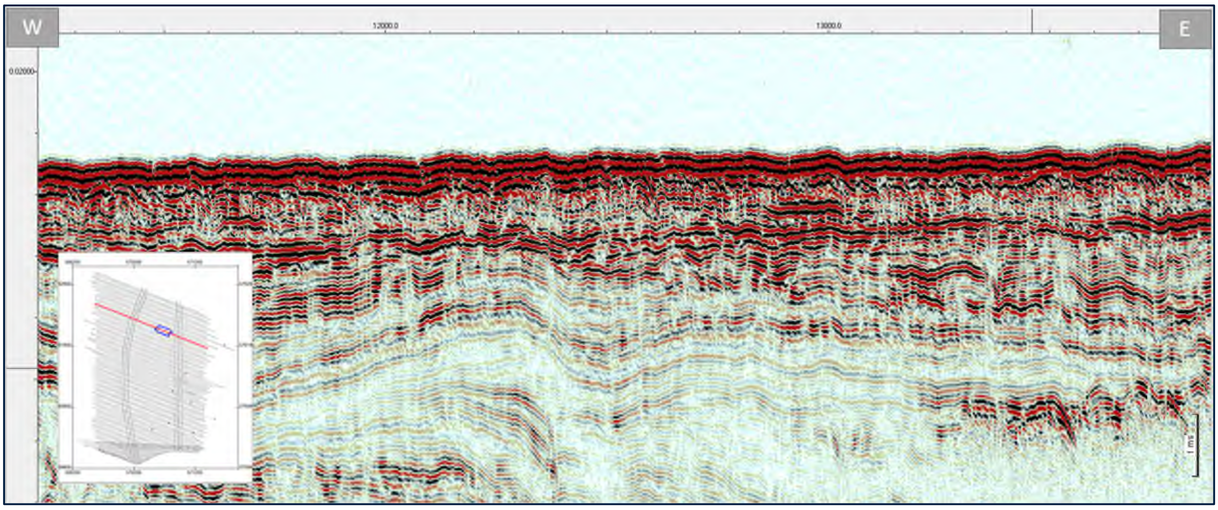


Figure 7.15: Line TA2B070 with swell filter applied, width 120.

7.5.2 Sub-Bottom Profiler (Data Examples)

Sub-bottom profiler data quality was generally good throughout the entire survey. The survey area could be spilt in to four seismically distinct areas as follows:

- Very nearshore (Block A, Lines TA2A001 – TA2A018);
- South of the shipping channel (Block B lines TA2B019 – TA2B032);
- In the shipping channel (Block B lines TA2B033 – TA2B054);
- North of the shipping channel (Block B lines TA2B055 – TA2B082).

Each area was seen to have different seismic characteristics and notable features. The four areas can clearly be distinguished on the crosslines as seen in Figure 7.16 and Figure 7.17.

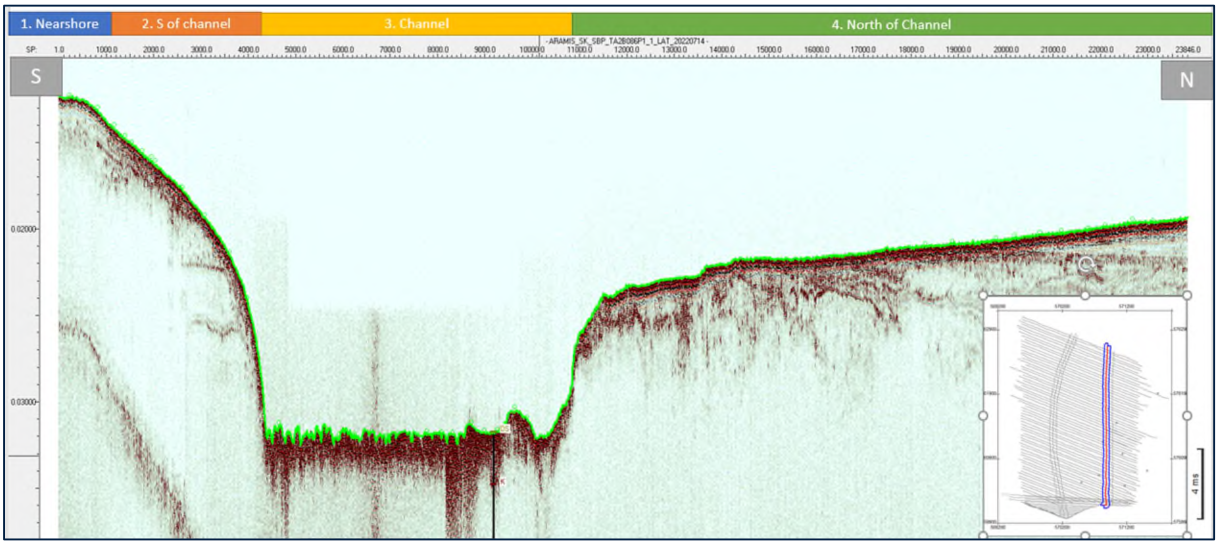


Figure 7.16: Eastern cross line TA2B086

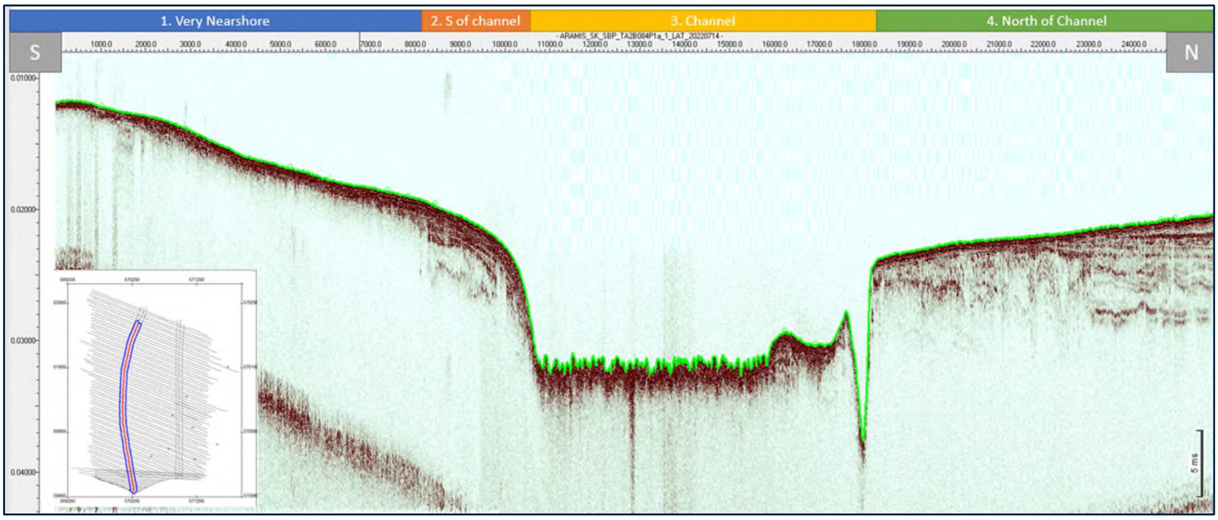


Figure 7.17: Western cross line TA2B084

For the very nearshore area, the data were heavily impacted by the effects of the sea defences. The presence of rock armour, shallow gas, and the likely reworking of the subsurface resulted in predominantly seismically transparent data in this area with limited observed seismic reflectors, Figure 7.18.

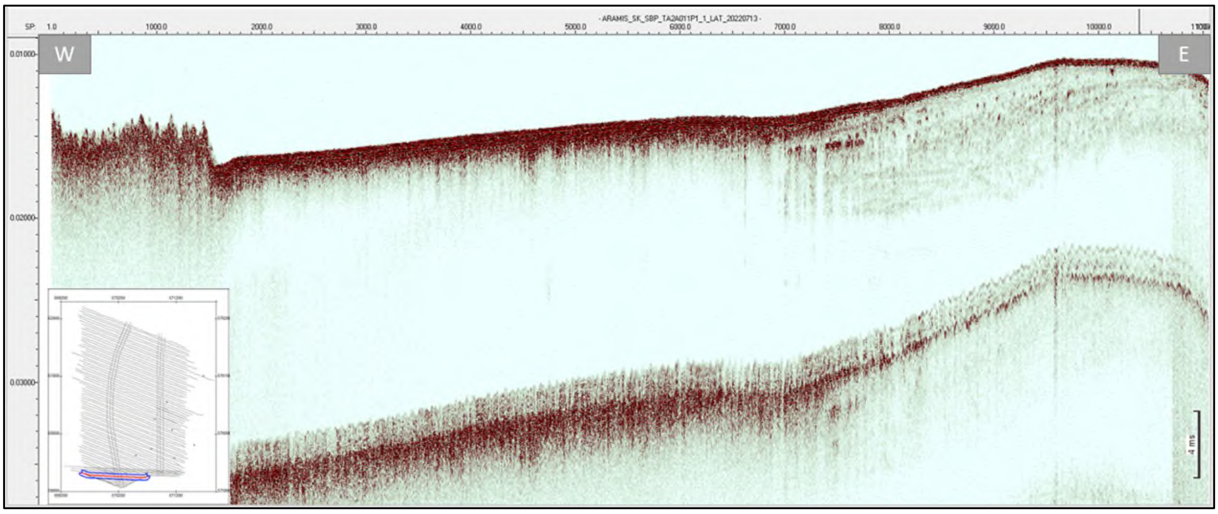


Figure 7.18: Line TA2A011, A representative example of the very nearshore (Block A) data.

For the area south of the shipping channel the seismic data were seen to consist of areas of clear seismic reflectors followed by large regions of seismic transparency. The cause of the seismic transparency is uncertain, however it is believed to be due to the presence of shallow gas, see Figure 7.19. In addition, in this area a possible channel feature was observed across multiple lines trending NNE – SSE. This possible channel feature correlated well with a series of anomalies seen in the single magnetometer data. The potential channel feature is seen in Figure 7.19 and presented in greater detail in Figure 7.20.

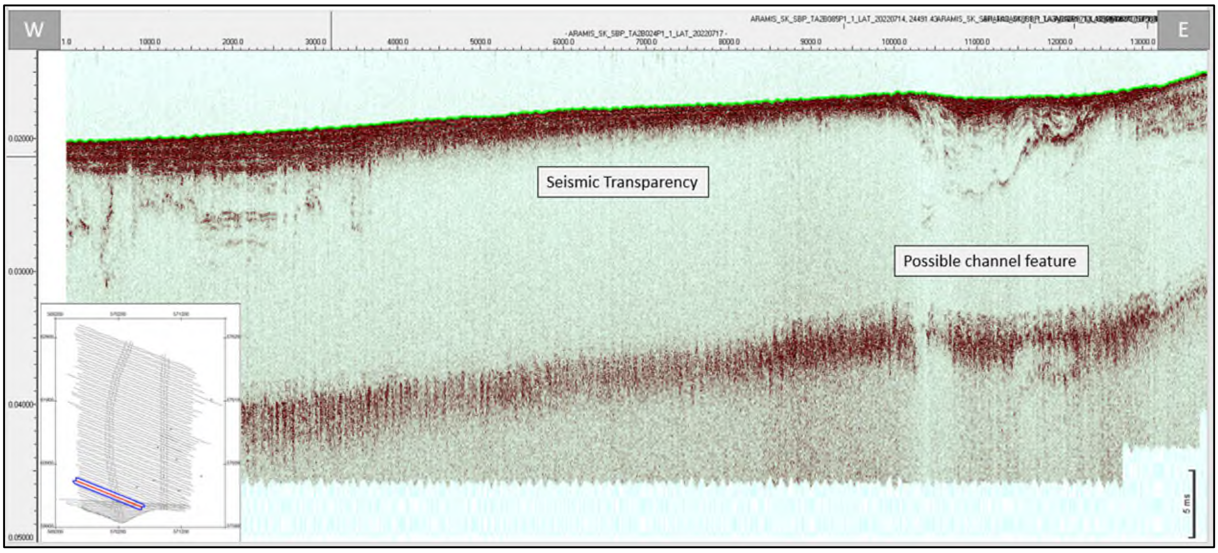


Figure 7.19: Line TA2B024, a representative data example from south of the shipping channel, including a potential channel feature.

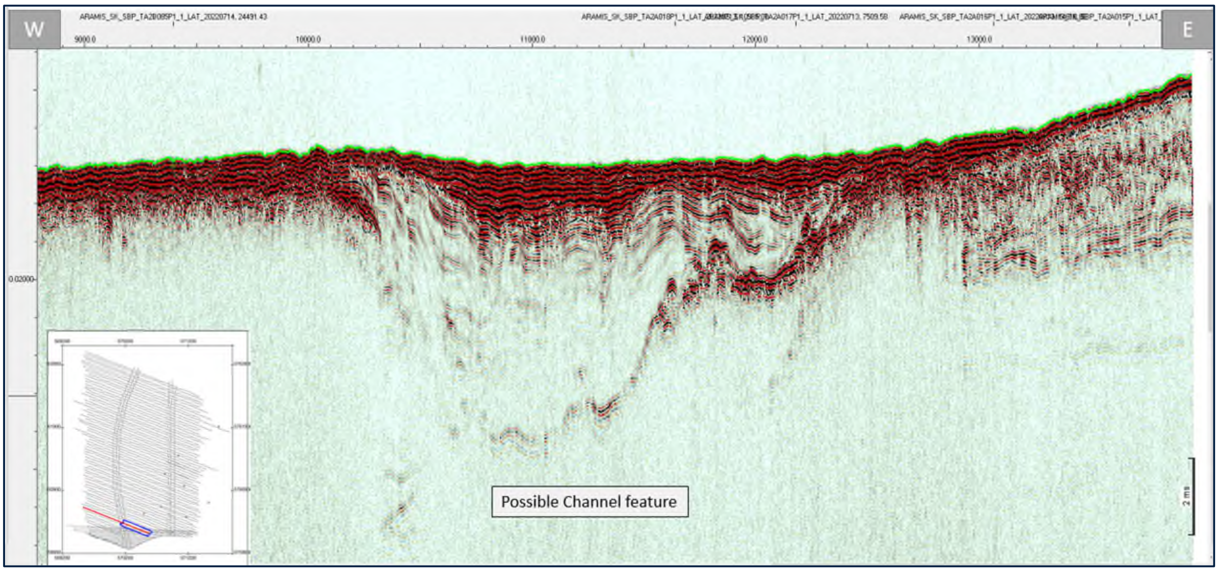


Figure 7.20: Data example of the potential channel feature in greater detail, Line TA2B024.

In the shipping channel the data were dominated by the impact of dredging. The dredging of sediment removed the horizons seen both north and south of the shipping channel. This area was characterised by high amplitude reflectors at the seafloor becoming chaotic and transparent rapidly with depth, Figure 7.21.

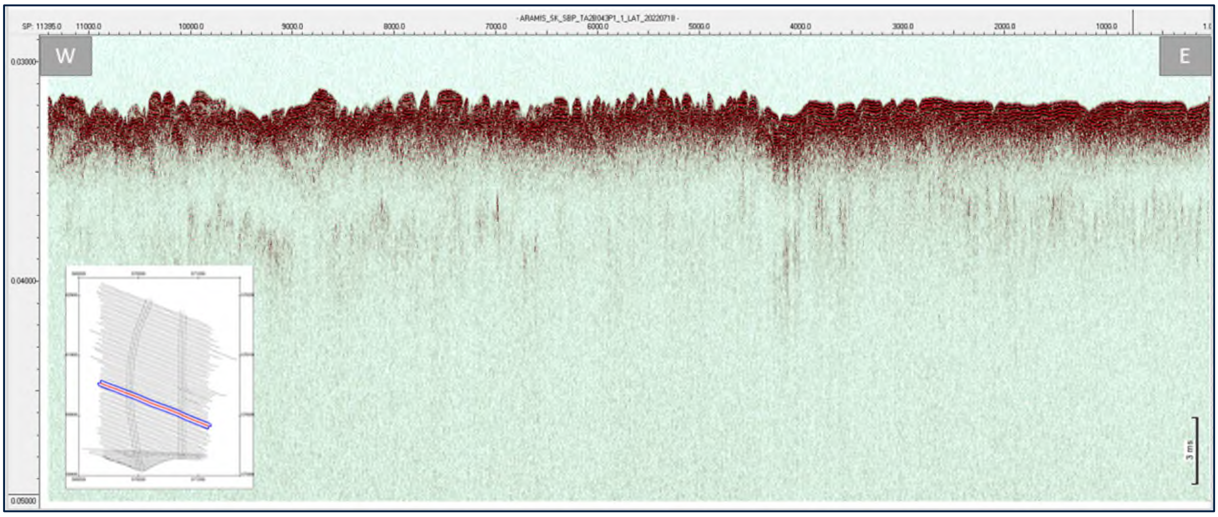


Figure 7.21: Line TA2B043. A representative example of data from the shipping channel.

North of the shipping channel the seismic data displayed multiple continuous reflectors and discontinuities, see Figure 7.22. Complex geological structures and multiple potential units were observed. Interpretation of these units is covered in section 8.3.2

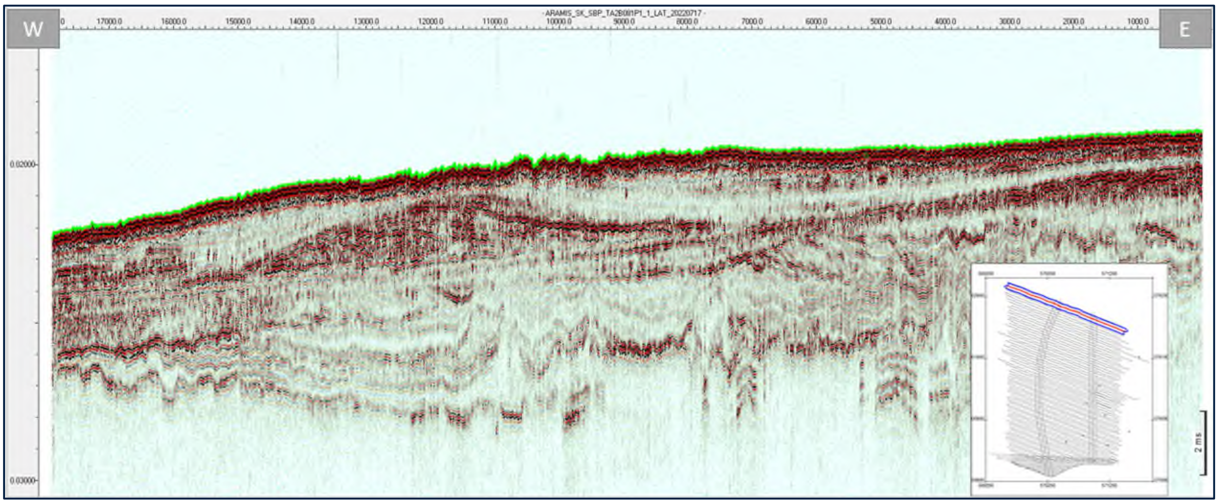


Figure 7.22: Data example from the northern region of the site.

7.6 Single Magnetometer

The magnetometer data quality was monitored throughout the survey. Spatial accuracy within 2 m was achieved with a USBL positioning beacon placed on the towed side scan sonar fish. The overall data quality was good. The processors QCed the positioning and quality of the magnetometer data, all data met the specification requirements of the project.

7.6.1 Single Magnetometer (Limitations)

During acquisition, limitations to the data quality arose from challenges that were encountered as part of data collection. Limitations included:

- Magnetic signal spikes
- Signal strength below 400
- Navigation gaps longer than 10 seconds

When limitations in the data quality arose, the data were manually interrogated. Where possible small spikes were interpolated and short drops in signal strength were assessed to identify the impact on data quality. For the navigation gaps, and in regions where the reduction of signal strength impacted the data quality, data were infilled. An example of an interpolated magnetic signal spike is provided in Figure 7.23. An example of a drop in signal strength below 400, and negligible impact on the data quality is shown in Figure 7.24.

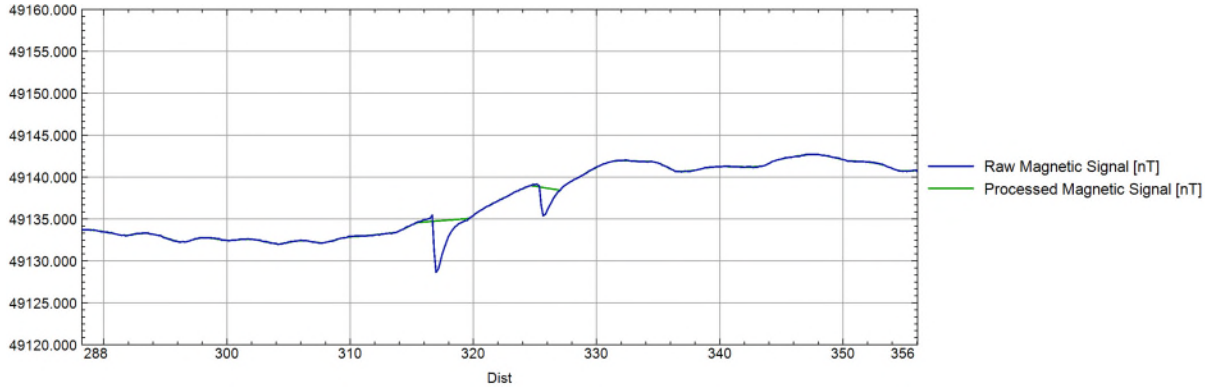


Figure 7.23: An example of two signal spikes and the interpolated processed data.

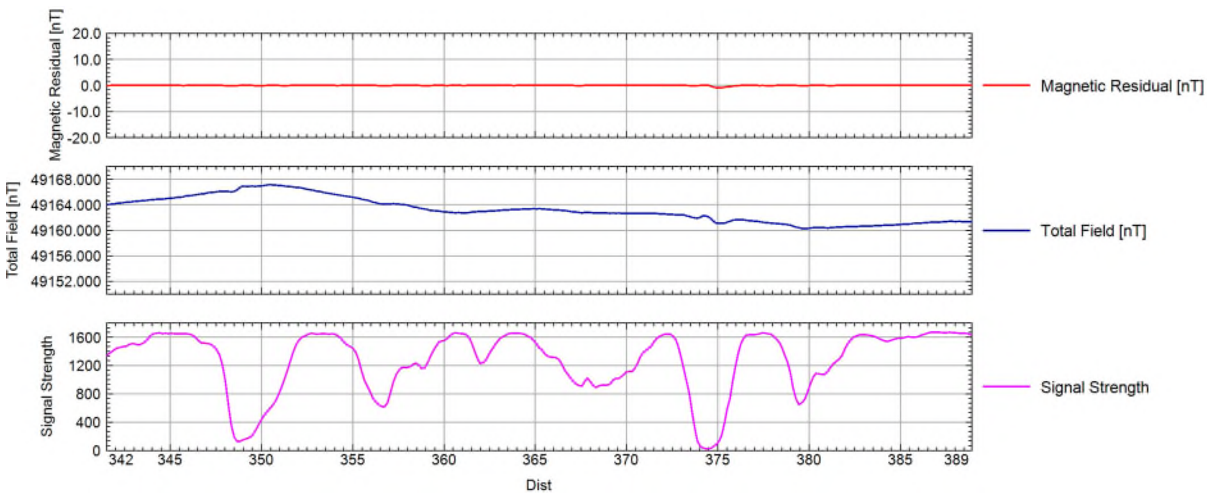


Figure 7.24: Example of signal strength dropping below 400, Line TA2B054_Inf

7.6.2 Single Magnetometer (Data Examples)

Processed data were displayed as a grid of magnetic residual and line by line profiles. Figure 7.25. presents an overview of gridded magnetometer residual. Figure 7.26 and Figure 7.27 present representative examples of a linear profile across the survey area.

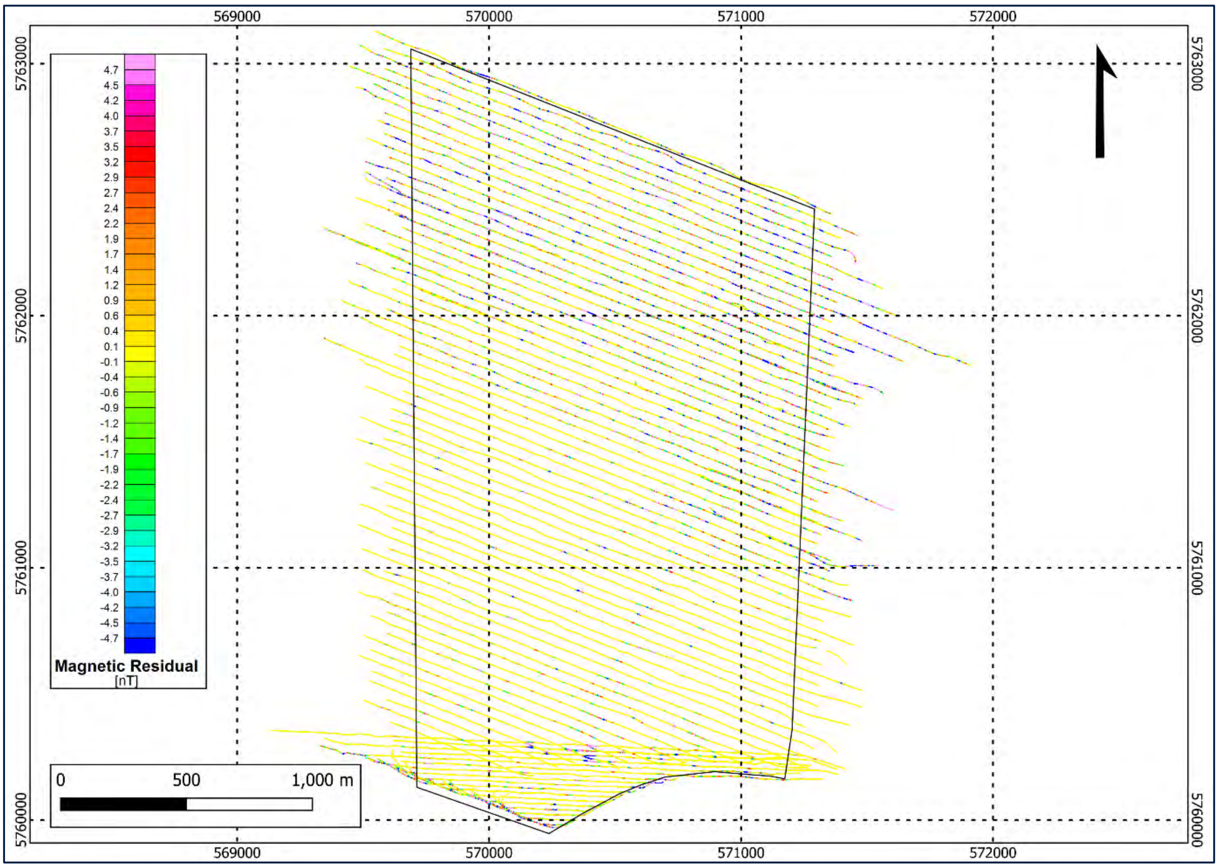


Figure 7.25: Overview of the single magnetometer magnetic residual grid.

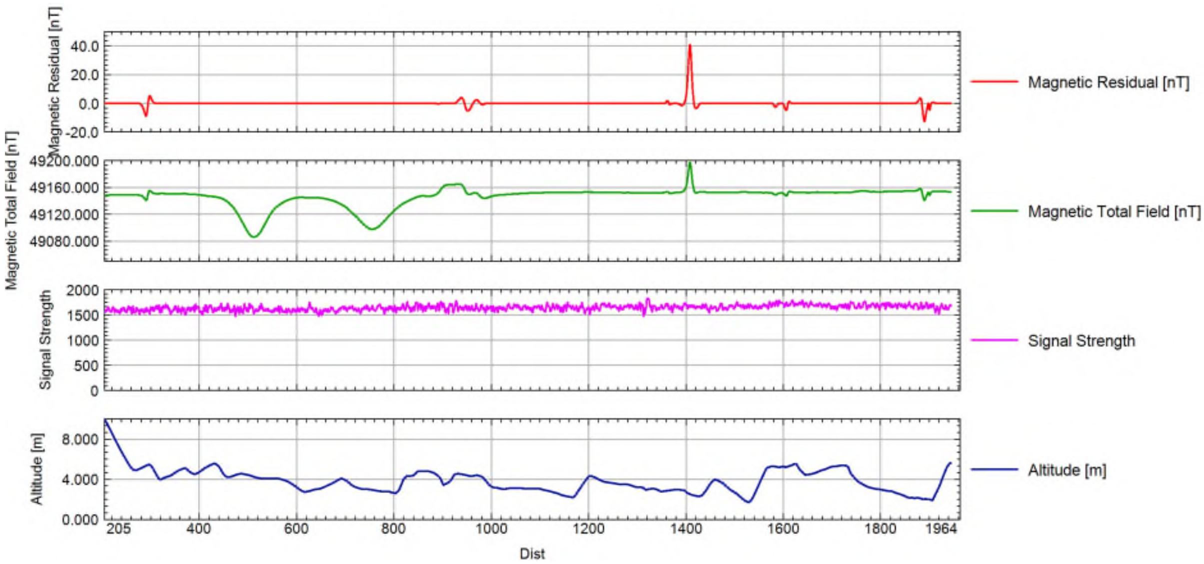


Figure 7.26: Single Magnetometer data example. Line TA2B033.

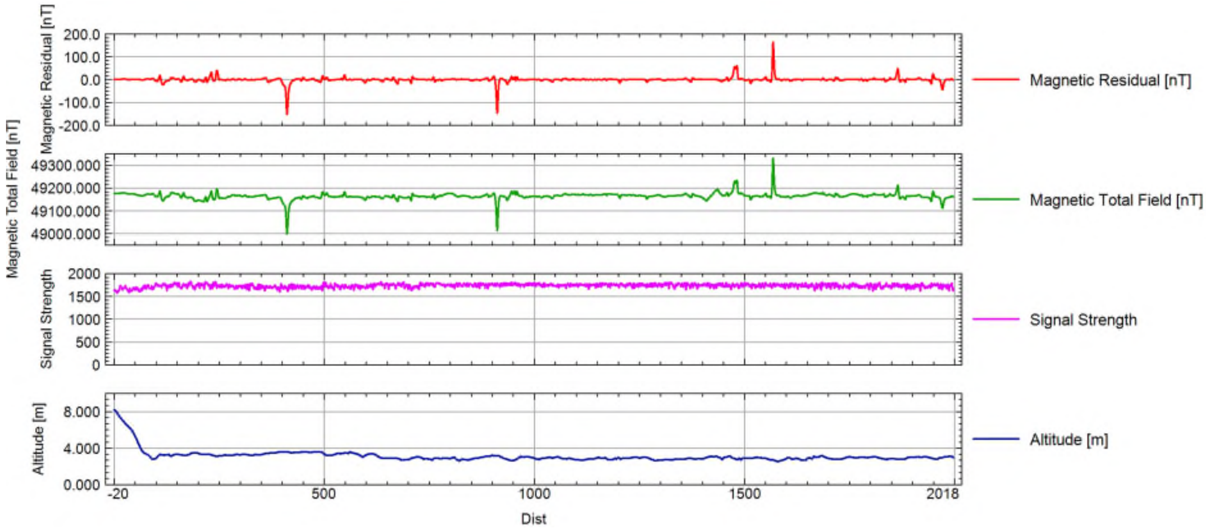


Figure 7.27: Single magnetometer data example. Line TA2B066.

As seen in Figure 7.25 there is a distinct difference in magnetic residual between the northern and southern halves of the survey area. The Northern area is characterised by higher levels of signal variability, thought to be associated with geological noise, Figure 7.28. The southern half of the site is less variable in magnetic residual signal. A linear feature is seen to run across the data trending NNE – SSW, Figure 7.29, and coincides with the potential channel feature caused by the dredging of recently posed HKZ cables observed in the SBP and MBES datasets (Figure 7.20).

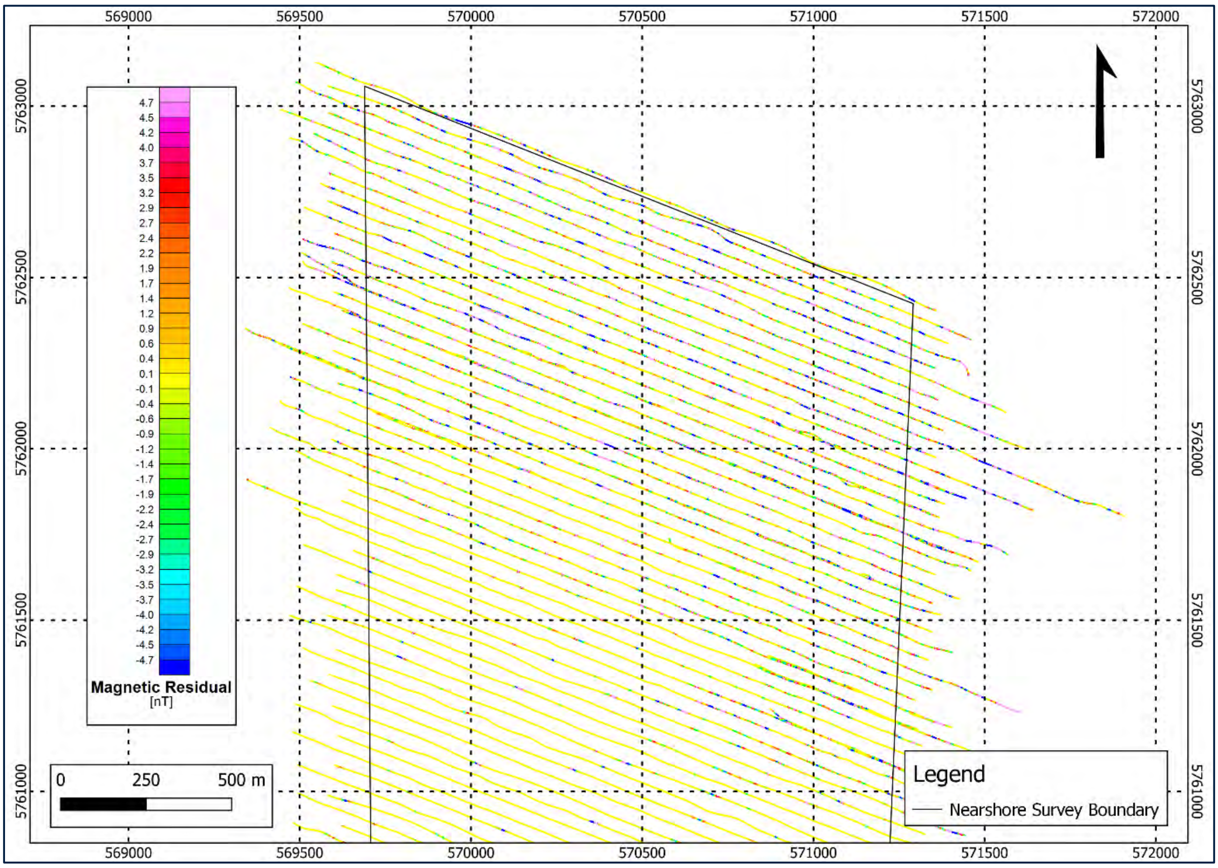


Figure 7.28: The northern portion of the survey area highlighting the high levels of signal variation.

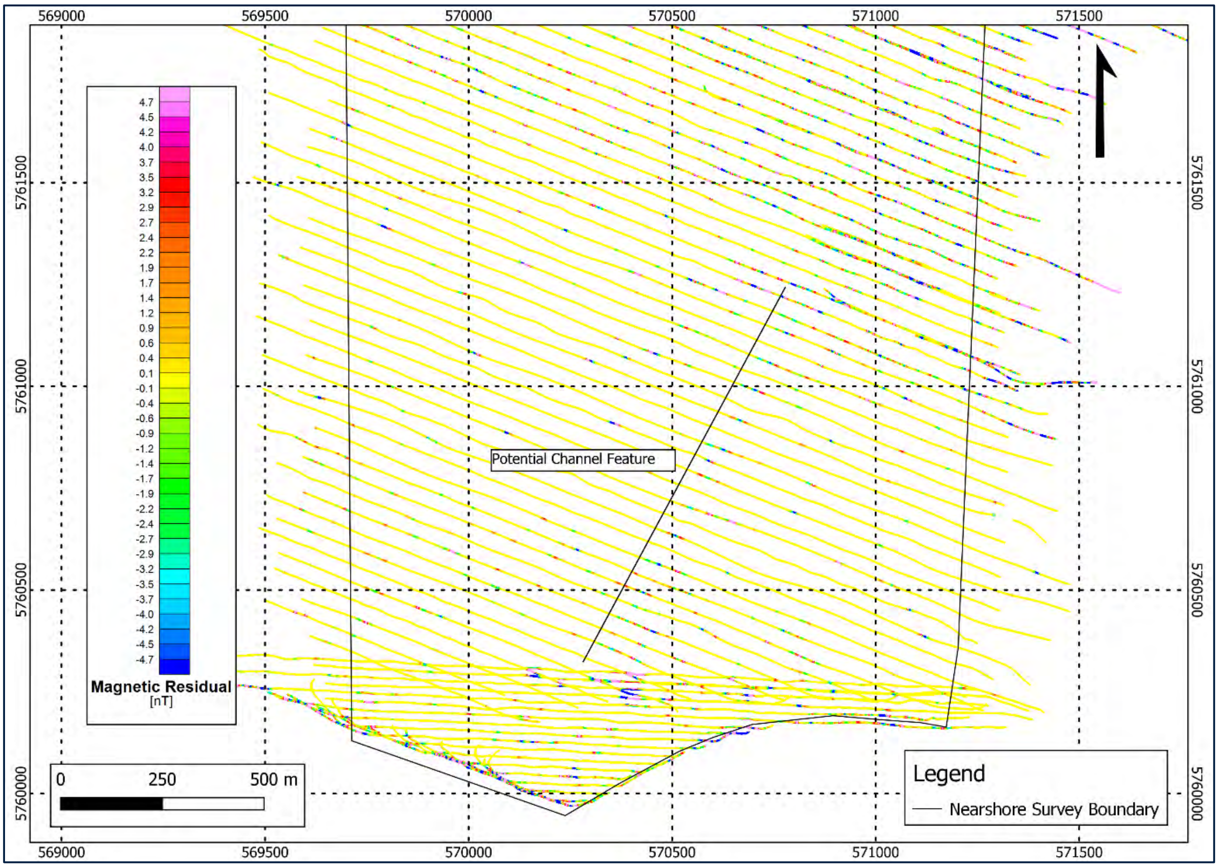


Figure 7.29: The southern portion of the survey area with the potential channel feature highlighted.

In the southmost lines of Block A, the impact of the sea defences is clearly observed, Figure 7.30. A complex magnetic residual is seen across this area and is thought to correspond to the rock armour observed in the SSS and SBP datasets.

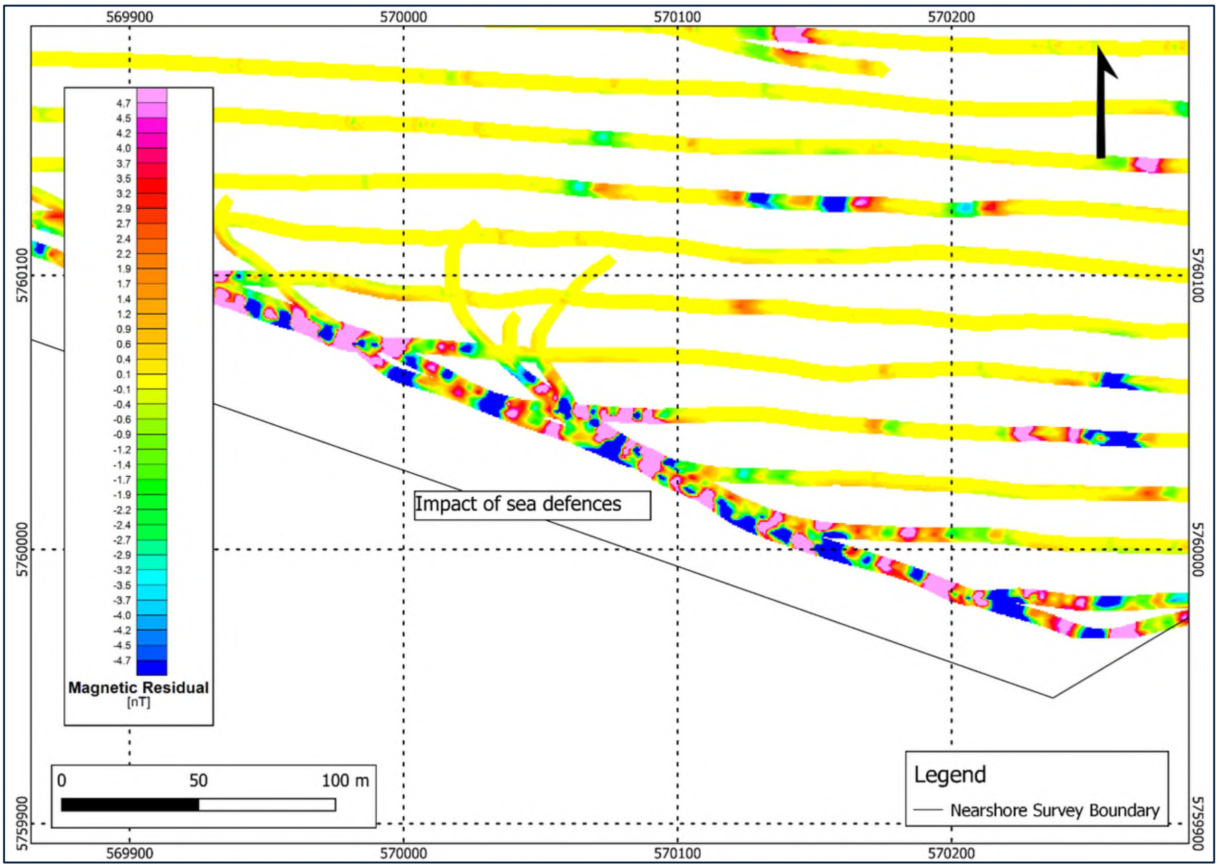


Figure 7.30: Impact of sea defences in the single magnetometer data.

7.7 Seismic Refraction and MASW

Seismic refraction and MASW data were acquired using Fugro's GAMBAS system, which uses a stop-and-go winch to lay the hydrophone streamer onto the seafloor at each shot.

The GAMBAS acquisition method and description of processing for compressional waves is detailed in appendix H. GAMBAS processing for MASW is detailed in appendix I.

Charting results of all the profiles are presented in appendix K on plate 1 to 25.

7.7.1 Compressional Wave Analysis

Data were checked on site during acquisition. The seismic refraction signal was seemingly good and the first arrivals were easily detected for each shot (Figure 7.31).

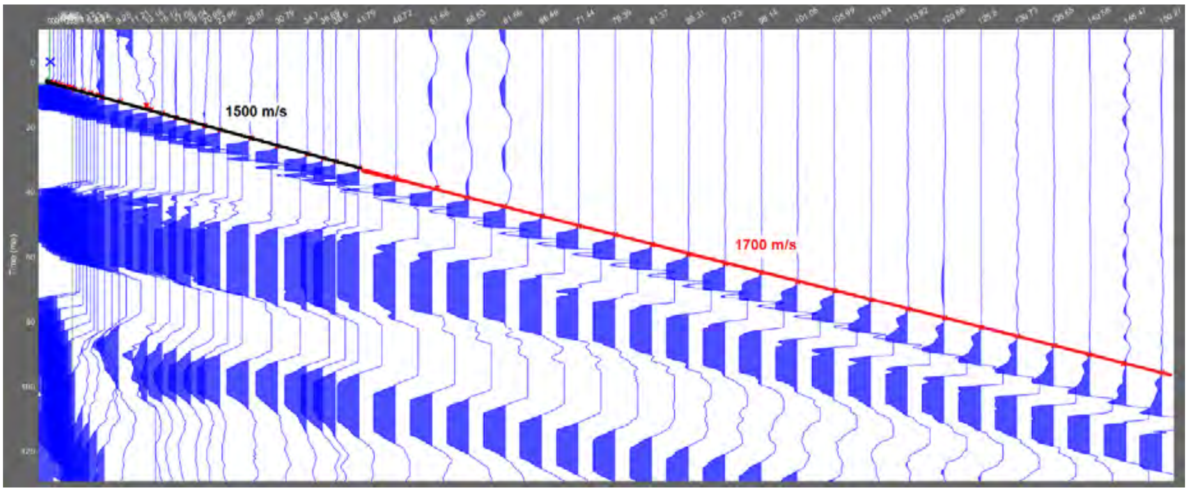


Figure 7.31: Typical seismic shot record

After processing, however, some profiles or part of profiles show constant low velocities, centered around 1500 m/s (+/- 30 m/s), which is equivalent to the water velocity. Figure 7.32 illustrates the lack of any faster, refracted arrival than the direct arrival (faster arrivals would combine to produce a flatter line on distant channels).

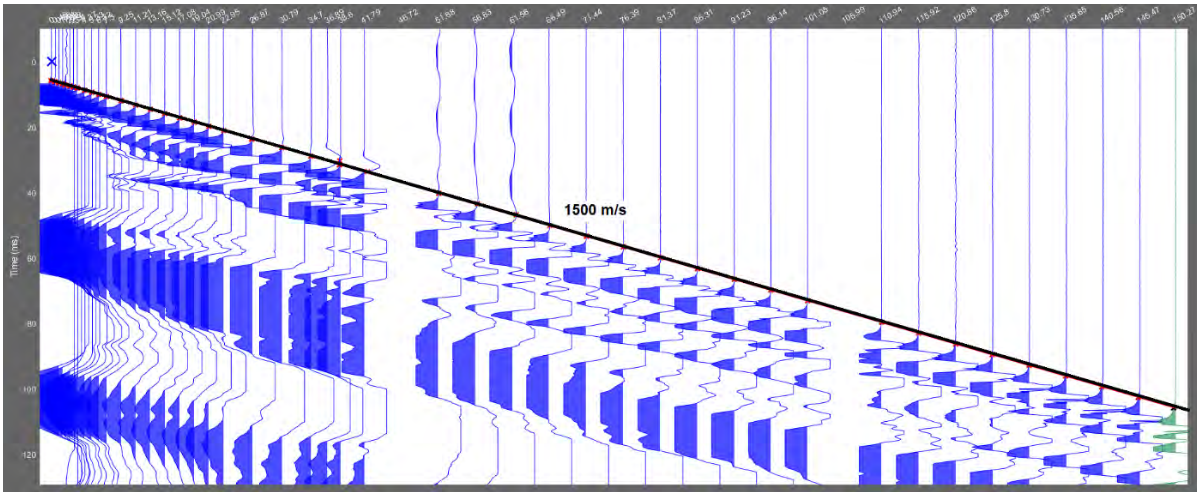


Figure 7.32: Seismic shot record showing no velocity variation

Two hypotheses could explain this observation:

1. The first layer is constituted of very soft sediment with velocities very close to the sea water. As the depth of investigation is dependent of the streamer length and of velocities variations, in this hypothesis, the minimum resolvable depth will be dependent of the thickness of the first layer and the velocity of the second layer. Figure 7.33 illustrate the minimum resolvable depth for 4 scenarios. We observe that for a first layer of 1500 m/s and a streamer length of 150 m, the minimum resolvable depth is comprised between 12 m (first layer thickness of 12 m and second layer velocity of 1600 m/s) and 40 m (first layer thickness of 40 m and second layer velocity of 2900 m/s). For those two layers velocities, a thicker first layer would not display any velocity variations on the hodochrones with a velocity centered around 1500 m/s.

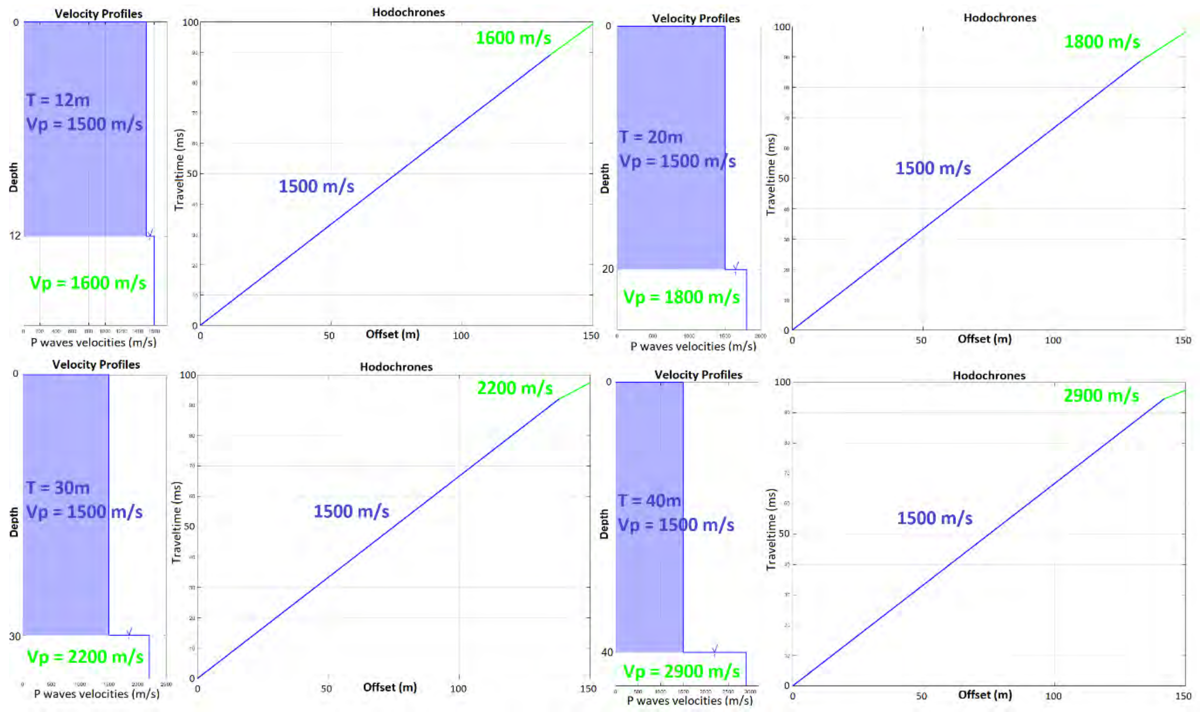


Figure 7.33: Minimum resolvable depth direct modulization for a first layer of 1500 m/s

2. The second possibility is that the first layer is made of sediment with gas content. Such soils are challenging to image with seismic methods that rely on compressional waves due to the high seismic attenuation capacity of gas (signal attenuation or diminution of the layer velocity with velocity lower than the water one). Consequently, in this kind of environment, it is usual to measure only the water velocity.

As, the SBP data confirm the presence of dispersed biogenic gas on a large area within the shallow sediments, and as the SBP data interpretation show a first layer thickness variations mostly comprise between 0.5 and 7 meters and exceptionally going to 12 meters for The Naaldwijk unit, we strongly believed that the Vp sections showing no velocity variation are the consequence of the presence of gas. For those profiles seismic refraction method was unable to provide any usable data.

The full process of refraction data shows that these profiles are located in the navigation channel and at the south of it. Figure 7.34 represents their localisations.

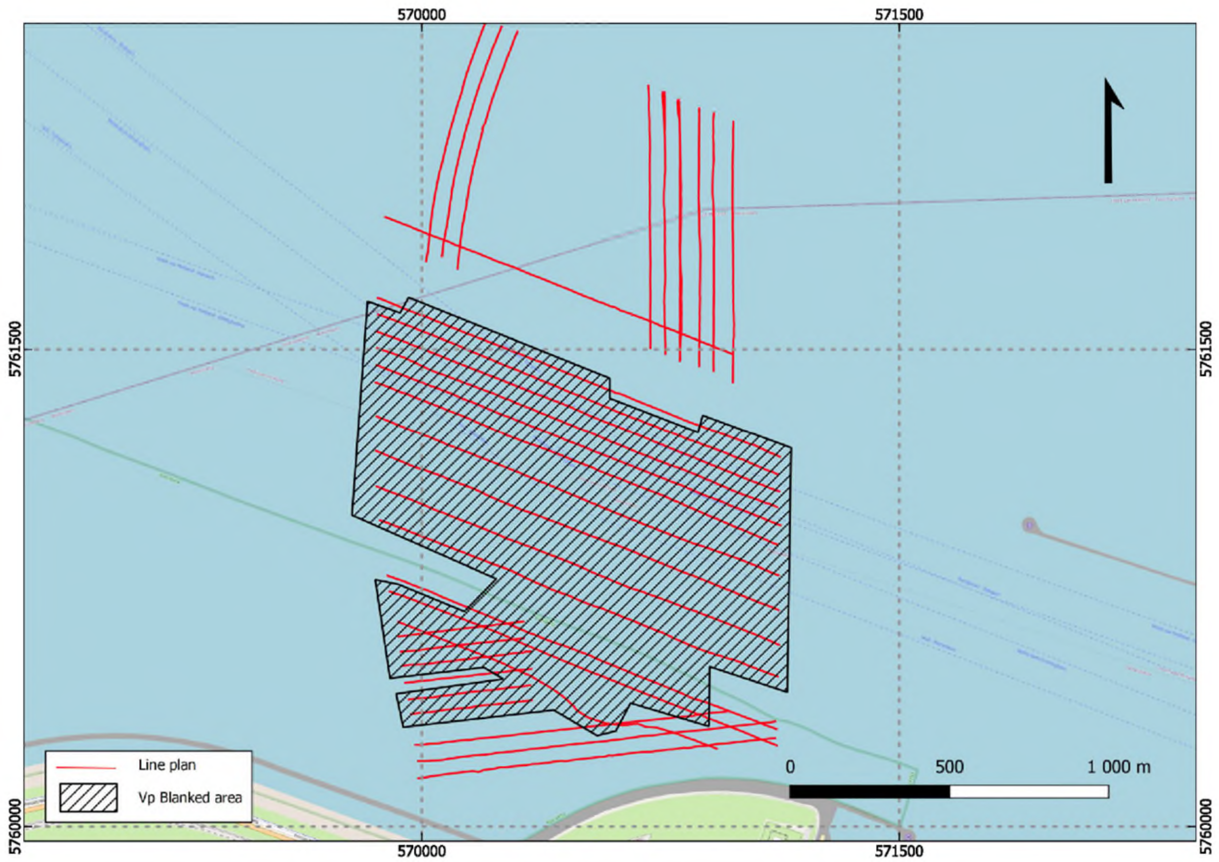


Figure 7.34: Map representation of the Vp blanked area

Profiles located to the north of the navigation channel and next to the shoreline are of good to very good data quality. They show Vp velocities comprises between 1450 and 1900 m/s that are characteristic of sedimentary layers.

7.7.2 MASW Analysis

The MASW processing of GAMBAS data involves four main steps:

1. Merge bathymetric, positioning and seismic data;
2. Signal pre-processing;
3. Picking of the dispersion curve;
4. Definition of a Vs model by inversion of the dispersion curves.

Data were checked on site during acquisition and the seismic signal plotted and controlled in the phase velocity – frequency domain.

All raw MASW data show a strong guided wave (Figure 7.35). Guided waves are a kind of wave which develop on the soil when its upper and lower boundaries are free of traction (presence of gas or very soft materiel). Their velocity is a bit higher than the Rayleigh waves and they trend to mask a part of the signal we are looking for.

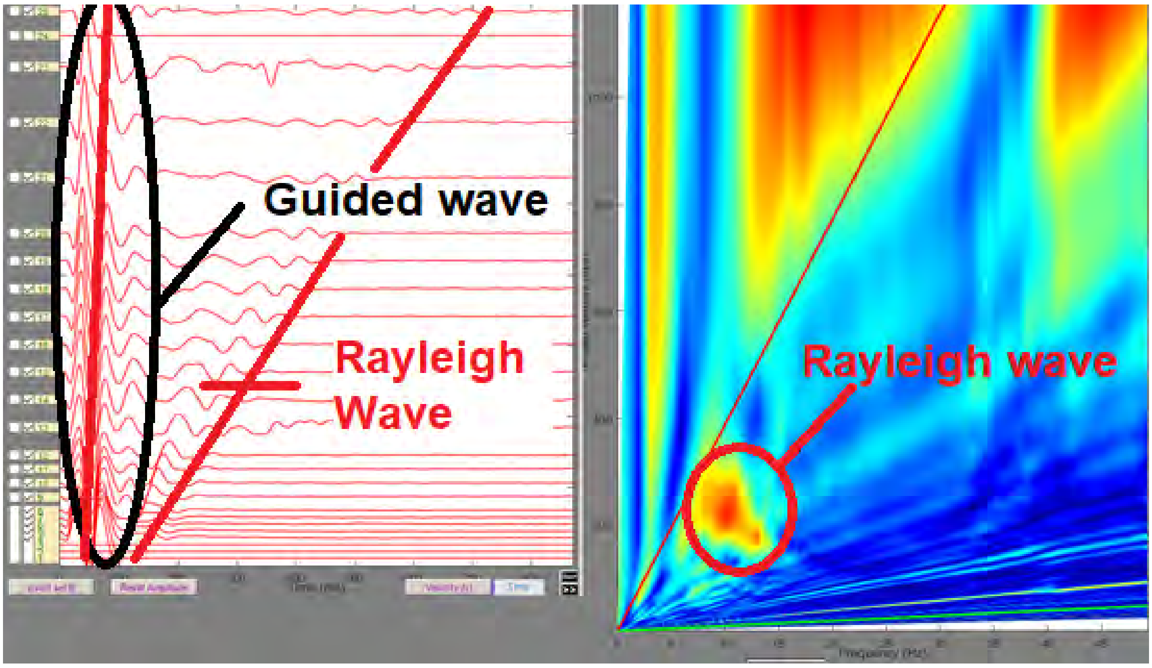


Figure 7.35: Example of MASW record without filtering

To process correctly the data, guided wave need to be filtered. Most of the time, this process is enough to allow a good extraction of the Rayleigh wave dispersion. Figure 7.36 below, presents the same signal after processing.

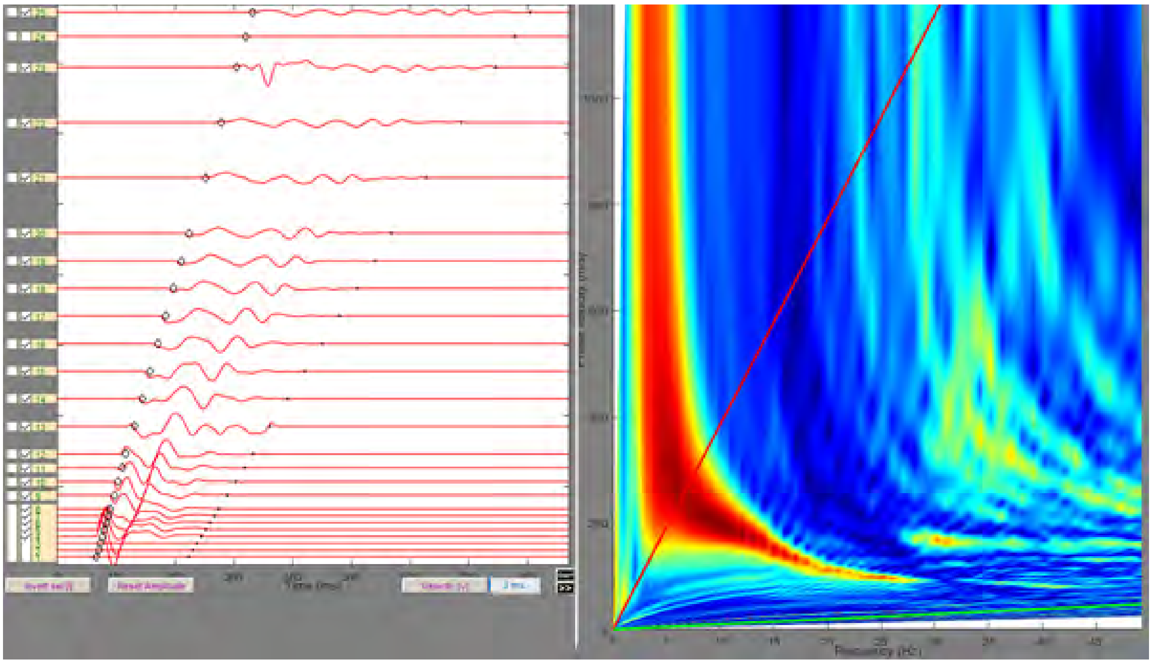


Figure 7.36: Example of MASW record after filtering.

However, when the guided wave velocity becomes too close to the Rayleigh wave ones, it could lead to a degradation of the dispersion of the Rayleigh wave.

In some area we can observe a weak but detectable fundamental mode (Figure 7.37). For those shots Vs resulting models are considered to be reliable. A good consistency of the adjacent profiles is observed when comparing them against one another.

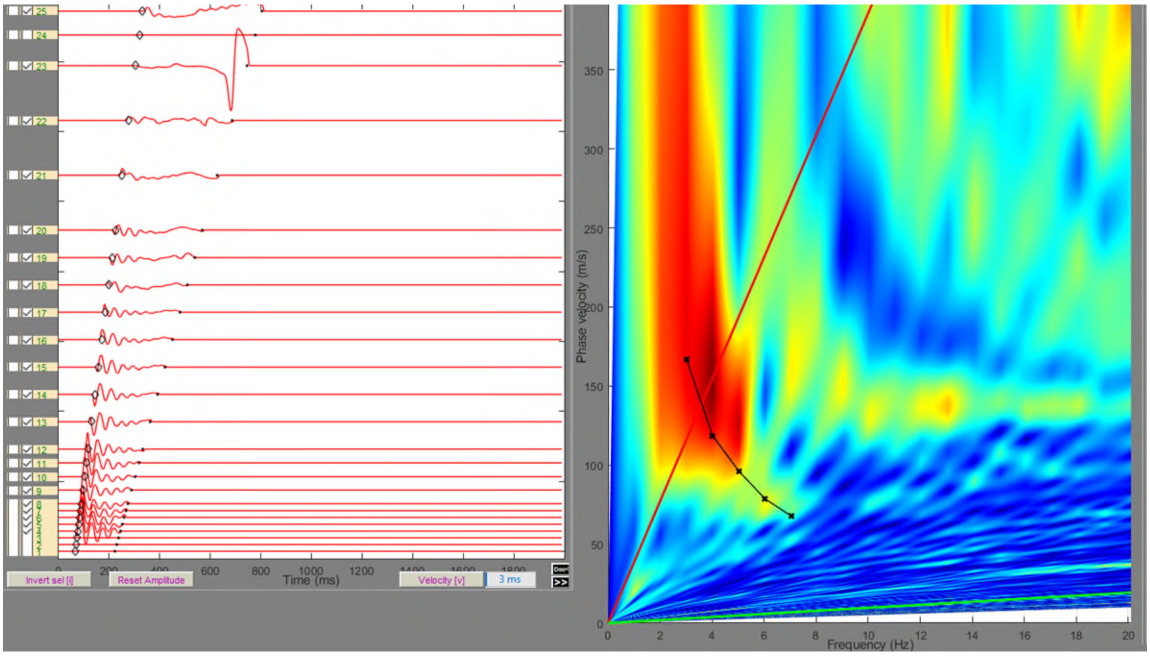


Figure 7.37: Example of moderate MASW record signal.

Other areas show no Rayleigh wave dispersion and consequently no MASW results could be presented.

The full process of MASW data shows that these areas are mostly located in the navigation channel and at the south of it. Figure 7.34 represents their localisations.

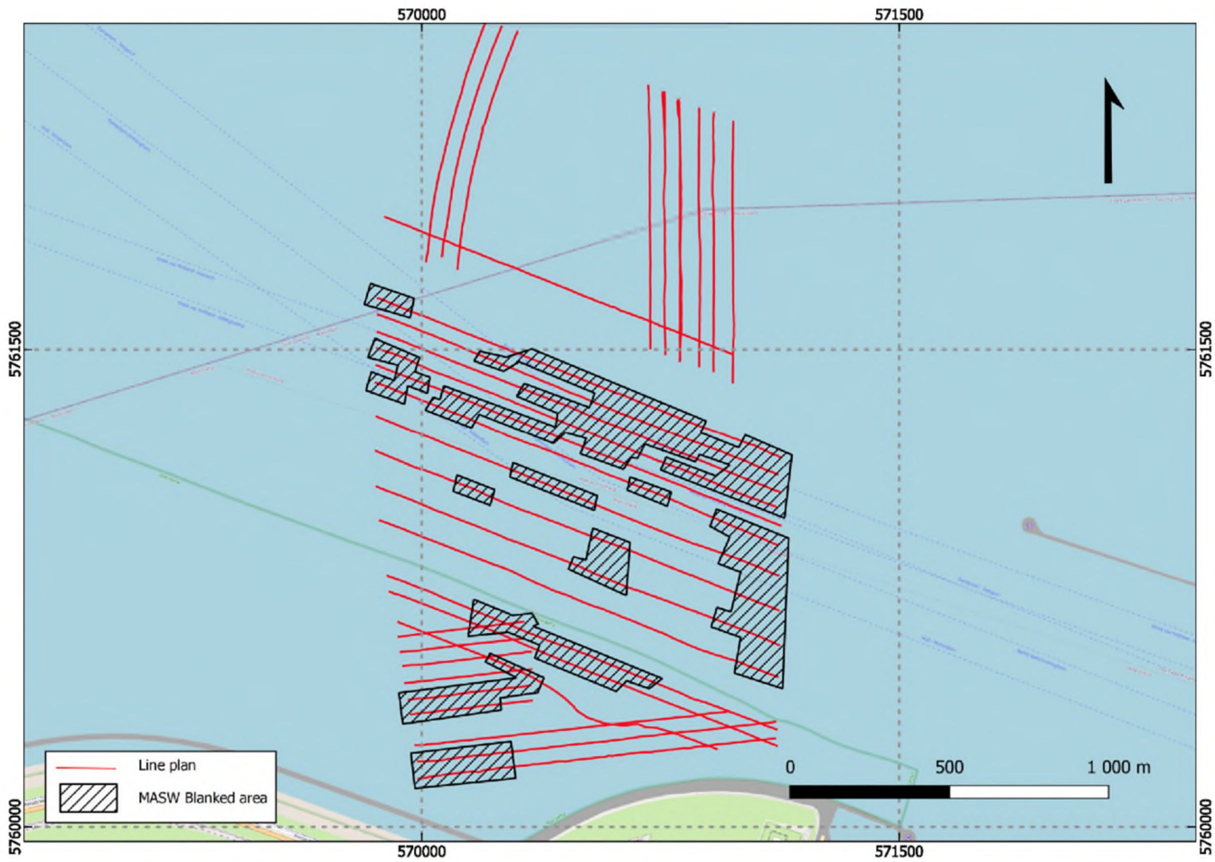


Figure 7.38: Map representation of the MASW blanked area

Area that are not blanked in the navigation channel and at the south of it are generally of moderate to good MASW data quality.

Profiles located to the north of the navigation channel are of good to very good data quality.

These profiles show Vs velocities comprises between 70 and 400 m/s that are characteristic of sedimentary layers.

8. Interpretation

8.1 Bathymetry

An overview of the bathymetry and the relative seafloor gradient within the near shore area (Block A & B) is shown in Figure 8.1. The overall water depth varies between 1.83 m and 31.98 m LAT. The statistics plot of the bathymetry of the near shore area is shown in Table 8.1.

Table 8.1: Statistics of MBES data of Block A and B

MBES data	Min [m]	Max [m]	Range [m]
Block A & B	-31.98	-1.83	30.15

The bathymetry shows clearly the dredged Maasmond Kanaal (navigation channel) within the near shore investigated area (Block A & B). This anthropogenic channel has a width of 833 m and maximum depth of 31.98 m LAT. The southern part of the dredged Maasmond Kanaal has an average depth of 24.50 m LAT and it is intersected by dredging scours.

From shore to the dredged Maasmond Kanaal the bathymetry decreases gradually from 1.83 m LAT to 24.50 m LAT.

From the dredged Maasmond Kanaal to offshore the bathymetry increases gradually from 18.50 m LAT to 16.10 m LAT.

The southern and the northern parts of the dredged Maasmond Kanaal is intersected by a mostly flat seafloor with localised areas of bedforms (such as ripples, megaripples and sand waves) and some areas of irregular seabed. Most of the near shore area is characterised by gentle seafloor slopes of 1°- 3°. In proximity to the dredged Maasmond Kanaal the gradient exceeds 10° (Figure 8.1 and Figure 8.2).

The bathymetry data clearly shows the dredged trenches of the recently posed HKZ cables (Kabel van windgebied HK (zuid) naar Maasvlakte).

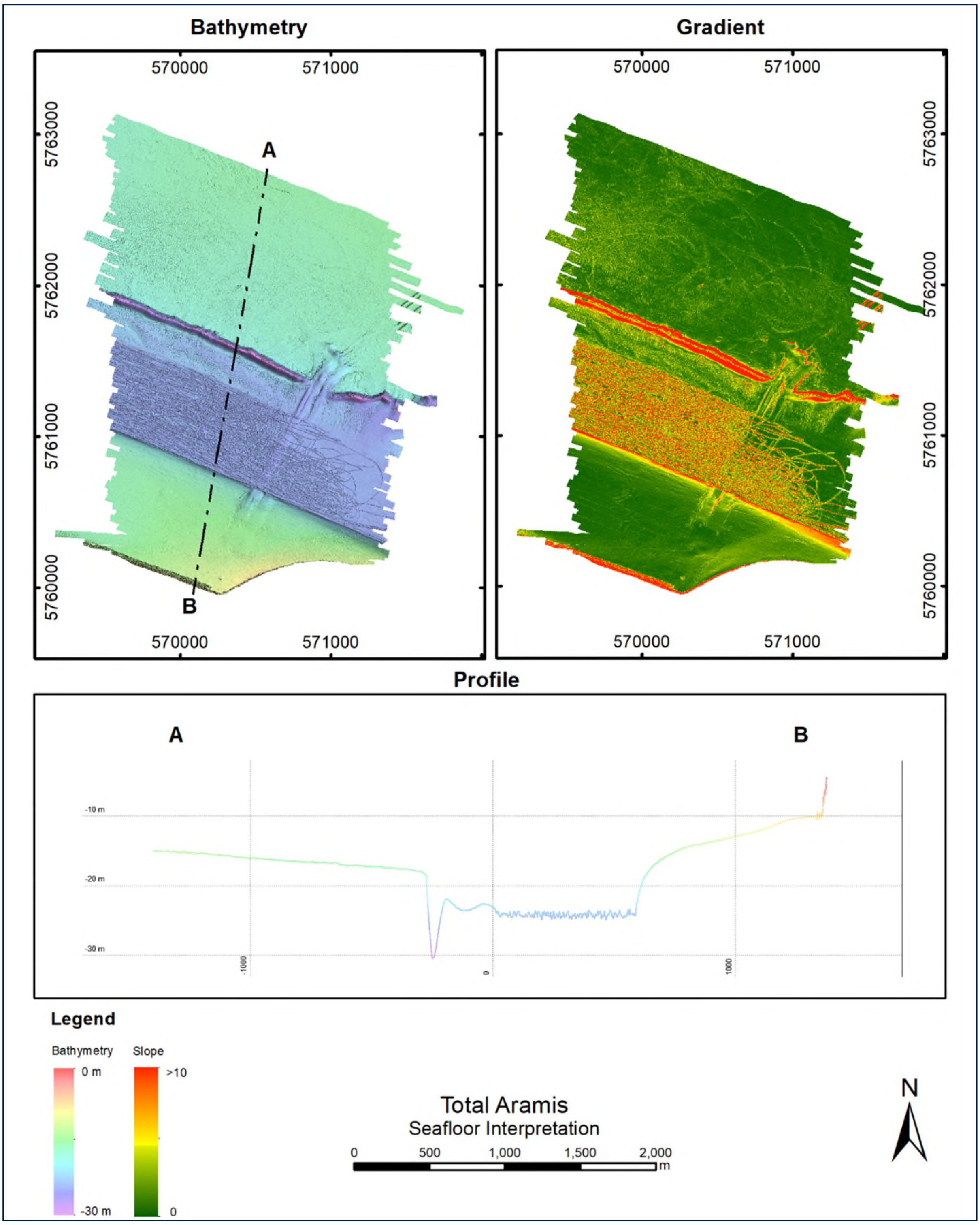


Figure 8.1: Bathymetry and gradient data of the near shore area (Block A&B), example of profile section 1

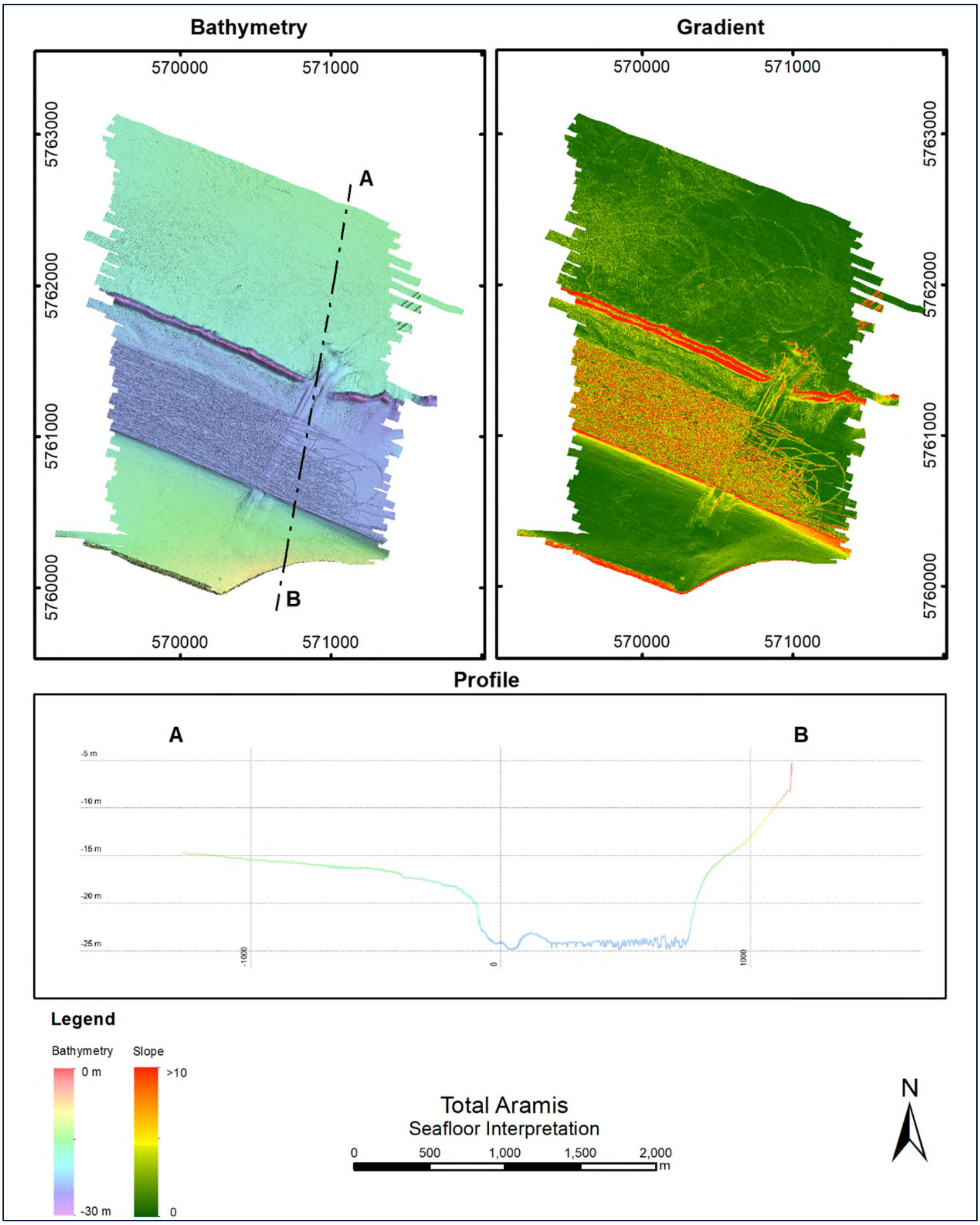


Figure 8.2: Bathymetry and gradient data of the near shore area (Block A&B), example of profile section 2

8.2 Seafloor Characterisation

Seafloor characterisation was interpreted from variations in the reflectivity of the high frequency SSS data and the backscatter, the seafloor features have been identified from the bathymetry and from the gradient data. An overview of the seafloor sediment and seafloor features interpreted over the survey area is presented in Figure 8.3.

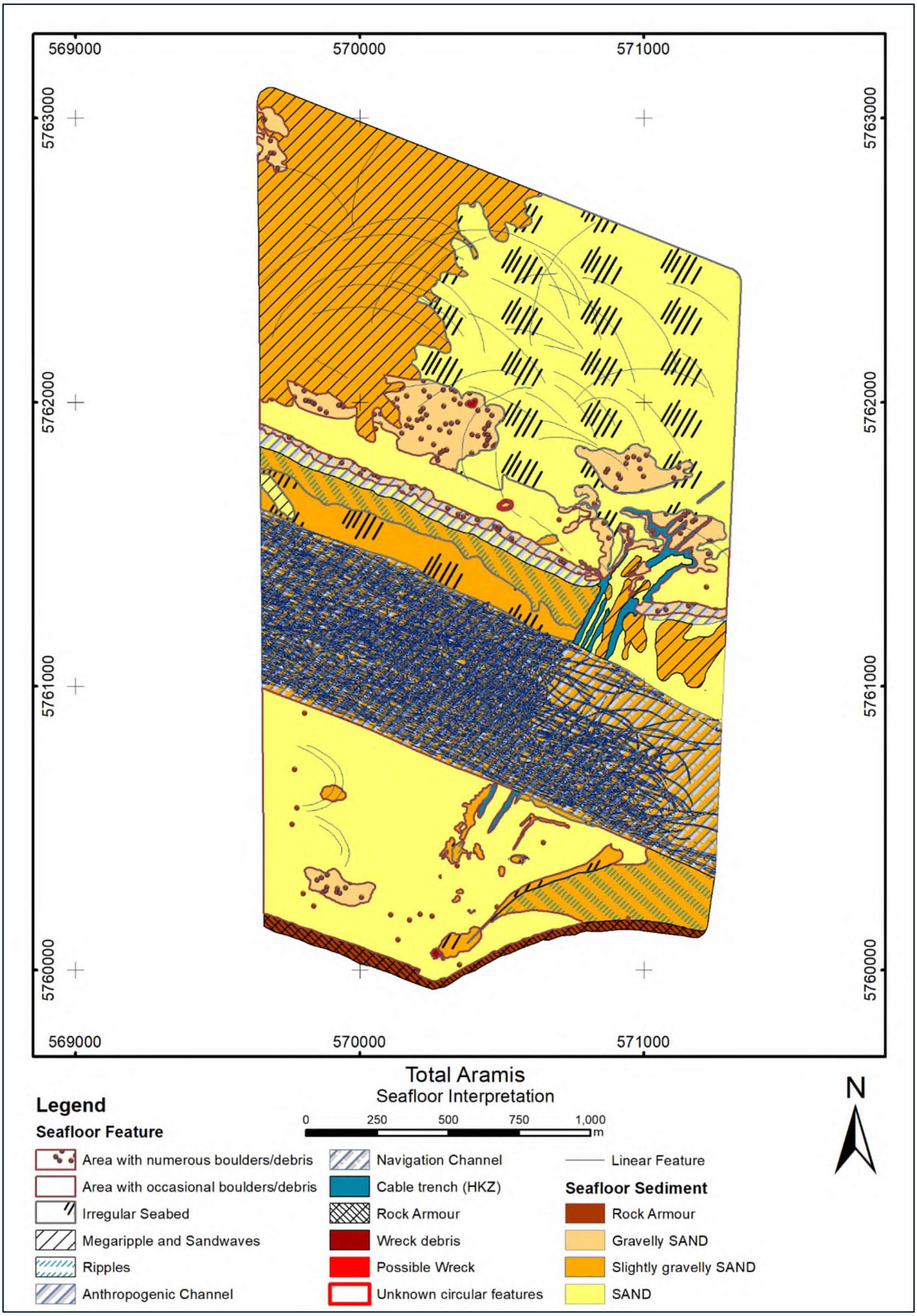


Figure 8.3: Overview of the seafloor sediment and seafloor features interpreted over the survey area

8.2.1 Seafloor Morphology

The near shore area is part of a dynamic landscape where Quaternary formations have been shaped by different geological processes and continue to be modelled by marine conditions to the present day.

Marine currents have mobilised and redistributed surficial sediments, creating bedforms of different scales and representing different orders of magnitude as well as erosional features.

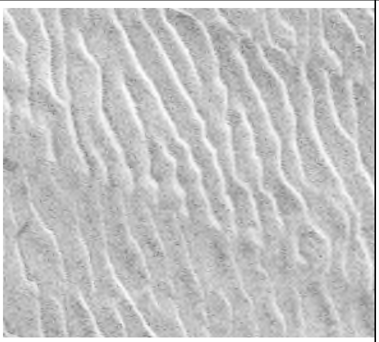
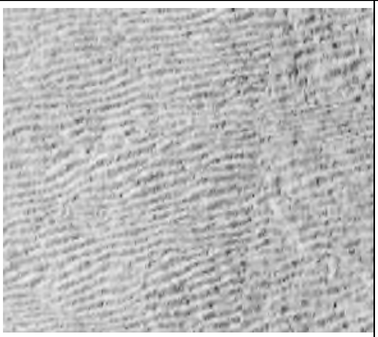
Seafloor morphology interpretation was based on the combination of data from MBES and SSS. The data analysis was carried out using acoustic characteristics such as overall pattern, roughness and reflectivity.

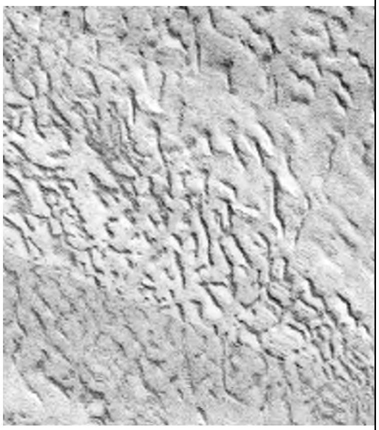
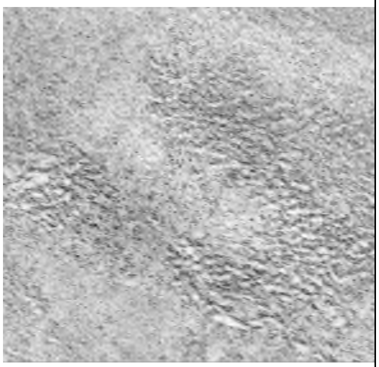
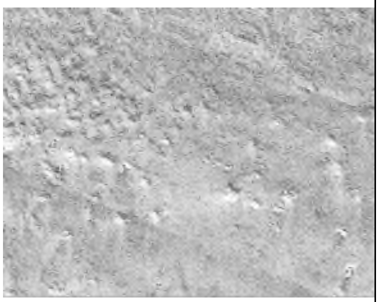
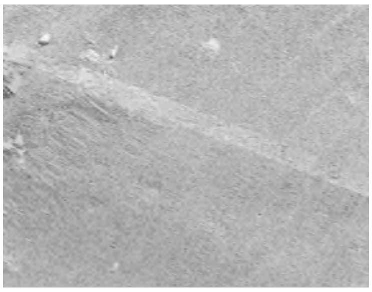
The following morphological characteristics were identified in the near shore area:

- Bedforms (ripples, megaripples and sand waves)
- Irregular seafloor
- Area with numerous boulders/debris
- Area with occasional boulders/debris

The acoustic characteristics of the identified morphological types are summarized in Table 8.2.

Table 8.2: Acoustic characteristics of the identified morphological types

SSS Image	Acoustic Description	Morphological Interpretation
	Low to medium reflectivity	Megaripples and sand waves
	Low to medium reflectivity	Ripples

 	Medium to high reflectivity	Irregular seafloor
	Medium to high reflectivity	Area with numerous boulders
	Medium reflectivity	Area with occasional boulders

Most of the seafloor in the near shore area is intersected by anthropogenic features, nevertheless areas of megaripples and sand waves have been identified.

8.2.1.1 Bedforms

Two types of bedforms were identified in the near shore area:

- Megaripples and sand waves
- Ripples

These bedforms are produced by the action of bottom and tidal currents, which redistribute seabed sediments. The classification scheme by Ashley et al. 1990, was adopted in this report and is detailed in Table 8.3.

Table 8.3: Classification scheme for bedforms (modified from Ashley et al. (1990)

First Order Description				
Size				
Spacing	0.60 m to 5 m	5 m to 10 m	10 m to 100 m	>100 m
Height	0.075 m to 0.40 m	0.40 m to 0.75 m	0.75 m to 5 m	>5 m
Term	*Small (ripples)*	*Medium (megaripples)*	*Large (sand waves)*	*Very large (sand dunes)*
Shape				
2D	Symmetric or asymmetric			
3D	Sinuous or hummocky			
Second Order Description				
Superposition				
Simple	No bedforms superimposed			
Compound	Smaller bedforms superimposed			

Megaripples and sand waves can be found in topographical lows, where the sediment accumulates, and the currents rework the sediment creating these bedforms. In general, the observed shape is symmetric, and the orientation is north-west to south-east. Their wavelength ranges from approximately 5.0 m to 8.0 m and wave heights vary between 0.3 m and 0.9 m. These bedforms are mostly associated with slightly gravelly SAND as interpreted from SSS and MBES data (Figure 8.4).

In the near shore area, symmetrical (linear) ripples are the most common bedform type. These types of ripples are typically found in shallow coastal waters and sandy substrate. They have generally north-west to south-east orientation. Their wavelength ranges from approximately 3.0 m to 9.0 m and wave heights vary between 0.1 m and 0.3 m (Figure 8.5 and Figure 8.6). They are mostly associated with areas of slightly gravelly SAND as interpreted from the SSS and MBES data.

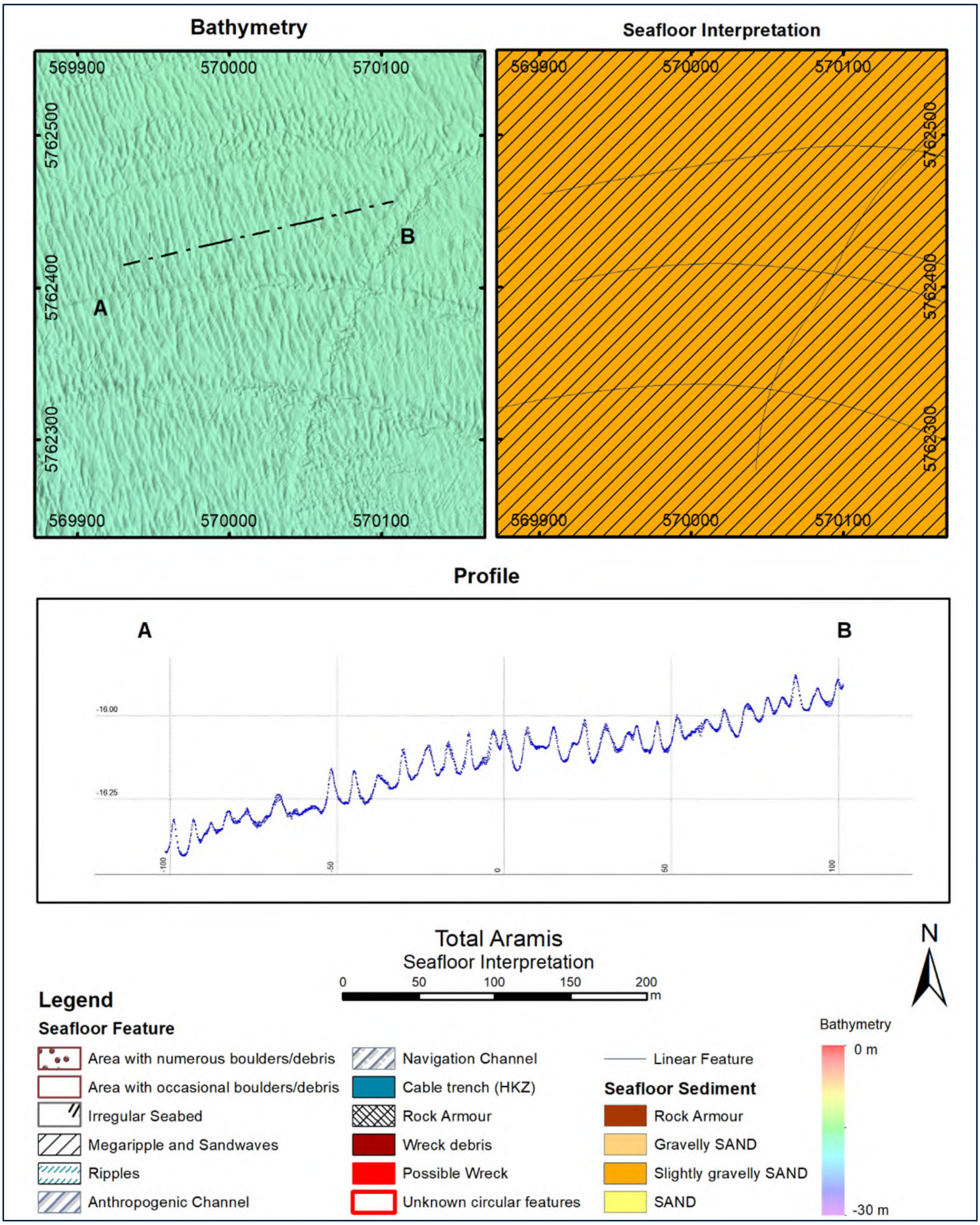


Figure 8.4: Example of bedform interpretation: megaripples and sand wave

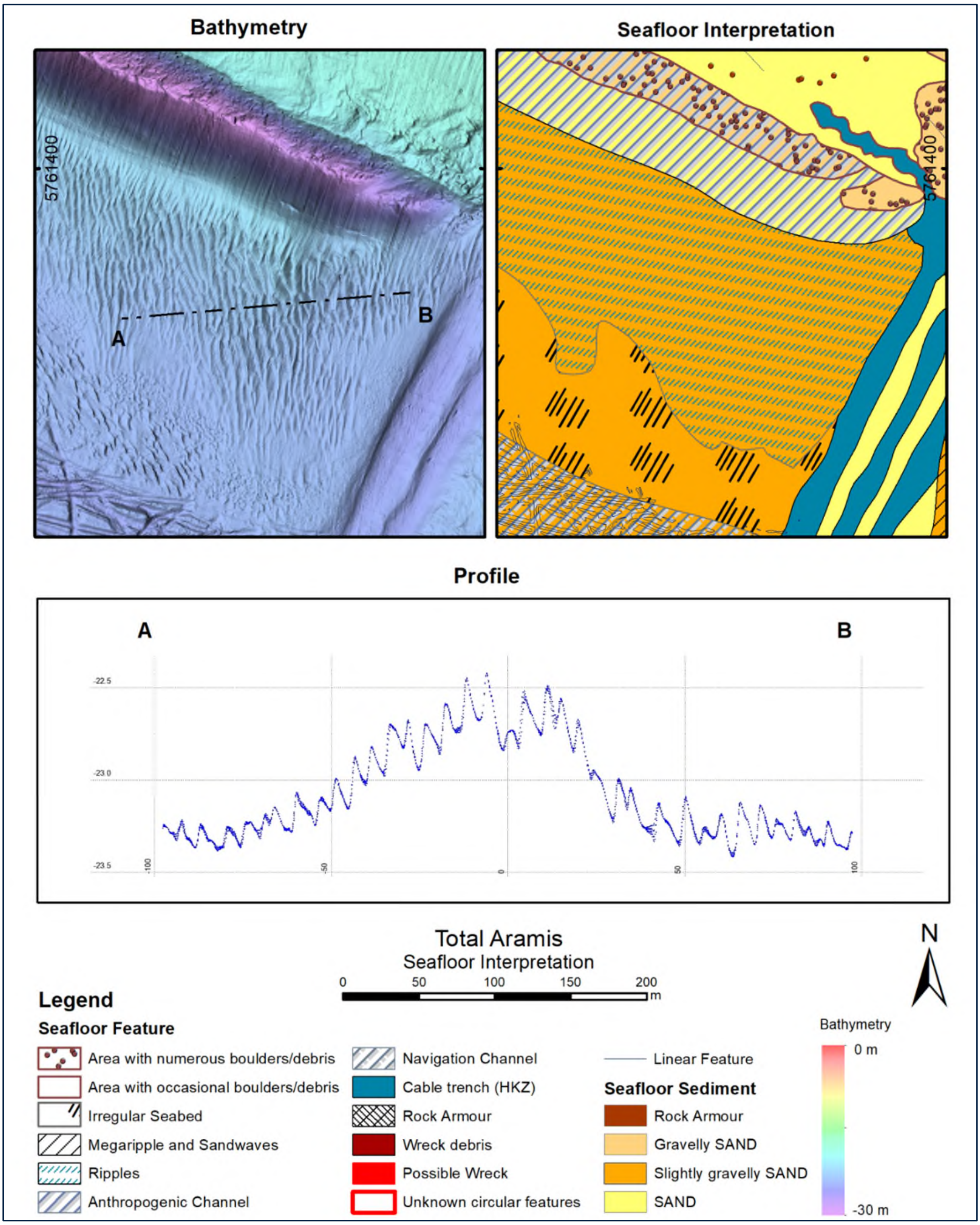


Figure 8.5: Example of bedform interpretation: ripples

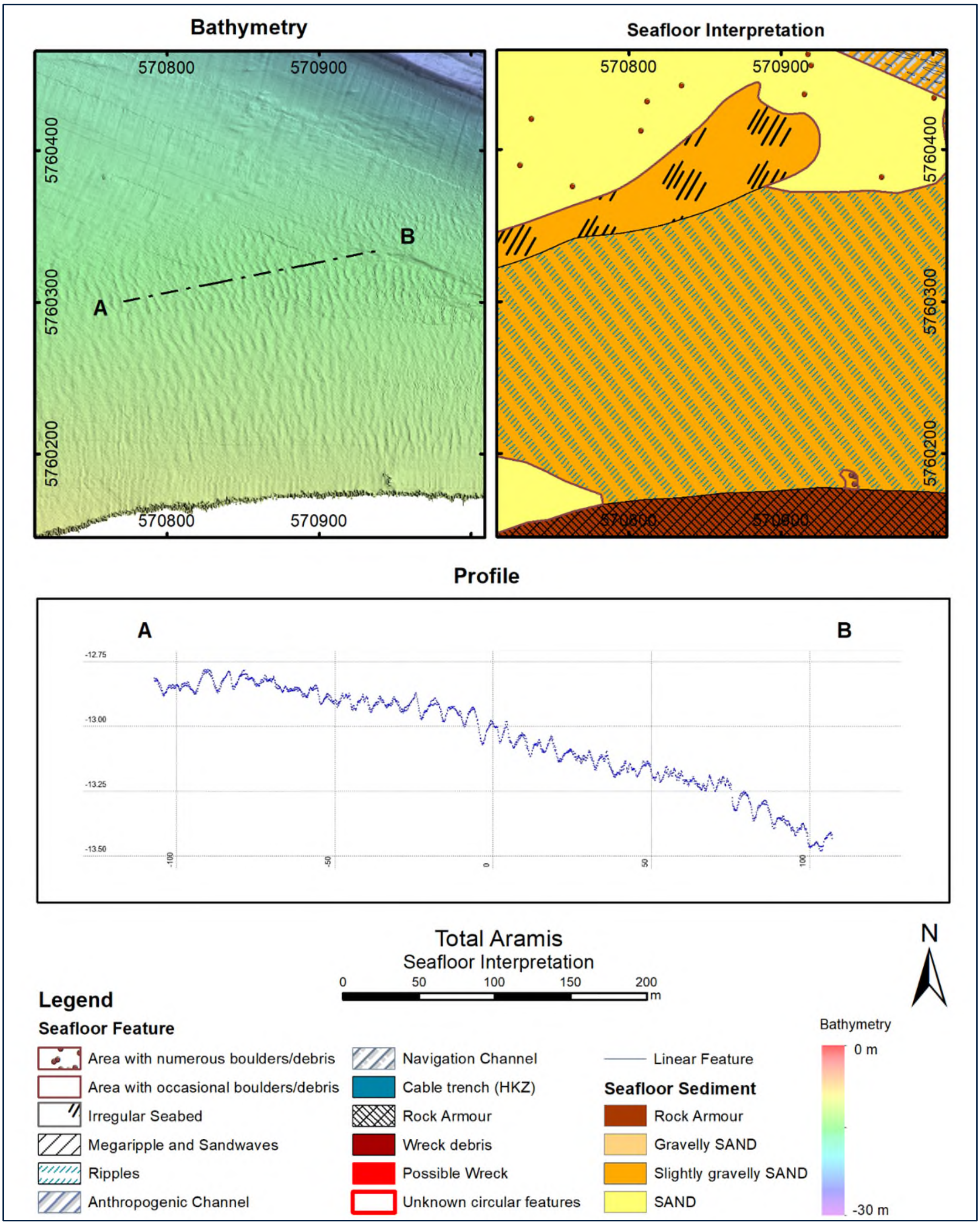


Figure 8.6: Example of bedform interpretation: ripples

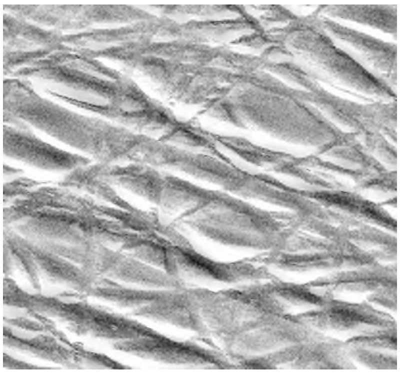
8.2.3 Seafloor Features

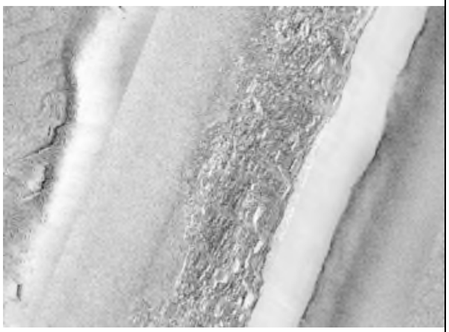
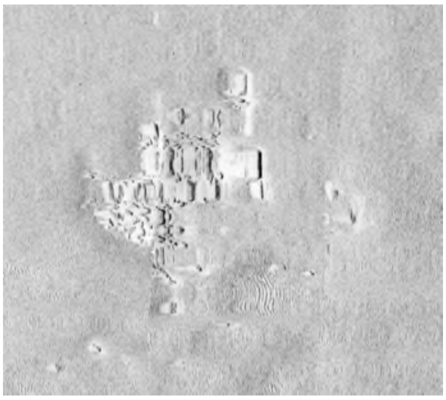
The following seafloor features were identified at the near shore area:

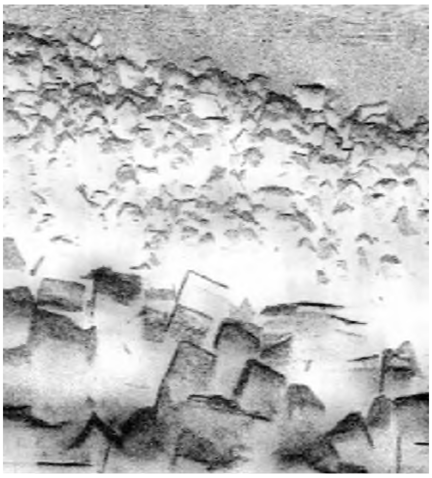
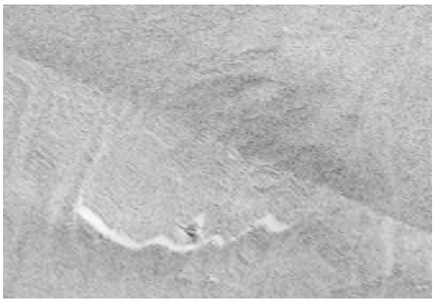
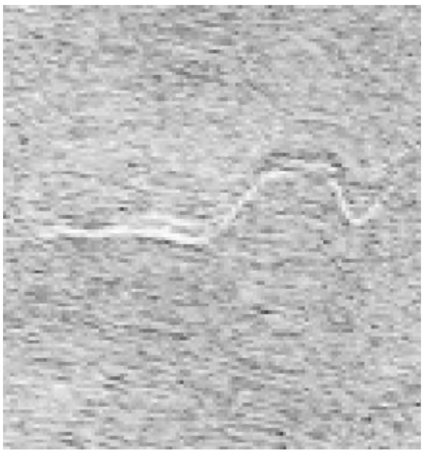
- Scours
- Sediment dumping features
- Anthropogenic channel
- Wreck debris and possible wreck
- Possible fishing gear
- Cable trench (HKZ)
- Rock armour
- Unknown circular features
- Unknown linear features

The acoustic characteristics of the identified seafloor features are summarized in Table 8.4.

Table 8.4: Interpretation of seafloor features

SSS Image	Acoustic Description	Features Interpretation
	Low to medium reflectivity	Scours
	Low to medium reflectivity	Sediment dumping features

	Low to high reflectivity	Anthropogenic channel
 	Low to high reflectivity	Wreck debris and possible wreck
	Low to medium reflectivity	Possible fishing gear

	Low to high reflectivity	Cable trench (HKZ)
	Low to high reflectivity	Rock Armour
	Low to high reflectivity	Unknown circular features
	Low to high reflectivity	Unknown linear features

The following pictures show examples of the interpreted seafloor features in the survey area. Figure 8.7 shows the interpreted trenches of the recently posed HKZ cables (Kabel van windgebied HK(zuid) naar Maasvlakte).

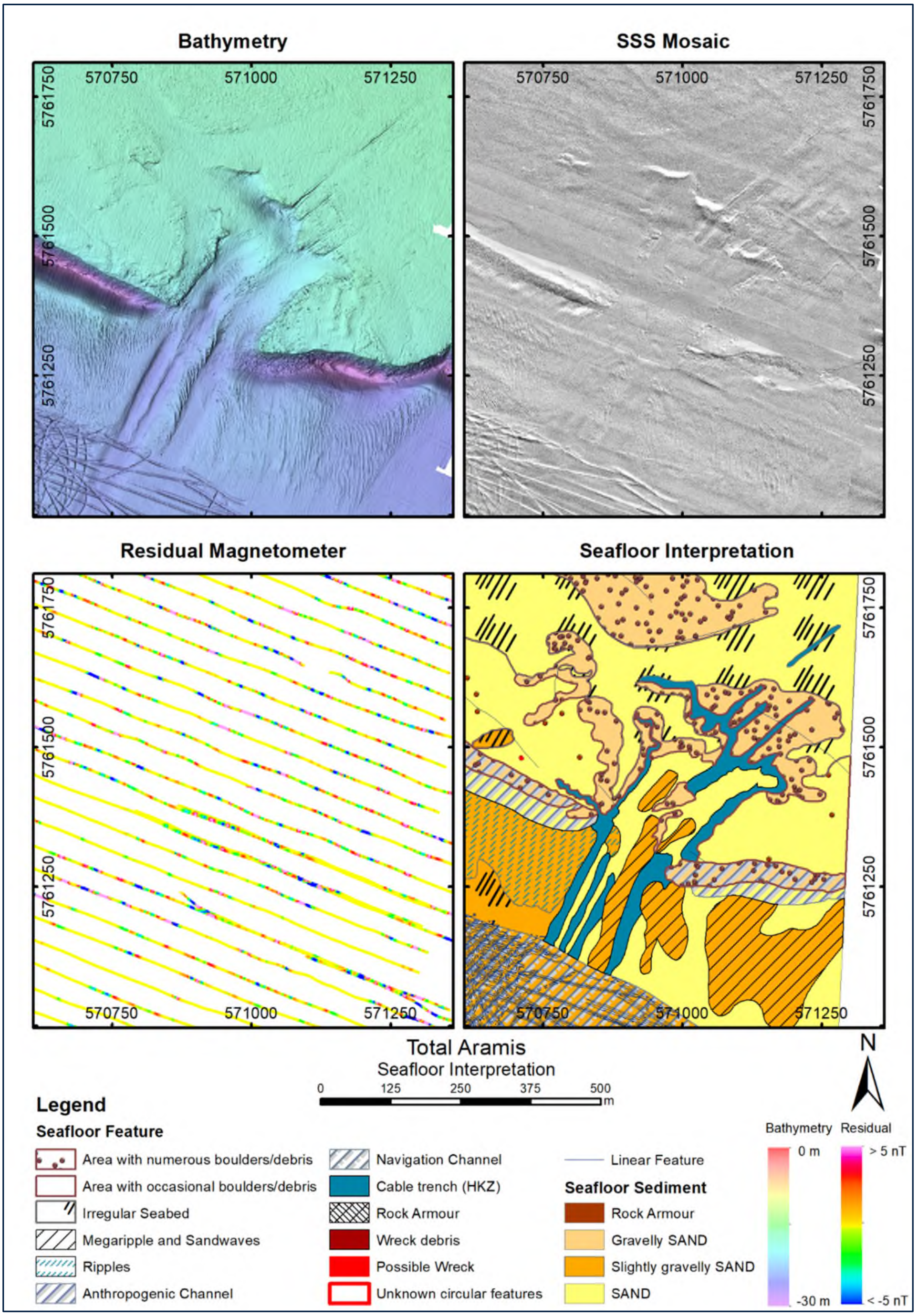


Figure 8.7: Trenches of the recently posed HKZ cables (Kabel van windgebied HK (zuid) naar Maasvlakte)

Examples of the dredged Maasmond Kanaal (navigation channel) and the dredging scour marks in the channel are shown in Figure 8.8 and Figure 8.9. The HKZ cable trenches and the relative magnetic signature visible in the magnetic residual grid are shown in Figure 8.8.

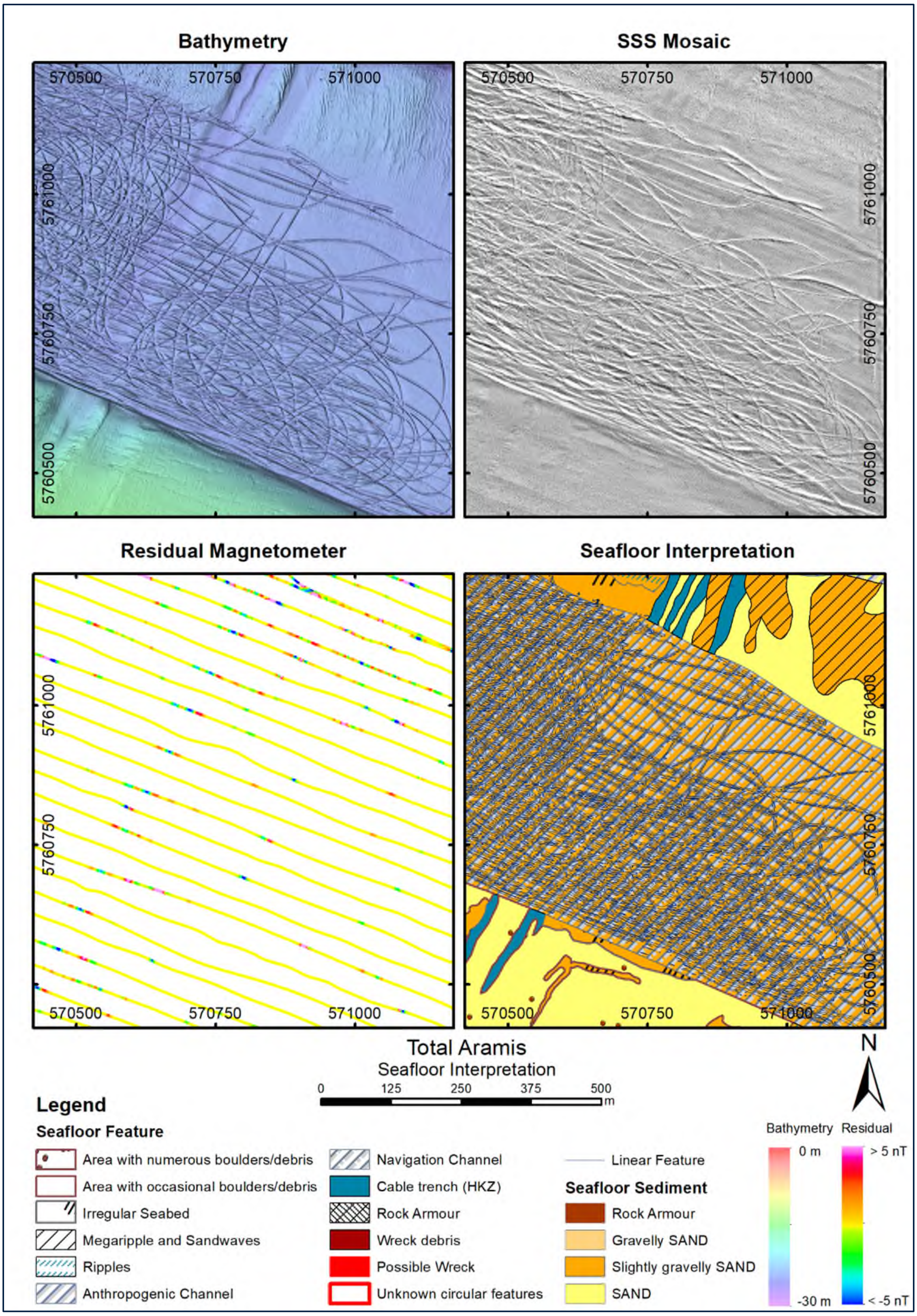


Figure 8.8: Example of the dredged Maasmond Kanaal and the dredging scours present in the channel. Trenches of the HKZ cables are also visible and the relative magnetic feature of the cable is visible in the residual magnetic grid

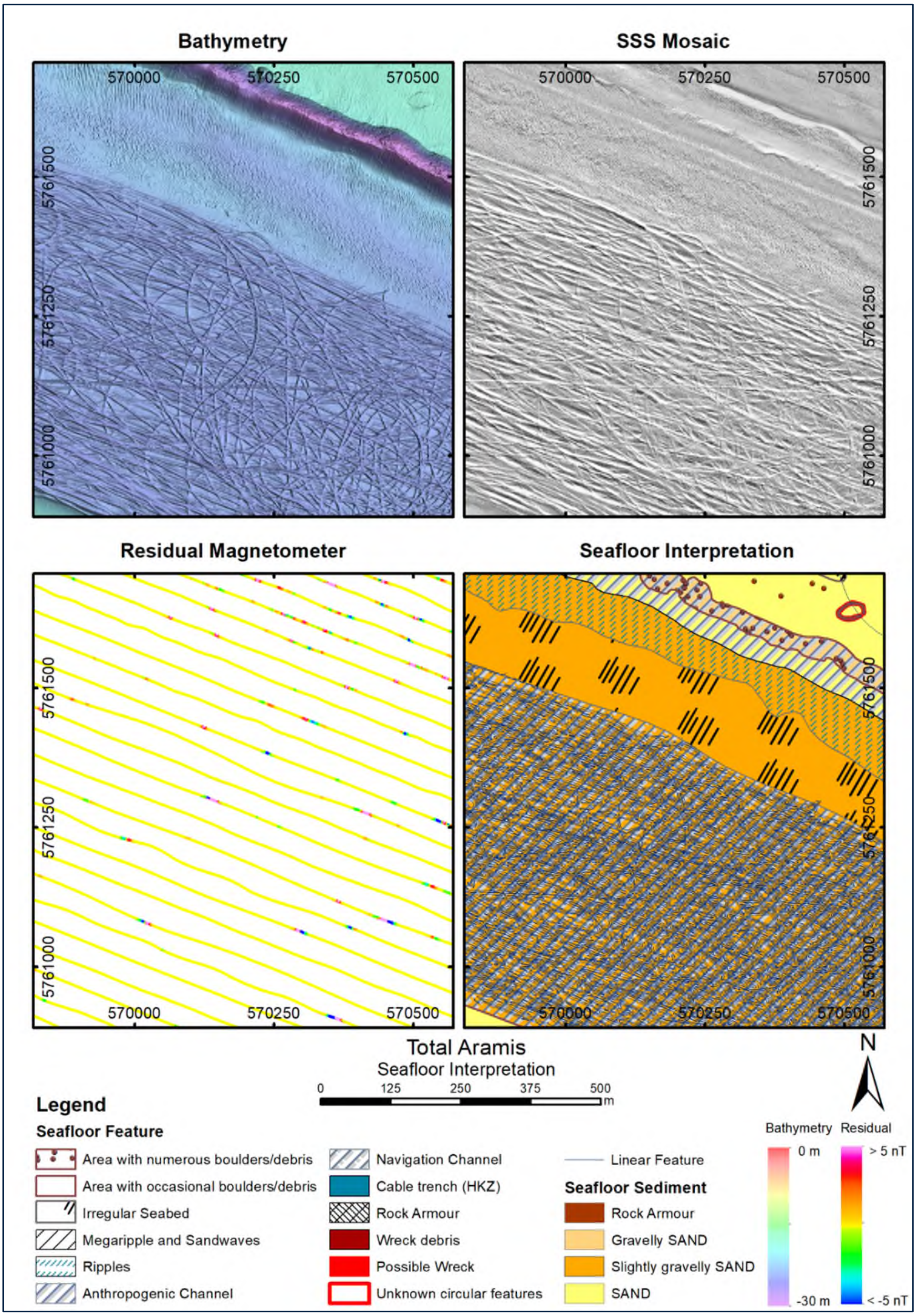


Figure 8.9: Example of the dredged Maasmond Kanaal and the dredging scours present in the channel

The south-east part of the Maasmond Kanaal up to the shore area is shown in Figure 8.10. The rock armour is visible and has been interpreted.

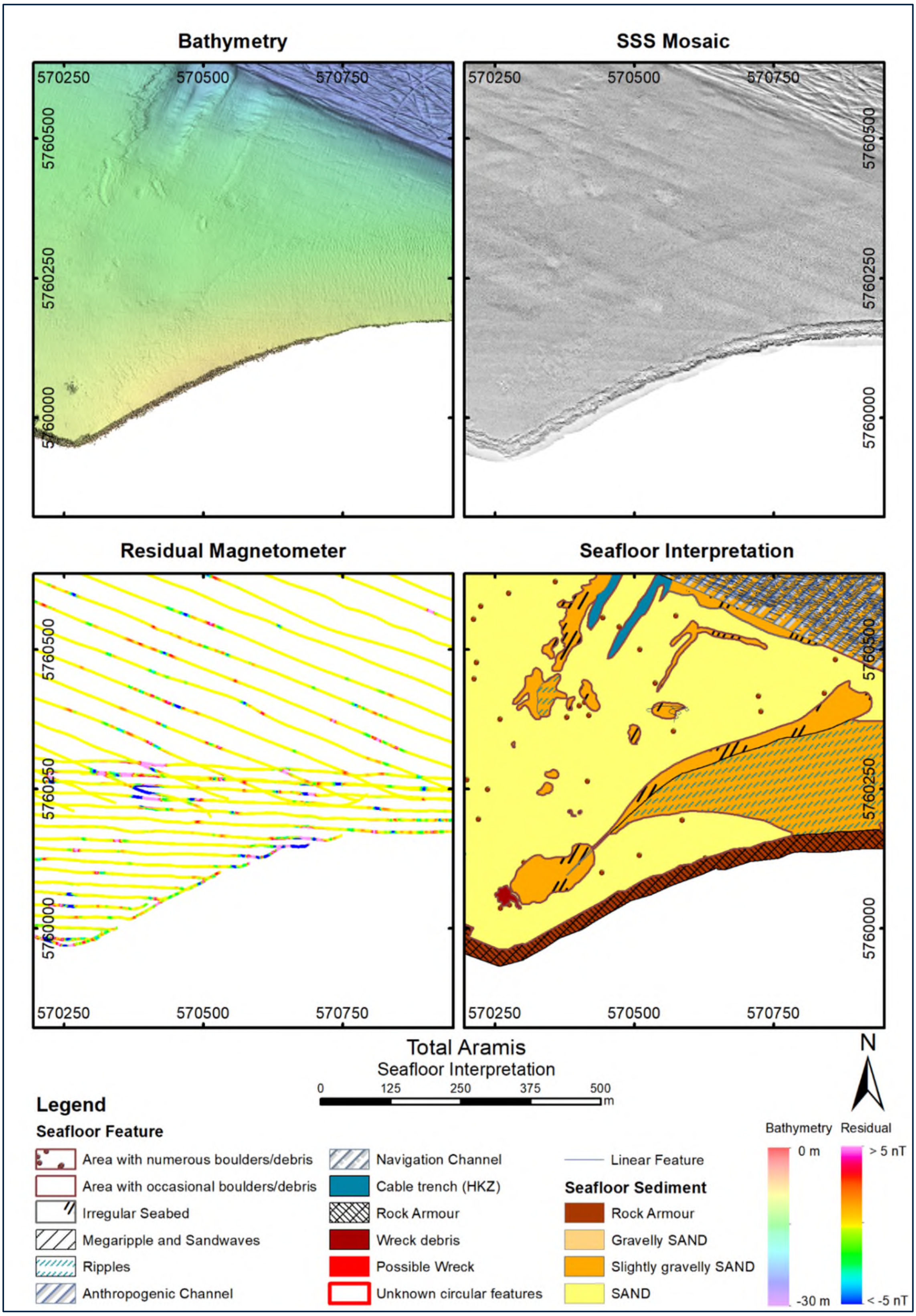


Figure 8.10: Overview of the interpetation of the southeast near shore area

The southwestern part of the Maasmond Kanaal up to the shore area is shown in Figure 8.11 The rock armour is visible and has been interpreted. This part is relatively free from morphological bedforms. There are few magnetic anomalies not correlated with evidence of surficial targets. For example, in Figure 8.12 a very large (> 300 nT) magnetic anomaly is visible and it is possibly related to the HKZ buried cables.

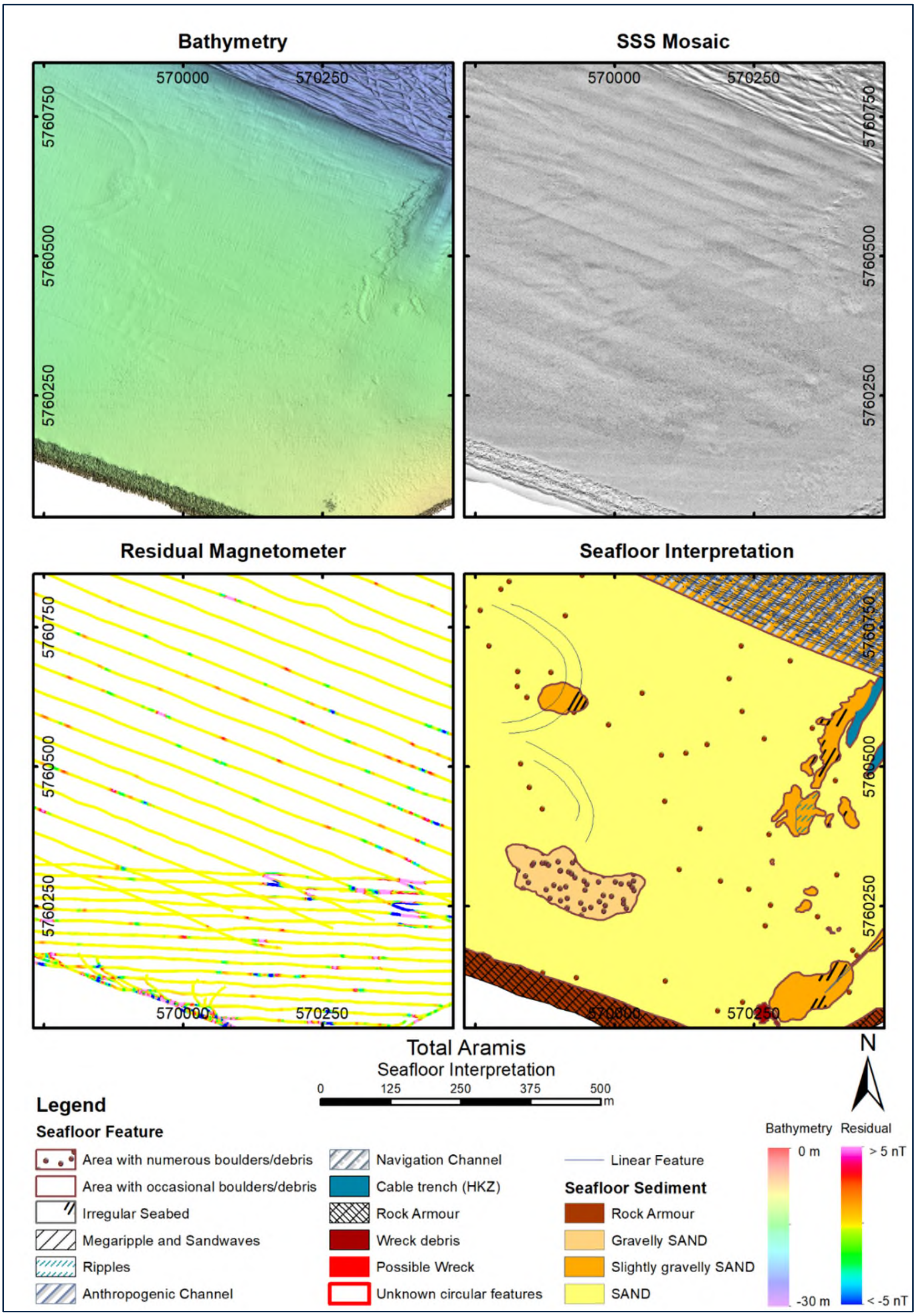


Figure 8.11: Overview of the interpetation of the southwest near shore area.

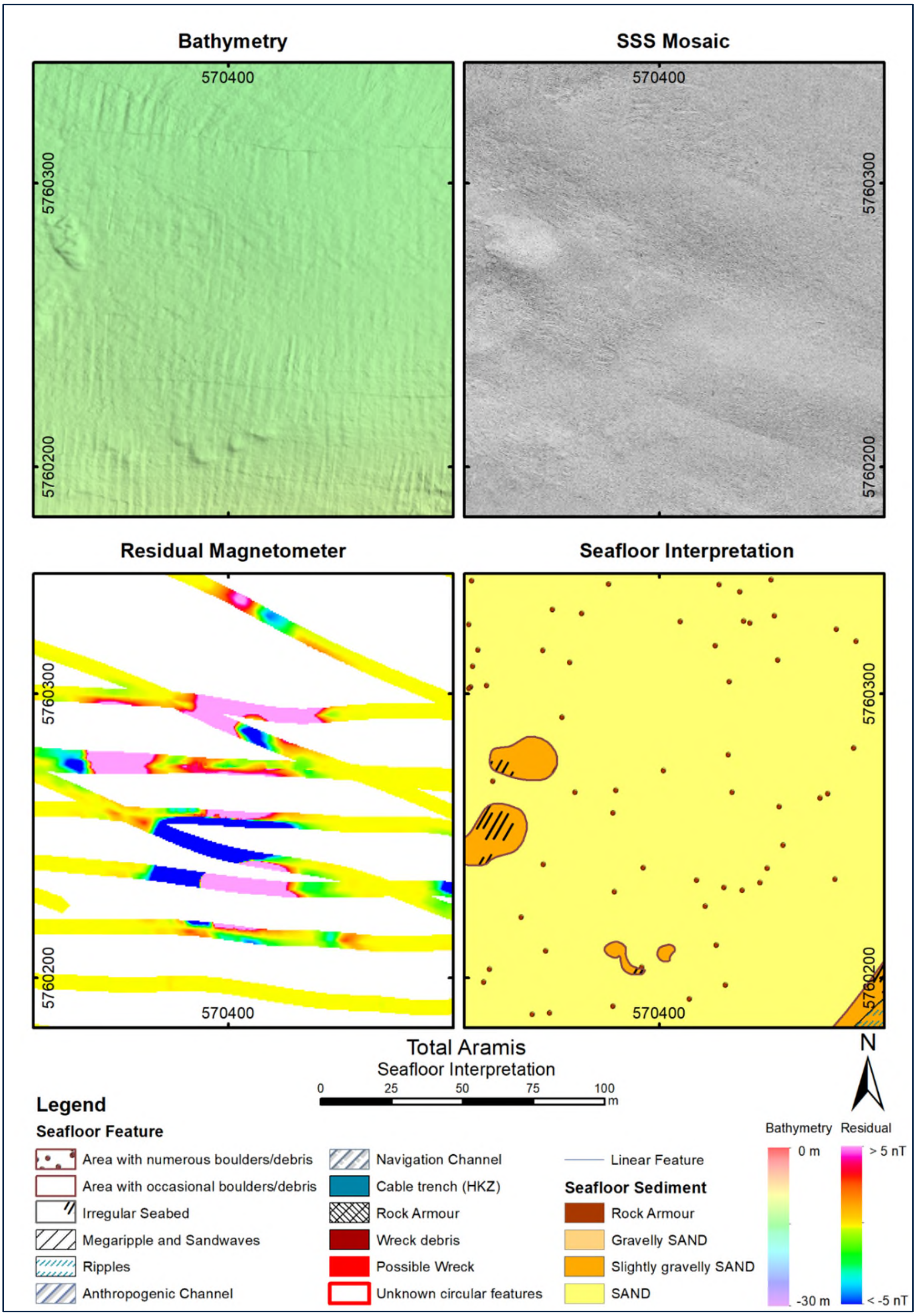


Figure 8.12: Detail of the interpetation of the southwest near shore area: MAG anomaly detected probably related to the HKZ buried cables

The interpretation of the area from the Maasmond Kanaal to offshore is shown in Figure 8.13. This area is intersected by semi - circular linear features that can possibly be related to sediment dumping after dredging the Maasmond Kanaal.

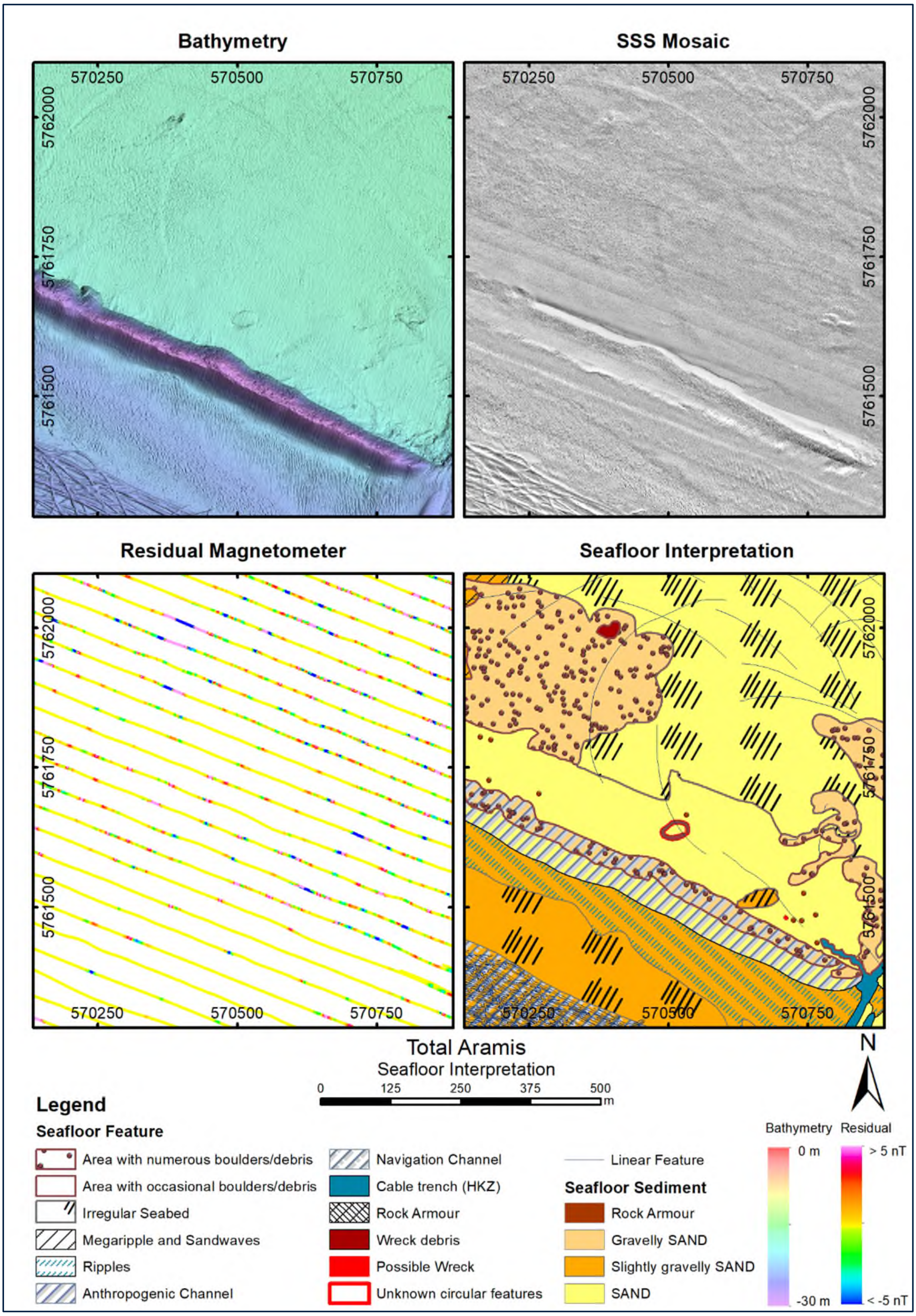


Figure 8.13: overview of the seafloor interpretation

In this area an unknown circular feature (Figure 8.14) has been interpreted and is possibly related to an archaeological site.

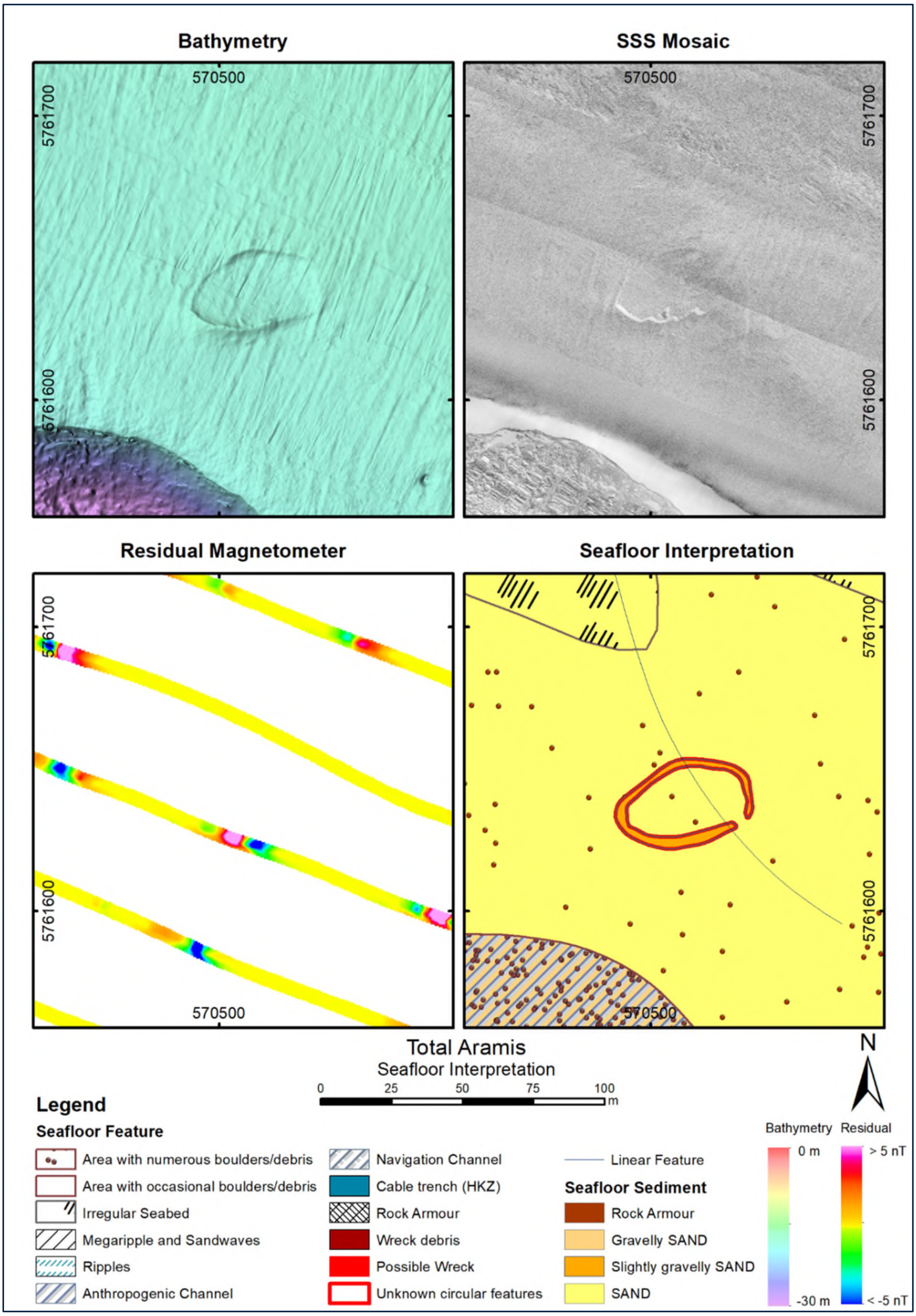


Figure 8.14: Circular unknown feature interpreted in the survey area

The MBES profiles of the interpreted unknown circular features is shown in Figure 8.15. This feature has a length of 47.7 m, a width of 24.8 m and a maximum depth of 0.54 m.

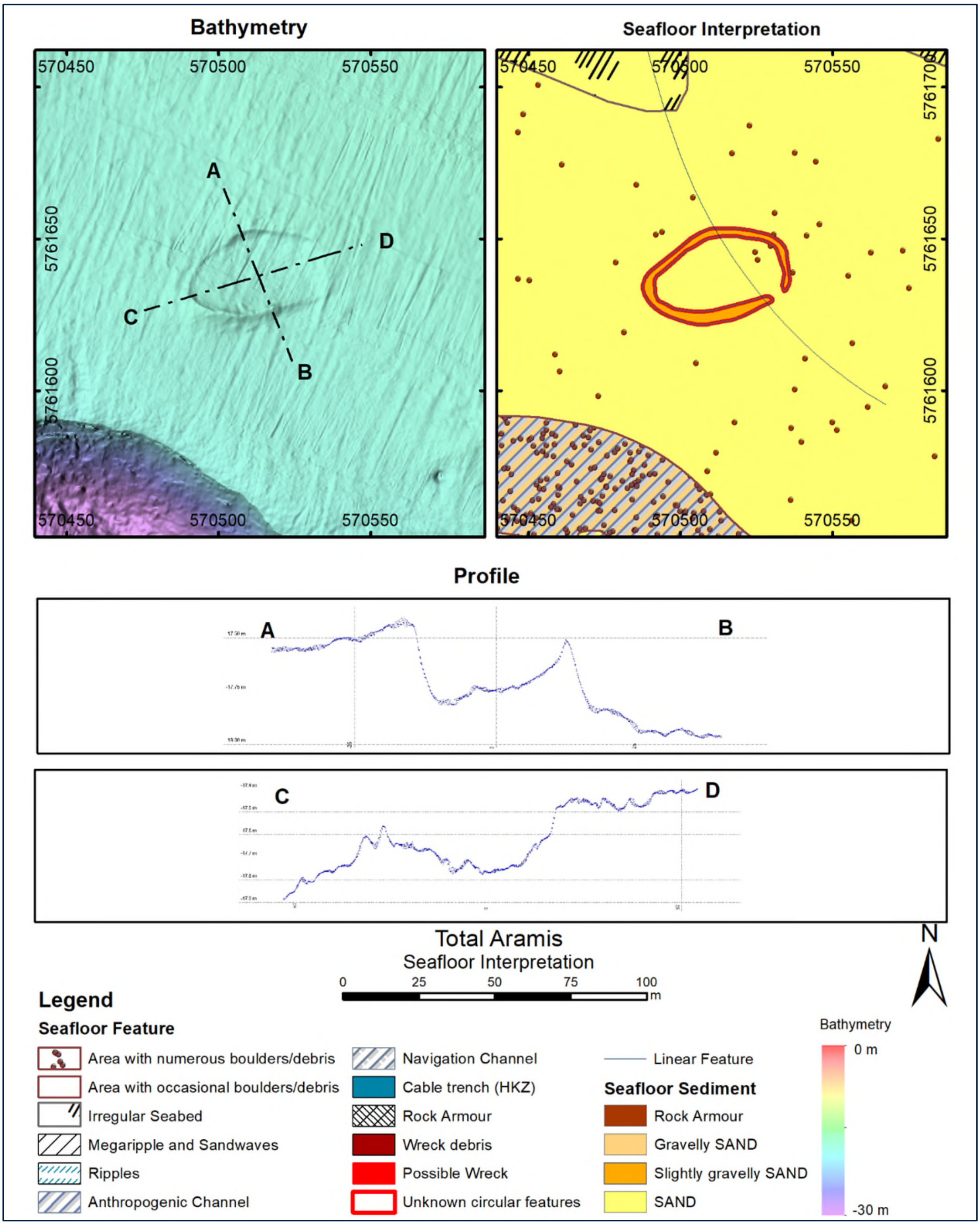


Figure 8.15: MBES profiles of the interpreted unknown circular features

The near shore area contains two wreck debris areas, and they are presented in Figure 8.16 and Figure 8.17.

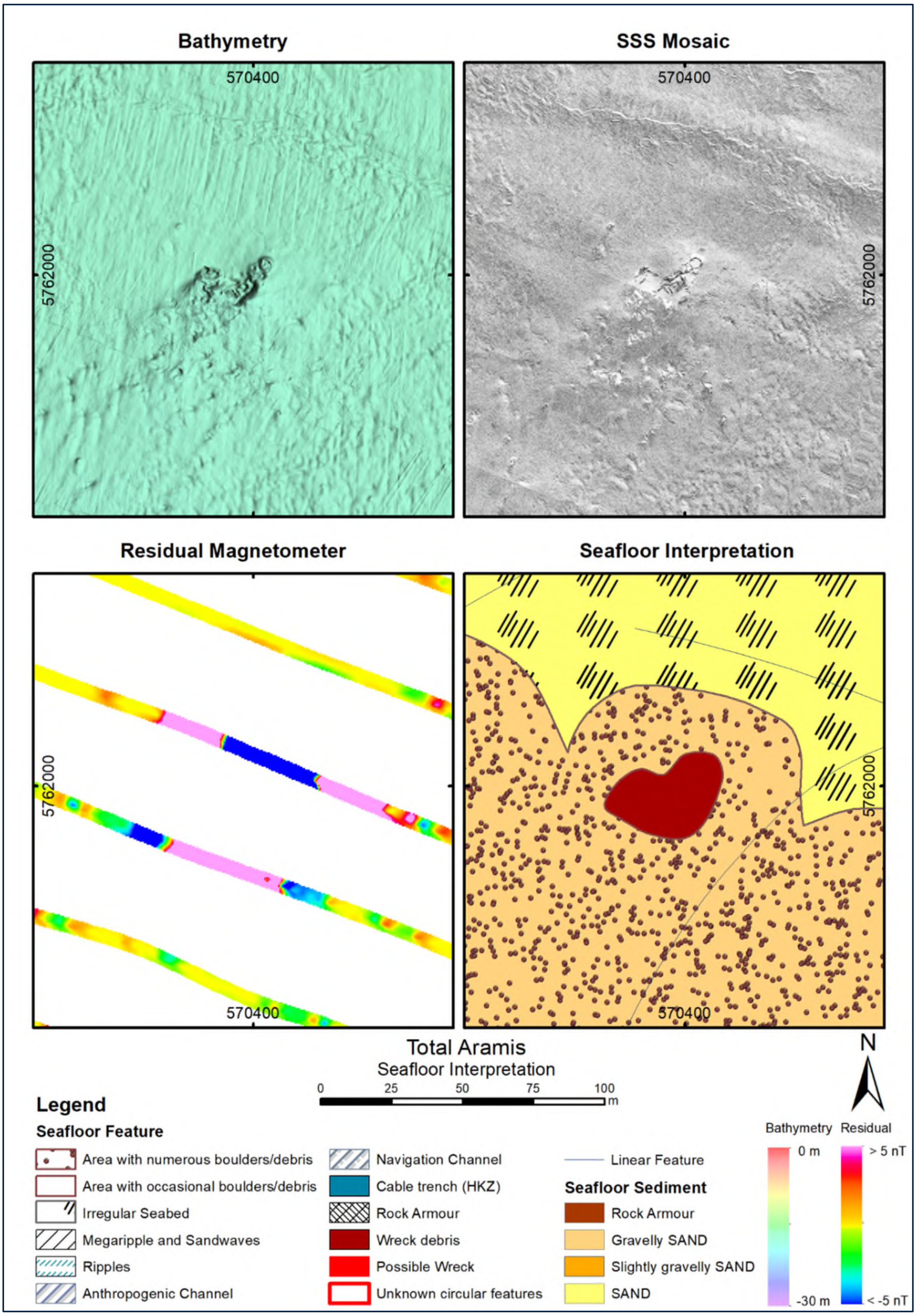


Figure 8.16: Interpreted wreck debris area

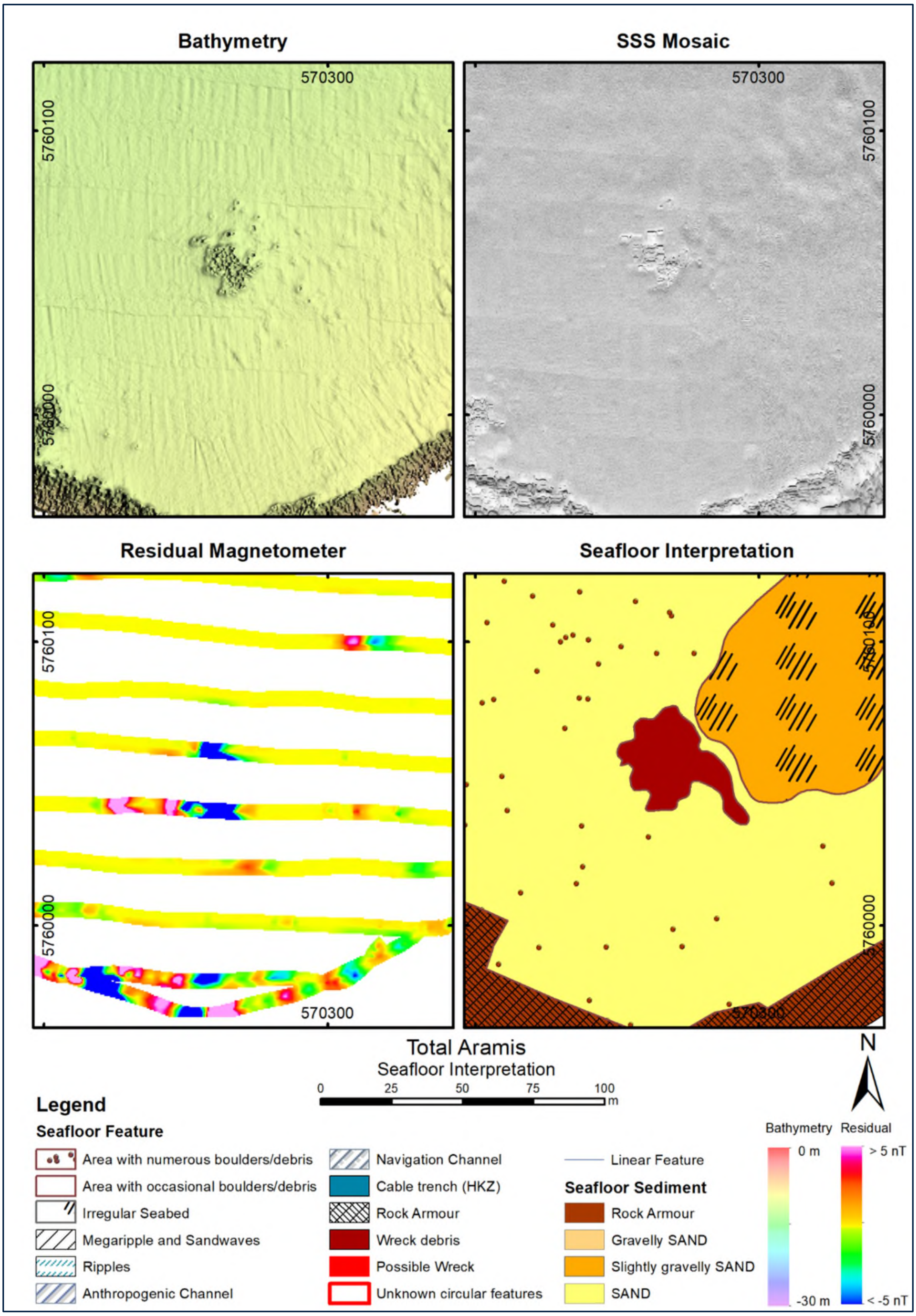


Figure 8.17: Interpreted wreck debris areas

An area interpreted as numerous debris is shown in Figure 8.18. Since this area is adjacent to the rock armour it is possible that it is related to a local collapse of the rock armour itself.

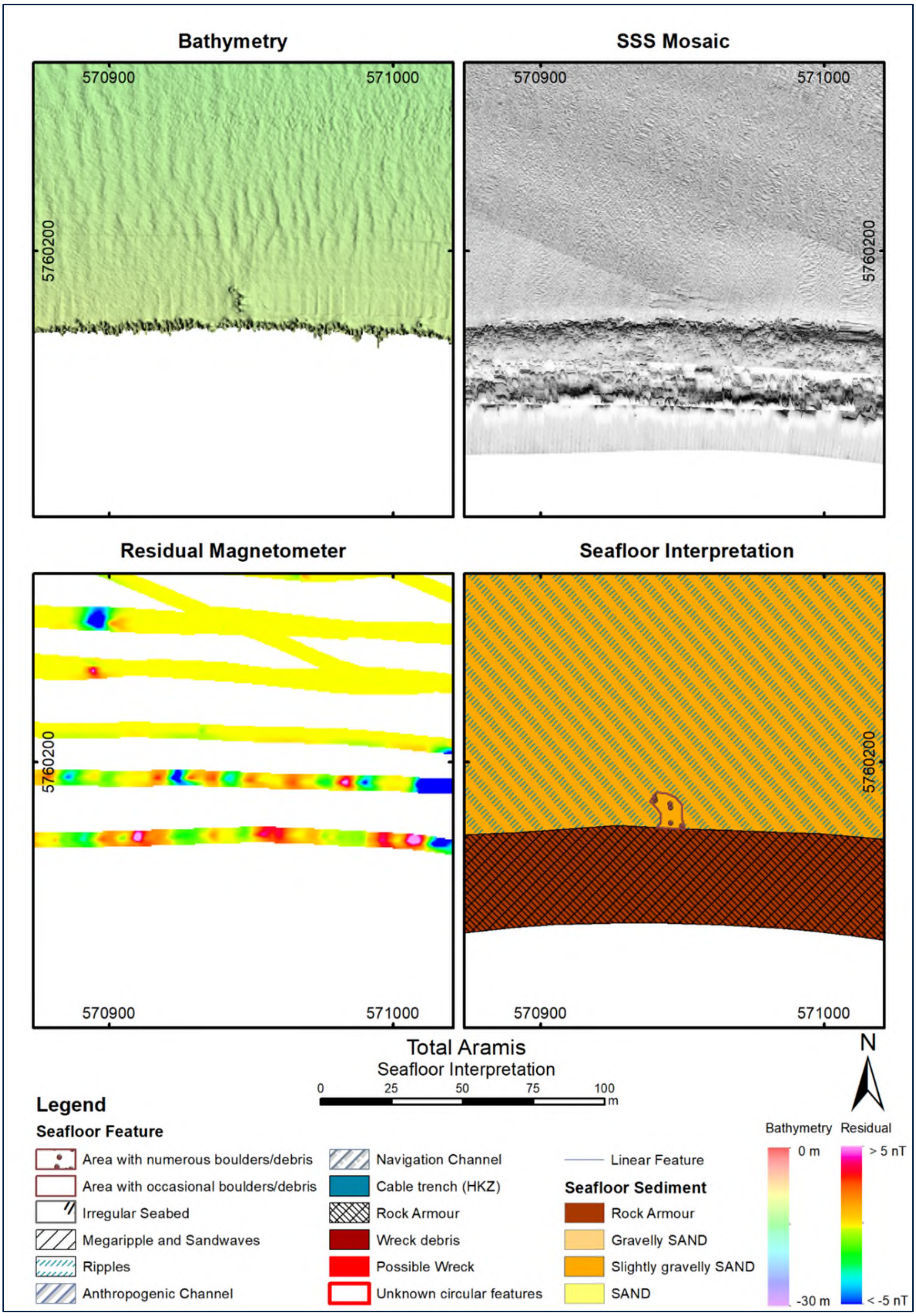


Figure 8.18: Interpreted area with numerous debris.

Two areas with irregular seafloor possibly related to recent fishing activities are shown in Figure 8.19 and Figure 8.20.

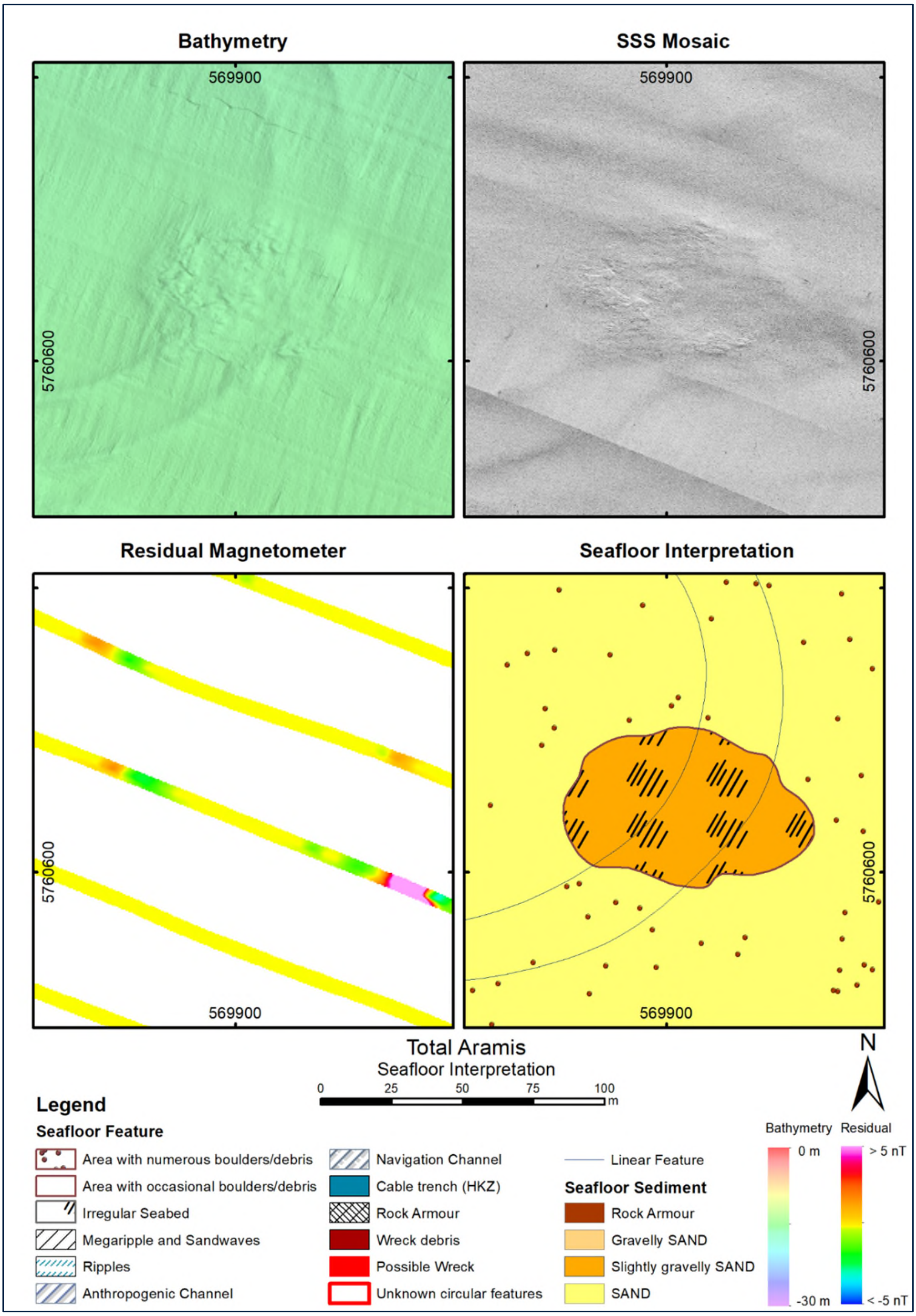


Figure 8.19: Interpeted area of irregular seafloor possibly related to recent fishing activity.

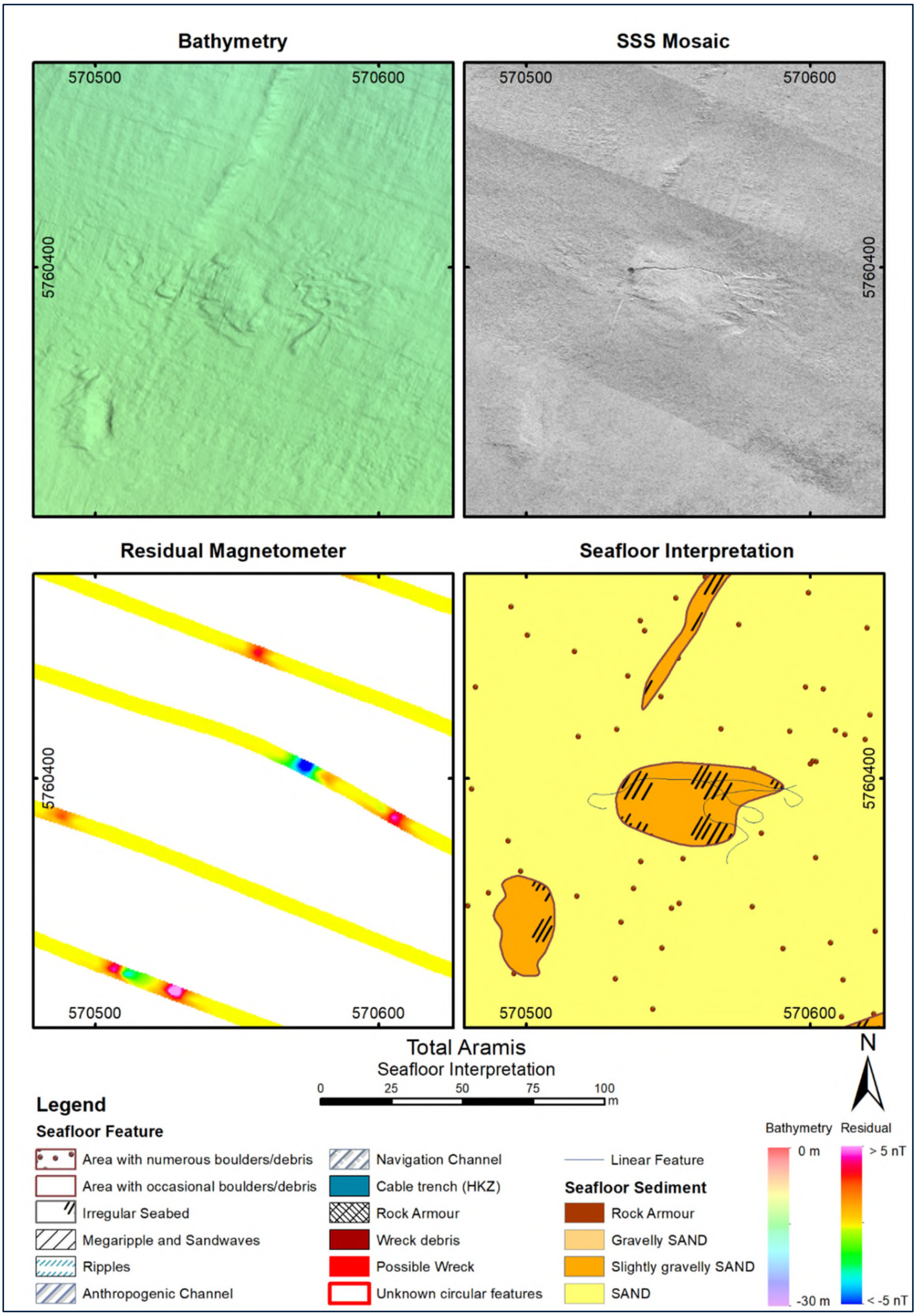


Figure 8.20: Interpreted area of irregular seafloor possibly related to recent fishing activity.

The Figure 8.21 shows an example of a magnetic anomaly of 101.2 nT not correlated with any surficial feature.

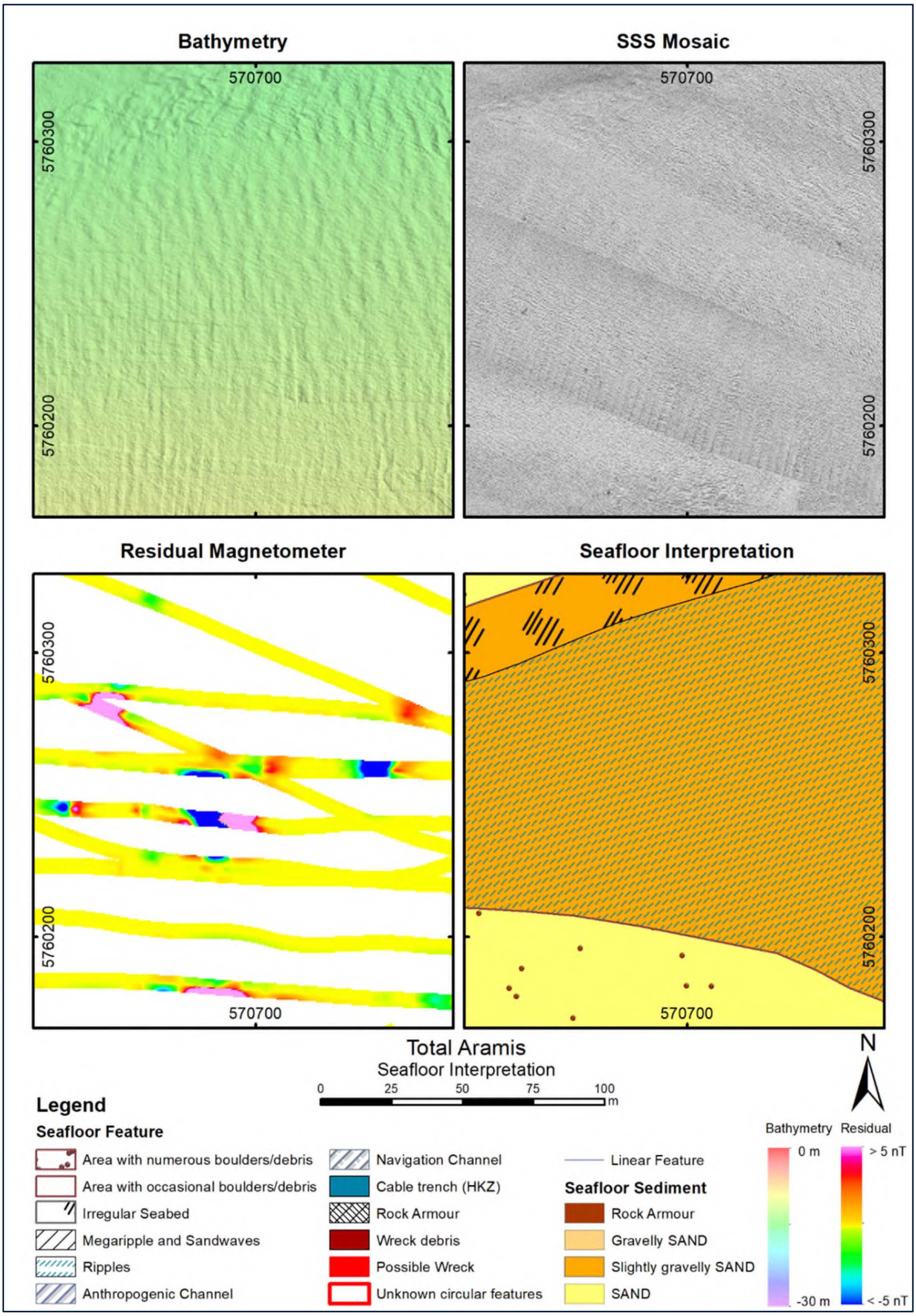


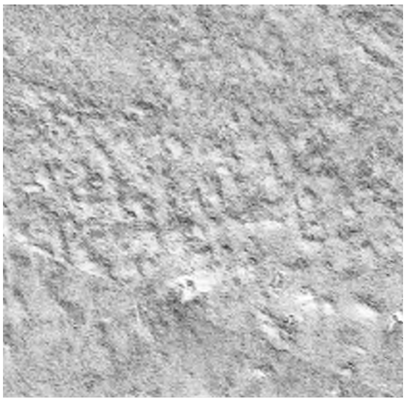
Figure 8.21: Magnetic anomaly not correlated with any visible surficial features.

8.2.4 Seafloor Sediments

An overview of the seafloor sediment interpretation and classification is presented in Figure 8.3.

Seafloor sediment interpretation and classification was based on a combination of data from MBES and SSS. The sediment classification was based on the British Standard code of practice (BSI, 2015). The data analysis was carried out using acoustic characteristics such as overall pattern, roughness and reflectivity. The acoustic characteristics of the types of morphology identified are summarized in Table 8.5.

Table 8.5: Lithological Classification based on acoustic information.

SSS Image	Acoustic Description	Lithological Classification
	Medium to low reflectivity	Gravelly SAND
	Medium to low reflectivity	Slightly gravelly SAND
	Low reflectivity	SAND

The seafloor sediments identified in the survey area were as follows:

- Gravelly SAND
- Slightly gravelly SAND
- SAND

8.3 Sub-Seafloor Interpretation

8.3.1 Geological Overview

The observed geological units in the nearshore survey area are all Quaternary in age. The geological overview is a summary of the regional geology information presented in the desk study *R201644 (03) Consultancy Report*.

The geology of the nearshore survey area was strongly influenced by climatic variations, the associated sea level fluctuations, and the presence of the Rhine river. With the survey area being affected by a series of glacial and interglacial periods.

During the Pleistocene the survey area was subject to a number of these glacial cycles. During periods of glaciation, the Elsterian Glaciation (475 – 410 ka) and Sallian Glaciation (370 -130 ka), sediment deposition was dominated by the major river systems entering the southern North Sea. Deposition consisted of periglacial sediments in deltaic and glaciolacustrine environments. Sediments consisting of sands, gravels, and clays were all deposited during this time. During the interglacial periods, Holsteinian Interglacial (410 – 370 ka) and Eemian Interglacial (130 – 115 ka), marine transgressions dominated the sediment environment. Shallow marine, fluvial, and lagoonal and estuarine clays and sands were laid down. During the Eemian interglacial transgression, the Kreftenheye Formation was deposited.

During the most recent glaciation, the Weichselian Glaciation (115 – 18 ka) the survey area was again dominated by periglacial environments, with erosion of underlying formations occurring.

During the Holocene (11.6 ka – Present), the post glacial marine transgression resulted in a tidal and lagoonal environment as the sea level rose. During this period the Naaldwijk Formation was laid down as sand and clays with localised peat beds. As the transgression progressed, the survey area was overlain by the sands of the Southern Bight Formation.

8.3.2 Geological Interpretation - SBP

Interpretation of the Innomar SBP dataset was carried out using IHS Kingdom 2020 software.

The units that were identified across the site were as follows:

- Unit A – Disturbed soils
- Unit B – Southern Bight
- Unit C – Naaldwijk Formation
- Unit D – Kreftenheye Formation

A summary of these interpreted units has been provided in Table 8.6.

Table 8.6: Summary of interpreted units from the nearshore SBP data

Unit No.	Unit Name	Top Boundary Horizon	Base Boundary Horizon	Seismic Character
Unit A	Disturbed Soils	H05	H15	Reflectors of reducing amplitude with depth. At the seafloor, reflectors are high amplitude, and show both complex cross cutting and discontinuous relationships alongside areas of parallel structure. As depth increases amplitude rapidly decreases and structure becomes less defined and more discontinuous. Reflectors are cut by the effects of subsequent dredging at the seafloor. Presence of shallow gas is likely within this unit.
Unit B	Southern Bight	H05	H10	Predominantly low to medium amplitude reflectors, with localised areas of high strength reflectors. Reflectors are continuous, parallel and follow the morphology of the top of the Naaldwijk unit below. Reflectors are crosscut by the seafloor and therefore are often seen to truncate within the survey area.
Unit C	Naaldwijk	H10	H15	A highly heterogenous unit with numerous complex structures, cross cutting relationships and variable amplitude reflectors. The north of the survey area is characterised by regions of well-stratified high-amplitude reflectors with areas of localised acoustic blanking. Whilst in other regions, lower amplitude reflectors are observed representing a change in sediment type. The unit is subdivided by a series of internal unconformities with channel infill structures with continuous and sub-horizontal reflectors with varying degrees of dip. In localised areas high levels of bed deformity are observed. The south of the survey area is characterised by substantially lower amplitude reflectors which attenuate rapidly with depth. Significant acoustic blanking is also observed throughout this region of the survey area.
Unit D	Kreftenheye	H15	Base not seen	Primarily seismically transparent with extremely low amplitude reflectors rarely observed within the survey area. However, where observed, this unit consists of some discrete regions of well-stratified reflectors whilst the majority

Unit No.	Unit Name	Top Boundary Horizon	Base Boundary Horizon	Seismic Character
				display sequences of complex discontinuous reflectors. The top of this unit has an indistinct structure which becomes increasingly less distinct towards the south of the survey area with reducing water depth and increasing presence of acoustic blanking.

The scope of the interpretation of the SBP dataset required the mapping of two distinct horizons and the seafloor, as defined by the first break.

Alongside the two scoped horizons several internal horizons, unconformities and possible additional horizons separating units were identified. These are discussed where relevant but have not been interpreted in detail. A summary of the interpreted horizons is provided in Table 8.7.

Table 8.7: Summary of interpretated SBP horizons within the nearshore scope

Horizon	Horizon Description	Horizon Name
H05	Seafloor	ARAMIS_SK_SBP_H05_Seafloor
H10	Top Naaldwijk	ARAMIS_SK_SBP_H10_Top_Naaldwijk
H15	Top Kreftenheye	ARAMIS_SK_SBP_H15_Top_ Kreftenheye

8.3.2.1 Geotechnical information

A total of 22 historic geotechnical locations were identified in the vicinity of the survey area. Of these, eight were in positions to assist interpretation. The geotechnical information consisted of boreholes and vibrocores. The geotechnical information came from a 2017 ground investigation. A summary of the geotechnical information used to assist interpretation is provided in Table 8.8.

Table 8.8: A summary of all available geotechnical information.

Location ID	Year of survey	Classification	Easting [m]	Northing [m]
BH_T_ADD_BH02	2017	Rotary Borehole	571042	5761452
BH_T_ADD_BH03	2017	Rotary Borehole	570830	5761161
VC_B004A	2017	Vibrocore	571522	5760707
HDD_BH08	2017	Rotary Borehole	571136	5760971
HDD_BH11	2017	Rotary Borehole	571170	5760478
BH_T_ADD_BH04A	2017	Rotary Borehole	570774	5760640
HDD_Exit_BH01	2017	Rotary Borehole	570500	5760530

Of the eight boreholes used to assist interpretation five were located within the shipping channel. Two were located on the flanks of the channel, one north and one south. The final borehole was located to the west of the northern portion of the site and is separated from the site by a probable anthropogenic feature on the seabed.

8.3.2.2 Limitations to interpretation

The primary limitations on SBP interpretations were:

- The removal of sediment by dredging
- Acoustic blanking and seismic transparency
- The impact of anthropogenic features

The removal of sediment by dredging to create the shipping channel erased the key horizons increasing the challenge of tying the interpretation of the north and south of the site together. Excavation into the Kreftenheye formation has also significantly increased the depth below LAT of the top of this unit within the shipping channel. As seen in Figure 8.22 the removal of the sediment has prevented continuous interpretation of the Naaldwijk formation across the site and cut down into the Kreftenheye formation.

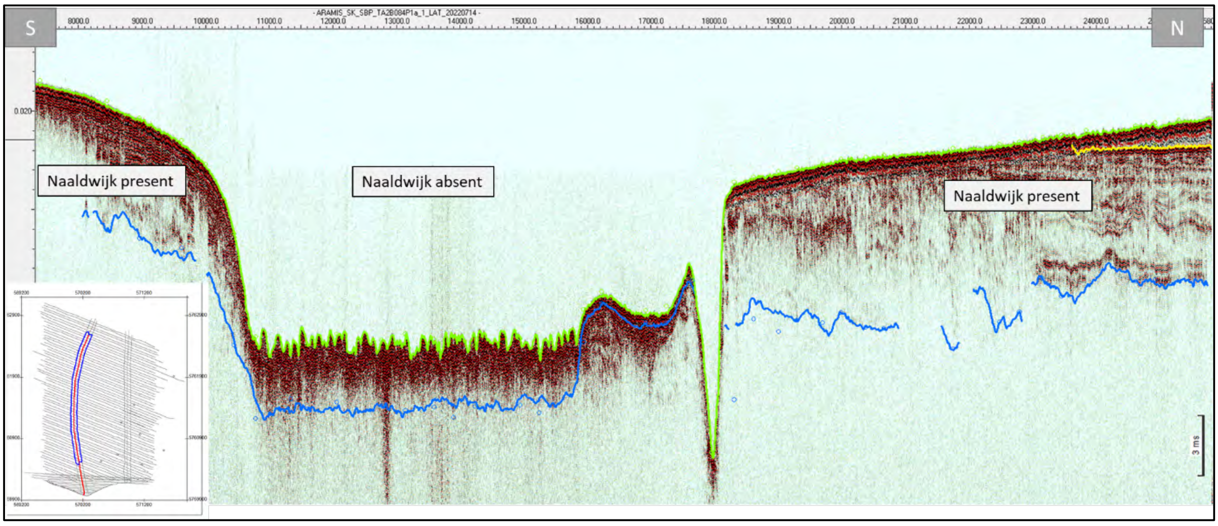


Figure 8.22: Line TA2B084 Showing the absence of the Naaldwijk unit in the centre of the site due to the dredging of the main channel.

In regions of acoustic blanking and seismic transparency, the confidence with which horizons were interpreted was reduced or in some cases made impossible. In both the northern and southern portions of the site, as shown in Figure 8.23 and Figure 8.24, it was highly likely that the top Kreftenheye horizon was present, but due to the impact of the acoustic blanking it was not possible to interpret. A map showing the extent of the observed acoustic blanking is shown in Figure 8.25.

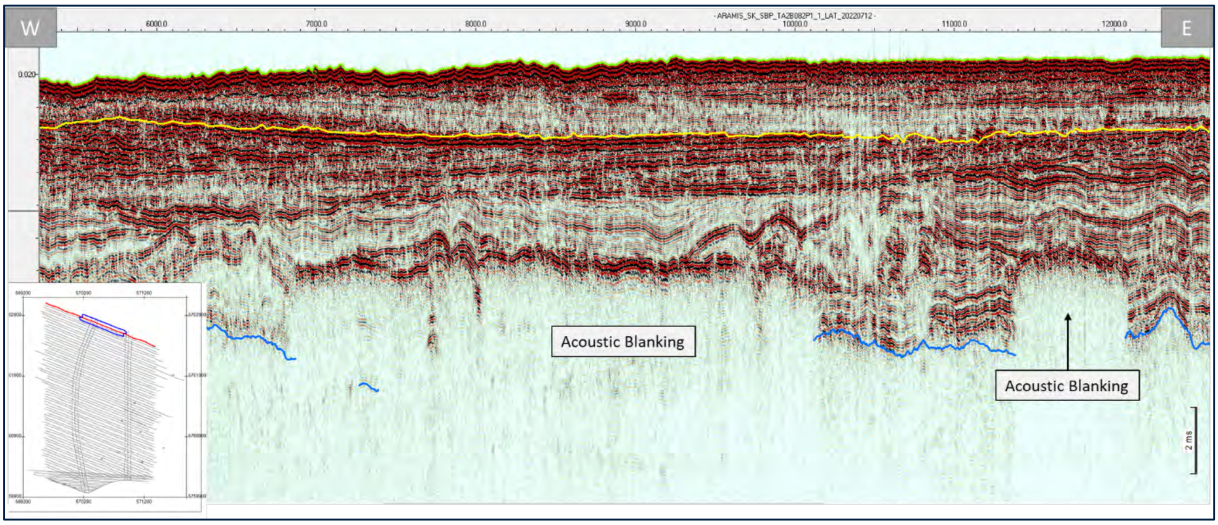


Figure 8.23: Line TA2B082, showing the impact of acoustic blanking on the interpretation of the Kraftenheye in the northern half of the site.

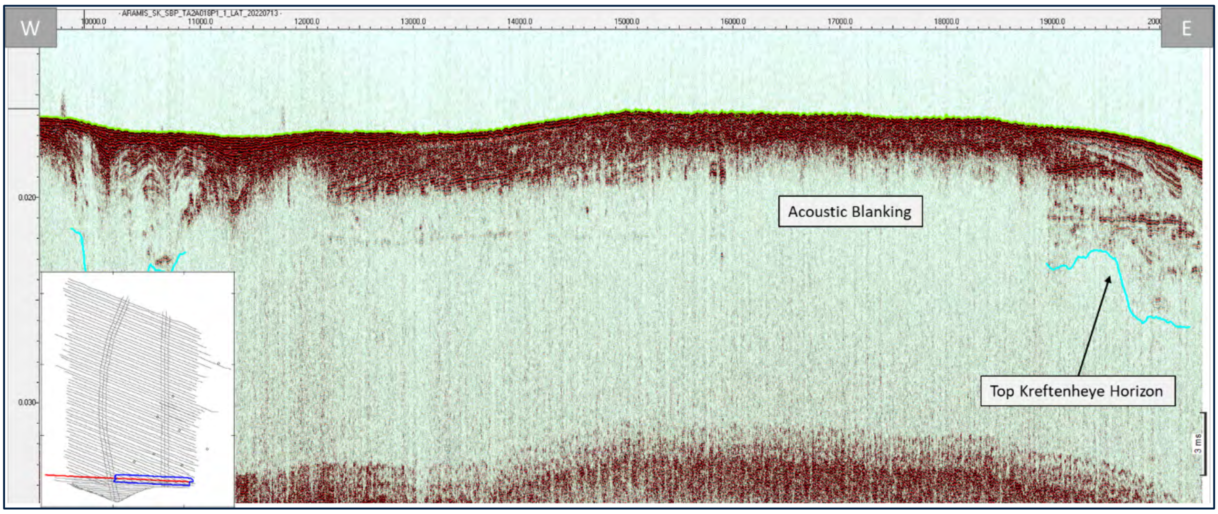


Figure 8.24: Line TA2A018, showing an example of acoustic blanking in a southern half of the site

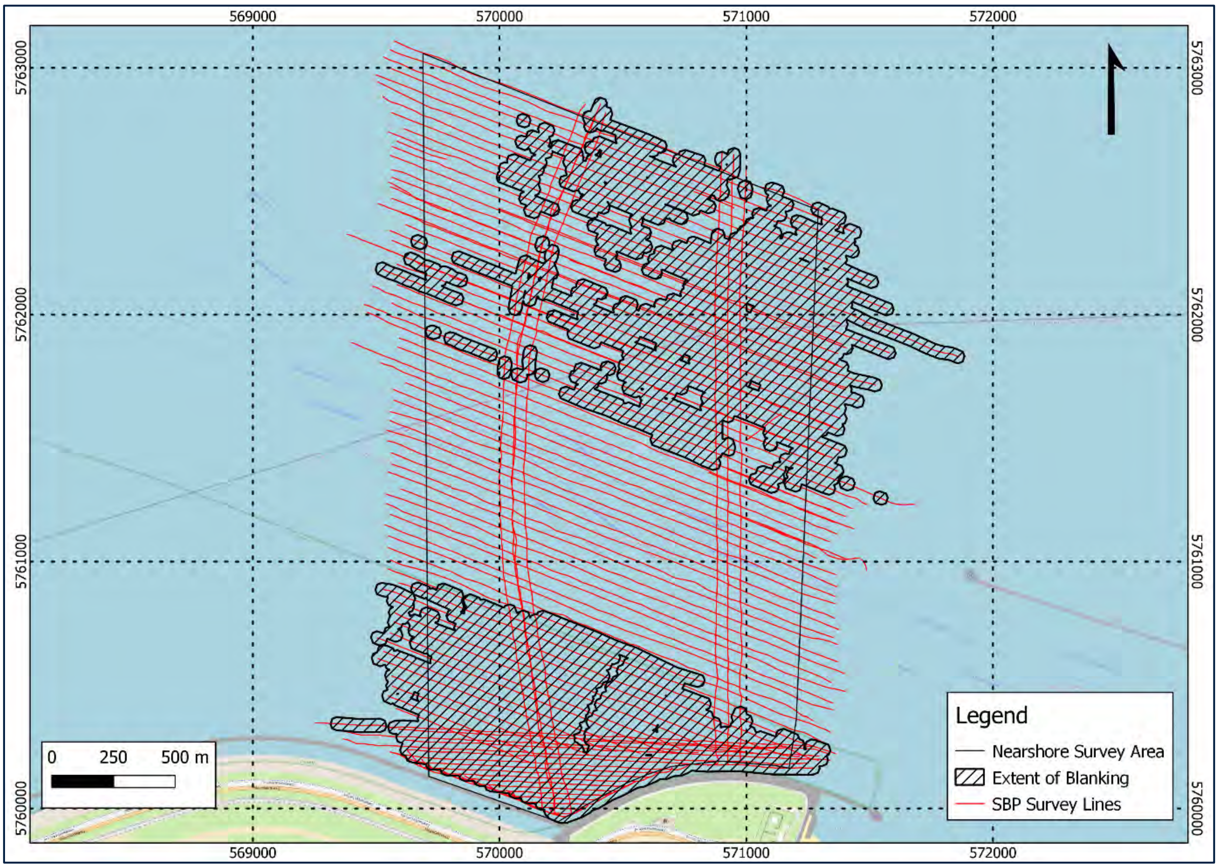


Figure 8.25: Extent of interpreted blanking for the SBP survey.

8.3.2.3 Overview of interpretation

Interpretation of the SBP data were carried out on all SBP files for a total of 97 lines. Interpretation of H05 (Seafloor) was achieved with high confidence on all lines. For horizon H10 (Top Naaldwijk) interpretation was achieved on a total of 77 lines with high confidence. For horizon H15 (Top Kreftenheye) interpretation was achieved on a total of 84 lines with a low confidence. Interpretation of unit boundaries was determined by the presence of a seismic reflector or change horizons only areas of distinct, continuous boundaries were interpreted and presented in the seismic character between regions. Where areas of acoustic blanking were present, interpolation of assumed present horizons was not carried out.

8.3.2.4 Unit A – Disturbed Soils

The Disturbed Soils were the uppermost sediments observed in the shipping channel, that ran through the middle of the site. The top of the unit was defined by the seafloor (H05) and the base of the unit was primarily defined by the top of the Kreftenheye (Unit D, H15), and occasionally by the top of the Naaldwijk (Unit C, H10). The Disturbed Soils unit was only found within the shipping channel. From the desktop study the Disturbed Soils were interpreted as very soft to soft clay, or medium dense (clayey or silty) sand laminated with clay. This top relatively weak layer was classified as a recent deposit in the channel and/or partly a remnant of the Naaldwijk formation that has been reworked and had its structure modified by the dredging works in the shipping channel. Within the channel the unit thickness ranged from 0 m to 4.62 m, Figure 8.26.

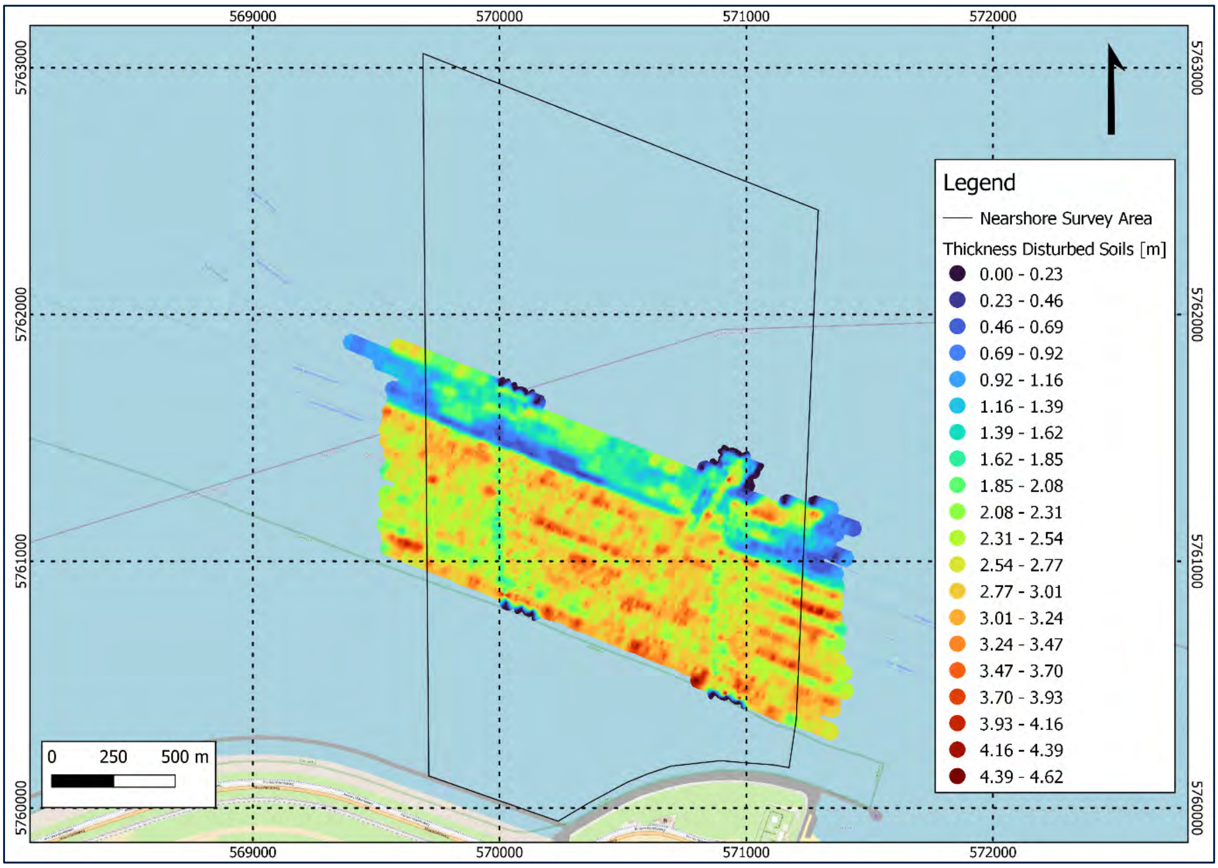


Figure 8.26: The extent and thickness of the interpreted Disturbed Soils unit.

The basal boundary of the unit, defined by H15 (Top Kreftenheye) was poorly defined, with interpretation being of low confidence. No clear reflector was present to distinguish between the base of the Disturbed Soils and the top of the Kreftenheye. The horizon between the two units was interpreted by a change of seismic character. As the amplitude and continuity of the unit decreased with depth, the horizon was interpreted along a consistent level of character change, Figure 8.27. Internally, the unit's seismic character was highly spatially variable, with regions of high amplitude, continuous parallel reflectors, potentially representing recent deposits. In other areas the reflectors were seen to be more chaotic in structure with numerous cross cutting relationships and discontinuous reflectors. Often reflectors and structure were cut into by dredge scars, Figure 8.28.

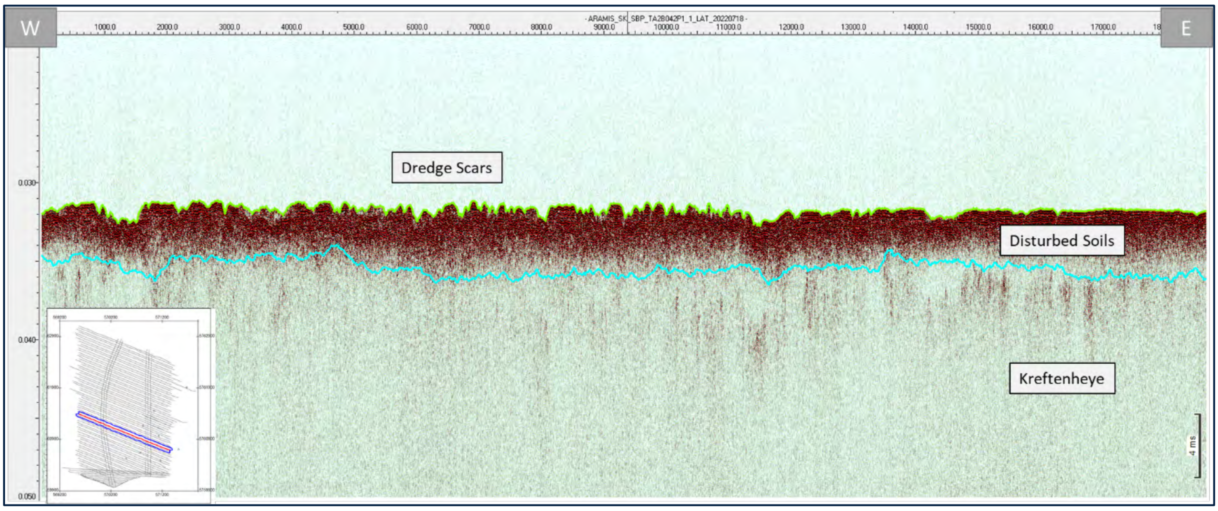


Figure 8.27: Line TA2B042, showing an example of the Disturbed Soil unit.

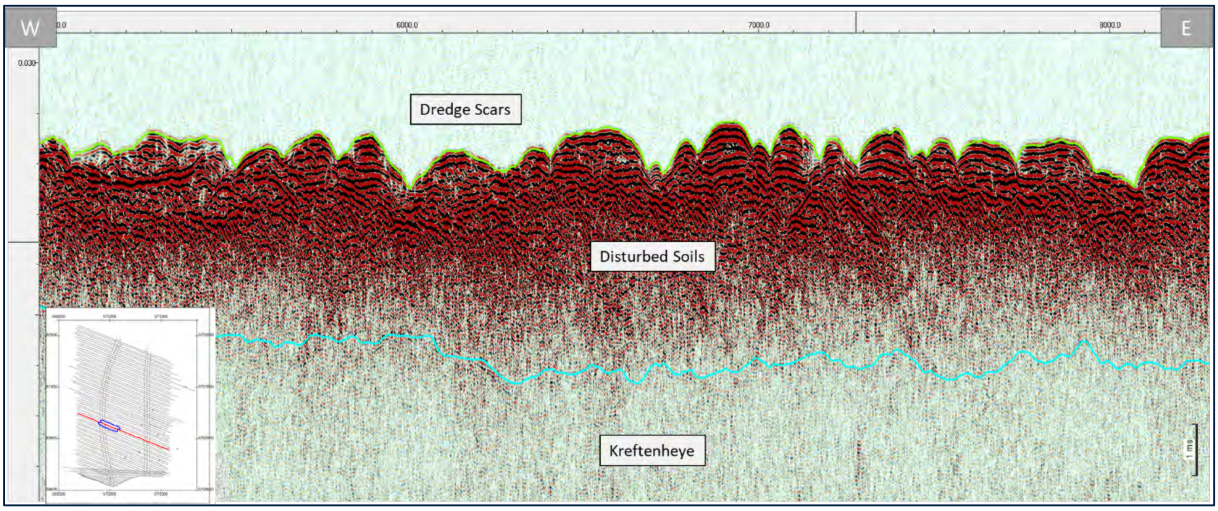


Figure 8.28: Line TA2B042, A focused example of the dredge scars and seismic structure observed within the Disturbed Soils unit.

8.3.2.5 Unit B – Southern Bight

The Southern Bight was the uppermost unit observed outside of the shipping channel. Consisting of very loose to dense, medium sand with frequent shells and shell fragments, it was observed in the northern most part of the nearshore survey area. The top of the unit was defined by the seafloor (H05) and the base of the unit was defined by the top of the Naaldwijk (Unit C, H10). Where present, the Southern Bight was seen as a thin cover of sediment with beds running parallel to the structure of the Naaldwijk unit below, Figure 8.29. The interpreted unit thickness ranged from 0.26 m – 2.05 m below sea floor (BSF) with a median thickness of 1.10 m, Figure 8.29.

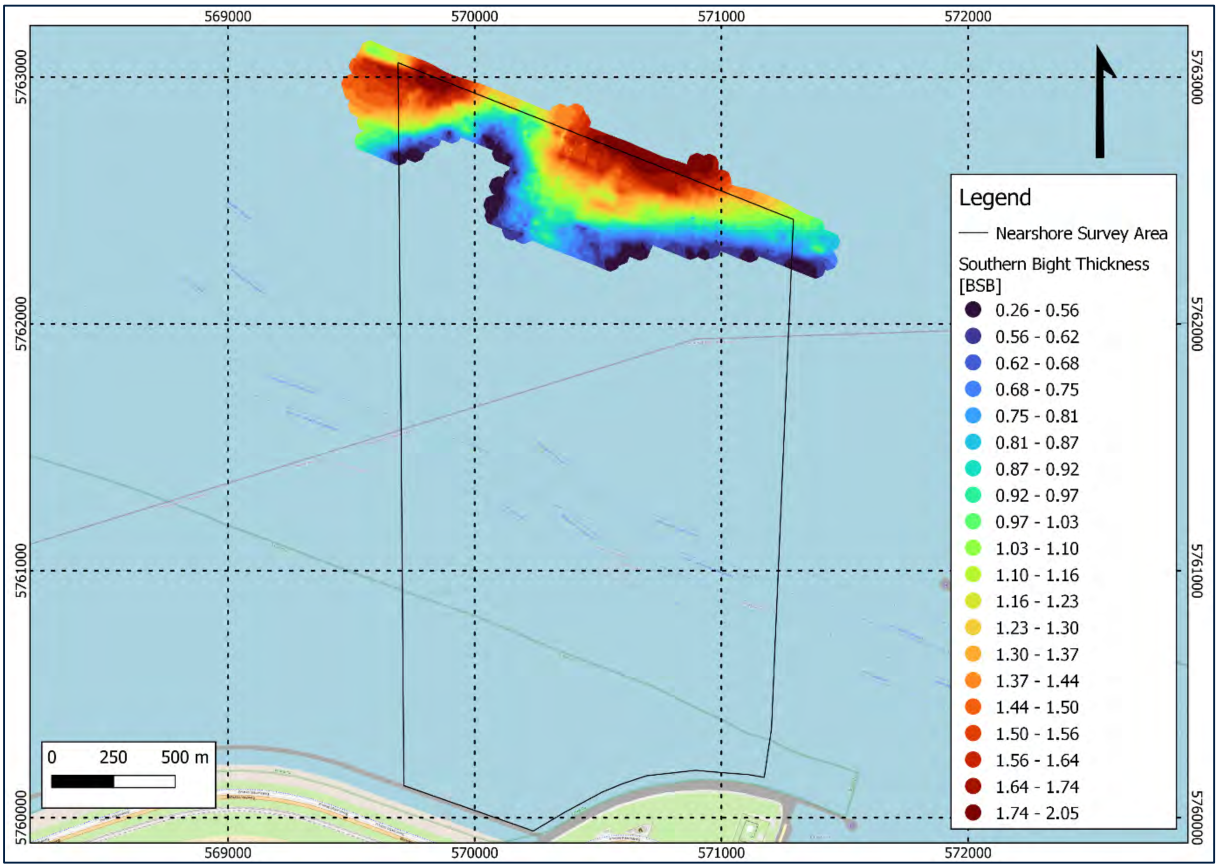


Figure 8.29: The extent and thickness of the interpreted Southern Bight unit.

The base of the unit, defined by H10 (Top Naaldwijk), was clearly defined by a changing of seismic character and a continuous discrete reflector and has been interpreted with high confidence. The unit's seismic character was spatially consistent across the areas of the site where it was seen. A series of low amplitude parallel reflectors that followed the topography of the interpreted horizon defined the unit, Figure 8.30 To the south the unit was seen to be thin, with the Naaldwijk unit coming to surface, Figure 8.31.

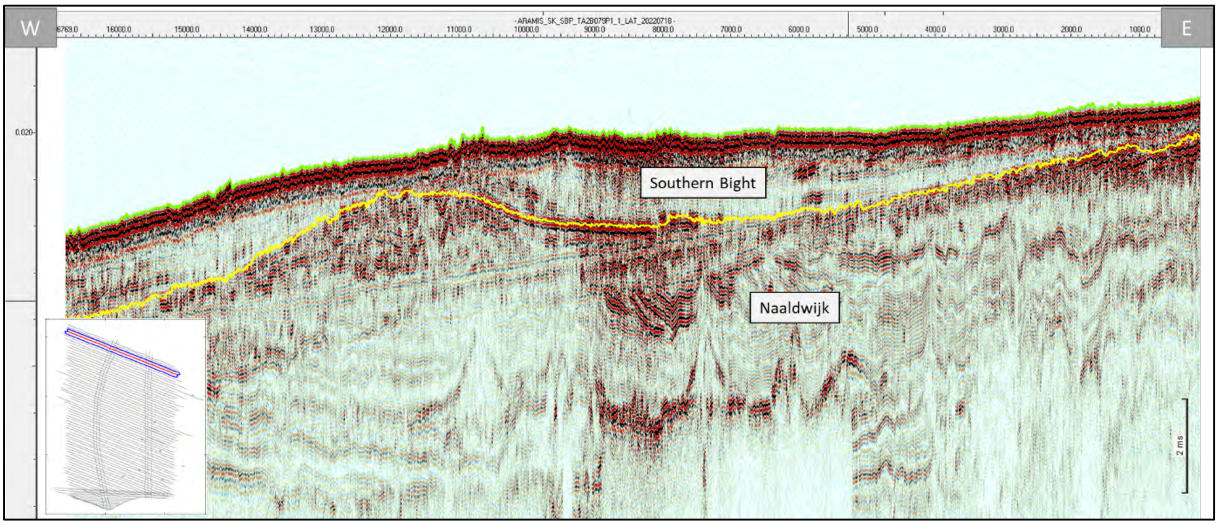


Figure 8.30: Line TA2B079, showing a representative example of the Southern Bight unit.

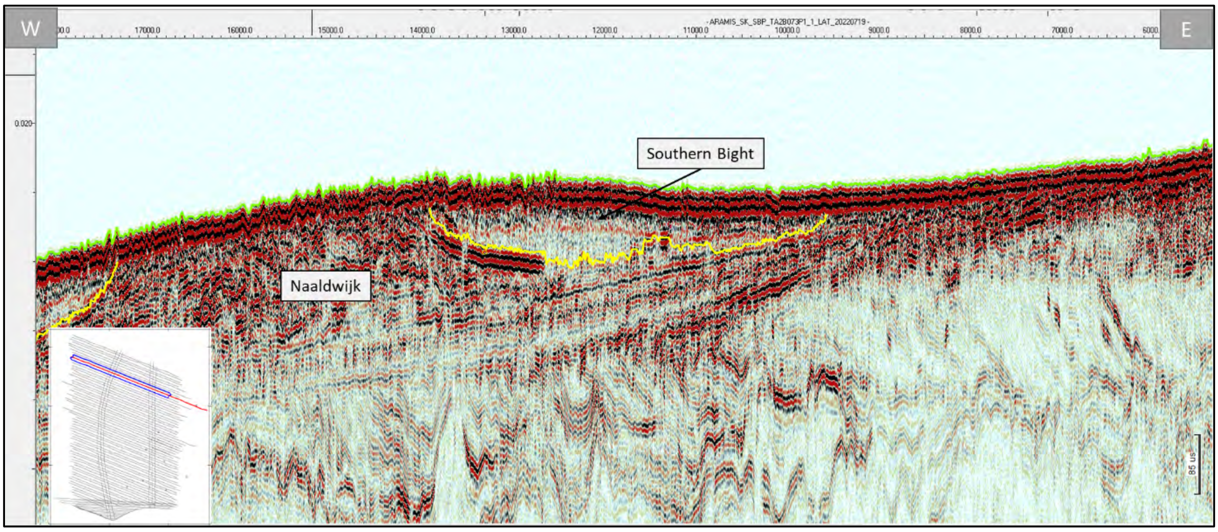


Figure 8.31: Line TA2B073 showing the gradual thinning and disappearance of the Southern Bight compared to Line TA2B079.

8.3.2.6 Unit C – Naaldwijk

The Naaldwijk was observed across the entire site, except for the shipping channel, Figure 8.32. The unit consisted of medium dense to very dense, fine, and medium sand and soft to firm (sandy) clay, with local peat interlayers. The top of the unit was defined by the horizon H10, (Top Naaldwijk) which corresponded to the base of the Southern Bight where present, or the seafloor when not. This horizon was clearly defined across the entire site and has been interpreted with a high confidence. The base of the Unit was defined by horizon H15 (Top Kreftenheye). The thickness of the unit ranges from 0 – 13.28 m, where interpretation has been possible, **Error! Reference source not found.** This horizon was i nterpreted with a low confidence and discussed in more detail in section 8.3.2.7.

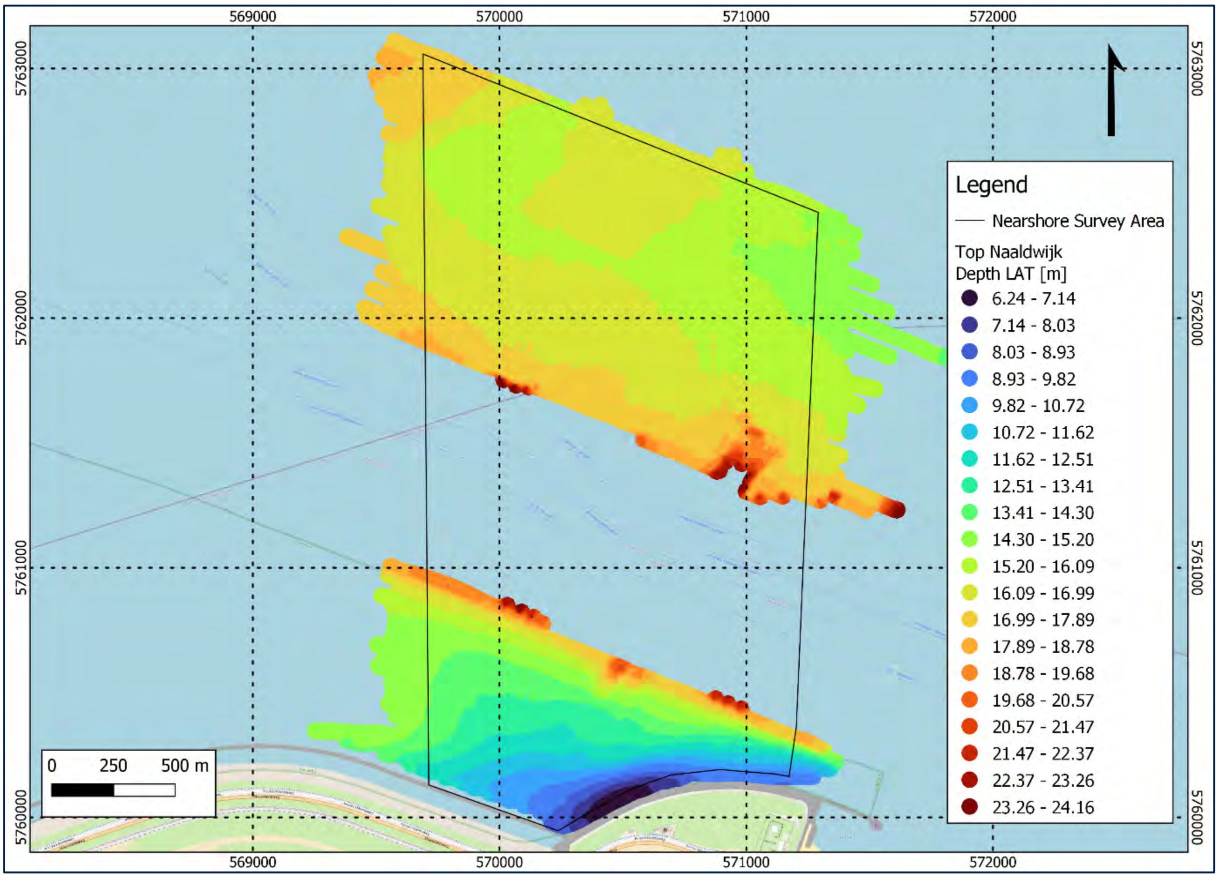


Figure 8.32: The extent and the depth to the top of the interpreted Naaldwijk unit.

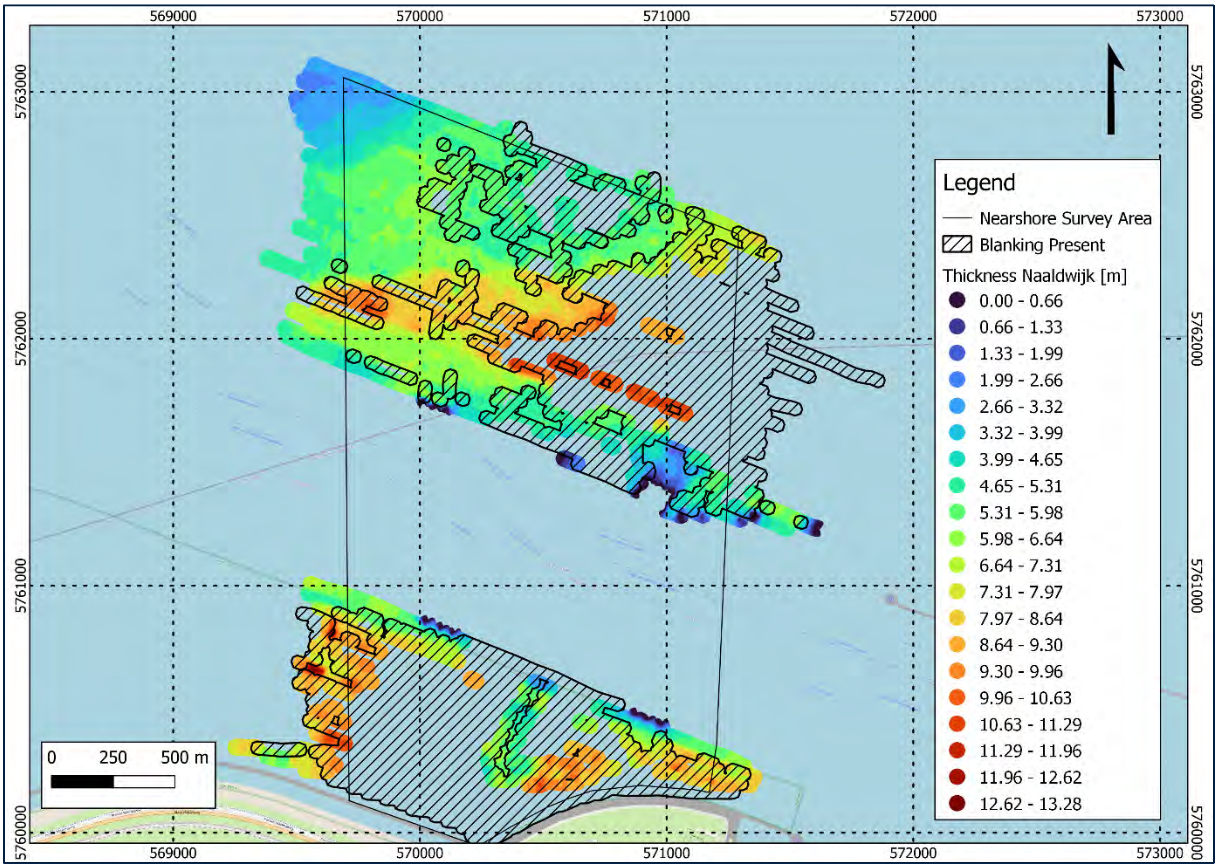


Figure 8.33: The interpreted thickness of the Naaldwijk unit. Where thickness is not interpreted it was because of blanking within the data.

The Naaldwijk unit was characterised by very high spatial soil variability, locally forming the infill of paleo-channels, where it reached maximum thickness. The unit's seismic character consisted of highly variable reflector amplitudes. Reflectors varied between high amplitude peat and clay layers and regions of lower amplitude sands. Below the highest amplitude reflectors, regions of acoustic blanking were seen. Shallow gas was also prevalent within the unit, with shallow gas blanking seen across the survey area, Figure 8.34. The unit is subdivided by a series of unconformities, that crosscut reflector structures. The unit forms channel infill structures with continuous and sub horizontal reflectors exhibiting varying degrees of dip. In localised areas high levels of bed deformity are observed, Figure 8.35. A cross line example of the Naaldwijk interpretation is shown in Figure 8.36.

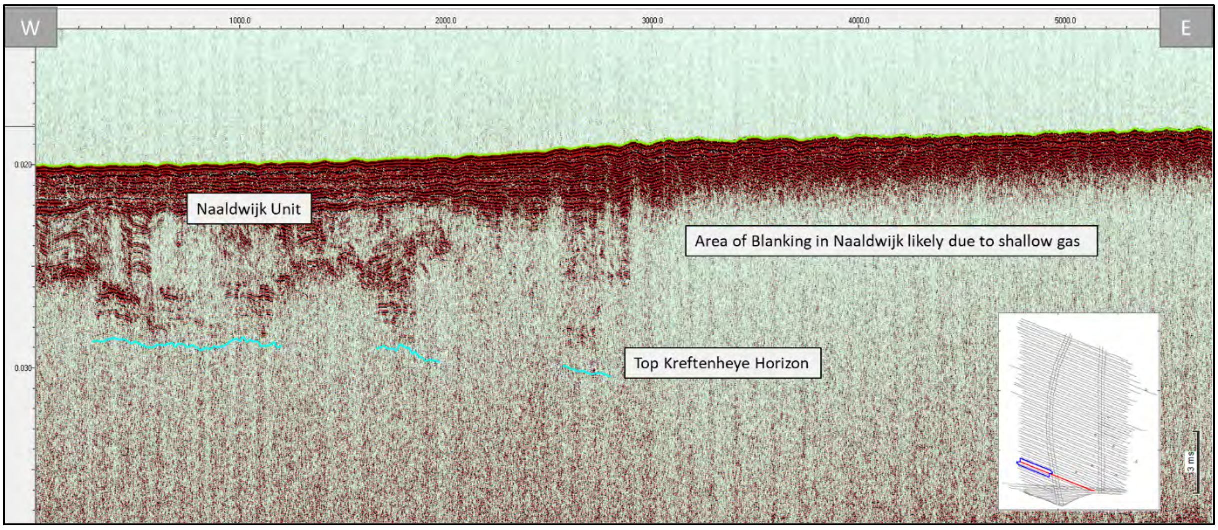


Figure 8.34: Line TA2B026 showing extensive blanking caused by shallow gas present in the Naaldwijk

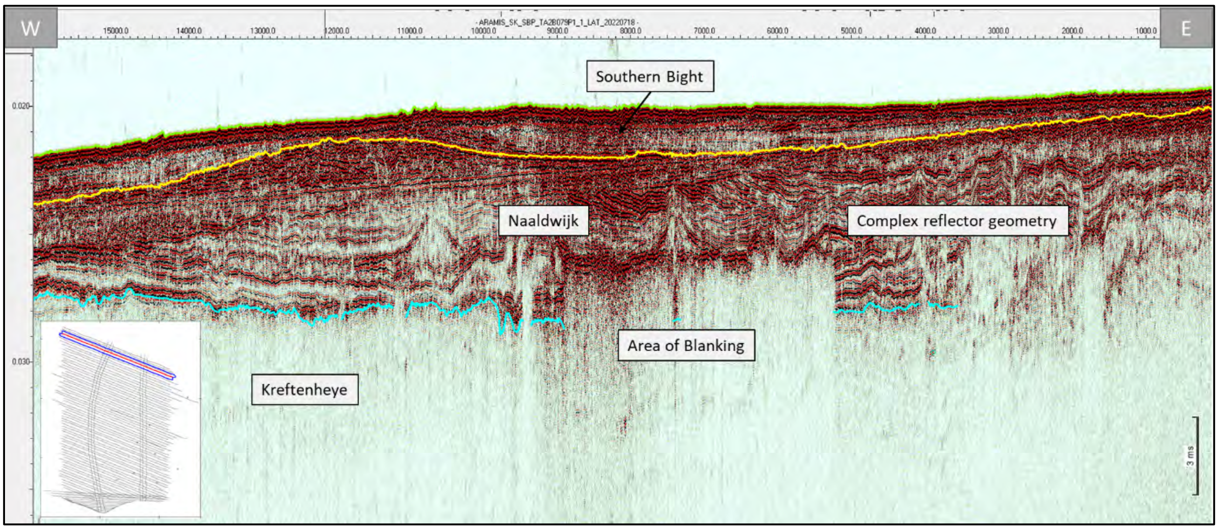


Figure 8.35: Line TA2B079 and example of the complex reflector geometry seen within the Naaldwijk

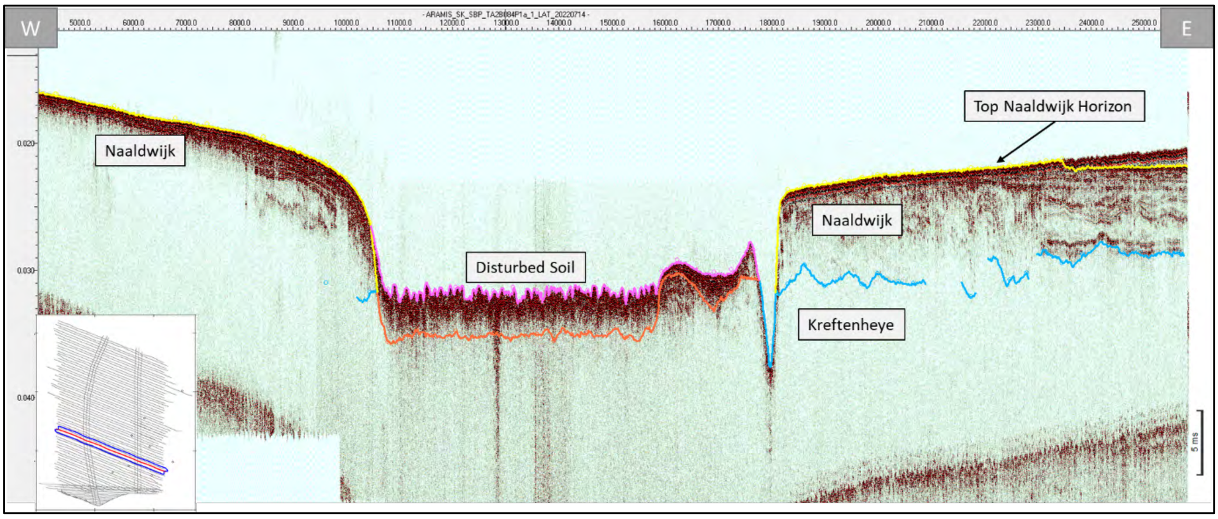


Figure 8.36: Line TA2B084, showing the extent of the Naaldwijk across the site in a cross line.

8.3.2.7 Unit D – Kreftenheye

The Kreftenheye is interpreted across much of the site, both within the shipping channel and outside the channel. The unit consists of very dense fine to medium sand, and locally is slightly gravelly to gravelly, contains traces of gravels or has laminae to thin beds of clay. The top of the unit is defined by the horizon H15 (Top Kreftenheye). In several areas the top of the unit is masked by the effects of acoustic blanking in the Naaldwijk formation. In these areas an interpretation of the Kreftenheye was not possible despite its likely presence. The Kreftenheye was interpreted across much of the site. The unit consists of very dense fine to medium sand, locally slightly gravelly to gravelly, locally with traces to few gravels, locally with laminae to thin beds of clay. The top of the unit was defined by the horizon H15 (Top Kreftenheye). In several areas the top of the unit was masked by the effects of acoustic blanking in the Naaldwijk layer. In these areas an interpretation of the Kreftenheye was not possible despite its likely presence, Figure 8.37 - Figure 8.39.

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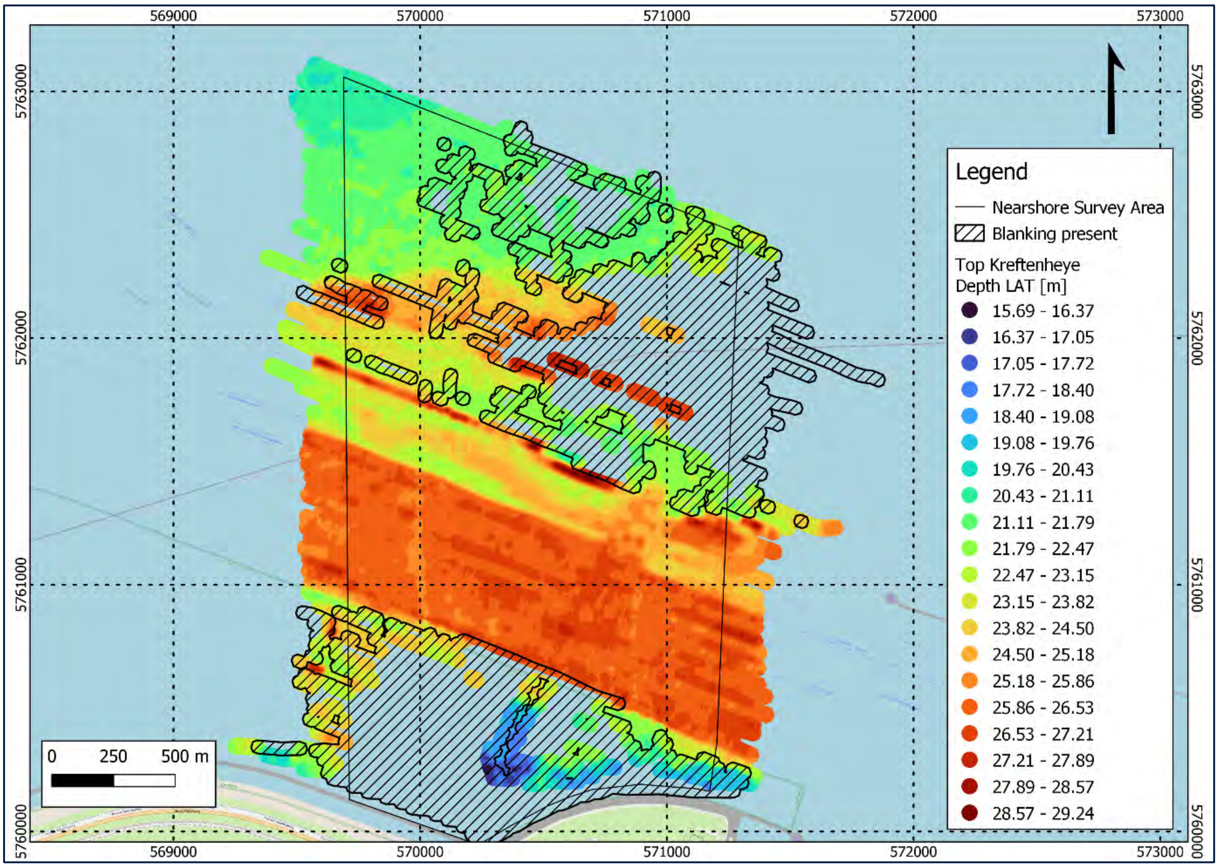

Figure 8.37: The interpreted extent and depth to the top of the Kreftenheye unit. Interpretation was not possible in areas of blanking due to the lack of data penetration.

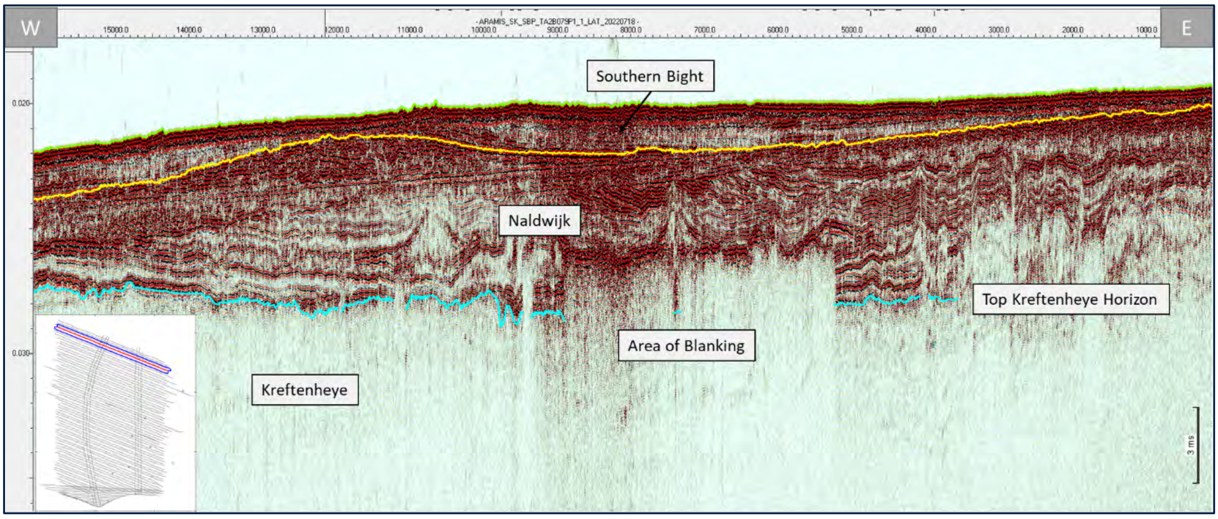

Figure 8.38: Line TA2B079 showing an example of the interpreted Top Kreftenheye horizon and the discontinuity of interpretation causes by the blanking in the north of the survey area

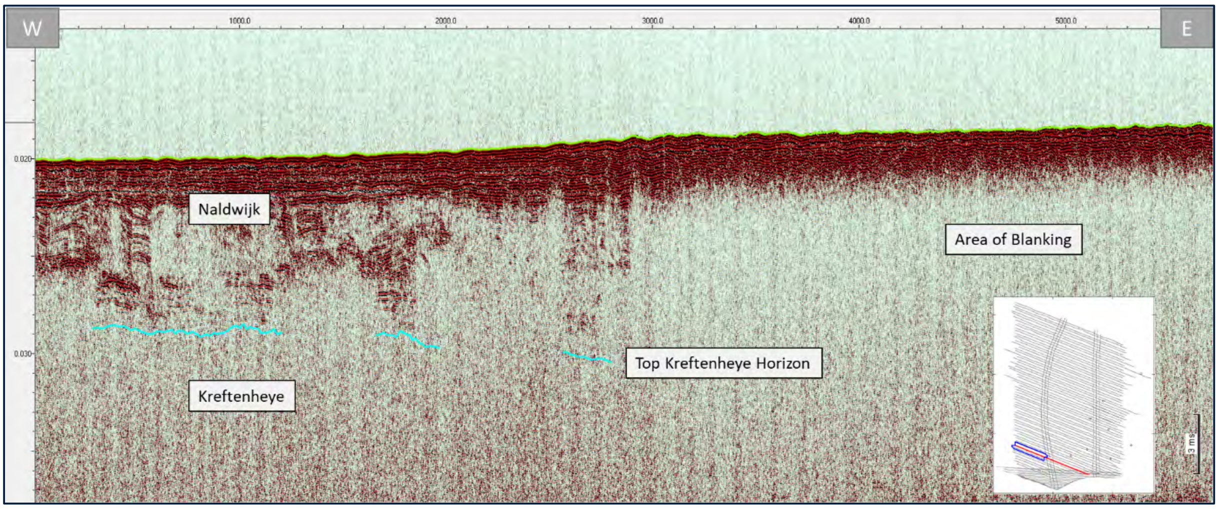

Figure 8.39: Line TA2B026 showing the limited interpretation of the Top Kreftenheye horizon due to blanking within the data.

Within the channel, the top of the unit has been modified by dredging activities and was interpreted based on a change in seismic character as no distinct seismic reflector dividing the Disturbed Soils (Unit A) and Kreftenheye (Unit D) was observed, Figure 8.40.

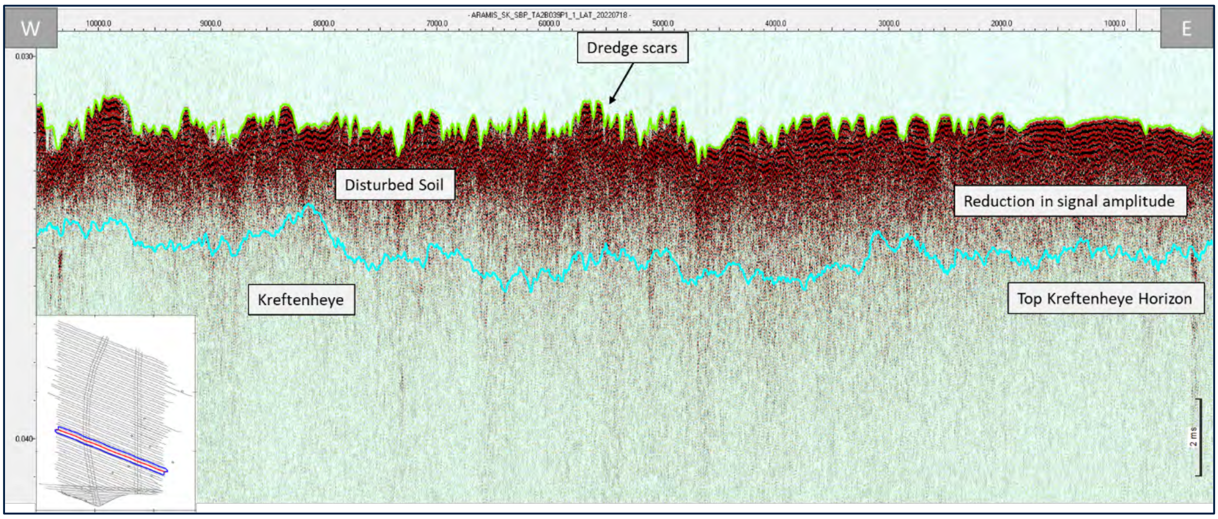

Figure 8.40: Line TA2B039, showing a representative example of the Top Kreftenheye interpretation within the shipping channel.

The internal structure of the unit is rarely seen within the survey area. Where observed, its character is highly spatially variable such that some regions show high amplitude well-stratified reflectors whilst other regions display a complex sequence of high to low amplitude discontinuous reflectors, Figure 8.41. The base of the unit is not observed, and the interpretation of the basal horizon is beyond the scope of this report.

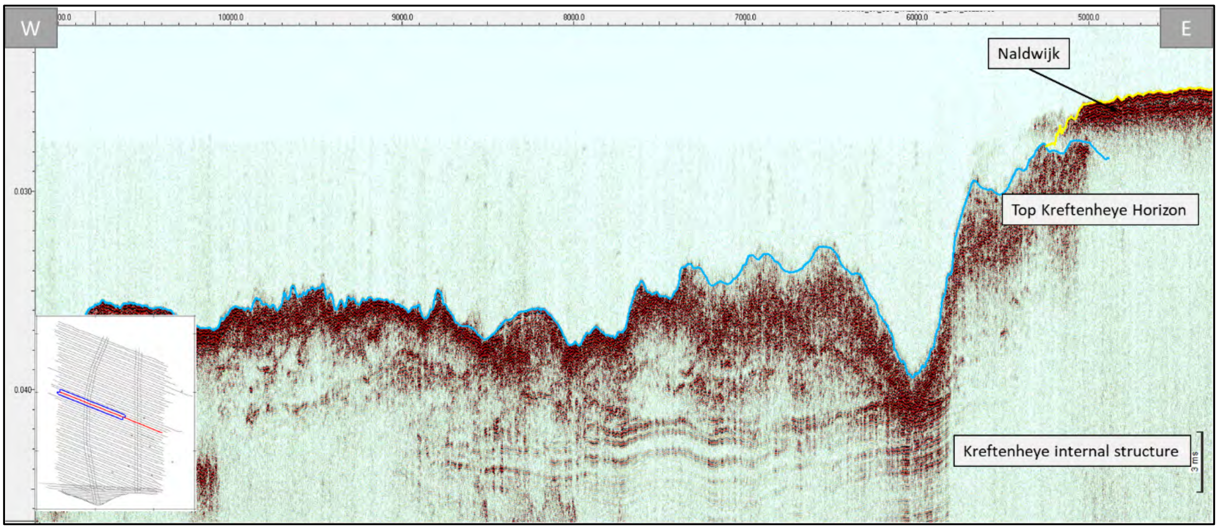

Figure 8.41: Line TA2B054, Showing the internal structure of the Kreftenheye unit.

This interpretation of the Kreftenheye unit and the H15 Top Kreftenheye horizon are both of low confidence. The impact of the shallow gas, with the presence of the seafloor multiple in the south, and the lack of clear reflectors caused a challenge for interpretation. The interpretation of the top of the unit was mostly derived from a change in seismic characteristic within the data or an ending of the clear Naaldwijk reflectors above. Additional datasets such as UHRS, seismic refraction, and MASW should be taken into consideration when defining the presence of this unit.

8.3.3 Velocities Derived from Seismic Refraction and MASW

The compressional and shear wave velocities along the proposed lines were collected using the Gambas, a bottom towed seismic system.

A relatively narrow range of velocities was measured across the site. Compressional velocities interpreted from seismic refraction range from 1450 m/s up to 1900 m/s and are centred between 1500 and 1700 m/s. Shear wave velocities interpreted from MASW are comprised between 70 m/s and 400 m/s and are centred between 70 and 250-300 m/s.

These velocities are characteristic of very soft to moderately soft sediments. Over the site, compressional and shear wave velocities are relatively homogeneous and generally regularly increasing with depth from seabed. Velocities seem to increase with mechanical properties of soil, smaller velocities corresponding to very loose unconsolidated sediments and higher ones to moderately soft sediments.

It must be noted that the velocity classes shall generally not be used in order to discriminate geotechnical units. Different lithologies can in fact present the same velocity range. This rule is even more applicable for the present geology where we observe an alternance of sedimentary layers. Velocities seem to vary more as a function of mechanical properties of soil rather than the geological units themselves.

The Vp and Vs velocity profiles resulting from the refraction and MASW acquisition are presented in the 25-panels alignment charts presented in Appendix J of the present report. On each profile, the interpreted limits between very soft sediments / soft sediments and soft sediments / moderately soft sediments have been picked. Table 8.9 below summarises the different velocity classes observed at each profile.

Table 8.9: Velocity Classes Derived from Seismic Refraction and MASW

Profile	Refraction			MASW			Area
	Average Vp range (m/s)	Bottom Depth (LAT)	Thickness (m)	Average Vs range (m/s)	Bottom Depth (LAT)	Thickness (m)	
1	1500-1575	15 to 20	5 to 12.5	50-100	15	2.5	South to the navigation channel
	1575-1675	-		> 100	23 to 30	7.5 to 16	
2	1500-1550	15 to 25	2.5 to 11	50-100	12 to 17	2.5 to 4	
	1550-1650	24 to 35	7.5 to 10.5	100-250	22 to 35	9 to 19	
	> 1650	-		>250	-	-	
3	1500-1550	20 to 25	8 to 11	50-150	15 to 20	1.5 to 5.5	
	> 1550	Blanked	-	150-275	30 to 34	10 to 16	
	-	-	-	>275	-	-	
5	-	Blanked	-	50-100	16 to 18	3 to 5	
	-	-	-	100-250	-	-	
8	-	Blanked	-	50-75	16 to 18	2.5 to 4	
	-	-	-	75-250			
9	-	Blanked	-	50-75	16 to 17.5	2.5 to 3.5	
	-	-	-	75-225	31 to 35	13.5 to 16.5	
	-	-	-	>225	-	-	
10	1500 - 1550	22 to 24	6 to 6.5	50-75	16 to 17.5	2.5 to 3.5	
	> 1550	Blanked	-	> 75	-	-	
11	1500-1550	16 to 24	2.5 to 9	50-75	14 to 18	2 to 4	
	1550-1675	30 to 32	10 to 12.5	75-225	29 to 34	9.5 to 18.5	
	> 1675	Blanked	-	>225	-	-	
13	1450-1550	20 to 22	7 to 8.5	50-100	16 to 20	2.5 to 4	
	1550-1700	Blanked	-	75-225	22.5 to 35	9 to 15.5	
	-	-	-	>225	-	-	
14	1450-1550	20 to 26	3.5 to 9	50-100	17 to 22	2.5 to 6.5	
	1550-1725	Blanked	-	100-225	28 to 31	9 to 15.5	
	-	-	-	>225	-	-	
15	-	Blanked	-	50-75	26 to 30	2.5 to 5	Navigation channel
	-	-	-	100-225	42 to 44	13 to 14.5	

Profile	Refraction			MASW			Area
	Average Vp range (m/s)	Bottom Depth (LAT)	Thickness (m)	Average Vs range (m/s)	Bottom Depth (LAT)	Thickness (m)	
	-	-	-	>225	-	-	Navigation channel
17	-	Blanked	-	50-75	27 to 30	2.5 to 5.5	
	-	-	-	100-225	31 to 36	6 to 10	
	-	-	-	>225	-	-	
18	-	Blanked	-	50-75	26 to 28	2.5 to 3.5	
	-	-	-	100-225	31 to 37	4 to 9	
	-	-	-	>225	-	-	
19	-	Blanked	-	50-75	26 to 28	2.5 to 3.5	
	-	-	-	100-225	31 to 37	3.5 to 10	
	-	-	-	>225	-	-	
21	-	Blanked	-	50-75	26 to 28	3.5 to 7	
	-	-	-	100-225	34 to 37.5	6.5 to 10	
	-	-	-	>225	-	-	
23	-	Blanked	-	50-100	26 to 28.5	2 to 4	
	-	-	-	100-225	30 to 37.5	2.5 to 12.5	
	-	-	-	>225	-	-	
24	-	Blanked	-	50-100	28 to 29.5	3 to 4	
	-	-	-	100-225	32.5 to 37.5	5 to 9	
	-	-	-	>225	-	-	
25	-	Blanked	-	20-75	26 to 29	2.5 to 5	
	-	-	-	>75	-	-	
26	1450-1550	25 to 27	2 to 3.5	50-75	25 to 28.5	2 to 5	
	> 1550	Blanked	-	> 75	-	-	
27	-	-	-	50-100	26 to 35	3.5 to 10.5	
	-	-	-	100-200	-	-	
28	1450-1550	25 to 27.5	2.5 to 4.5	50-100	27.5 to 31	4.5 to 7	
	> 1550	Blanked	-	> 100	-	-	
30	1500-1550	20 to 22.5	1.5 to 5	50 to 75	19 to 21	1.5 to 2	North to the navigation channel
	1550-1700	22.5 to 30	2 to 11	75 to 225	24 to 31	5 to 11.5	
	>1700	-	-	>225	-	-	
31	1500-1550	18 to 21	2 to 3	50 to 100	17.5 to 20.5	1.5 to 4.5	

Profile	Refraction			MASW			Area
	Average Vp range (m/s)	Bottom Depth (LAT)	Thickness (m)	Average Vs range (m/s)	Bottom Depth (LAT)	Thickness (m)	
	1550-1675	22.5 to 27.5	3.5 to 11.5	100 to 275	22 to 32	3 to 12	North to the navigation channel
	>1675	-	-	>275	-	-	
32	1500-1650	22.5 to 31	6.5 to 15	50 to 100	18 to 20.5	1.5 to 5	
	>1650	-	-	100 to 275	22 to 32.5	2.5 to 13	
	-	-	-	>275	-	-	
33	1500-1675	24 à 31	5 à 14.5	50 à 100	18.5 à 20	2.5 à 4	
	>1675	-	-	100 à 275	24 à 35	3.5 à 15	
	-	-	-	>275	-	-	
34	1500-1575	20 à 22.5	3 à 6.5	50 à 100	18 à 21	1 à 4	
	1600-1700	25 à 30	4 à 13	100 à 200	22.5 à 32.5	4.5 à 12.5	
	>1700	-	-	>200	-	-	
35	1500-1600	17.5 à 23	3 à 7	50 à 100	18 à 19	1.5 à 3.5	
	1600-1750	25 à 31.5	4.5 à 9	100 à 225	25 à 32	6 à 11	
	>1750	-	-	>225	-	-	
36	1500-1600	19 à 22	3 à 5	50 à 100	18 à 20	2 à 4	
	1600-1750	23.5 à 32	3 à 12	100 à 200	24 à 31	4.5 à 13.5	
	>1750	-	-	>200	-	-	
37	1500-1650	23 à 34	6 à 15	75 à 200	25 à 32.5	9 à 15.5	
	>1650	-	-	>200			
38	1500-1600	19 à 25	3 à 6.5	75 à 200	25 à 35	9 à 19	
	1600-1750	23 à 34	6 à 15.5	>200	-	-	
	>1750	-	-	-	-	-	
39	1500-1650	21.5 à 30	4.5 à 11	75 à 200	25 à 40	9 à 17.5	
	>1650	-	-	>200	-	-	

As explain at the beginning of this paragraph, it is often difficult to describe a geological unit only by its seismic velocities. This is even more true when there is an alternance of sedimentary layers. Table 8.10 below presents a possible relation between the Vp and Vs measured on site and the local geology.

Table 8.10: Vp and Vs velocities range in relation to local geology.

Unit No.	Unit Name	Vp range (m/S)	Vs range (m/s)
Unit A	Disturbed Soils	1450 to 1550	50 to 100
Unit C	Naaldwijk	1500 to 1700	50 to 200

Unit No.	Unit Name	Vp range (m/S)	Vs range (m/s)
Unit D	Kreftenheye	>1600	> 150

8.4 Contacts

8.4.1 Side Scan Sonar Contacts

A total of 1012 contacts were identified within the SSS dataset, of which 893 were boulders, 93 were suspected debris, 15 were linear debris, 9 were fishing gear and 2 were wrecks, summarised in Figure 8.42. Furthermore, 3 areas were classed as boulder fields in which the boulder density exceeded 10 per 100m x 100m. A total of 38 contacts fell within the UXO survey areas and are presented in Figure 8.43. Specific points of interest have been discussed in section 8.2.2. A complete contact list has been provided in Appendix E.

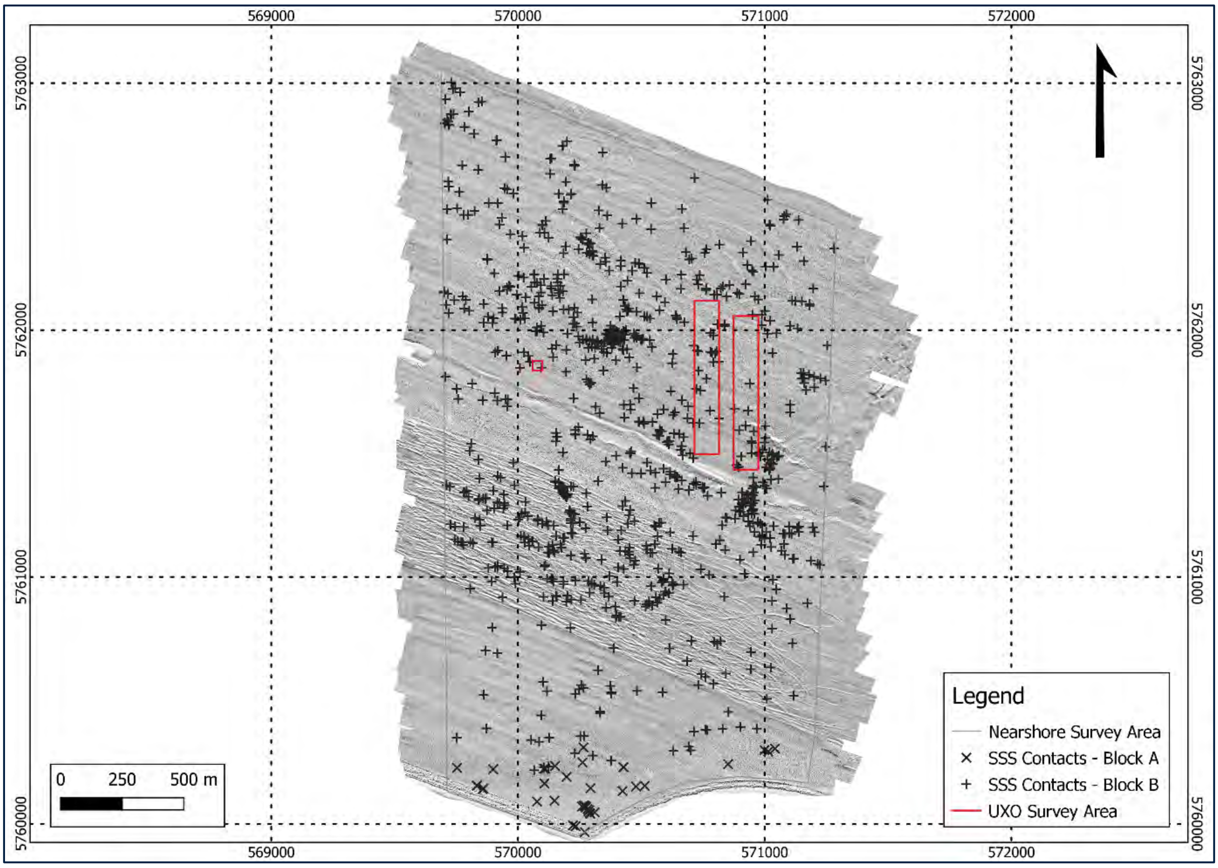

Figure 8.42: An overview of interpreted SSS contacts.

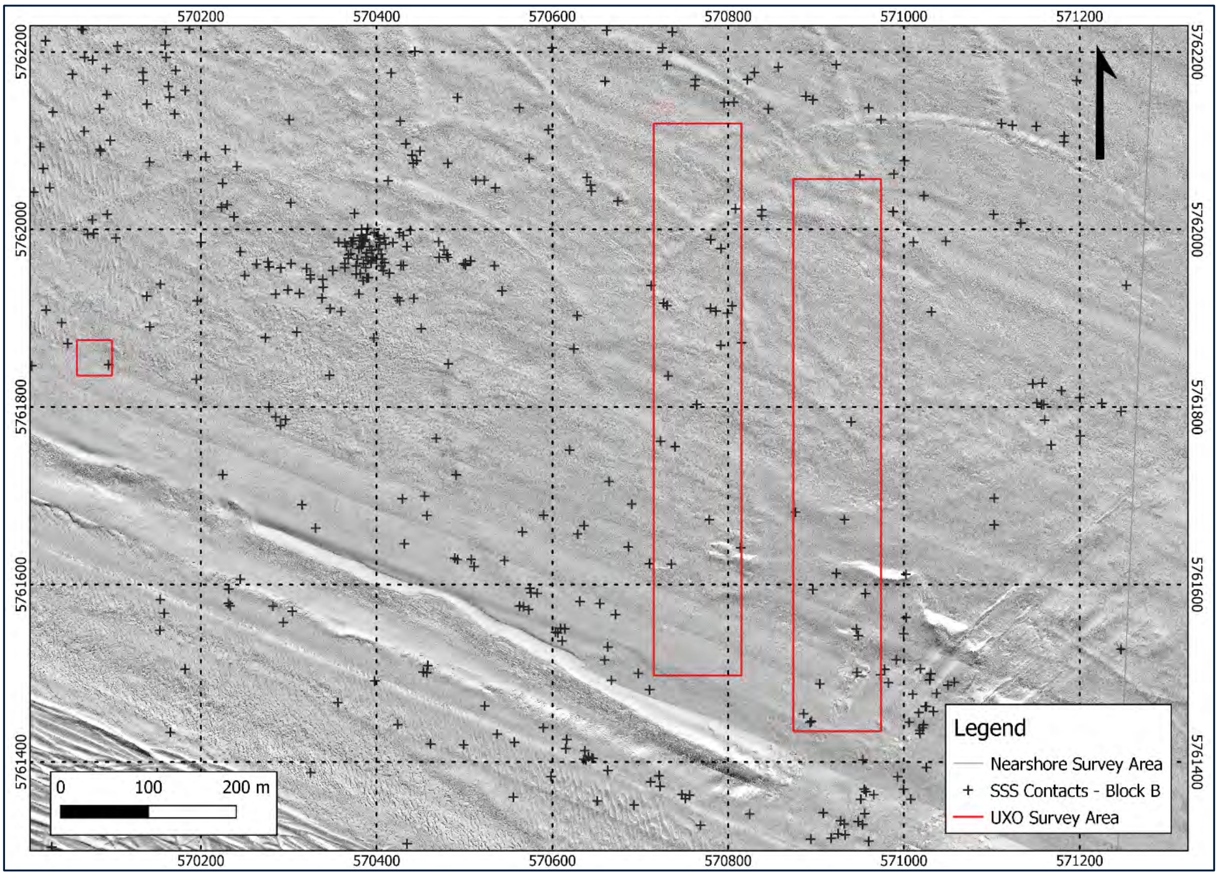

Figure 8.43: An overview of SSS contacts found in the UXO survey areas.

8.4.2 Magnetic Targets – Single Mag

A total of 863 targets were identified within the single magnetometer dataset, Figure 8.44. A total of 41 contacts fell within the UXO survey areas and are presented in Figure 8.45. Specific points of interest have been discussed in section 8.2.2. A complete list of targets is provided in Appendix G.

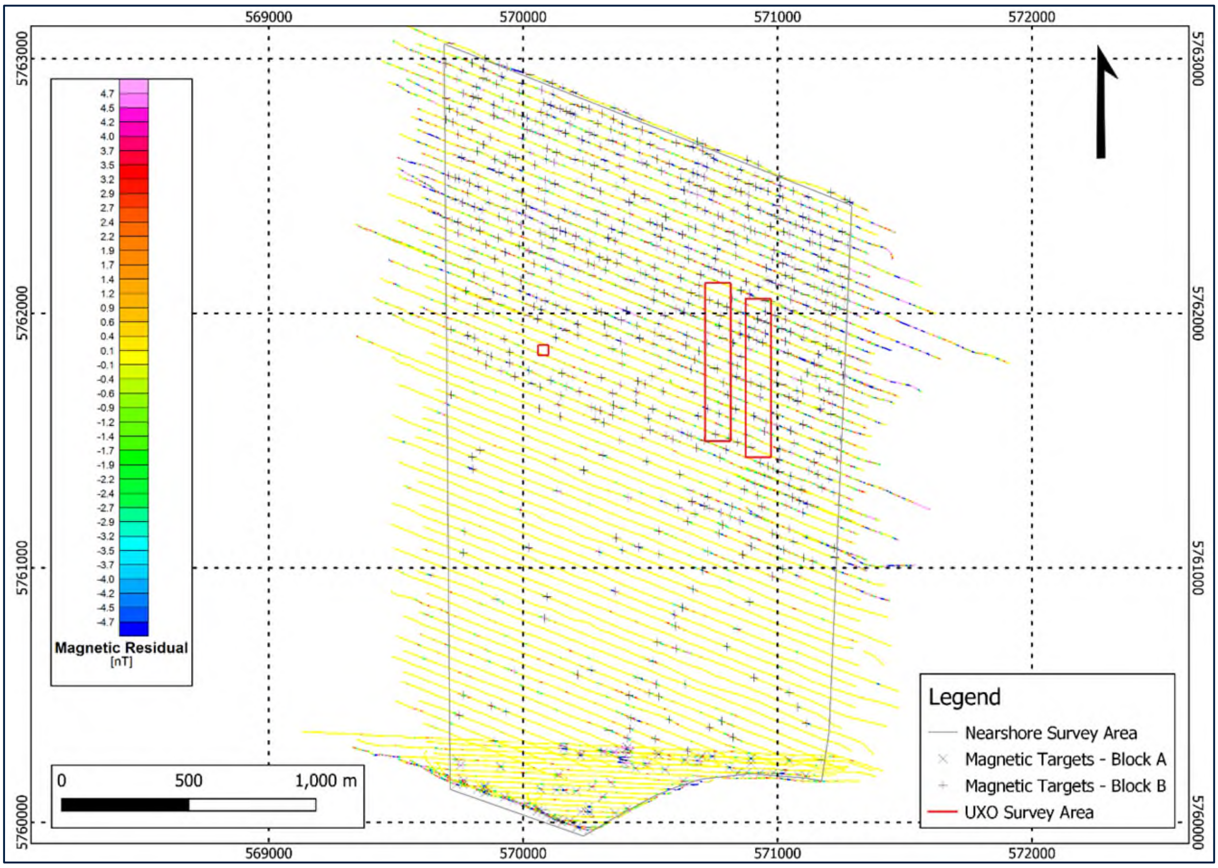

Figure 8.44: Overview of magnetic targets interpreted from single magnetometer data.

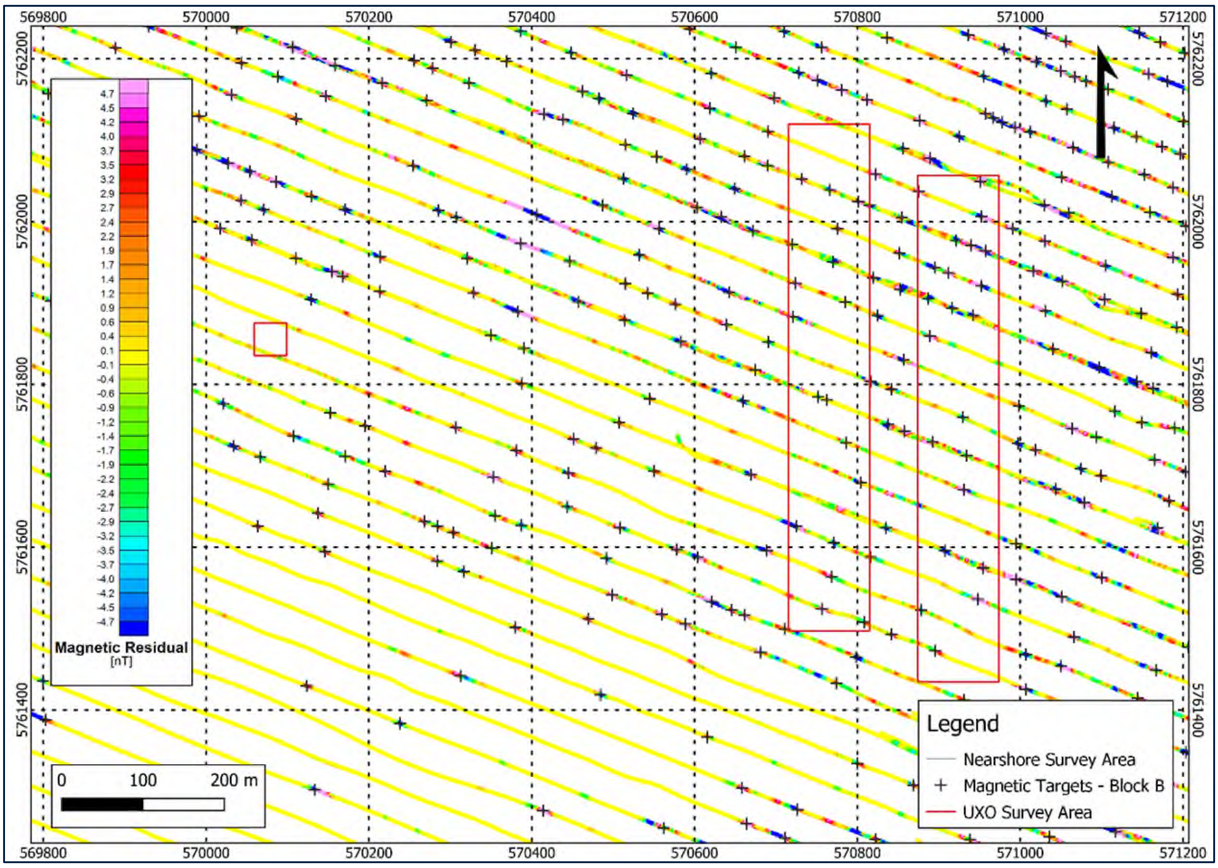

Figure 8.45: Magnetic targets interpreted within UXO survey area.

8.4.3 Buried Contacts

A total of 1644 buried contacts were interpreted from the SBP data, Figure 8.46: Overview of subsea contacts interpreted from the SBP data. Contacts were interpreted from hyperbola features using an automatic contact picking tool. The contacts were then integrated. and had a confidence level of low, medium, or high assigned. Where auto picking had failed to identify a contact or had falsely pick an artefact within the data, contacts were added or removed as appropriate. Low confidence contacts were only observed in the SBP dataset. Medium confidence contacts were contacts that correlated with the magnetic target list and were within the top 2 m of the sub surface. High confidence targets were targets that correlated to known objects and infrastructure. A complete target list has been provided in Appendix G.

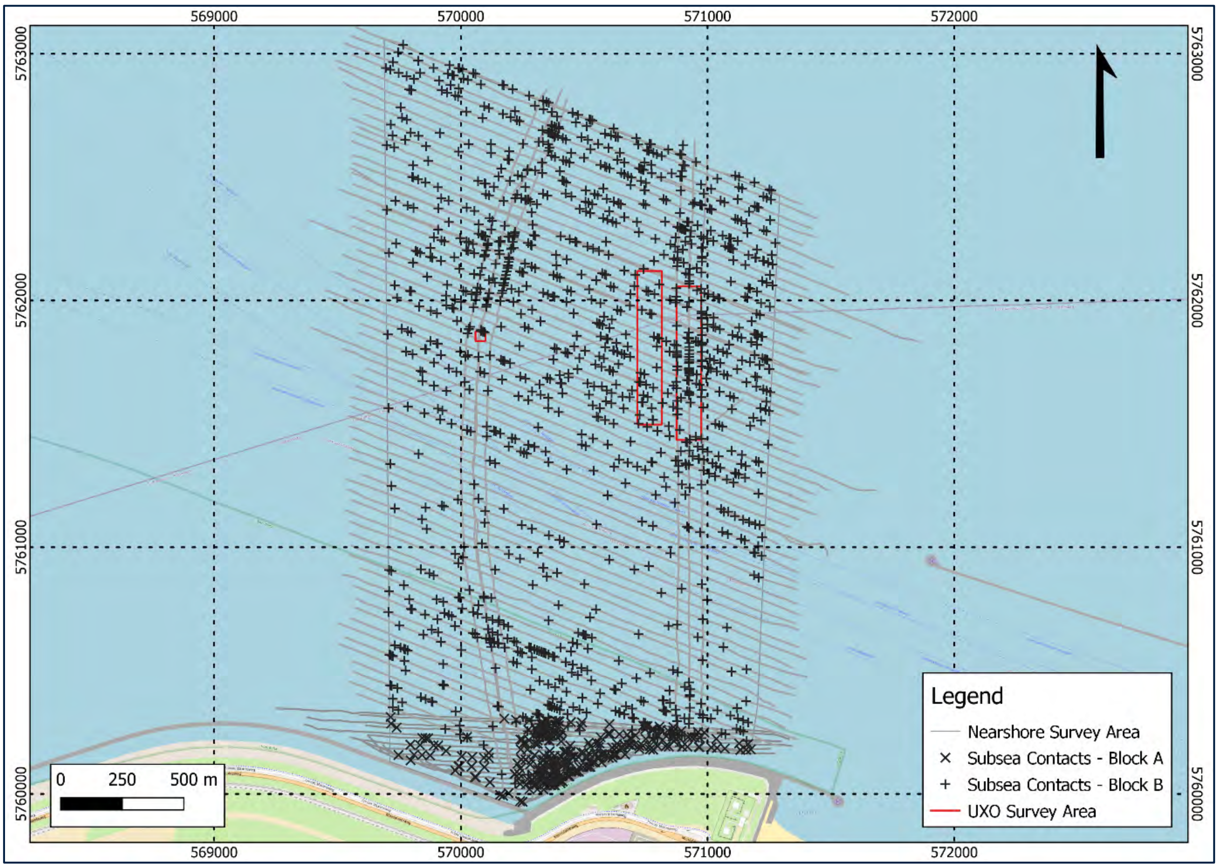

Figure 8.46: Overview of subsea contacts interpreted from the SBP data

8.4.4 Contact Correlation – SSS & Single Magnetometer

Contacts interpreted from side scan sonar and magnetometer datasets have been correlated to indicate where they may be related to the same seafloor object.

Single magnetometer magnetic anomalies were correlated to the SSS contacts in QGIS using an automatic correlation tool. Where contacts were located within 2 m of each other, they were considered correlated. This correlation does not consider vertical separation, as estimated burial depths for the magnetic anomalies has not been conducted as part of the survey scope of work.

In total, 8 contacts were found to correlate between the side scan sonar and the single magnetometer data across the survey area. Details of the correlated contacts have been provided in Table 8.11.

Table 8.11: Details of the correlated SSS and single magnetometer contacts.

MAG ID	Easting [m]	Northing [m]	MAG Shape	SSS ID	SSS Interp
BB_FS_MAG_0222	570154.23	5761938.29	Monopole	BB_FS_SSS_0593	Boulder
BB_FS_MAG_0247	570320.64	5761954.97	Complex	BB_FS_SSS_0607	Boulder
BB_FS_MAG_0274	570386.49	5761973.11	Monopole	BB_FS_SSS_0642	Suspected Debris
BB_FS_MAG_0298	570406	5762008.51	Monopole	BB_FS_SSS_0678	Wreck
BB_FS_MAG_0567	570479.63	5762450.36	Monopole	BB_FS_SSS_0884	Boulder
BB_FS_MAG_0605	570131.22	5762631.97	Complex	BB_FS_SSS_0916	Boulder
BB_FS_MAG_0691	570182.08	5762744.1	Monopole	BB_FS_SSS_0929	Boulder
BB_FS_MAG_0710	569841.79	5762923.34	Monopole	BB_FS_SSS_0946	Boulder

8.4.5 Potential Archaeology

Two wrecks were identified within the survey area from the side scan sonar and multibeam data. One was charted and observed to consist of a series of highly degraded structures, surrounded by a cluster of suspected debris forming an apron-like region SSW of the main structure. The dimensions of the main structure of the wreck were 31.9 m x 20.5 m x 1.6 m. No further historical details could be found regarding the charted wreck. An example of the wreck as seen in the SSS data is presented in Figure 8.16. A further uncharted wreck was observed to consist of a single intact structure representing only the hull with dimensions of 4.3 m x 2.4 m x 0.3 m. An example of the wreck as seen in the SSS data is presented in Figure 8.17.

No further contacts were identified of potential archaeological significance.

Appendix A

Guidelines on the Use of the Report

Guidelines on use of Report

This report (the "Report") was prepared as part of the services (the "Services") provided by Fugro GB Marine Limited ("Fugro") for its client (the "Client") under the terms of the relevant contract between the two parties (the "Contract"). The Services were performed by Fugro based on requirements of the Client set out in the Contract or otherwise made known by the Client to Fugro at the time.

Fugro's obligations and liabilities to the Client or any other party in respect of the Services and this Report are limited in time and value as defined in Contract (or in the absence of any express provision in the Contract as implied by the law of the Contract) and Fugro provides no other representation or warranty whether express or implied, in relation to the Services or for the use of this Report for any other purpose. Furthermore, Fugro has no obligation to update or revise this Report based on changes in conditions or information which emerge following issue of this Report unless expressly required by the Contract.

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Appendix B

Mobilisation and Calibration Report

Mobilisation Fugro Seeker

F197217-REP-MOB-SK 04 | 10 October 2022

TotalEnergies

Document Control

Document Information

Project Title	Aramis Project – Geophysical and Geotechnical Site Investigation
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Client Address	Bordewijklaan 18, 2591 XR – The Hague – The Netherlands
Client Contact	Toni Covic

Revision History

Issue	Date	Status	Comments on Content	Prepared By	Checked By	Approved By
01	25 July 2022	Complete	For Client Comments	RT	MJW	HA
02	16 August 2022	Complete	Updated for UXO Mode Change	RP	MJW	HA
03	23 September 2022	Complete	Updated for UHRS Mode Change	GM	MO	HA
04	10 October 2022	Complete	Updated for GAMBAS Mode Change	PH	HA	HA

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Borderwijklaan 18
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The Hague

10 October 2022

Dear Sir/Madam,

We have the pleasure of submitting the Mobilisation Report – Nearshore Work Package for the Aramis Project. This report presents the details of the vessel's mobilisation and calibration operations.

This report was prepared under the supervision of Helen Abbey (Fugro Seeker Vessel Manager).

We hope that you find this report to your satisfaction; should you have any queries, please do not hesitate to contact us.

Yours faithfully,

Helen Abbey
Fugro Seeker Vessel Manager

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Abbreviations

AORET	communications satellite covering Europe and Africa
C-O	computed minus observed
CRP	common reference point
ETRS	European Terrestrial Reference System
GNSS	Global Navigation Satellite System
IMU	internal measurement unit
LAT	Lowest Astronomical Tide
MAG	magnetometer
MBES	multibeam echosounder
NM	Nautical Miles
RINEX	Receiver Independent Exchange Format
SBP	sub-bottom profiler
SD	standard deviation
SSS	side scan sonar
SVP	sound velocity probe
SVS	sound velocity sensor
USBL	ultra short baseline
UXO	unexploded ordnance
UTM	Universal Transverse Mercator
WMSAT	Communications satellite covering the Atlantic

1. Introduction

The Carbon Capture and Storage (CCS) Aramis Project aims to reduce industrial CO2 in the Netherlands by developing CO2 transport facilities to allow for offshore storage of the gas. The CO2 once captured, is collected at a compressor station and a shipping terminal at the Maasvlakte, a hub in the port of Rotterdam. From this hub the CO2 is transported to offshore gas fields to be injected into depleted offshore gas field at a depth of about 3 -4 km below the seabed.

Fugro performed an offshore geophysical and geotechnical site investigation of the proposed offshore pipeline corridor, running from the Maasvlakte to offshore blocks L4/K6. This report provides information relating to the mobilisation and calibration of equipment onboard the survey vessel Fugro Seeker, working on the nearshore scope of work for the project.

Vessel mobilisation was undertaken between 3 and 12 July 2022 in the port of Scheveningen, Netherlands. Equipment verifications were carried out over various seabed features or targets located near the survey area. Subsequent mode changes were conducted as part of the survey and as such, additional equipment mobilisation information have been added to this report.

Guidelines on the use of this report have been provided in Appendix A.

The following verifications and validation checks were carried out prior to the start of survey operations and are described in detail within this report:

- Positioning system verification (05/07/2022);
- Heading verification (14/02/2022)
- Draught check (05/07/2022)
- Multibeam echosounder (MBES) patch test (11/07/2022);
- Sound velocity probe (SVP) comparison (11/07/2022
- Ultra short baseline (USBL) box-in calibration (14/02/2022)
- Side scan sonar (SSS) verifications (11/07/2022);
- Sub-bottom profiler (SBP) verifications (12/07/2022);
- Magnetometer (MAG) verifications (12/07/2022);
- Miniwing Gradiometer verifications (07/08/2022) prior to UXO survey.

1.1 Survey Overview

The following sub-sections provide details about the main survey equipment and the scope of work for the Client's Work Package 2 (WP2) for the TotalEnergies Aramis Project survey.

The nearshore geophysical survey was divided into the following four Work Elements:

- Geophysical (MBES, SSS, SBP and single MAG);
- Unexploded ordnance (UXO) (Magnetic Array);
- 2D UHRS;
- Refraction Seismic and multi-channel analysis of surface waves (MASW)

Following the mode change from one Work Element to another, this report was updated to include the calibration and verification information for the additional sensors.

1.2 Geodetic Parameters

The project geodetic and projection parameters are summarised in Table 1.1. The test coordinate is provided in Table 1.2.

Table 1.1: Geodetic Parameters

Global Navigation Satellite System (GNSS) Geodetic Parameters (Note 1)		
Datum:	International Terrestrial Reference Frame 2014	EPSG: 1165
Spheroid:	GRS 1980	
Semi major axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257222101	
ETRS89 Geodetic Parameters		
Datum:	ETRS89	EPSG: 6258
Spheroid:	GRS 1980	
Semi major axis:	a = 6 378 137.00 m	
Inverse Flattening:	1/f = 298.257 222 101	
Datum Transformation Parameters from ITRF2014 to ETRS89 (Note 2, Note 3)		
X-axis translation 0.05595 m	X-axis rotation –0.0027132 "	Scale difference 0.003495455 ppm
Y-axis translation 0.05345 m	Y-axis rotation –0.016413 "	
Z-axis translation –0.09784 m	Z-axis rotation 0.0265287 "	
Project Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 31N	EPSG: 16031
Latitude origin:	00° 00′ 00.000″ N	
Central meridian:	003° 00′ 00.000″ E	
Scale factor on central meridian:	0.9996	
False easting:	500 000 m	
False northing:	0 m	

Notes: 1) Fugro Starfix navigation software uses ITRF14 geodetic parameters as a primary datum; 2) The seven datum transformation parameters are calculated at epoch 2022.496 (01/07/2022). These are generated from reference epoch 2000.0 using the 14 parameter transformation version ETRF2000-ITRF2014 as defined by Zuheir Altamimi, Key results of ITRF2014 and implication to ETRS89 realisation. EUREF2016 Symposium; 3) The rotation parameters use Coordinate Frame rotation convention as defined by UKOOA.

Vertical Datum	
Vertical coordinate reference system	ETRS89 to LAT height using NLLAT2018

Table 1.2: Test Point

ITRF2014	Test Point Position
Latitude	53° 32′ 37.50000″ N
Longitude	004° 16′ 30.00000″ E
Ellipsoidal height	0.000 m Ell.
ETRS89	
Latitude	53° 32′ 37.48043″ N
Longitude	004° 16′ 29.97086″ E
Ellipsoidal height	-0.023 m Ell.
UTM zone 31N	
Easting	584 484.290 m
Northing	5 933 516.515 m
Chart Datum Height	-40.248

1.3 Vertical Datum

All vertical data for the survey was reduced to LAT.

2. Survey Equipment

2.1 Vessel Details

Fugro Seeker (Figure 2.1) is a purpose-built hydrographic and geophysical survey vessel, commissioned, owned, maintained, and operated by Fugro. The vessel was fully mobilised in accordance with Fugro standard procedures. The vessel is equipped for 12-hour operations up to 60 nm from haven and is operated under Maritime and Coastguard Agency (MCA) workboat category 2. Vessel characteristics are shown in Table 2.1.

Figure 2.1: Fugro Seeker

Table 2.1: Vessel Characteristics

Vessel	Fugro Seeker
Length	12.0 m
Beam	4.88 m
Gross Tonnage	17 ton
Draught	1.07 m
Endurance	12 hours
Survey speed	4 knots
Transit speed	15/18 knots

2.2 Vessel Dimensional Control

A dimensional control survey of the Fugro Seeker was performed in July 2017 (Appendix B). The offsets of key instruments were computed and entered into Starfix 2020 acquisition software. These offsets included primary and secondary positioning systems, multibeam echosounder, inertial measurement units and various nodes throughout the vessel. The mounting angle offsets of the multibeam echosounder measured during the dimensional control were confirmed or improved when conducting the patch test.

2.3 Survey Positioning

Primary and Secondary Global Navigation Satellite System (GNSS) positioning was provided from separate Fugro StarPack GNSS receivers. The antennas were installed with clear and unobstructed hemispherical views. The systems were interfaced directly into the online navigation system, providing positional precision better than 0.10 m horizontally and 0.10 m vertically using a Fugro Starfix G2+ positioning solution from WMSAT and AORET.

2.4 Attitude Sensor

An Applanix POS MV 320 Internal Measurement Unit (IMU) provided attitude data to the Fugro Seeker. The POS MV IMU was mounted at the Common Reference Point (CRP). The POS antennas were mounted above the roof of the vessel, providing unobstructed hemispherical views. The IMU to MBES head lever arm was measured using a Leica Total-Station during the vessel dimensional control survey and entered into the POS MV control software.

2.5 Multibeam Echosounder

Fugro Seeker is equipped with two Teledyne RESON 7125 multibeam echo sounders, permanently mounted, one on each hull. Attitude, time and sound velocity were interfaced into the multibeam processing software to aid in their operation. Multibeam bathymetry data were acquired using Fugro Starfix 2020 software.

2.6 Side Scan Sonar

Two EdgeTech 4200 dual frequency 300/600KHz side scan sonar towfish (one deployed, one spare) where mobilised on board Fugro Seeker. The EdgeTech 4200 SSS was towed using a standalone winch with armoured cable from the stern of the vessel. Data was acquired with EdgeTech Discover software. The side scan sonar was tracked using the USBL positioning system.

2.7 Sub Bottom Profiler

An Innomar SES-2000 medium parametric sub bottom profiler was mobilised on the Fugro Seeker. The system was mounted on the vessel's side arm. Data was acquired with the Innomar Seswin24bit software. Heading, time and attitude data are interfaced into the processing unit from the POS MV and positioned using Fugro Starfix 2020.

2.8 USBL System

Subsea positioning was provided by a Sonardyne Mini Ranger 2 USBL system, permanently mobilised on the Fugro Seeker. The system was pole mounted and deployed / recovered easily from a side mounted arm. Heading, time and attitude data were interfaced from the Applanix POS MV IMU. Computed range and bearing measurements for deployed beacons were interfaced into Fugro Starfix 2020.

2.9 Sound Velocity Probe

Valeport miniSVP sensors were used for the measurement of the speed of sound in seawater. The profilers are programmed to measure temperature, depth and sound velocity at pre-set intervals. The recorded data was then downloaded and applied in real-time to Starfix and the USBL system. In addition, a RESON SVP-70 SVS mounted at the MBES provided real-time sound velocity readings.

2.10 Magnetometer

Two geometrics G882 magnetometers were mobilised to Fugro Seeker (one deployed, one spare). When deployed the single magnetometer was towed behind the SSS fish using a soft tow cable at a fixed length of 9.95 m. The magnetometer was tracked using the Sonardyne Mini Ranger 2 USBL positioning system, with the beacon attached directly to the SSS providing the position to which the magnetometer offset was applied. Magnetometer data was logged simultaneously using Maglog and Starfix NG software. The magnetometers' digital depth and altitude sensors were calibrated prior to the start of survey operations at Fugro's Portchester office.

2.11 Miniwing Gradiometer

For the UXO detection phase, two Geometrics G882 magnetometers were mounted to a fixed frame (Miniwing) with a fixed 1.5m horizontal offset. The Miniwing was towed behind the vessel and positioned using a Sonardyne WSM 6+ beacon mounted 1.4m up the cable. The Sonardyne USBL system was used to provide Starfix NG with navigation data from which to calculate offsets for each magnetometer sensor. Raw data from each magnetometer was interfaced into the Starfix software and monitored by the online geophysicist.

2.12 UHRS

Geo Marine Survey System's were subcontracted to conduct the UHRS acquisition on board Fugro Seeker. The Mobilisation Report for the UHRS equipment on the vessel is located at Appendix F.

2.13 GAMBAS

For the refraction and MASW phase, a sled mounted airgun and streamer were mobilised to acquire seismic data. The streamer was attached to the aft end of the sledge and both were towed along the seabed during acquisition. Two streamers were required for the project; a 150m streamer fitted with refraction and MASW hydrophone arrays, and a 90m streamer made of two shorter MASW hydrophone arrays. The 150m streamer was mobilised initially, and was swapped with the 90m streamer as required for the survey area. The sledge was positioned using a Sonardyne WSM 6+ beacon mounted in the sledge. The Sonardyne USBL system was used to provide Starfix NG with navigation data from which to calculate offsets for both the airgun sledge and streamer. The forward end of the streamer was directly attached to a towpoint on the aft end of the sledge and also positioned with the beacon on the sledge. The position of the tail of the streamer was estimated using the Starfix Towed Object Solution. Raw data from the GAMBAS system was interfaced into the Geodes software and monitored onboard by the online GAMBAS geophysicist.

3. Vessel Reference Frame

3.1 Vessel Offsets

All systems were mounted relative to the XYZ reference frame of the vessel. The Y-axis being the fore-aft centre line, the X-axis running perpendicular to the Y-axis through the common reference point (CRP), and the Z-axis being positive upwards from the CRP (Figure 3.1). The online navigation software Starfix 2020 used this reference frame to correct vessel nodes for position. The POS MV 320 used a reversed reference frame whereby the X-axis is the fore-aft centre line, and the Y-axis ran perpendicular to the X-axis through the CRP and the Z-axis was positive downwards from the CRP to correct for attitude and heading.

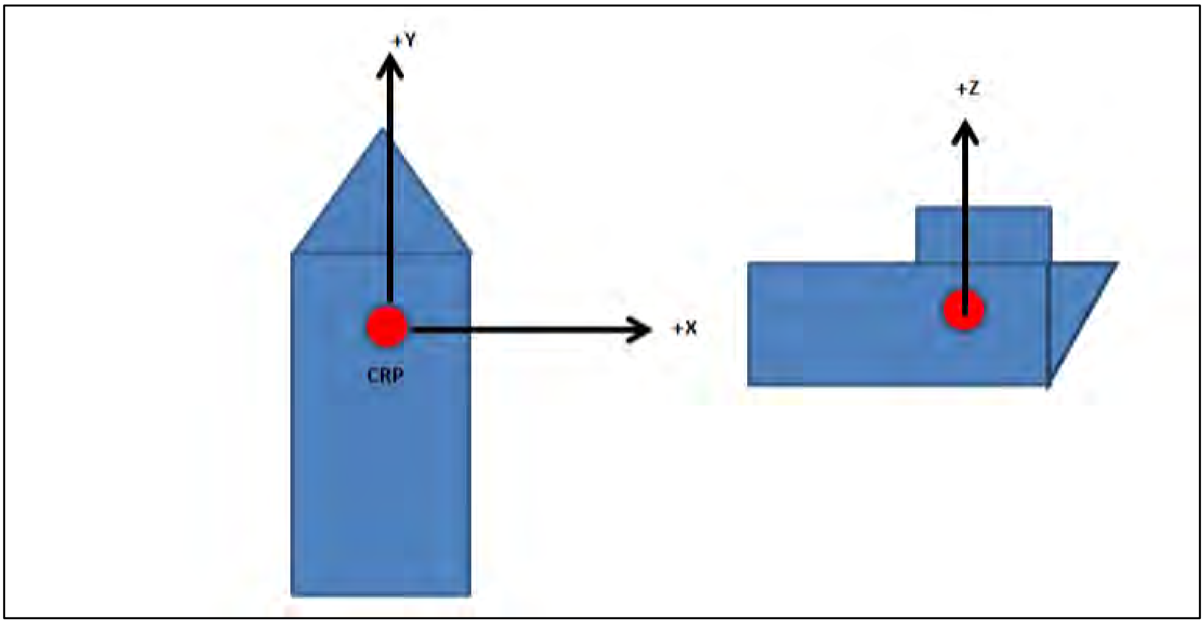


Figure 3.1: Vessel Reference Frame for Geophysical Survey

A vessel offset diagram is included in Figure 3.2 and the calculated offset values are summarised in Table 3.1.

Table 3.1: Vessel Offsets

Number	Offset	X [m]	Y [m]	Z [m]
1	Vessel CRP (POS MV IMU)	0.000	0.000	0.000
2	MBES Port Acoustic Centre	-1.640	-2.152	-3.038
3	MBES Stbd Acoustic Centre	1.438	-2.124	-3.006
4	POS Aft Antenna	1.260	0.472	1.427
5	StarPack Secondary Antenna	1.282	0.943	1.465
6	StarPack Primary Antenna	1.255	1.423	1.465
7	Spare Node/Leica Antenna	1.284	1.894	1.354
8	POS Fwd Antenna	1.255	2.377	1.422
9	Aft Port Bollard	-2.384	-4.339	-0.396

Number	Offset	X [m]	Y [m]	Z [m]
10	Aft Stbd Bollard	2.042	-4.319	-0.337
11	USBL Sonardyne Mini Ranger 2	2.540	1.990	-3.260
12	Innomar Transducer	2.461	2.664	-3.259
13	A-frame port pad eye	-2.465	-4.955	0.822
14	A-frame middle pad eye	-0.169	-4.974	0.859
15	A-frame starboard pad eye	2.132	-4.947	0.877
Note: A-frame pad eyes surveyed as part of dimensional control survey but not generally used as they are variable				

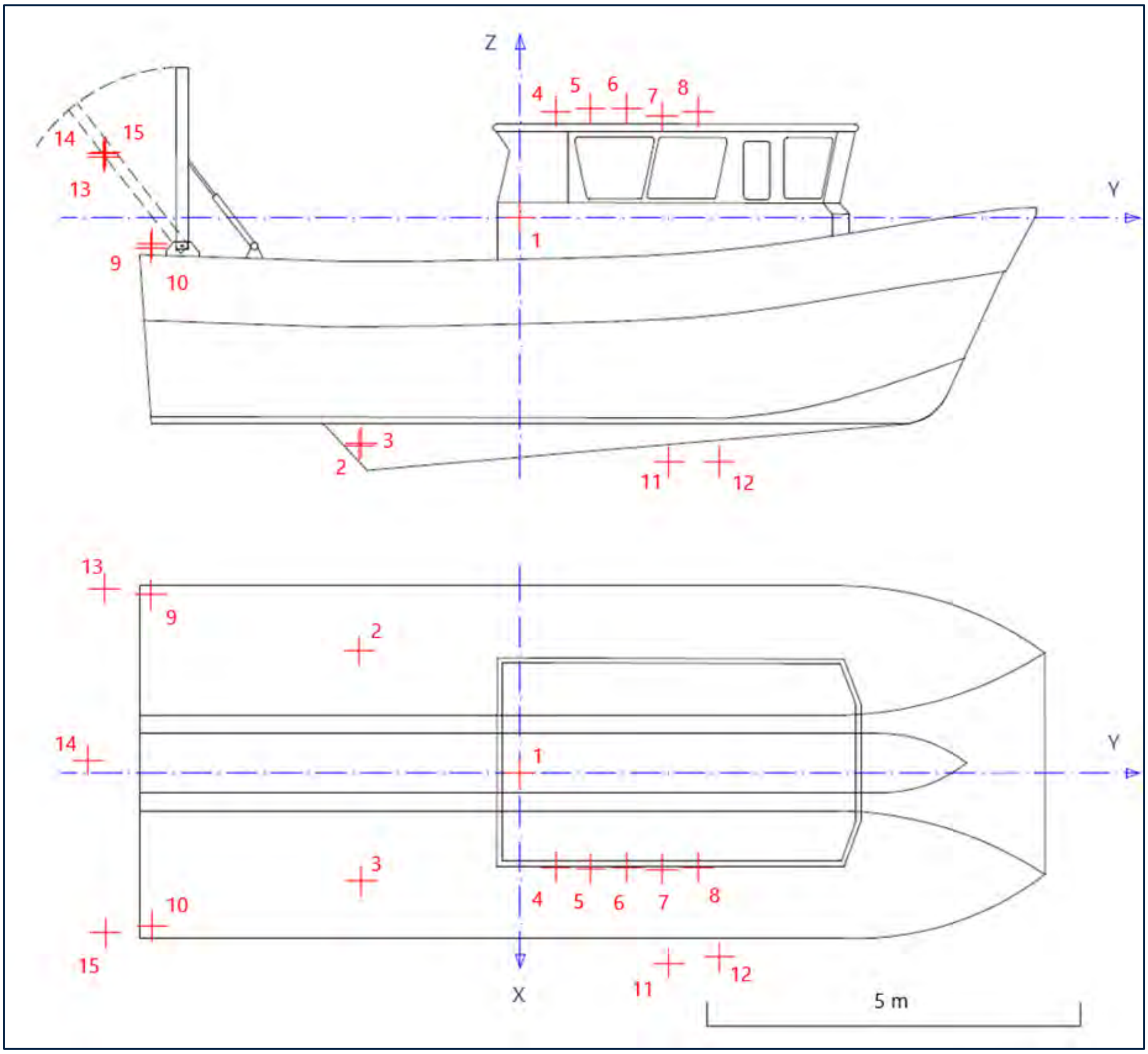


Figure 3.2: Vessel offset diagram

3.2 Static Position Validation

On 5 July 2022, a combined node offset check and static positioning comparison was carried out whilst the vessel was alongside in Scheveningen.

The primary and secondary GNSS positioning systems (Fugro StarPack primary, Fugro StarPack secondary) were compared against a Leica 1200 GNSS independent positioning system. The Leica was PPK processed using a local GNSS reference station. The online survey system Starfix 2020 exported computed positions of the Leica offset according to the primary and secondary positioning systems together with the heading, pitch and roll system. The data comparison was recorded at 1 Hz for 30 minutes. Table 3.2 shows the results of the comparison. Figure 3.3 shows the horizontal scatterplots of the position comparison.

Figure 3.3: Position comparison – scatterplot

Table 3.2: Node offset check and position comparison

System Comparison	Δ Easting [m]	Δ Northing [m]	Δ Height [m]
Leica 1200 PPK vs Fugro StarPack G4+ Primary	0.020	0.007	-0.007
Leica 1200 PPK vs Fugro StarPack G4+ Secondary	0.002	0.024	-0.024

System Comparison	Δ Easting [m]	Δ Northing [m]	Δ Height [m]
Leica 1200 PPK vs POSPac	0.004	0.014	-0.025

3.3 Heading Verification

The vessel heading was verified against a GNSS derived heading whilst the vessel was alongside Hartlepool on 14 February 2022. A Leica 1200 GNSS antenna was placed on the port forward bollard and along with the primary StarPack G4+ GNSS, a baseline of 6.67 m was established. All systems were logged simultaneously for 35 minutes. The Leica 1200 GNSS data were processed using PPK techniques referenced to the LOFT RINEX station.

The resulting Leica 1200/StarPack G4+ primary GNSS positions were used to calculate a true heading relative to the vessel reference frame. The heading was compared at 1 second epochs to observations logged by the vessel POS MV system and a heading C-O (computed minus observed) was established. Results of the verification are shown in shown in Table 3.3. A plot of C-O is shown in Figure 3.4 The mean C-O for the POS MV system was 0.00°.

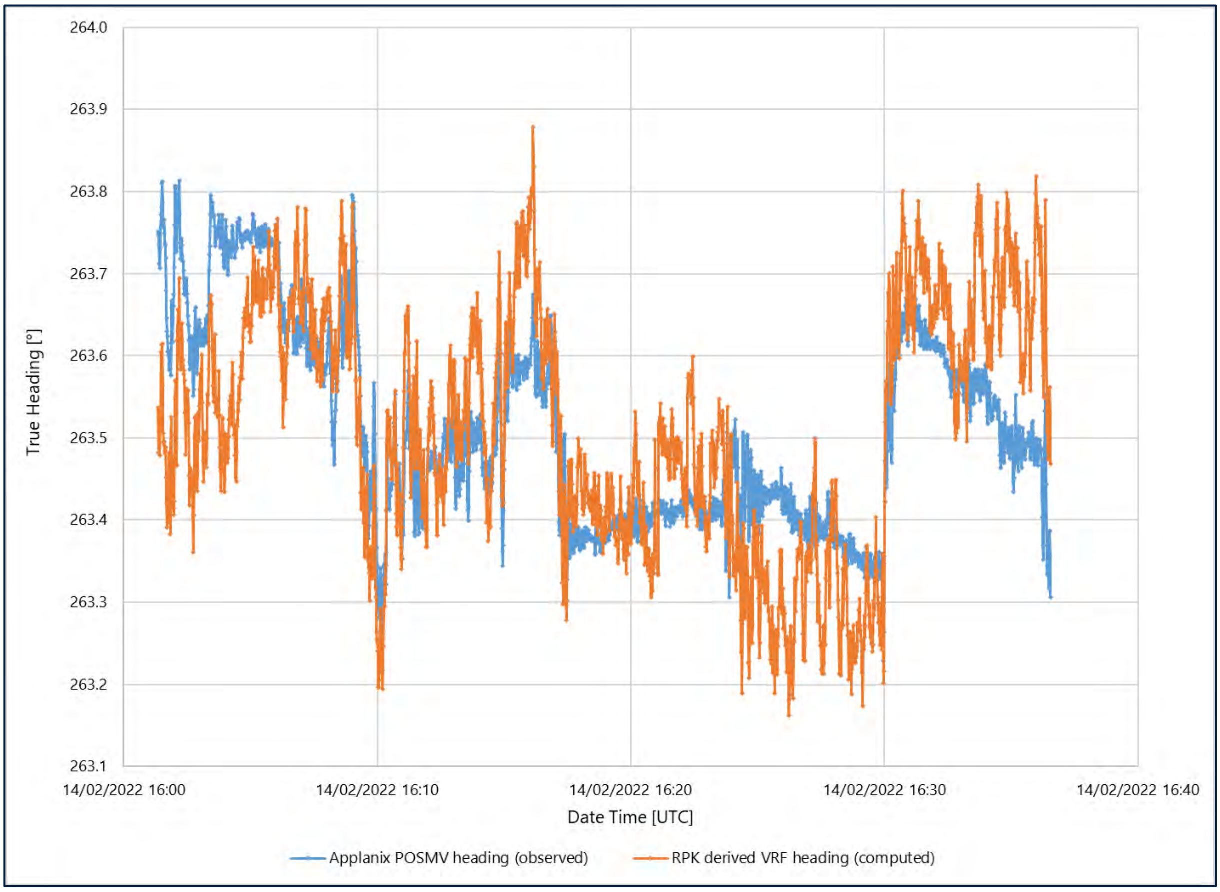


Figure 3.4: Comparison of GNSS derived heading and Applanix POS MV heading sensor

Table 3.3: Comparison of Vessel Heading Sensors to True Heading

Heading Verification	C-O [°]	SD [°]
GNSS baseline derived	0.00	0.11

3.4 Draught Check

The vessel draught measurement was carried out whilst the vessel was alongside in Scheveningen on 5 July 2022. Measurements were taken with a lead line from the aft bollard to the waterline and from this the CRP to waterline was calculated and entered into Starfix 2020 as -1.97 m.

4. Multibeam Echo Sounder

4.1 Patch Test

A standard patch test calibration was conducted on 11 July 2022 over a wreck (Figure 4.1). The water depth was approximately 22 m. The calibration accounted for roll, pitch and heading (yaw) between the vessel's motion reference unit and the mounting angles of the Teledyne RESON 7125 heads. The patch test also included a test for latency. Before commencing the patch test all values were returned to zero. Results of the calibration were entered into Starfix 2020 and are summarised in Table 4.1 for the port and Table 4.2 for the starboard transducer.

Table 4.1: Multibeam patch test calibration results – Port head

Port Head	Starting Value	Correction	Result
Roll	+15.0°	+0.73°	+15.73°
Pitch	0.0°	-1.0°	-1.0°
Yaw	0.0°	-1.7°	-1.7°
Latency	0.0 s	0.0 s	0.0 s

Table 4.2: Multibeam patch test calibration results – Starboard head

Stbd Head	Starting Value	Correction	Result
Roll	-15.0°	+1.03°	-13.97°
Pitch	0.0°	+1.25°	+1.25°
Yaw	0.0°	-1.1°	-1.1°
Latency	0.0 s	0.0 s	0.0 s

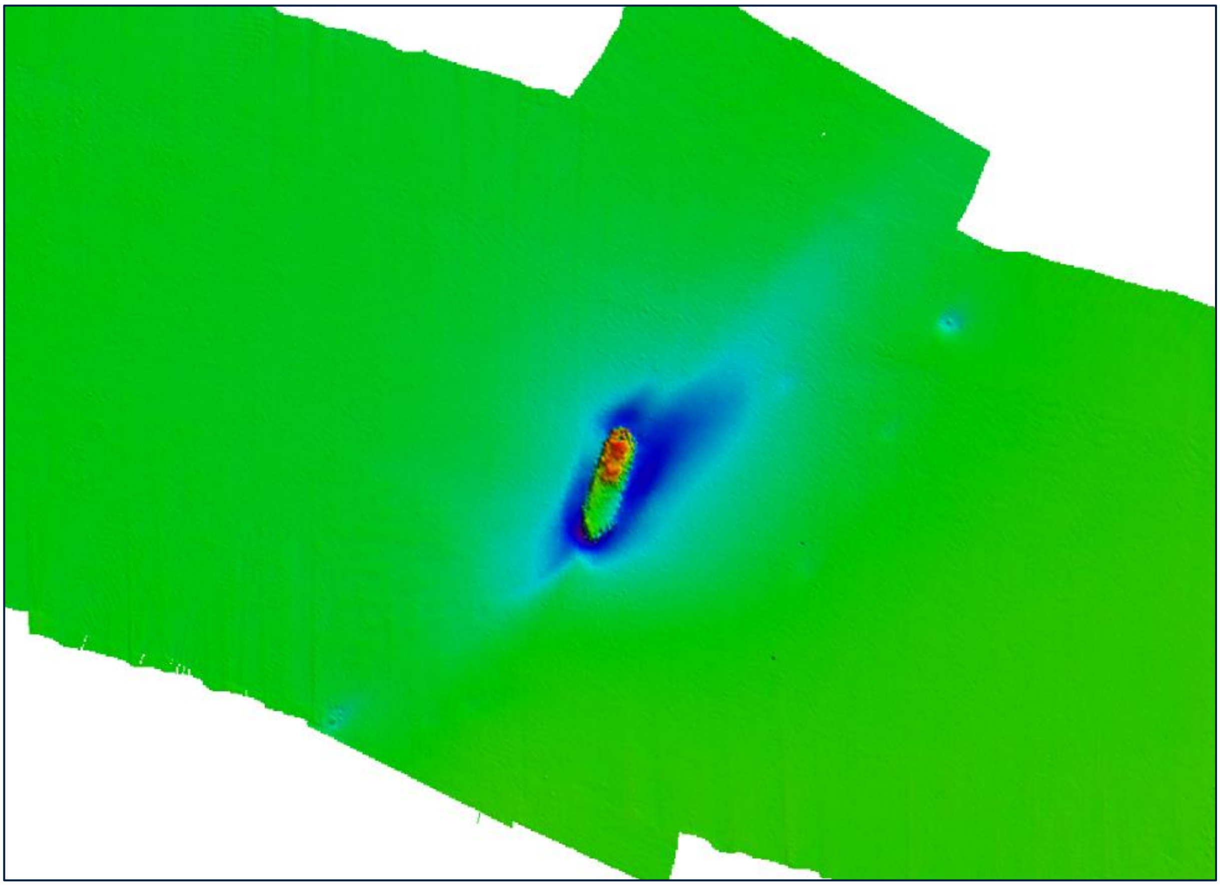


Figure 4.1: MBES Calibration Site

4.1.1 Pitch

The pitch error is an angular misalignment between the axis of the vessel's reference coordinate system (measured by the motion sensor) and the pitch axis of the sonar transducer head. The pitch error was determined by comparing selected beams of two calibration lines sailed over a significant feature on the seabed in opposite directions at the same speed. The profiles were selected as close to nadir as possible to ensure the pitch correction was determined as accurately as possible. Port and starboard pitch correction calibrations are shown in Figure 4.2 and Figure 4.3 respectively.

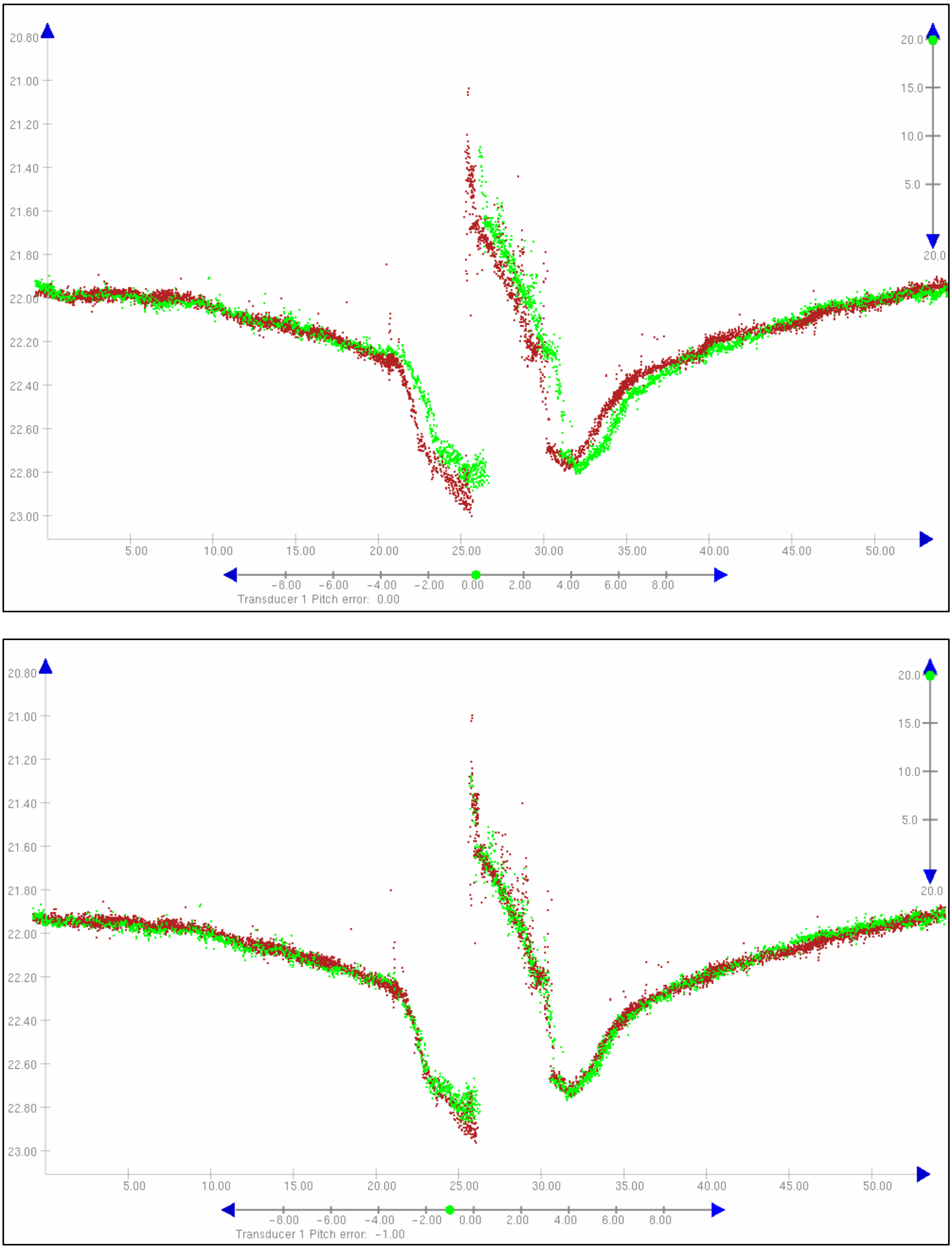


Figure 4.2: Port transducer pitch correction (before and after correction applied)

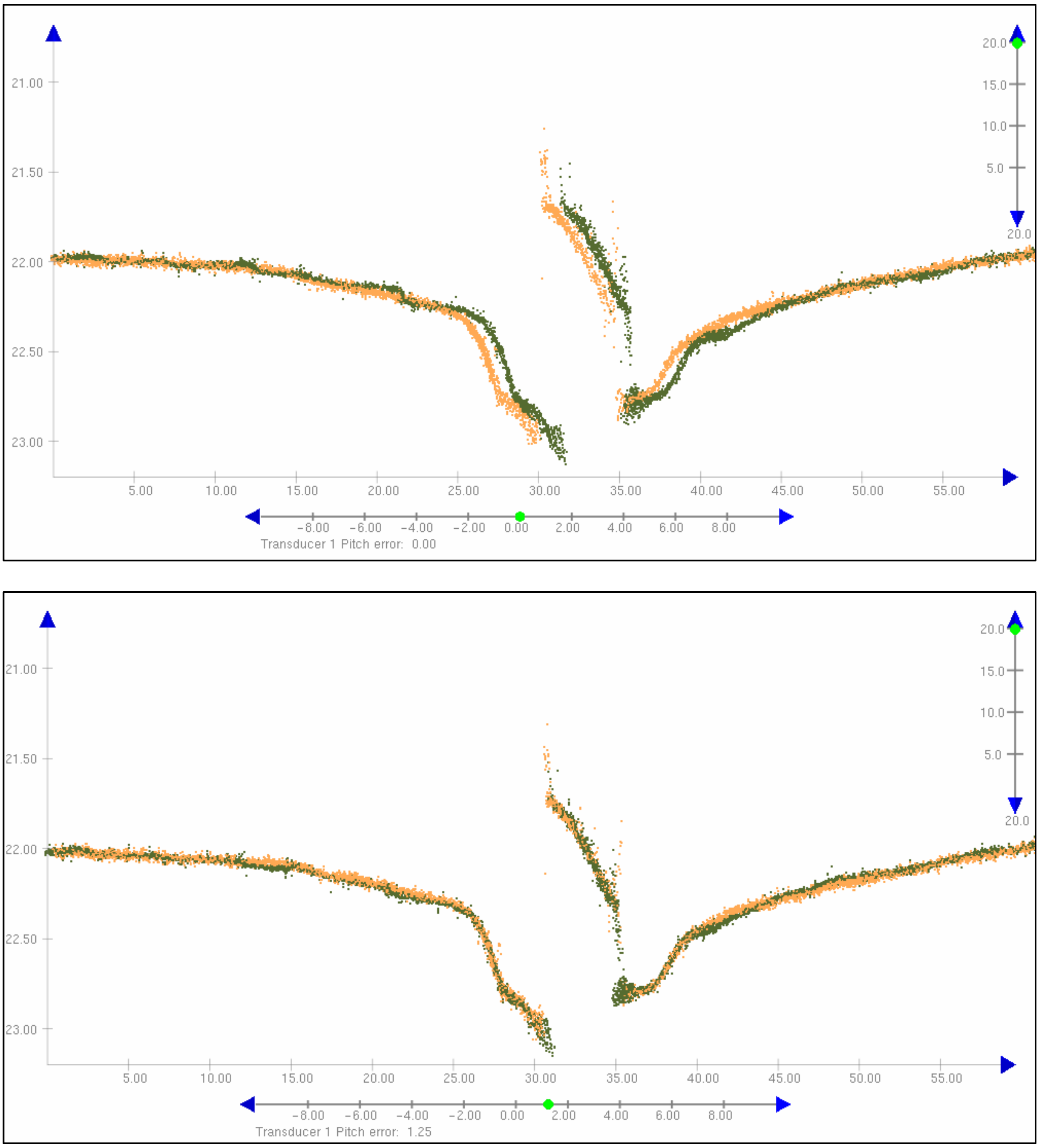


Figure 4.3: Starboard transducer pitch correction (before and after correction applied)

4.1.2 Roll

Roll error is an angular misalignment between the roll axis of the vessel's reference coordinate system (measured by the motion sensor) and the roll axis of the sonar transducer head. A roll adjustment was not applied before undertaking the patch test. The roll error was determined by running two calibration lines at the same speed in opposite directions, with the widest swath and greatest overlap between reciprocal lines used. Port and starboard roll correction calibrations are shown in Figure 4.4 and Figure 4.5 respectively.

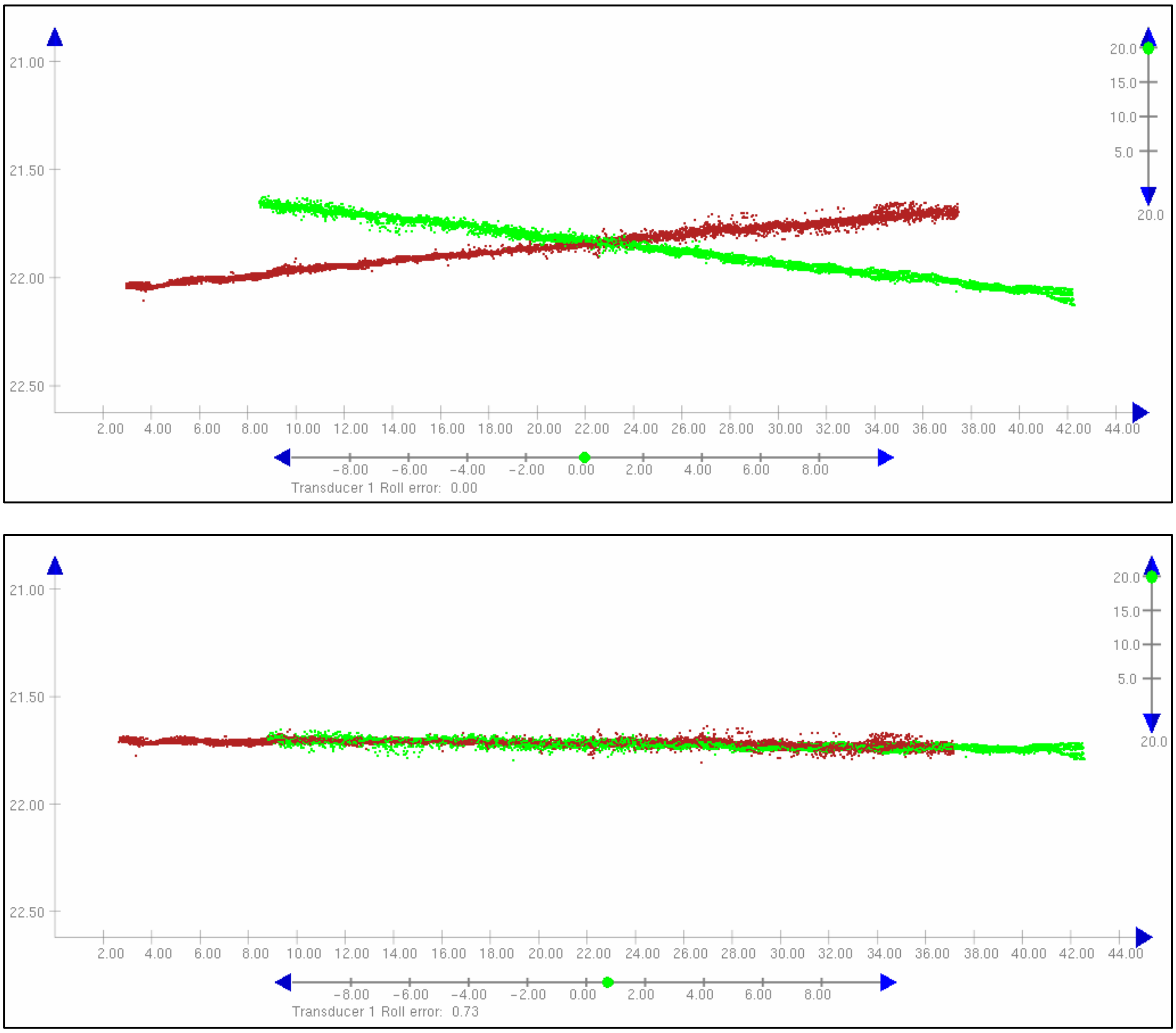


Figure 4.4: Port transducer roll correction (before and after correction applied)

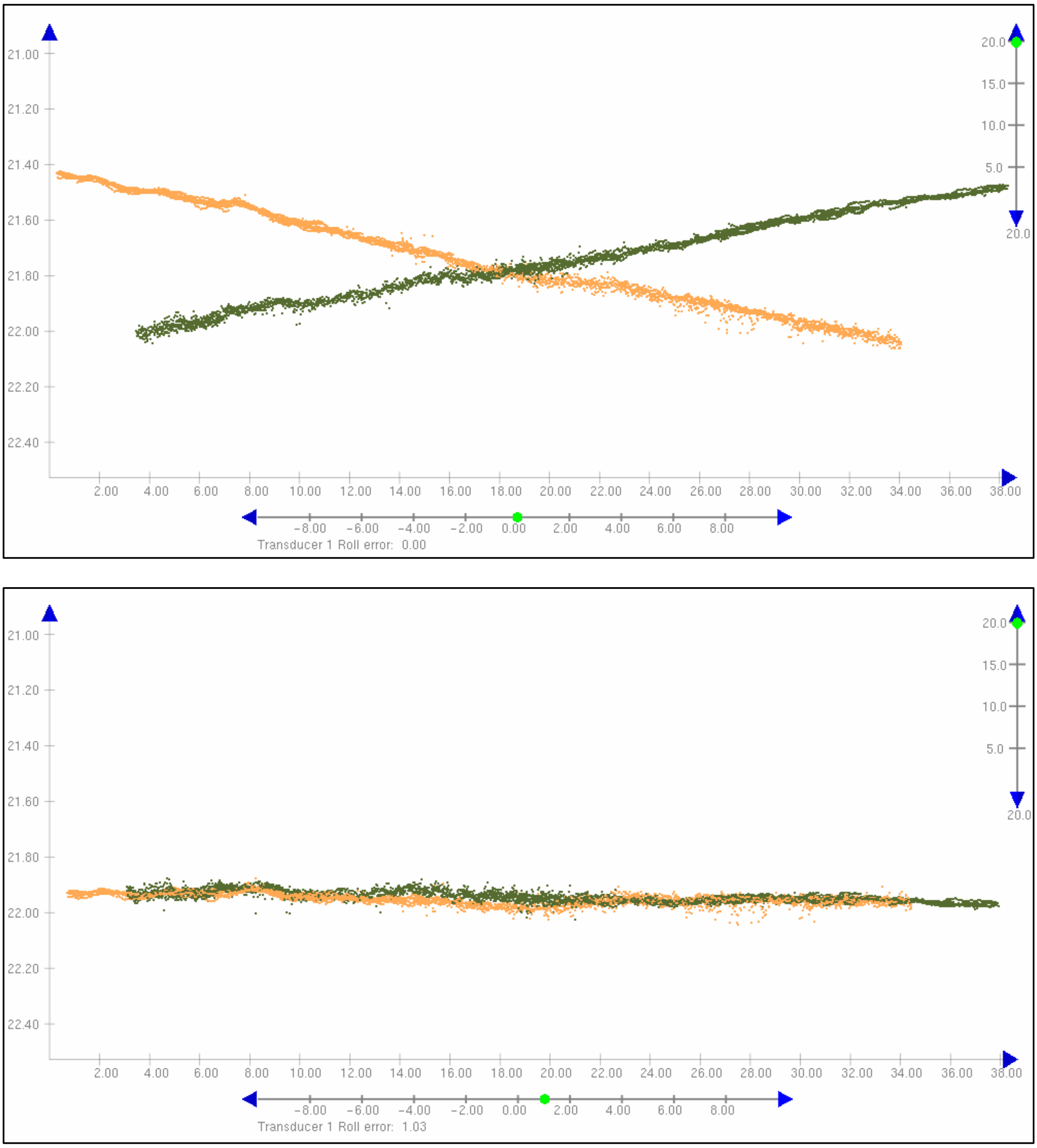
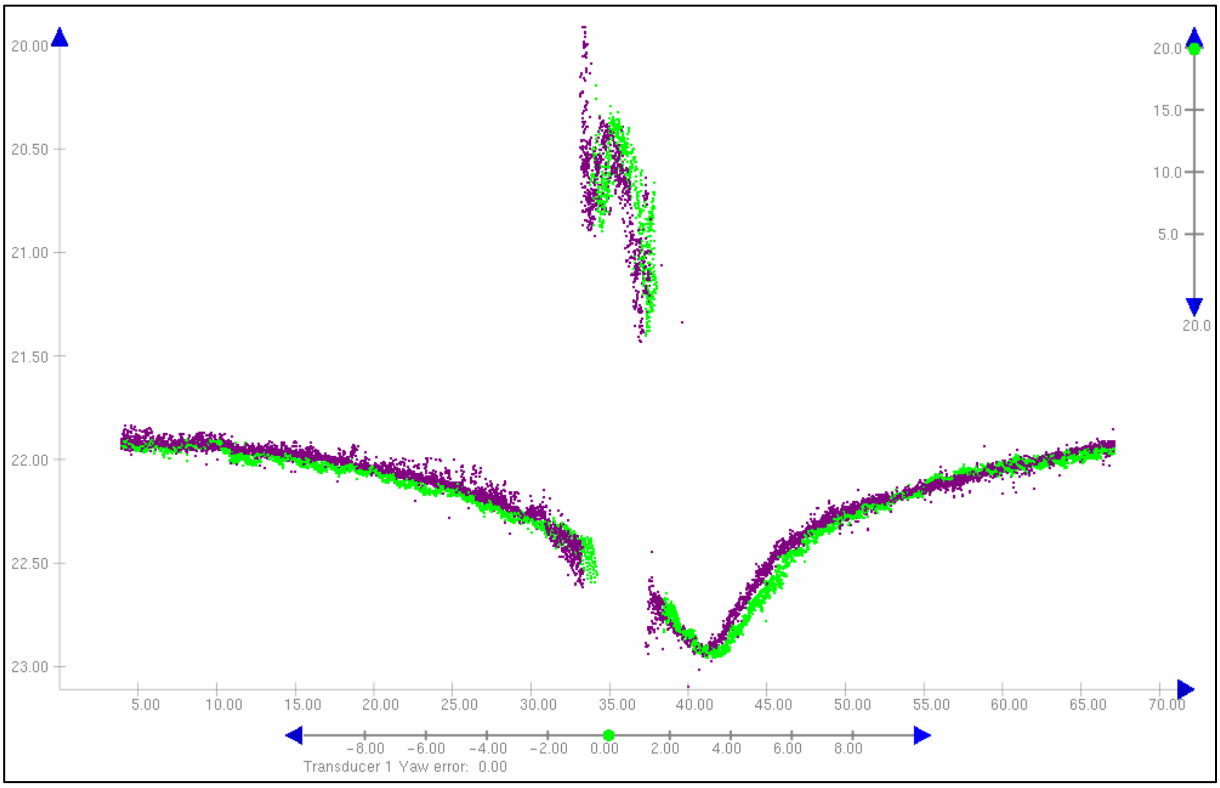


Figure 4.5: Starboard transducer roll correction (before and after correction applied)

4.1.3 Heading (Yaw)

Heading error is an angular misalignment between the axis of the vessel's reference coordinate system (measured by the motion sensor) and the heading axis of the sonar transducer head. The heading error was determined by comparing the outer beams from two calibration lines sailed over a significant feature on the seabed in the same direction at the same speed. Port and starboard yaw correction calibrations are shown in Figure 4.6 and Figure 4.7 respectively.



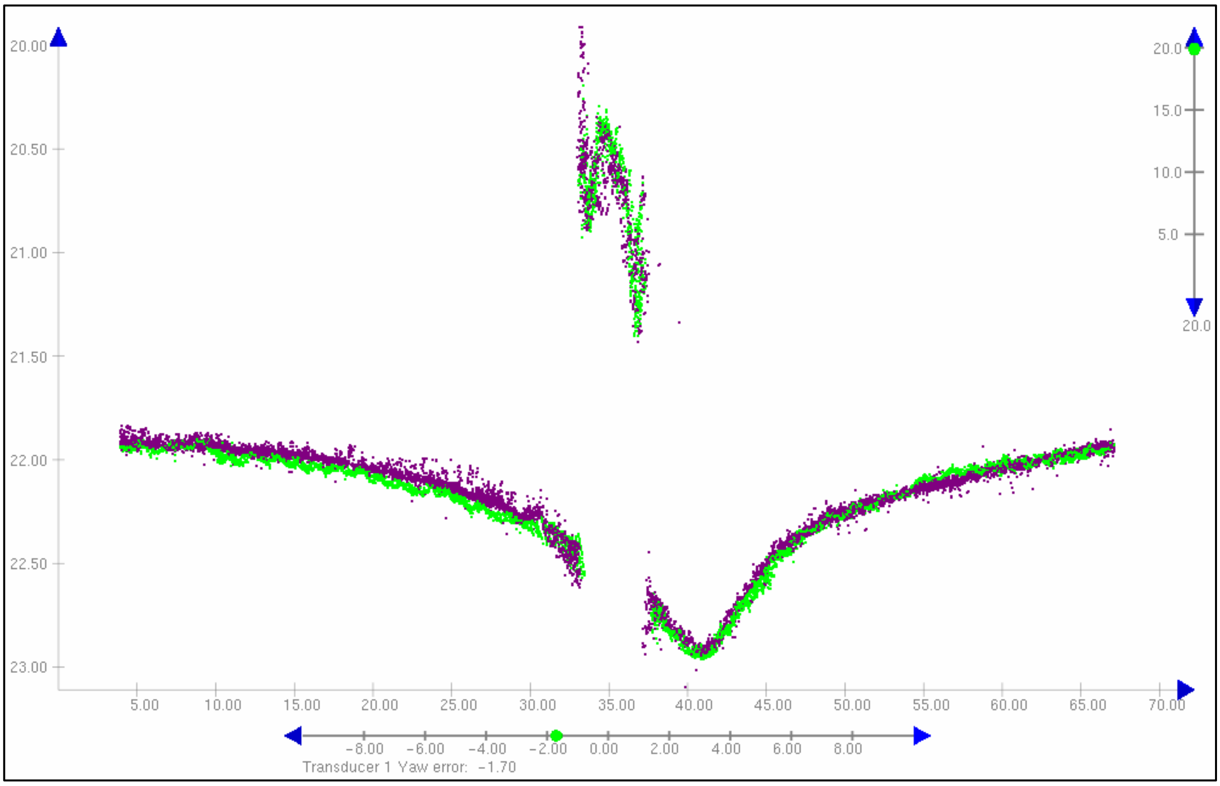
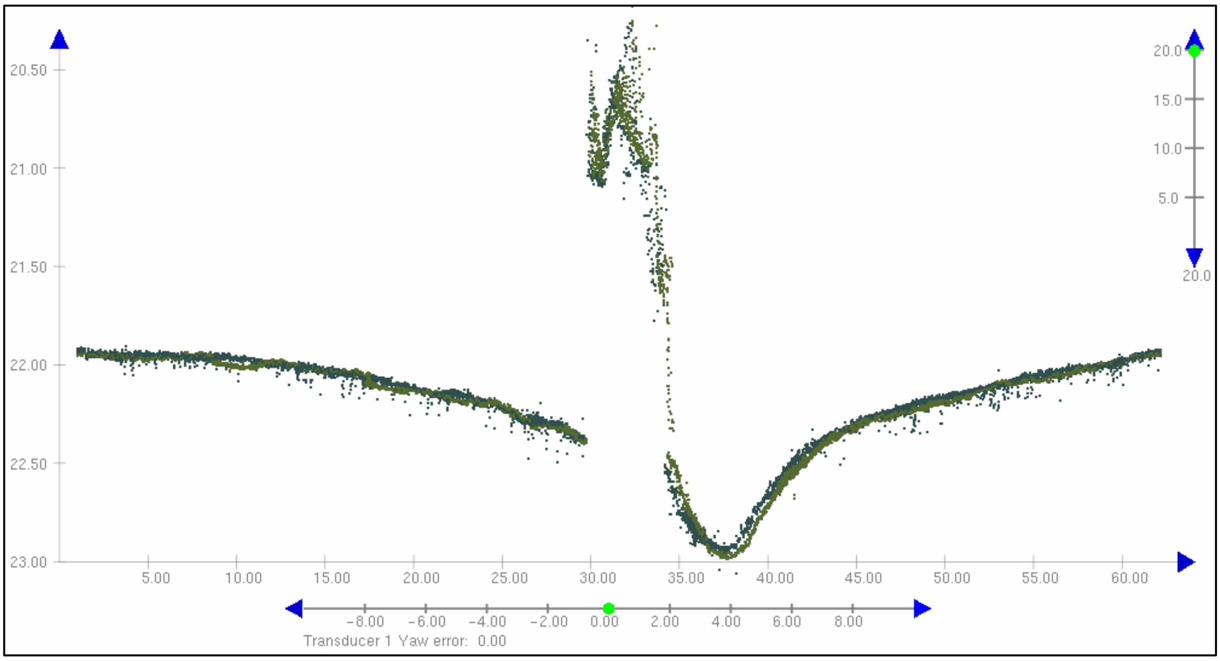


Figure 4.6: Port transducer heading correction (before and after correction applied)



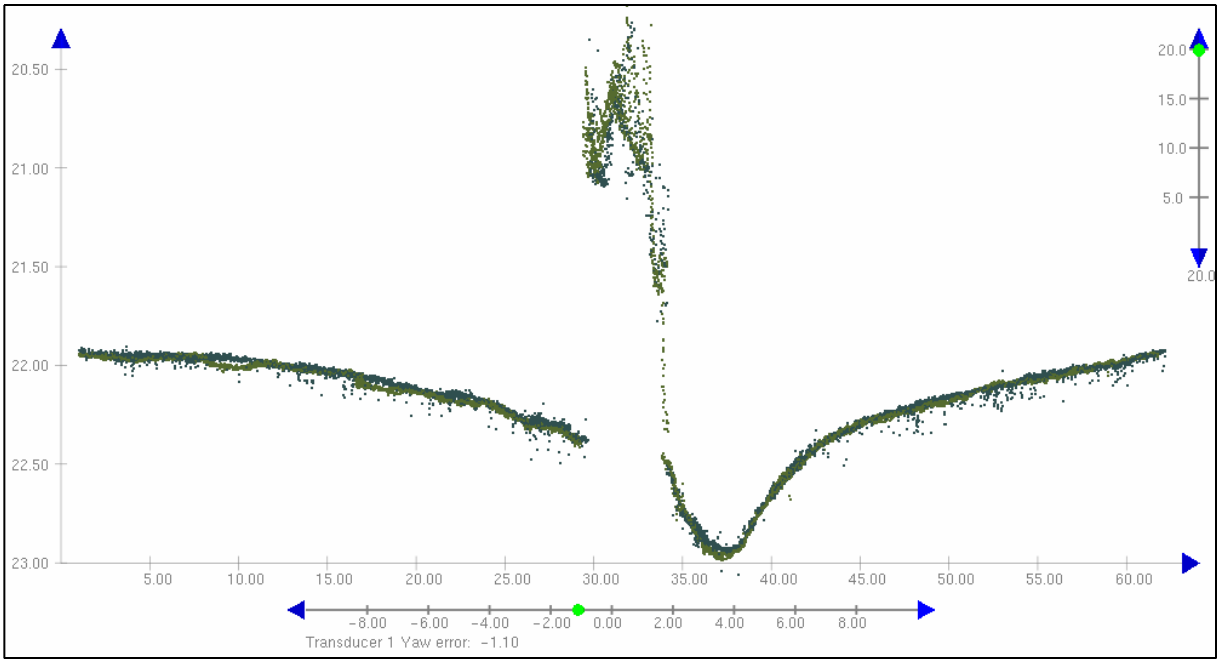


Figure 4.7: Starboard transducer heading correction (before and after correction applied)

4.1.4 Latency

A latency check was carried out to determine any possible time synchronisation errors between the multibeam echosounder and the positioning systems. The latency check involved running a line over a seabed feature in the same direction at two different speeds and was carried out as part of the patch test. The results of the latency check showed no discernible positioning offset between lines and therefore proved that all time synchronisation functioned correctly. Port and starboard latency checks are shown in Figure 4.8 and Figure 4.9 respectively.

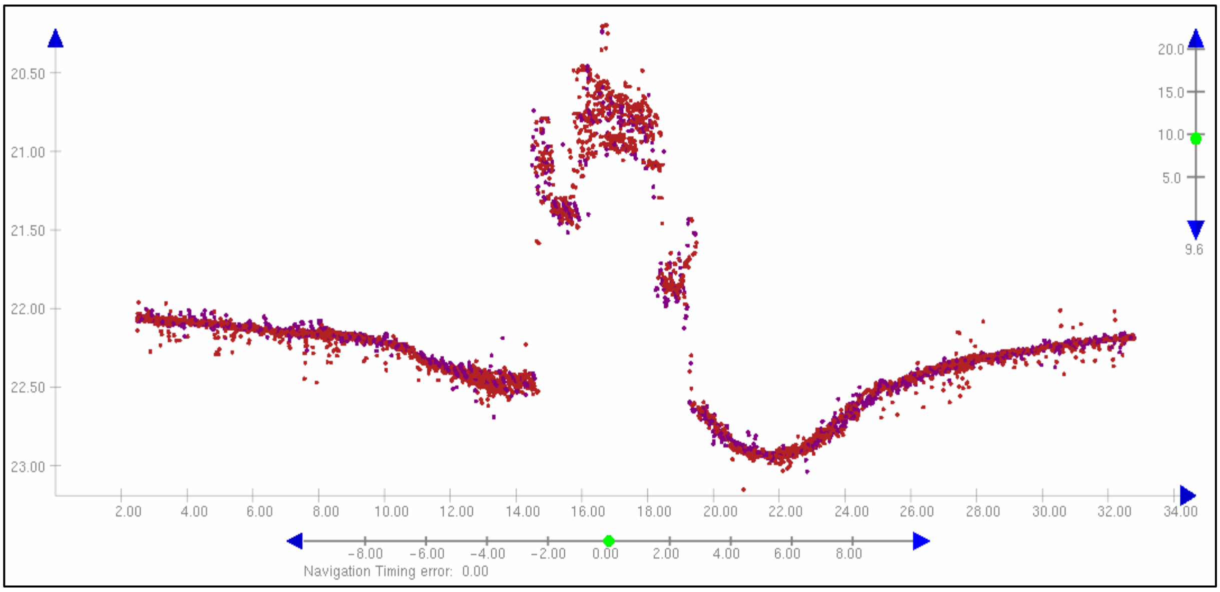


Figure 4.8: Port transducer latency check – no correction required

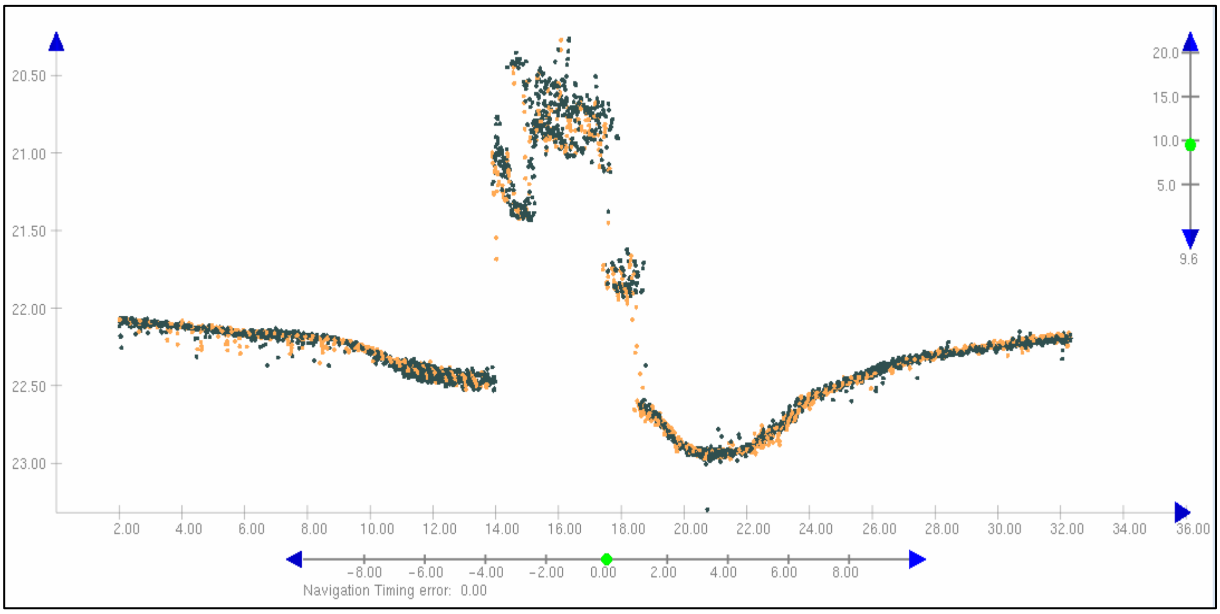


Figure 4.9: Starboard transducer latency check – no correction required

5. Sound Velocity Profiler

5.1 Methodology

Valeport miniSVP sensors were used for the measurement of the speed of sound in seawater. The profilers were programmed to measure temperature, depth, and sound velocity at pre-set intervals. The recorded data was then downloaded and applied in real-time to Starfix and the USBL systems. In addition, a RESON SVP-70 SVS was mounted at the MBES and provided real-time sound velocity readings.

Calibration certificates for the Sound Velocity Probes have been included Appendix C and the certificate for the Sound Velocity Sensor has been included in Appendix D.

5.2 SVP Comparison

Both SVP units and the in-situ SVS unit were tested in a 12 m water depth (WD) on 11 July 2022. The two SVPs were deployed simultaneously through the water column, whilst the reading of the SVS was also recorded. The results of the test are shown in Figure 5.1. The average difference in recorded sound velocity between the two SVP units was 0.05 m/s. The sound velocity observed by the SVS was within 0.5 m/s of the value recorded by the SVP units at the same depth.

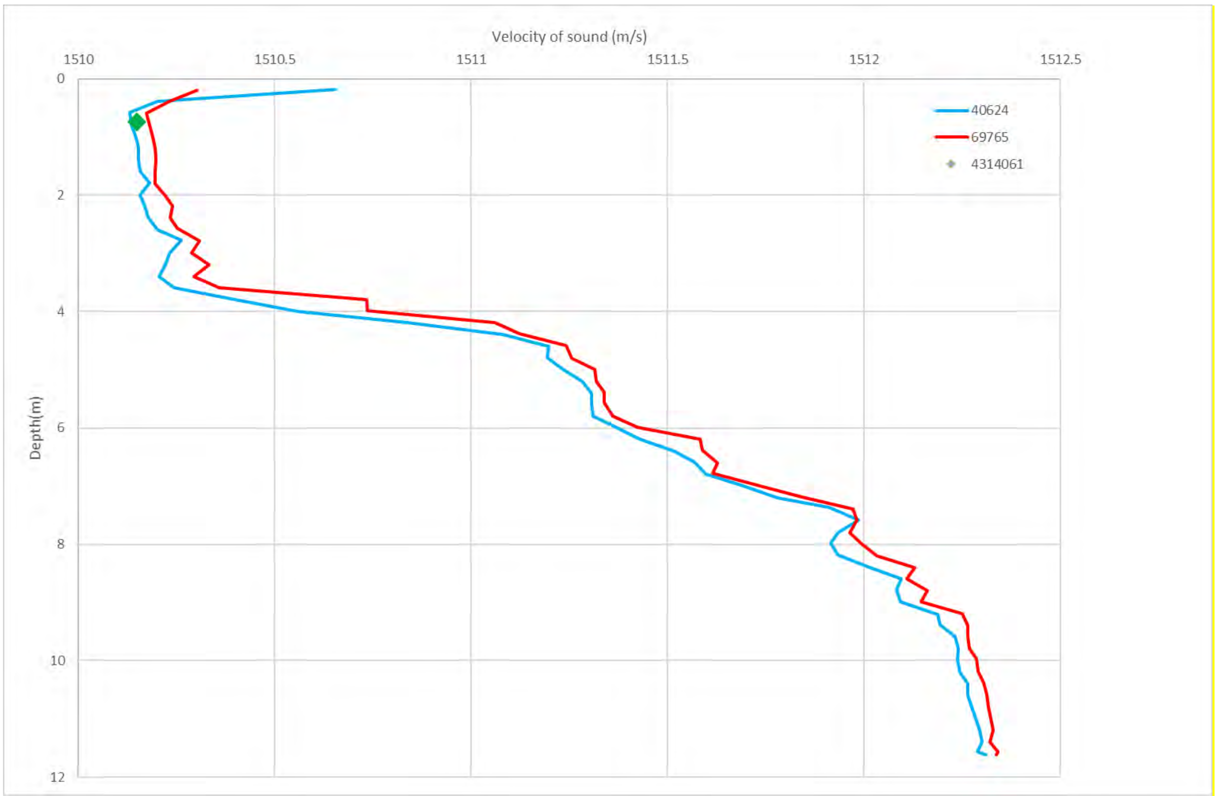


Figure 5.1: SVP and SVS comparison

6. USBL

6.1 USBL Box-In Calibration

A box-in calibration of the vessel's USBL system was carried out on 19 February 2022. The calibration accounted for any physical misalignment of the USBL transducer, and demonstrated that the system could position a transponder/beacon to a standard deviation (95 % 2-Sigma) of within ± 2.5 m.

A USBL transponder beacon was attached to a weighted anchor and deployed on the seabed in a water depth of 25 m. The sound velocity profile of the seawater was measured. The vessel sailed a pre-determined line pattern centred on the position of the USBL transponder, offset by 25 m, allowing for observations to the transponder to be acquired in all quadrants. The USBL calibration values were initially determined from the automatic least squares function in Starfix 2020's USBL calibration tool. These were further enhanced by manually removing outliers using the Starfix 2020 USBL calibration editor tools.

Once satisfied with the results of the calibration, the buoy was recovered and the USBL beacon was brought to the surface and collected. The calibrated transponder position generated by Starfix 2020 calibration utility is shown in Table 6.1.

Table 6.1: Statistics for calibrated transponder positions

Geodetic Parameters: OSGB36, BNG		
Beacon Position	After Calibration [m]	SD
Easting	454 644.200	0.05
Northing	534 763.936	0.05
Depth	25.047	0.10

The Starfix USBL Calibration Utility generated new values for roll, pitch, heading and scale (Table 6.2), which were then applied to the Starfix 2020 online acquisition software.

Table 6.2: Updated USBL calibration values

Parameter	Value	SD
Roll	-2.91	0.13
Pitch	-1.38	0.05
Heading	2.00	0.03
Scale Factor	0.996773915	0.00

Complete USBL calibration results are presented within **Error! Reference source not found.**.

7. Side Scan Sonar

7.1 Rub Test

The side scan sonar towfish were tested on 5 July 2022 in Scheveningen Haven (Netherlands) on the back deck of the Fugro Seeker with a conventional rub test. The purpose of this test was to demonstrate that all sonar channels were being received by the acquisition software. The results are shown in Figure 7.1.

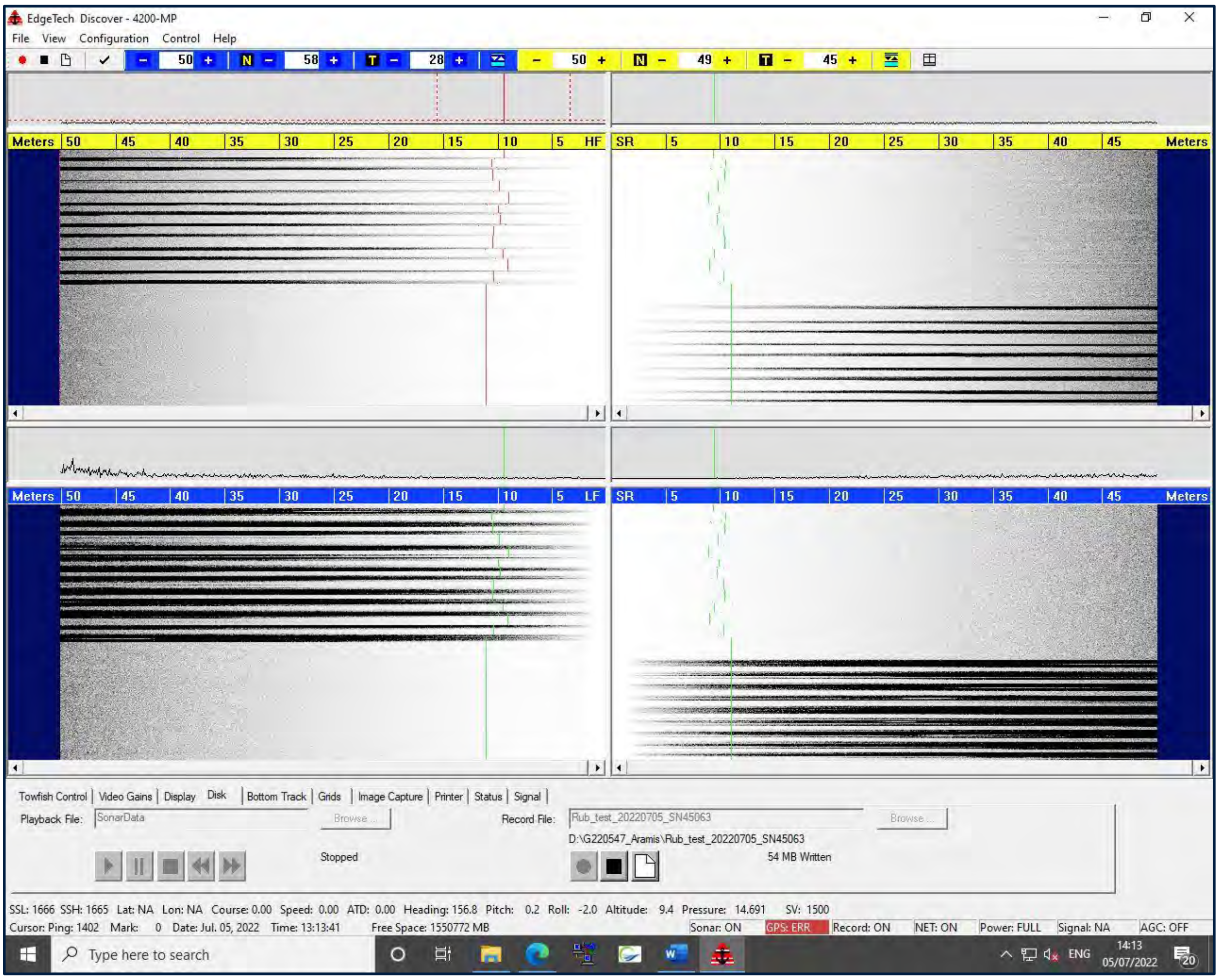


Figure 7.1: Rub test of EdgeTech 4200 side scan sonar towfish SN45063

7.2 Positional Verification

The positional accuracy of the SSS via the USBL system was verified on 11 July 2022. Four lines were acquired around a known wreck running approximately NNE-SSW using 50 m SSS range. The data was processed, and for each line the position of a representative point of the wreck's bow was used as a contact. The MBES position was used as the basis for measuring SSS offsets. The average offset between the interpreted SSS positions and the MBES-derived position was 0.72 m at 50 m SSS range thus, within specification (≤ 2 m accuracy).

The full results of the positional verification are presented in Table 7.1 which demonstrates the average distance of each SSS contact from the MBES contact, and the distance of the average of all 4 contacts from the MBES contact. The SSS and MBES images with measured positions are presented in Figure 7.2 and Figure 7.3.

Table 7.1: Interpreted SSS contact offsets to MBES

Geodetic: WGS84 UTM Zone 31N						
Line	Orientation	Easting [m]	Northing [m]	ΔX [m]	ΔY [m]	Δ Total [m]
MBES	-	572925.10	5769576.03	-	-	-
SSS_box01_Contact	NNE-SSW	572925.93	5769576.95	0.83	0.91	1.24
SSS_box02_Contact	SSW-NNE	572924.76	5769577.85	0.34	1.82	1.85
SSS_box03_Contact	NNE-SSW	572925.02	5769574.15	0.08	1.88	1.88
SSS_box06_Contact	SSW-NNE	572926.24	5769577.61	1.14	1.57	1.94
SSS Average	-	572925.49	5769576.64	0.39	0.61	0.72

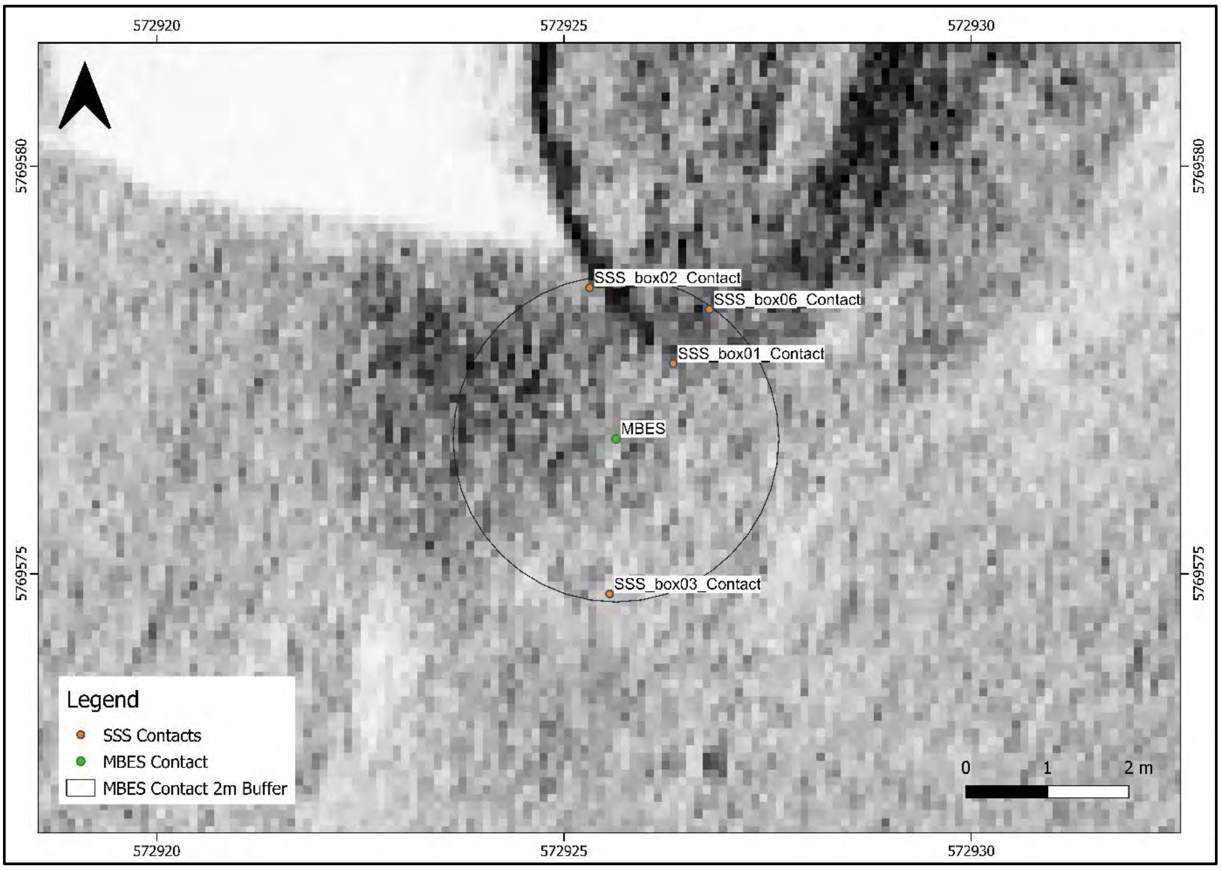


Figure 7.2: SSS positional verification contact picks with SSS verification line SSS_box01 underlain

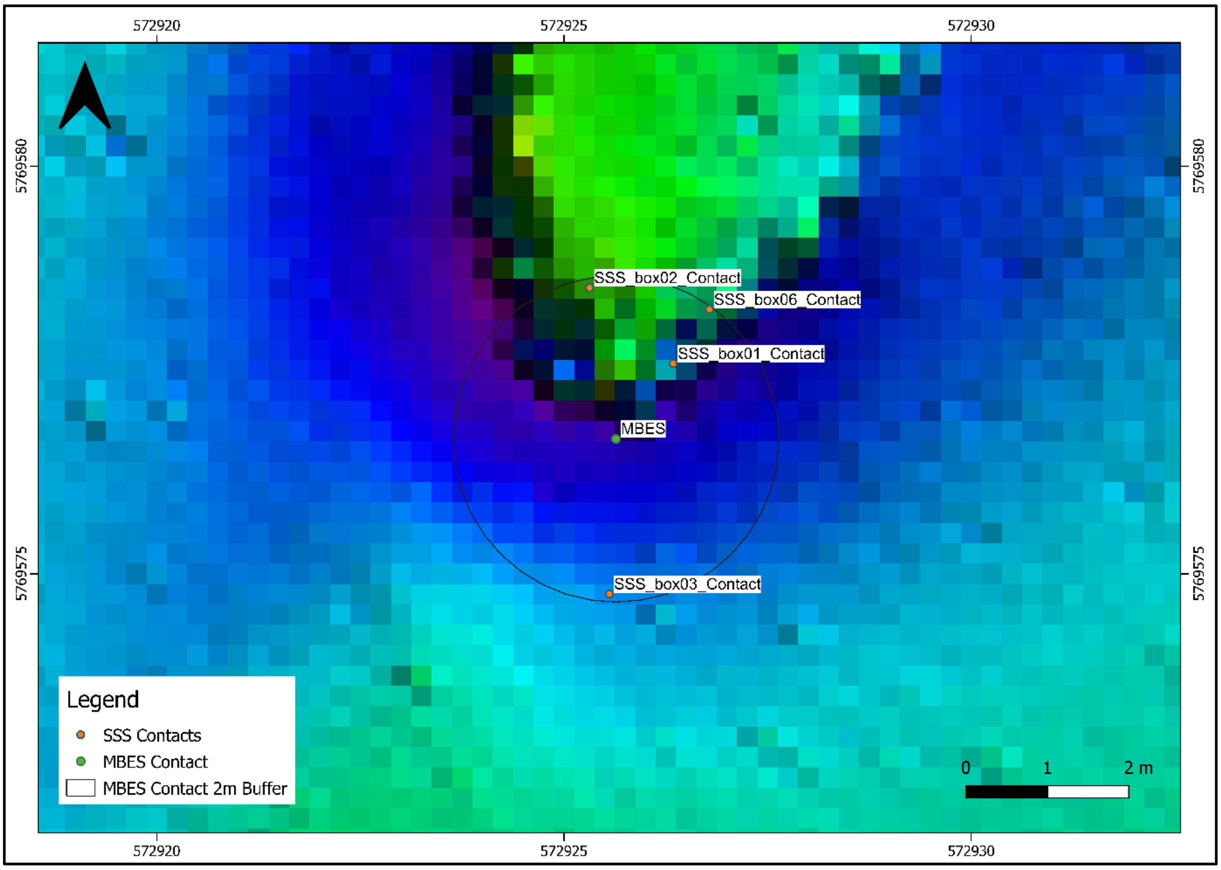


Figure 7.3: SSS positional verification contact picks with MBES underlain

8. Sub-Bottom Profiler

8.1 Wet Test

The Innomar system was wet tested alongside in Scheveningen Haven (Netherlands) on 05 July 2022. The Innomar pole was deployed, and data were recorded for 15 minutes to ensure that the Innomar SESWIN recording software was correctly configured.

The recorded files confirmed that the online setup was correct, and that all the required information was present. The wet test confirmed that the required navigation strings were being received, merged into the recorded data and that the position data were accurate.

A screenshot showing the navigation strings and motion input being received by the recording software is included as Figure 8.1.

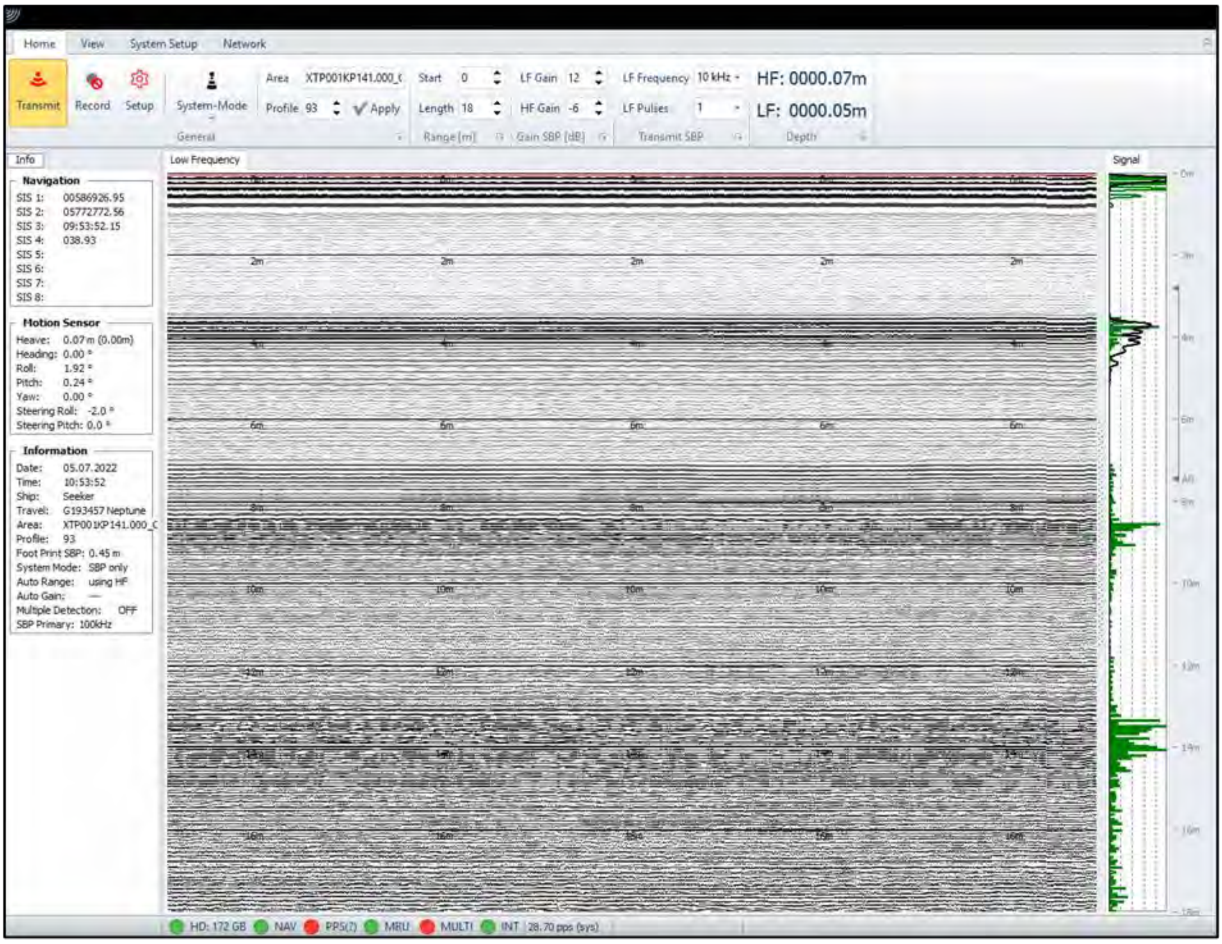


Figure 8.1: SBP wet test. Data screenshot

8.2 Acquisition parameters test

The Innomar system was tested over a typical area of seabed close to Scheveningen (Netherlands) on 11 July 2022. Four survey lines were run at 6kHz with 1 pulse, 8kHz with 1 pulse, 8kHz with 2 pulses and 10kHz with 1 pulse to demonstrate that the system was operating correctly; achieving the expected penetration and resolution, and that the positioning data were accurate.

Results of the test are summarised as follows:

Frequency: 6 kHz with 1 pulse

Obtained penetration up to 11.5 m with good vertical resolution of seismic horizons and buried targets down to 7.5 m. Horizons were well defined throughout the section and generally remained continuous with increasing depth at this frequency, Figure 8.2.

Frequency: 8 kHz with 1 pulse

Obtained penetration up to 7.5 m with good vertical resolution and buried target resolving in the upper 5 m, however horizons quickly became poorly defined and discontinuous with increasing depth, Figure 8.3.

Frequency: 8 kHz with 2 pulses

Obtained penetration up to 7.5 m, however vertical resolution of fine-scale internal boundaries is substantially reduced relative to the single pulse data. Furthermore, horizons quickly became poorly defined and discontinuous below approximately 3m, Figure 8.4.

Frequency: 10 kHz with 1 pulse

Obtained penetration up to 5.5 m with good vertical resolution and buried target resolution in the upper 3 m, however horizons quickly became poorly defined deeper than approximately 4 m and very discontinuous, Figure 8.5.

While providing very good vertical resolution in the upper layers, the penetration of the signal was found to be insufficient at 10 kHz with 1 pulse and 8 kHz with 2 pulses. In addition, the data at 8 kHz with one pulse obtained good signal penetration, however horizons became poorly defined and discontinuous beyond the upper layers. It was determined that a frequency of 6 kHz with one pulse provided the best quality of seismic data, in terms of the trade-off between resolution, penetration and target detection and therefore these settings will be used during SBP acquisition. Images showing the raw test lines are shown below:

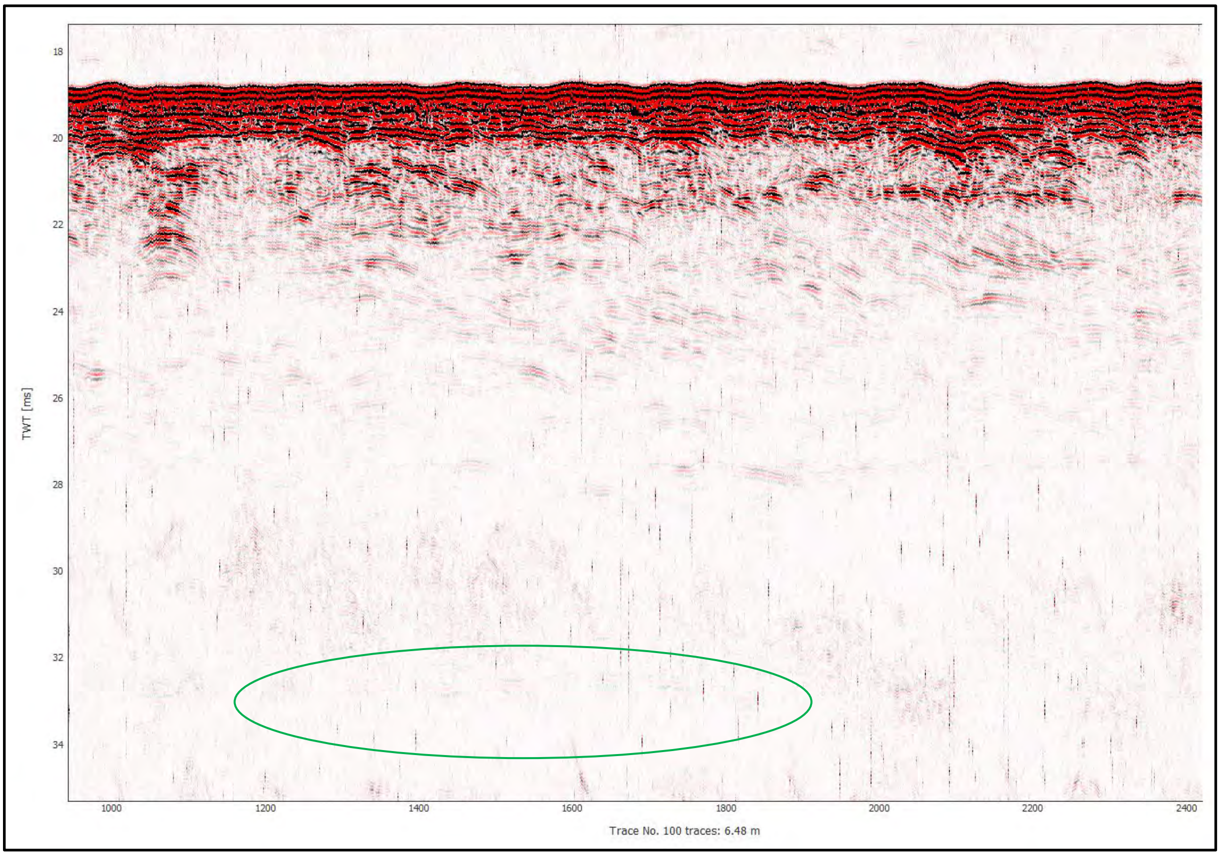


Figure 8.2: Innomar settings test – 6 kHz, 1-pulse – demonstrating deepest observed horizon (green circle)

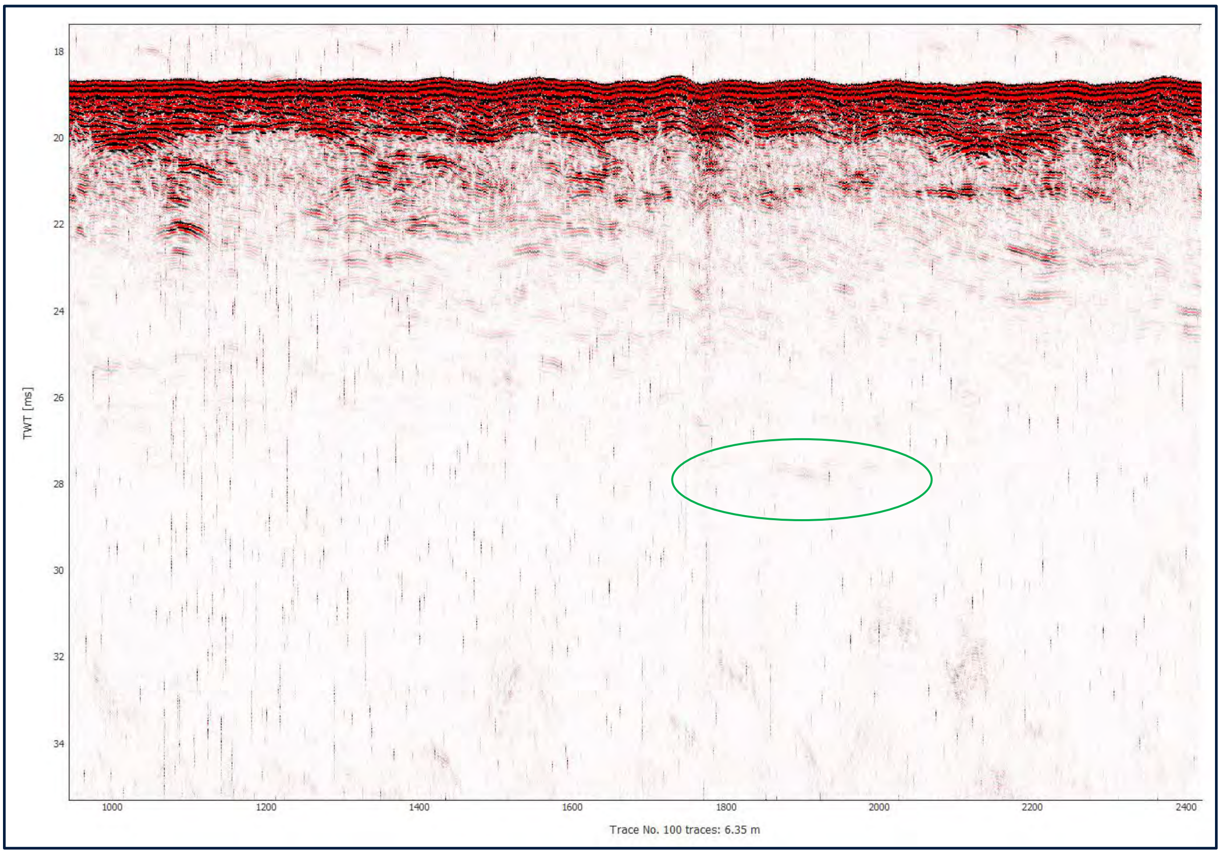


Figure 8.3: Innomar settings test – 8 kHz, 1-pulse – demonstrating deepest observed horizon (green circle)

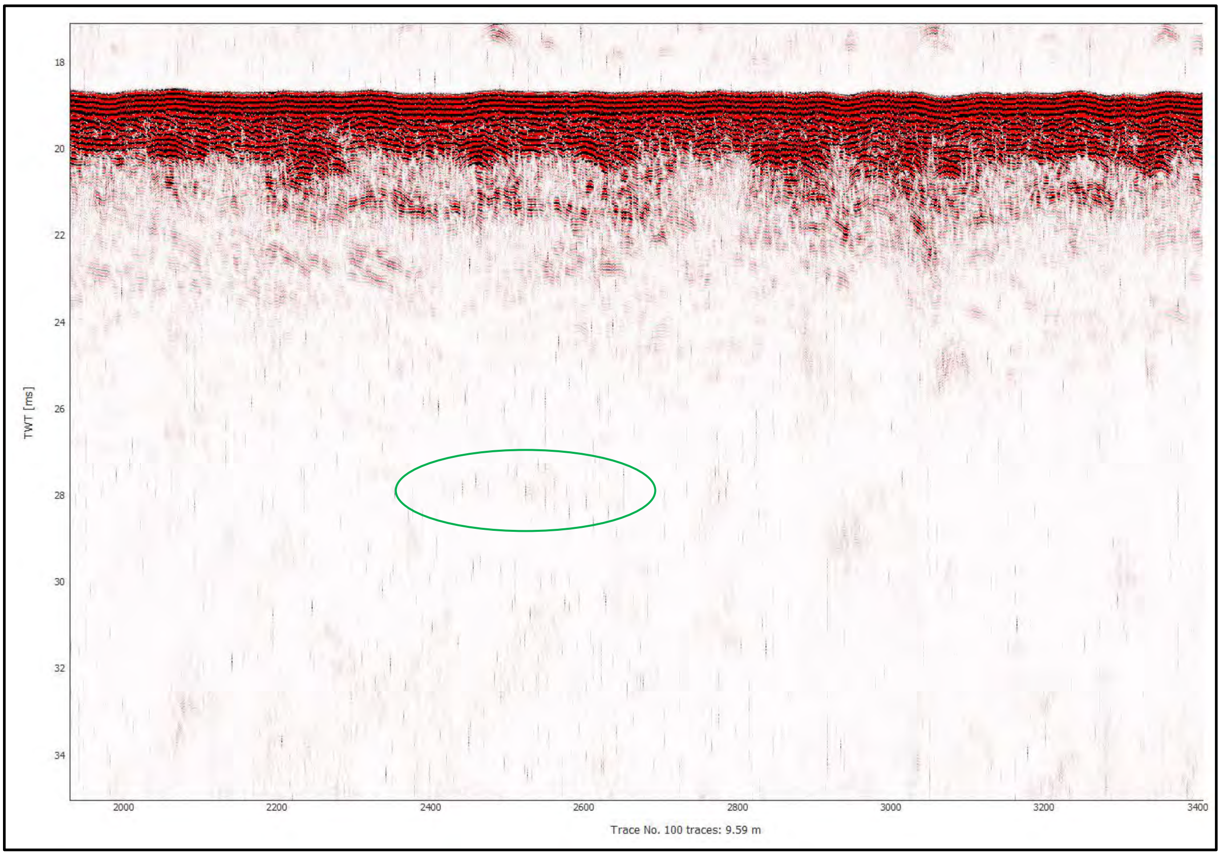


Figure 8.4: Innomar settings test – 8 kHz, 2-pulses – demonstrating deepest observed horizon (green circle)

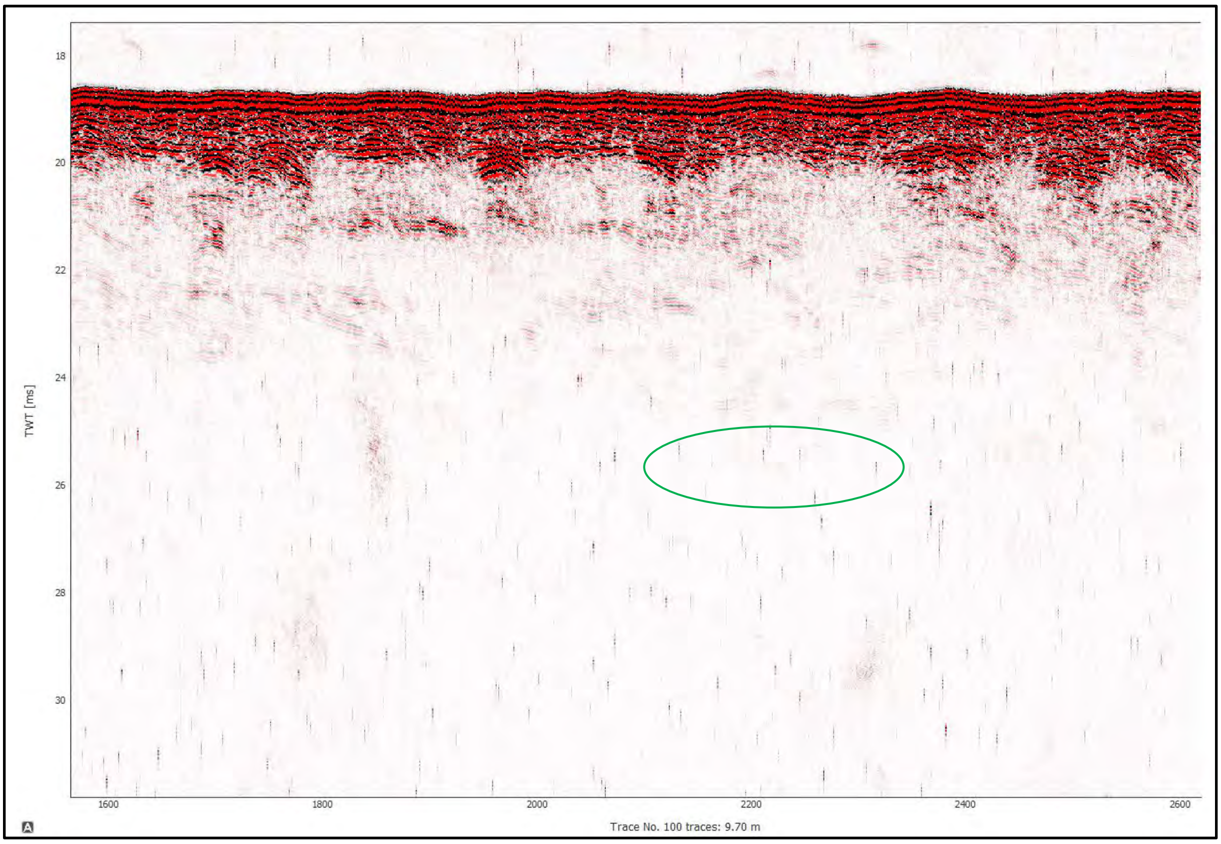


Figure 8.5: Innomar settings test – 10 kHz, 1-pulse – demonstrating deepest observed horizon (green circle)

8.3 Positioning verification

Six lines were surveyed in opposite directions over a known wreck to assess the positional accuracy of the Innomar system. Contacts appeared to be generally broad over the wreck, however the shallowest points were determined from the apexes of the hyperbolae. Picked contacts showed good correlation with shoal or edge locations of the wreck as observed in the MBES data, demonstrating that the positioning of the SBP system was within the specification. The SBP positional verification results are shown in Figure 8.6. SBP data examples from lines surveyed over the Wreck are shown in Figure 8.7, Figure 8.8, and Figure 8.9.

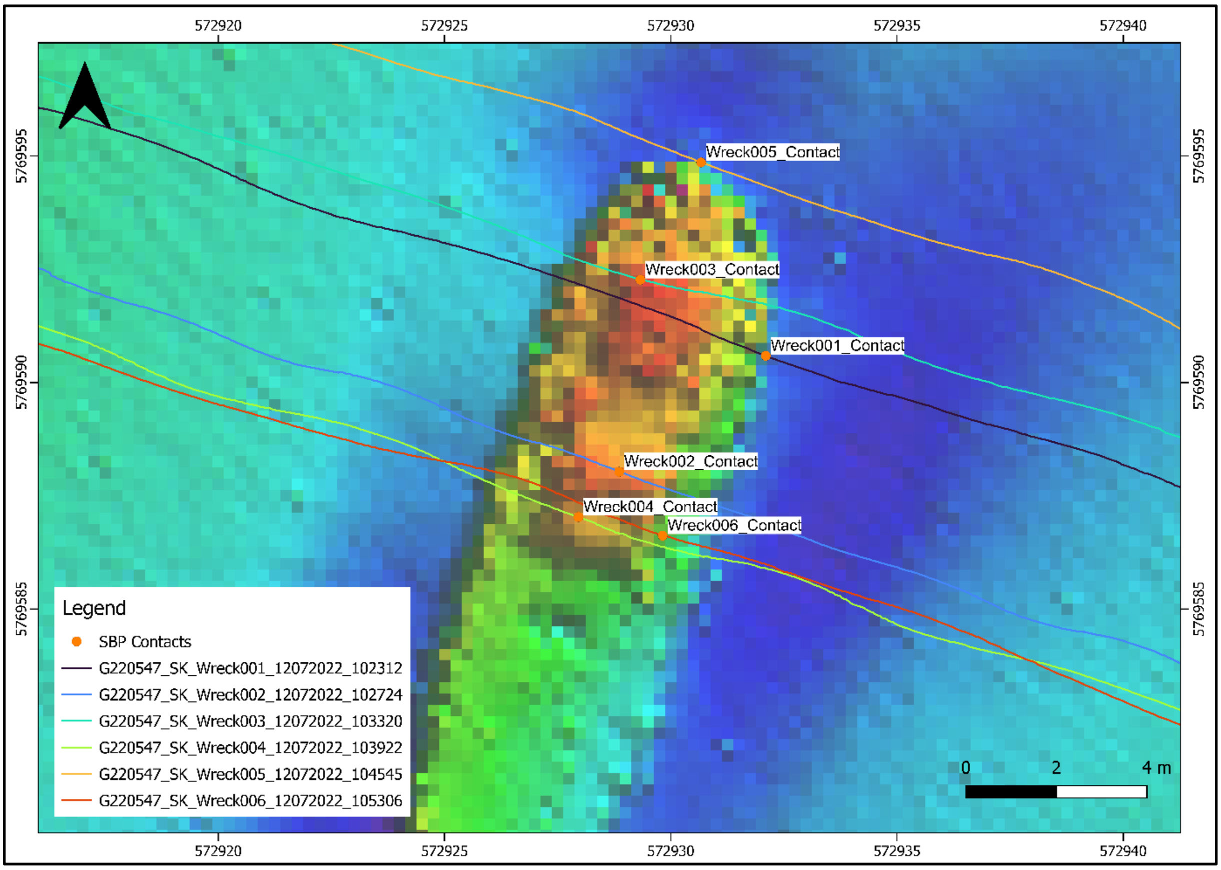


Figure 8.6: SBP verification lines across the wreck with contacts picked along each line (orange points)

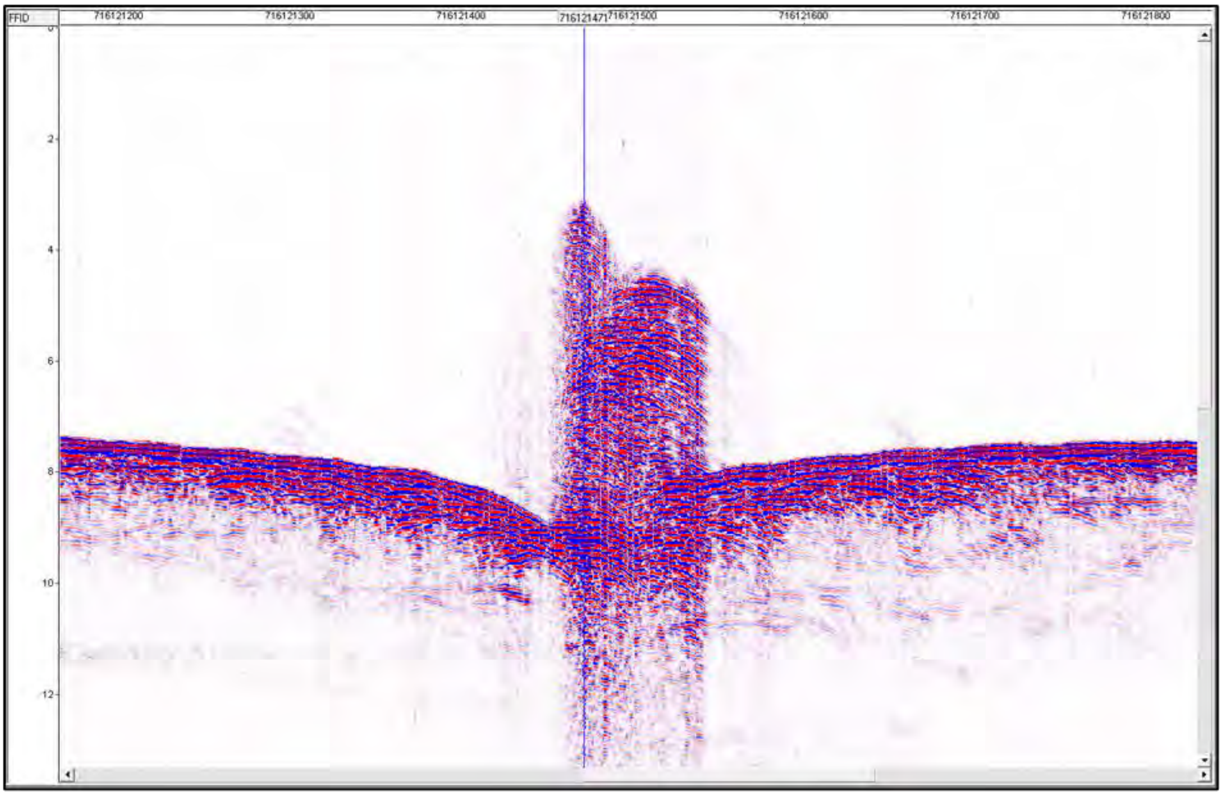


Figure 8.7: SBP data with the location of the edge of the wreck observed on SBP verification line Wreck001

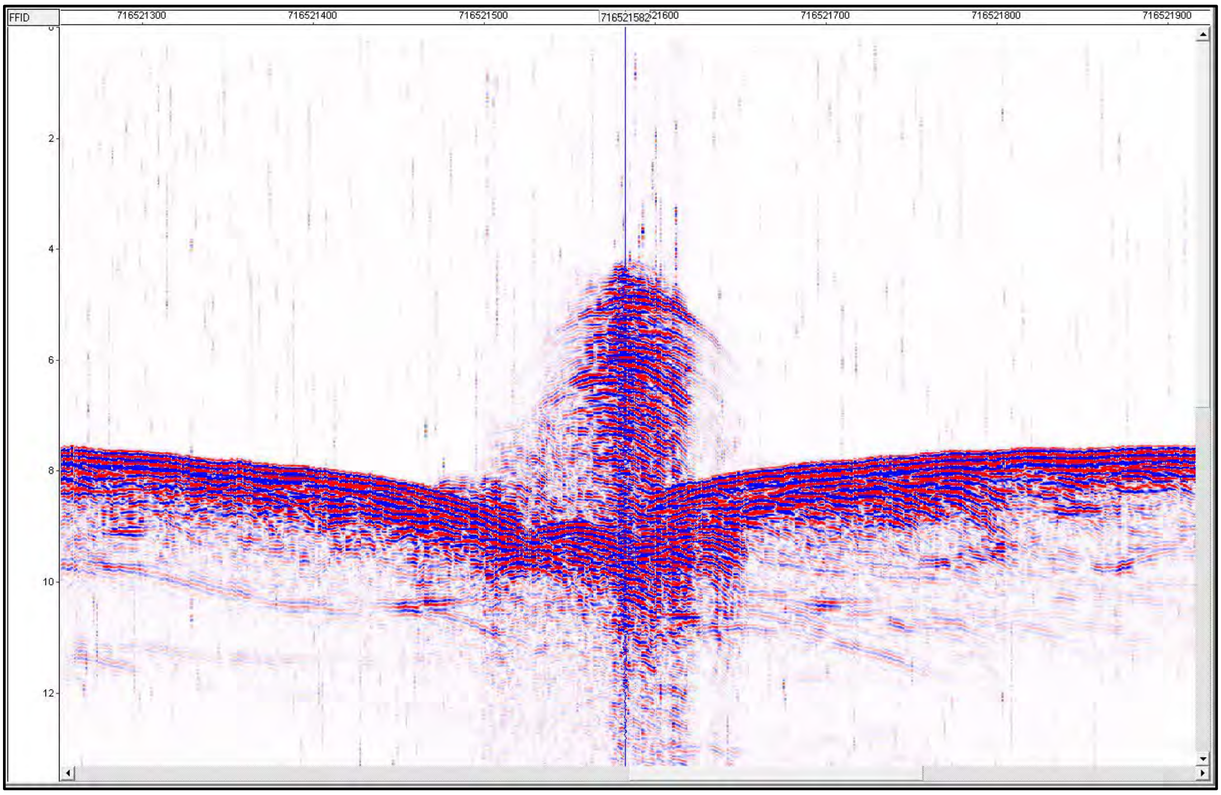


Figure 8.8: SBP data with the location of a shoal point of the wreck observed on SBP verification line Wreck003

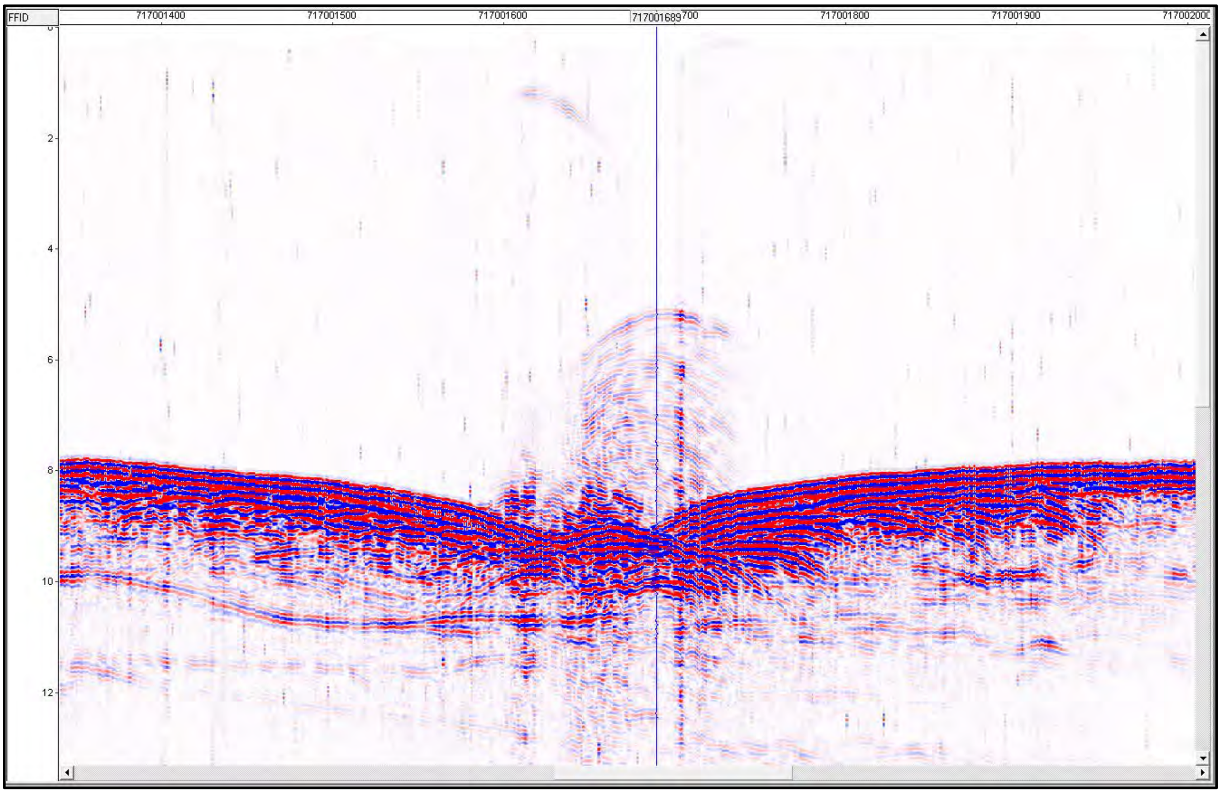


Figure 8.9: SBP data with the location of the edge of the stern of the wreck observed on SBP verification line Wreck005

9. Single Magnetometer (MAG)

The positional accuracy of the magnetometer system was first verified on 12th July 2022. Six lines in total were run in a cross pattern over an observed anomaly. The data were processed and for each line the position was interpreted from the magnetic total field profile using the centre of the anomaly. The position of all picked anomalies was averaged to provide a common centre point. The interpreted targets show that the positioning was consistent in all orientations, with an average distance from the common centre point equalling 1.53 m and a maximum distance of 3.05 m as shown in Figure 9.1 and Table 9.1. This anomaly was not visible and thus unable to verify against the MBES, however the consistency of results in the lines, together with the results on the USBL calibration gave confidence in the performance of the magnetometer system.

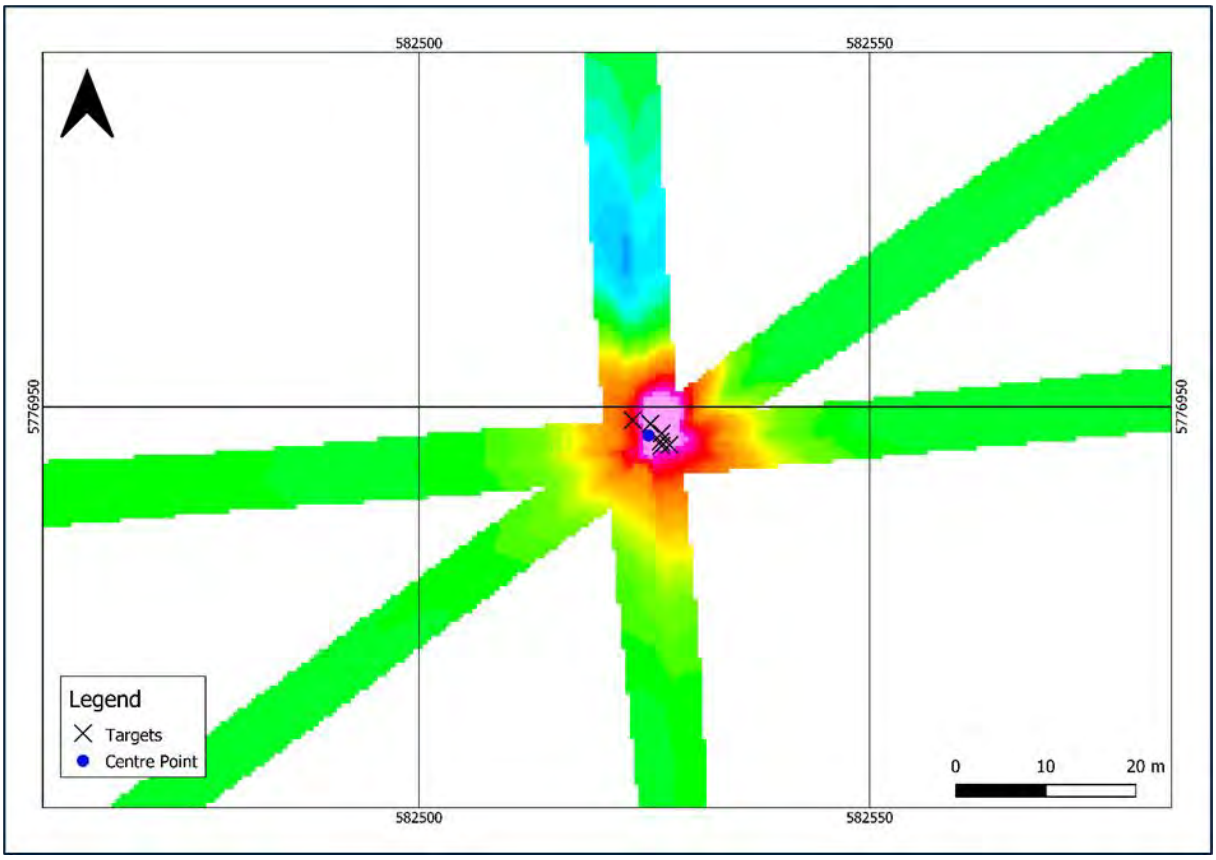


Figure 9.1: MAG positional verification over a singular anomaly

Table 9.1 Interpreted magnetometer targets compared to opposite direction lines

Line name	Line direction	Easting [m]	Northing [m]	Distance to target on opposite direction line [m]	Compared with
V000		582526.8	5776946.0	0.90	Centre Point
V000a		582526.9	5776946.9	0.65	Centre Point
V00A		582523.7	5776948.3	3.05	Centre Point
V00Aa		582525.6	5776948.0	1.39	Centre Point
V00B		582526.9	5776945.5	1.33	Centre Point
V00Ba		582527.8	5776945.6	1.85	Centre Point
			Average	1.53	

10. Miniwing Gradiometer

During mobilisation the mounting of the magnetometers in the Miniwing frame was verified using a ferrous object. This ensured that the raw data from each sensor was associated with the correct offset (Mag 1 = Port, Mag 2= Stbd).

Subsea positioning of the magnetometer data was verified in a surrogate item trial (SIT). Details of this verification will be provided in the SIT report (F197217-REP-SIT-SK).

11. GAMBAS

All equipment was tested before shipment from the Fugro warehouse in Nanterre (France). Maintenance checklists are presented in appendix G.

The streamer hydrophone arrays were tested for resistance and isolation. A "match" test and a "noise" test was used to detect hydrophones or cable breaks, and also bad or noisy sensors. The umbilical cables were also tested for resistance, isolation and air pressure.

The air gun was disassembled, checked, cleaned with freshwater and then reassembled. The solenoid was dry tested by activating the click made when the system triggers.

The seismic recording units, the geodes were interfaced with the Seismodule Controller software. This was tested by using its included auto-control test: a voltage pulse is triggered towards each hydrophone to evaluate their performance. The resulting waveform is captured and standard deviation analysed several times by the software so that the operator can accurately control reliability of signal to noise ratio without any external triggered acoustic noise. Air cylinders certifications are controlled and renewed if necessary.

The mobilisation of seismic equipment onboard Fugro Seeker was conducted between the 24th and 29th of September.

The equipment was tested once installed onboard. The geodes and streamers were tested again with the auto-control function of the geode. Hydrophones spacing was measured again to check. The air gun solenoid was dry tested by controlling the click made at the time of the trigger. A dry test of the operation sequence was carried out and the alarm system that triggers the air panel purge in case of emergency was tested.

12. Data Management

Data acquired on-board was stored on a server located in the computer rack. A backup of the data was uploaded onto a Fugro platform which can be accessed by the office for remote processing. When required a data drop is compiled onto a separate HDD and sent to the office and is saved on a server.

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Appendix A

Guidelines on Use of Report

This report (the “Report”) was prepared as part of the services (the “Services”) provided by Fugro for its client (the “Client”) and in accordance with the terms of the relevant contract between the two parties (the Contract”) and to the extent to which Fugro relied on Client or third-party information as was set out in the Contract.

Fugro’s obligations and liabilities to the Client or any other party in respect of this Report are limited to the extent and for the time set out in the Contract (or in the absence of any express provision in the Contract as implied by the law of the Contract) and Fugro provides no other representation or warranty whether express or implied, in relation to the use of this Report, for any purpose. Furthermore, Fugro has no obligation to update or revise this Report based on any future changes in conditions or information which emerge following issue of this Report unless expressly required by the provisions of the Contract.

This Report was formed and released by Fugro exclusively for the Client and any other party expressly identified in the Contract, and any use and/or reliance on the Report or the Services for purposes not expressly stated in the Contract, will be at the Client’s sole risk. Any other party seeking to rely on this Report does so wholly at its own and sole risk and Fugro accepts no liability whatsoever for any such use and/or reliance.”

Appendix B

Dimensional Control Report

Fugro Seeker

Dimensional Control Report

0	Draft	A Spratt	A Spratt	A Spratt	21/07/2017
Rev	**Description**	**Prepared**	**Checked**	**Approved**	**Date**

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CONTENTS

1. INTRODUCTION

Vessel Reference Frame (VRF)
The first step of the dimensional control survey was to determine the vessel reference frame. This was achieved by consultation of the vessel technical drawings to determine the horizontal design frame. Vessel heading is defined to be co-aligned with the lubber line of the vessel which is physically located on the vessel and was surveyed using land survey techniques. This was confirmed by surveying symmetrical reference points at the bow and stern on the port and starboard sides of the vessel identified from the technical drawings. Prior to dry docking of the vessel the horizontal design frame was checked against measurements taken from reference points installed on the bow and stern to the water line, this was carried out to confirm how the vessel settles in the water and how true this is to the design frame.

Horizontal and Vertical Offsets
Horizontal and vertical offsets where then determined by using land survey techniques. The surveyor installed temporary survey stations around the vessel and carried out a closed loop traverse around the vessel taking measurements to the phase centres of all GPS antennas, the vessel CRP on the top of the MRU, and to reference points used in survey such as a draft mark and tow points to within +/-2mm. The acoustic centre of the multibeam was also determined by taking measurements to the system which were then used in conjunction with the systems technical drawings to calculate the acoustic centre position to within +/- 2 mm.

MRU Reference Frame
During installation of the MRU, the system is attached to the vessel so its reference frame is as close to that of the vessel reference frame as possible. This is not always practically possible; therefore, the alignments of the MRU in relation to the VRF were determined in heading, pitch and in roll within a tolerance of +/-0.2° for entry into the system software.

Multibeam Reference Frame
During installation of the MBES, again the system is attached to the vessel so its reference frame is as close to that of the vessel reference frame as possible. As with the MRU this is not always practically possible due to the fabrication process, so the alignments of the transducer array in relation to the VRF are determined in heading, pitch and in roll within a tolerance of +/-0.2° using land survey techniques. These values are further confirmed during a multibeam patch test and applied in the online software.

2. OFFSETS (ALL VALUES RELATIVE TO VESSEL CRP)

All systems on the vessel were mounted on an XYZ reference frame of the vessel. The Y-axis being the fore-aft centre line and the X-axis running perpendicular to the Y-axis through the common reference point (CRP) and the Z axis being positive upwards from the CRP. The online navigation software QINSy uses this reference frame to correct vessel nodes for position.

The POS MV 320 uses a reversed reference frame whereby the X-axis is the fore-aft centre line and the Y-axis runs perpendicular to the X-axis through the CRP and the Z axis is positive downwards from the CRP.

The majority of offsets were calculated and vessel reference frame (VRF) derived using land survey techniques during vessel mobilisation in Southampton on 24 February 2014.

On 3 July 2017, 3 extra offsets were added when an overside pole for an Edgetech 6205 was added to the vessel.

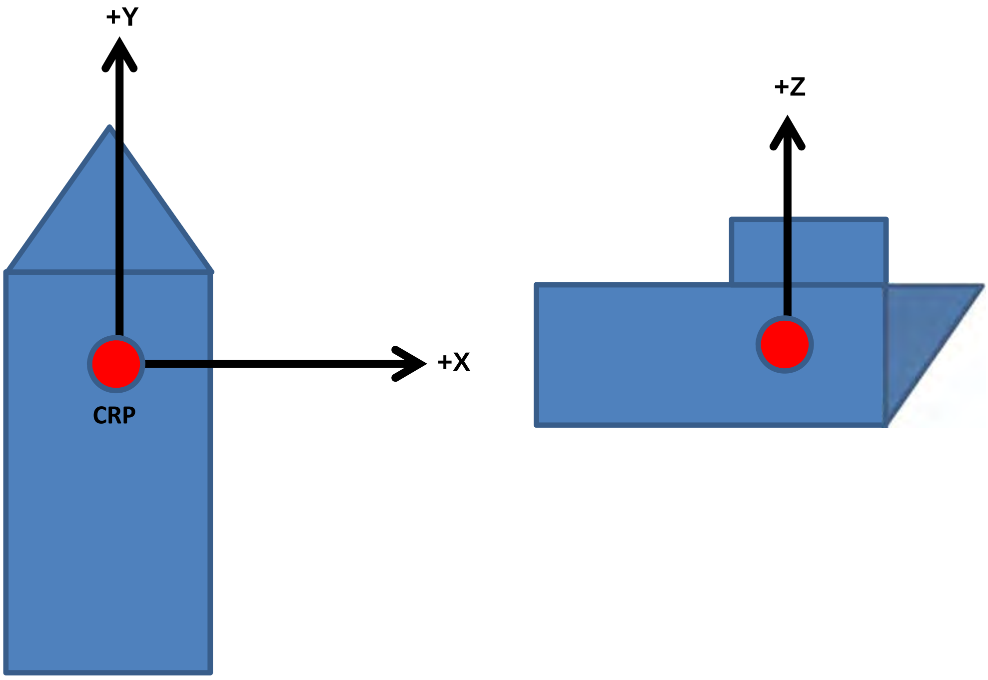


Figure 2.1 QINSy Reference Frame Convention

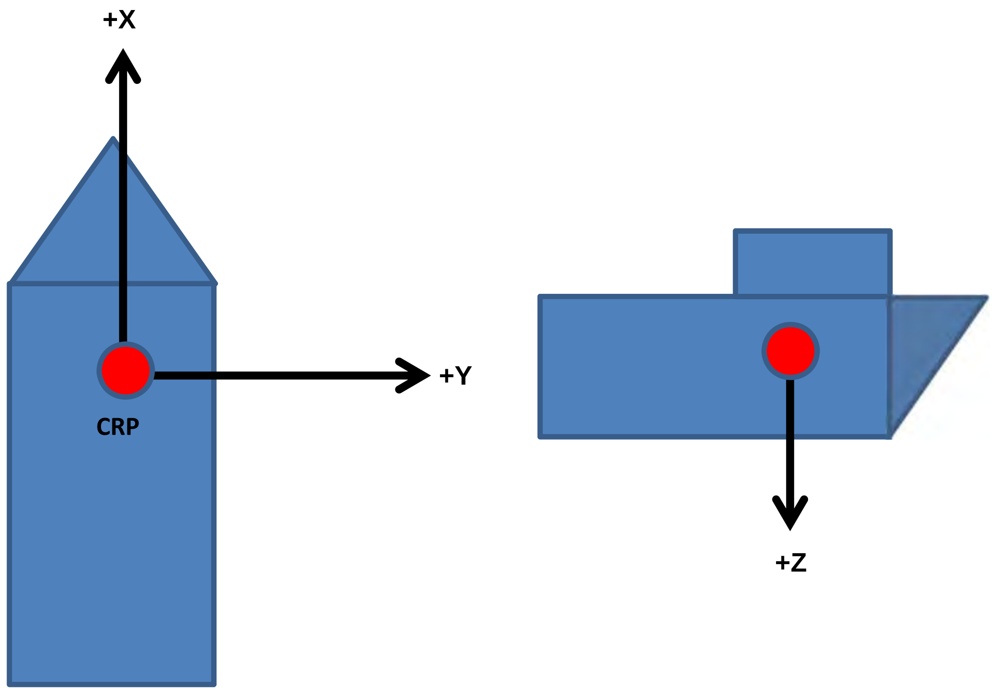


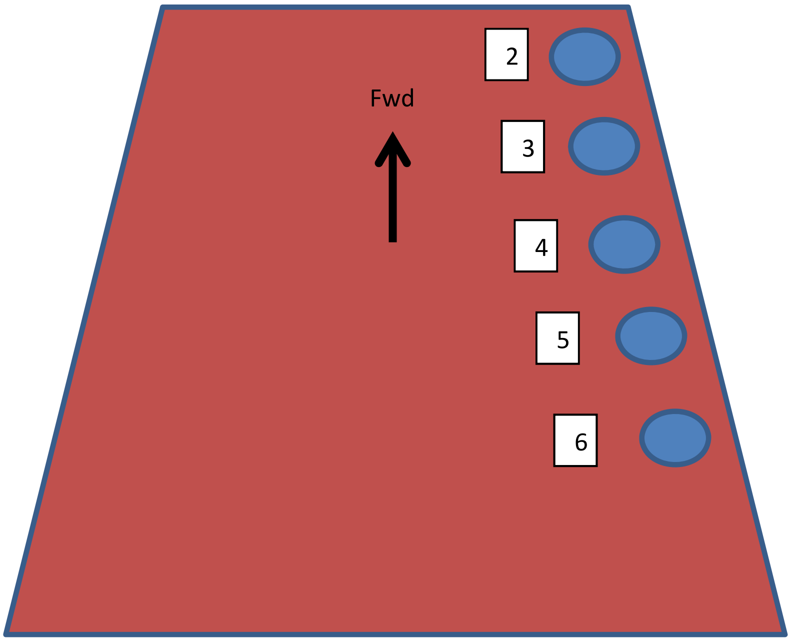
Figure 2.2 POS MV Reference Frame Convention

The position offsets, in the QINSy reference frame convention are provided in Table 2.1. The positions of the five roof-top antennae are shown in a schematic diagram of the Seeker wheelhouse roof in Figure 2.3.

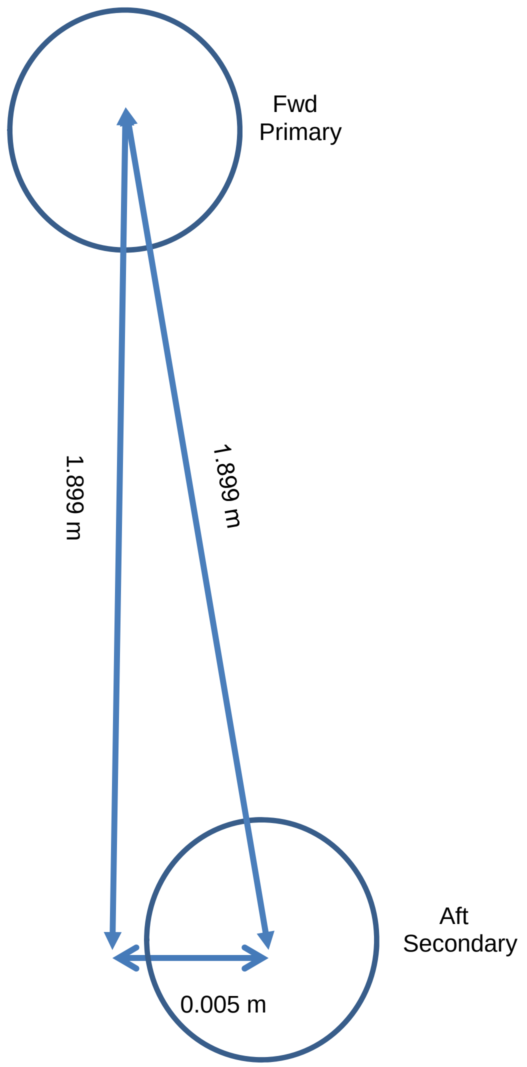
Table 2.1 Vessel Offsets (QINSy coordinate system)

Point ID	Description	X (+ to stbd)	Y (+ to bow)	Z (+ up)	Survey
1	Vessel CRP	0	0	0	2014
2	Fwd POS MV (Primary) Antenna	1.2550	2.3770	1.4220	2014
3	Fwd Mid Antenna (Spare)	1.2838	1.8935	1.3536	2014
4	Mid Starfix Antenna	1.2550	1.4230	1.4650	2014
5	Aft Mid Antenna Spare	1.2824	0.9428	1.3457	2014
6	Aft POS MV (Secondary) Antenna	1.2600	0.4720	1.4270	2014
7	Nexus USBL AC	0.7868	0.1076	-3.5490	2014
8	USBL Mount Punch Mark	0.7664	0.0580	-3.0591	2014
9	Pinger Punch Mark (Down)	-2.1265	1.3642	-2.8720	2014
10	Fwd Stbd Bollard Punch	1.7244	6.6089	0.3439	2014
11	Fwd Port Bollard Punch	-2.0679	6.6357	0.2962	2014
12	Aft Stbd Bollard Punch	2.0420	-4.3195	-0.3374	2014
13	Aft Port Bollard Punch	-2.3842	-4.3391	-0.3962	2014
14	Whip Antenna Base Stb	0.5504	1.9705	3.9283	2014
15	Whip Antenna Base Pt	-1.1026	2.0168	3.8571	2014
16	Target Tape Pt Inner	-1.5676	0.2078	0.8985	2014
17	Target Tape Mid Inner	0.1710	0.2194	0.9852	2014
18	Target Tape Stb Inner	0.8600	0.2249	0.9601	2014
19	Target Tape Pt Outer	-1.7251	-1.0286	0.9652	2014
20	Target Tape Stb Outer	1.3630	-0.9910	1.0201	2014
21	Stbd RESON AC	1.4380	-2.1240	-3.0060	2014
22	Port RESON AC	-1.6400	-2.1520	-3.0380	2014
23	Plate on top of Edgetech 6205 pole	2.4610	2.6640	0.1880	2017
24	Base of Edgetech 6205 pole	2.5500	2.6400	-2.8570	2017
25	Base of Edgetech 6205 pole, after removal of 0.345 m length	2.5430	2.6470	-2.5120	2017

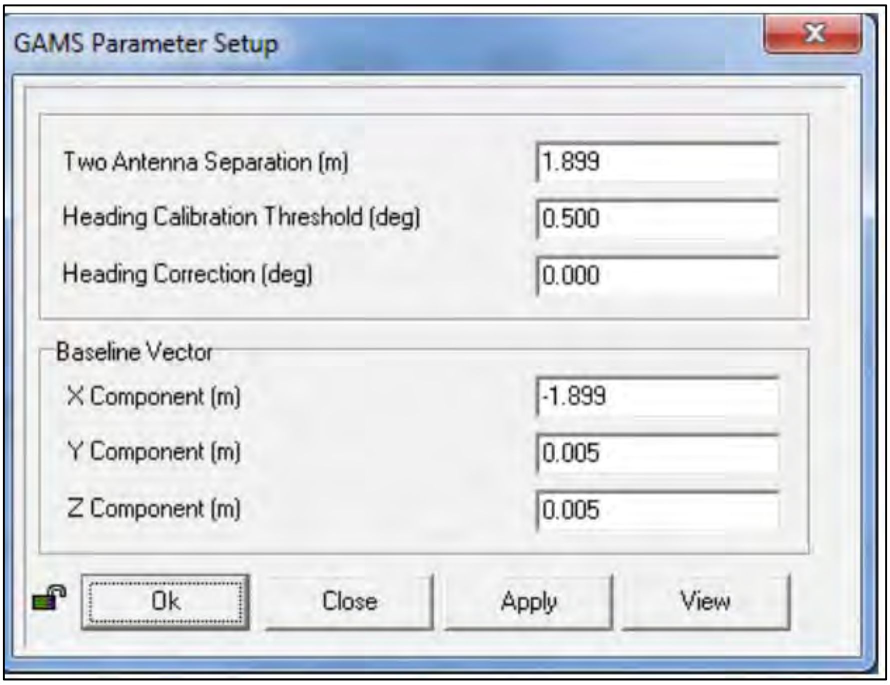
Figure 2.3 **Fugro Seeker wheelhouse roof with antenna positions**



3. POS MV ANTENNA MOUNTING DIMENSIONS

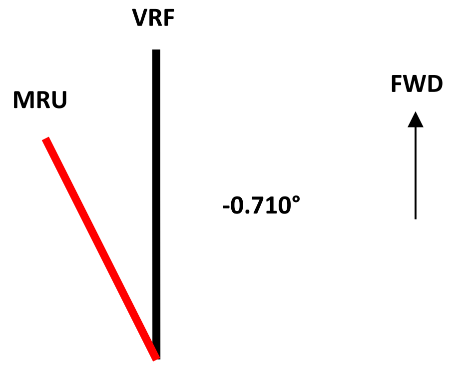


3.1 GAMS values to enter into POS MV

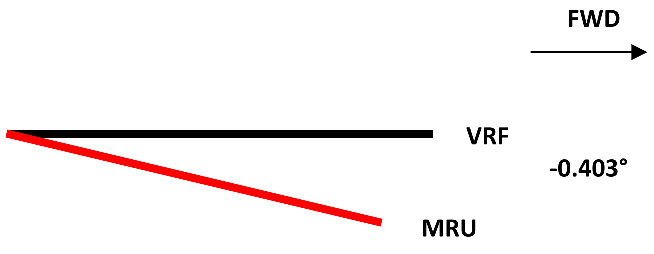


4. POS ROTATION (MRU) WITH REFERENCE TO VESSEL REFERENCE FRAME (VRF)

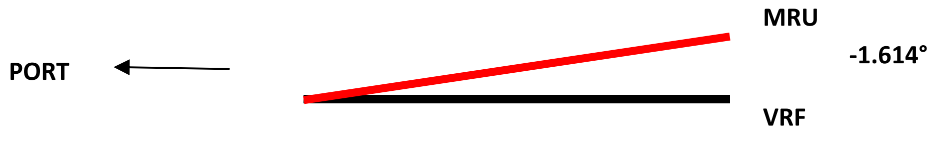
4.1 Heading



4.2 Pitch

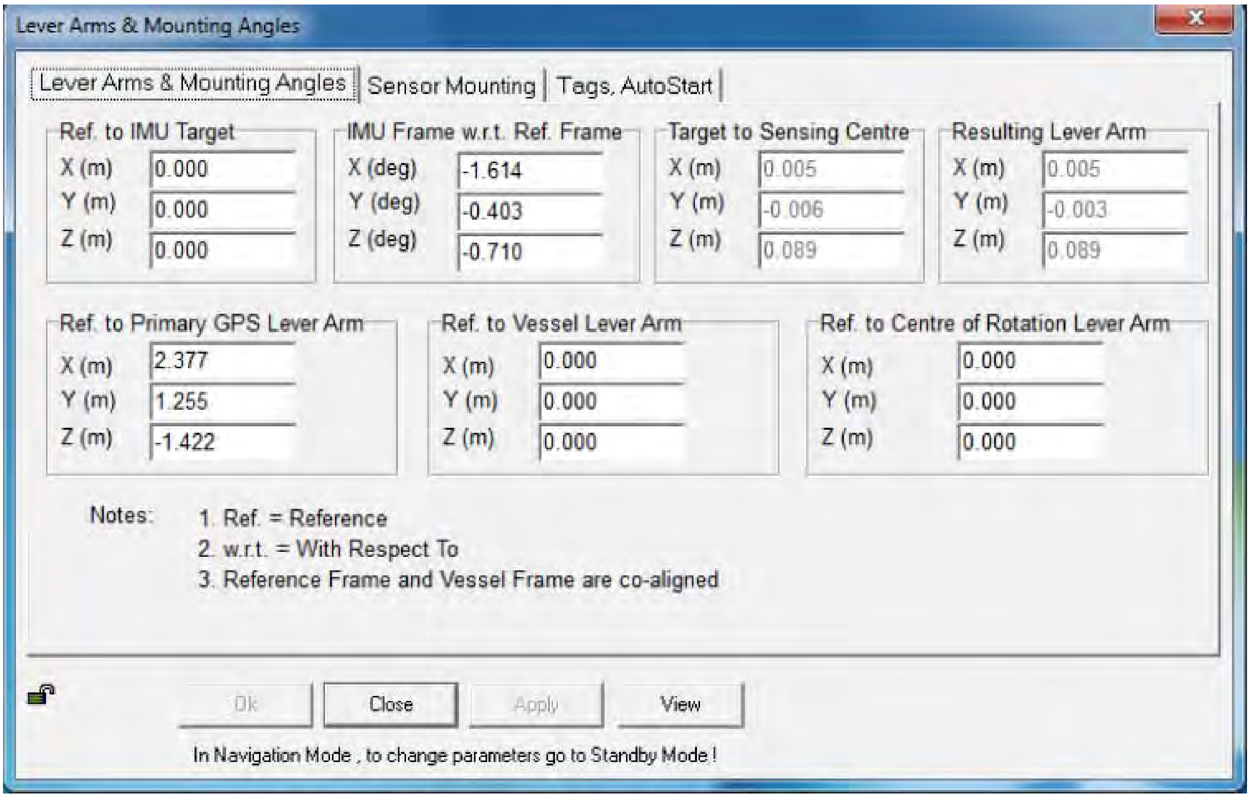


4.3 Roll



4.4 Mounting values to enter into POS MV

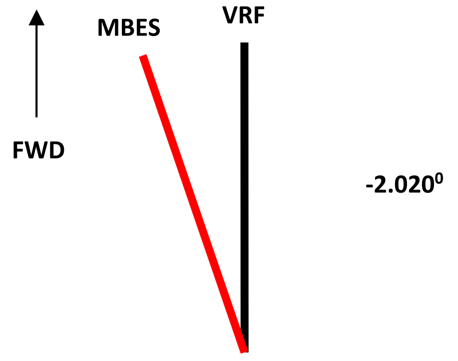
Note the below follows the POS MV's sign convention



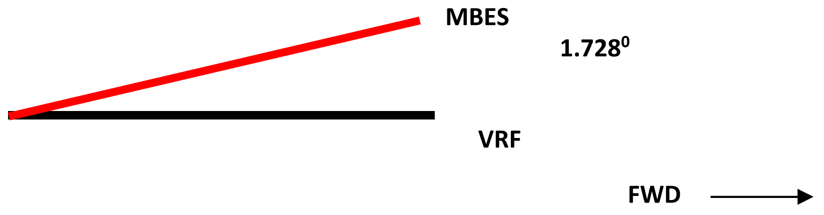
5. STBD MBES ROTATIONS WITH REFERENCE TO VESSEL REFERENCE FRAME

To be confirmed by MBES patch test

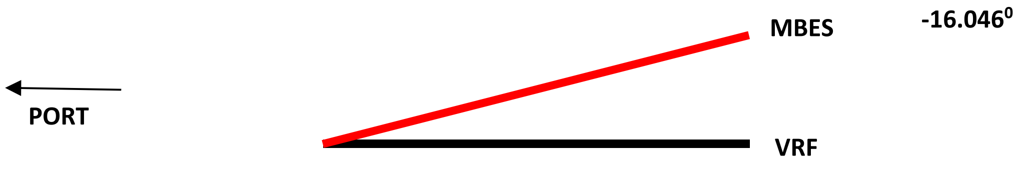
5.1 Heading



5.2 Pitch



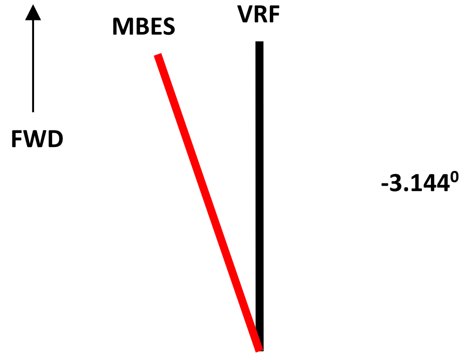
5.3 Roll



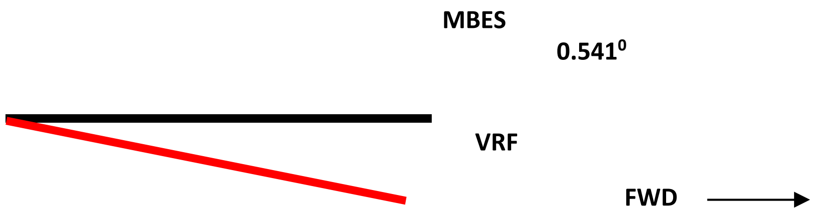
6. PORT MBES ROTATIONS WITH REFERENCE TO VESSEL REFERENCE

To be confirmed by MBES patch test

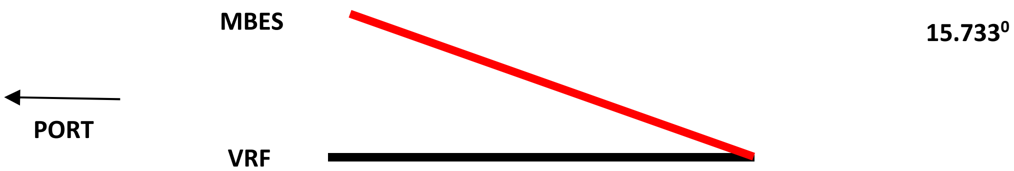
6.1 Heading



6.2 Pitch

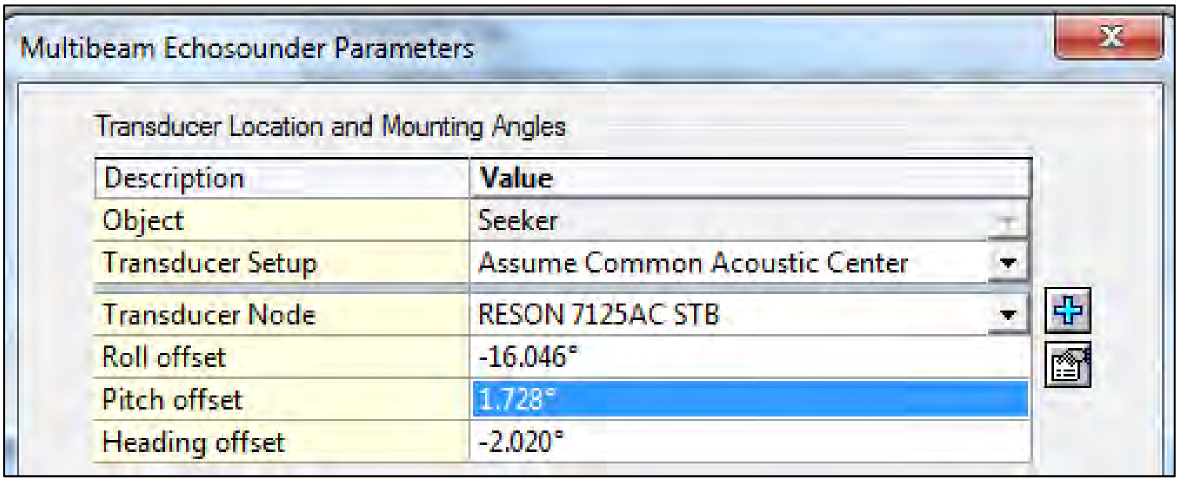


6.3 Roll



6.4 Patch Test Values to Enter into QINSy

Starboard RESON

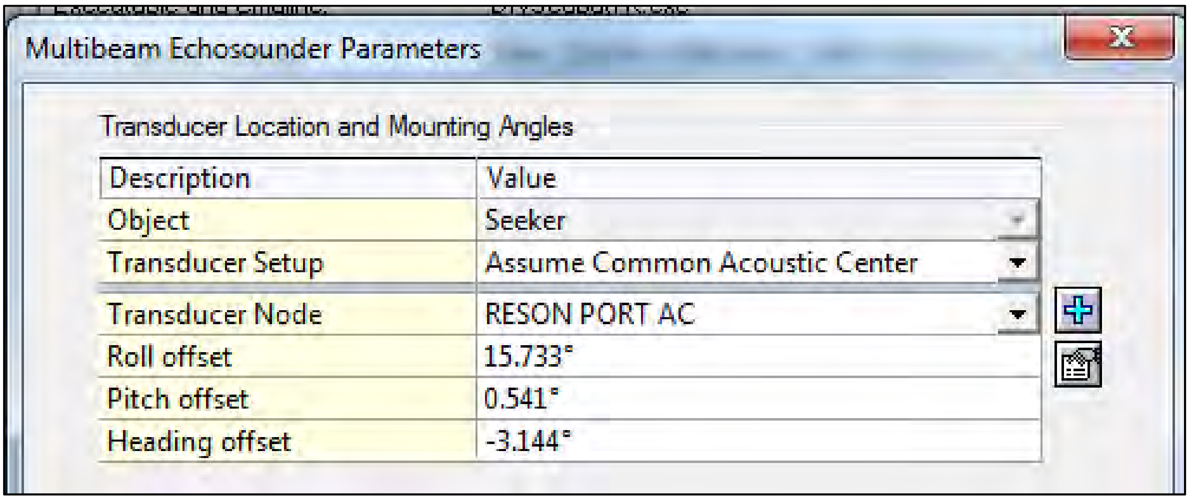


Multibeam Echosounder Parameters

Transducer Location and Mounting Angles

Description	Value
Object	Seeker
Transducer Setup	Assume Common Acoustic Center
Transducer Node	RESON 7125AC STB
Roll offset	-16.046°
Pitch offset	1.728°
Heading offset	-2.020°

Port RESON



Multibeam Echosounder Parameters

Transducer Location and Mounting Angles

Description	Value
Object	Seeker
Transducer Setup	Assume Common Acoustic Center
Transducer Node	RESON PORT AC
Roll offset	15.733°
Pitch offset	0.541°
Heading offset	-3.144°

7. OBSERVATION POINT PHOTOGRAPHS

Point 1 – CRP

Point 2 – Fwd POS MV (Primary) Antenna

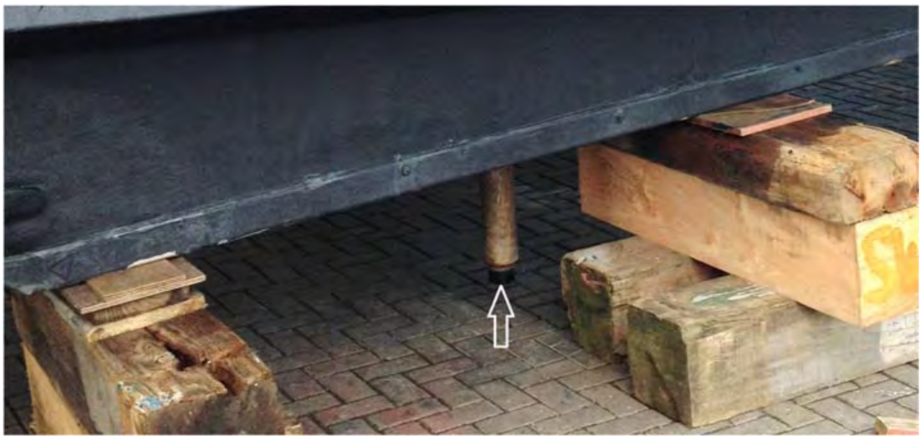
Point 3 - Fwd Mid Antenna (Spare)

Point 4 – Mid Starfix Antenna

Point 5 – Aft Mid Antenna Spare

Point 6 – Aft POS MV (Secondary) Antenna

Point 7 – Nexus USBL AC

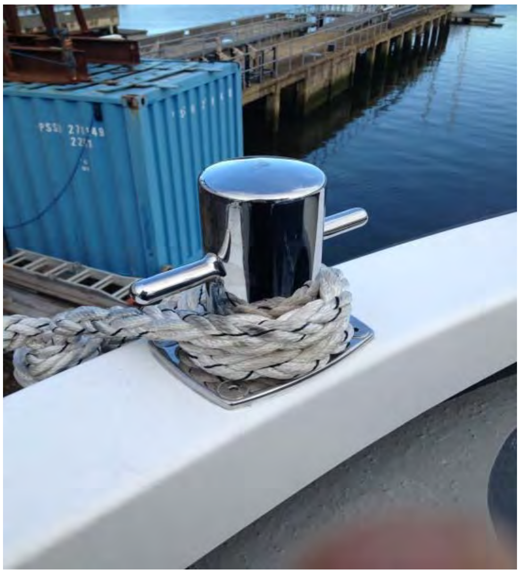


Point 8 – USBL Mount Punch Mark

Point 9 – Pinger Punch Mark (Down)

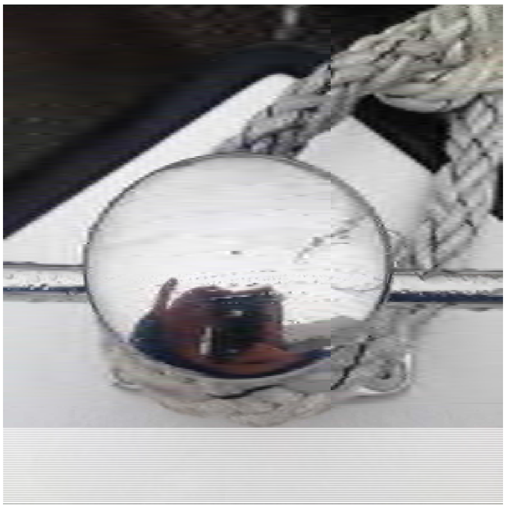
Point 10 – Fwd Stb Bollard Punch

Point 11 – Fwd Pt Bollard Punch Mark



Point 12 – Aft Stb Bollard Punch

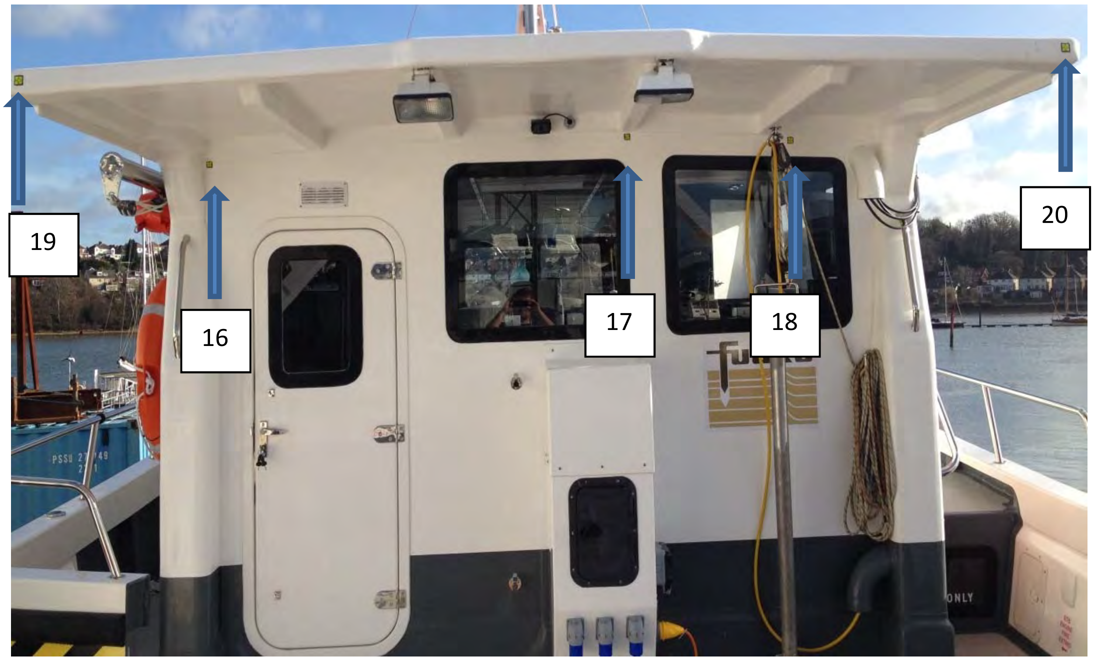
Point 13 – Aft Pt Bollard Punch



Point 14 – Whip Antenna Base Stbd

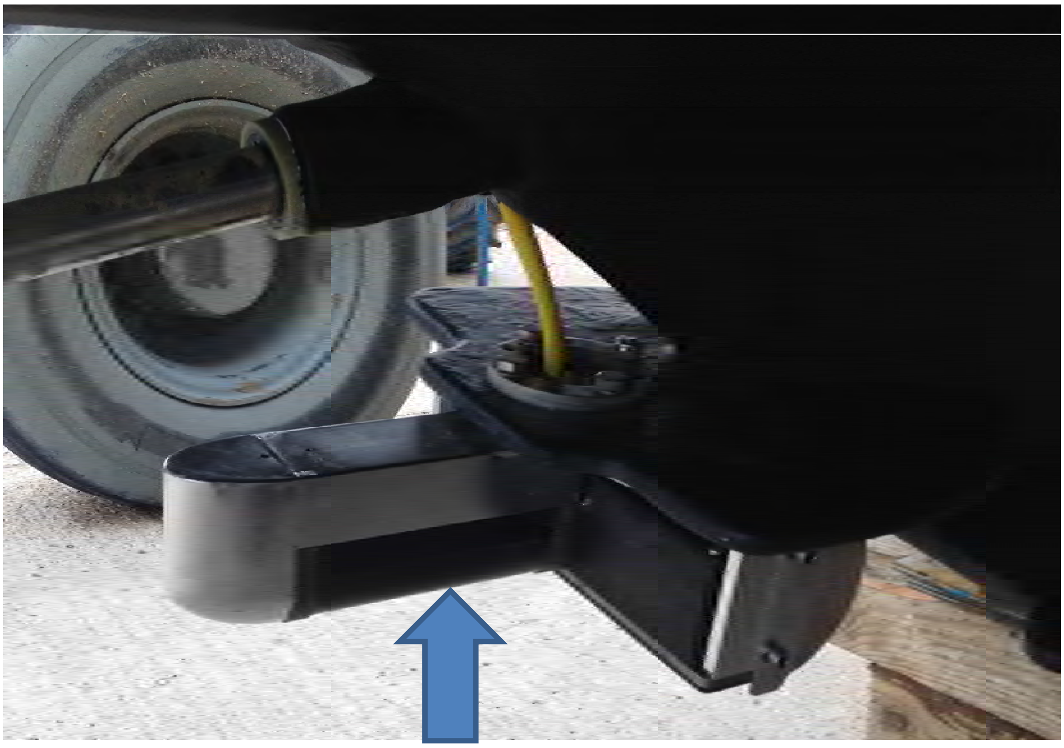
Point 15 – Whip Antenna Base Portt

Points 16,17,18,19 and 20



Point 21 – Stbd RESON 7125

Point 22 - Port RESON 7125



Point 23 – Plate on top of Edgetech 6205 pole

Point 24 – Base of Edgetech 6205 pole

Appendix C

SVP Calibration Certificate

CALIBRATION CERTIFICATE

This document certifies that the instrument detailed below has been calibrated according to Valeport Limited's Standard Procedures, using equipment with calibrations traceable to UKAS or National Standards.

Calibration Certificate Number:	**69441**
Instrument Type:	miniSVP
Instrument Serial Number:	40624
Calibrated By:	N.Paddon
Date:	25th November 2021
Signed:	NJP

Full details of the results from the calibration procedure applied to each fitted sensor are available, on request, via email. This summary certificate should be kept with the instrument.

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Valeport Limited
St. Peter's Quay, Totnes,
Devon TQ9 5EW UK

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sales@valeport.co.uk
www.valeport.co.uk

VAT No: GB 165 8753 67
Registered in England No: 1950444

Appendix D

SVS Calibration Certificate

TELEDYNE RESON
Everywhereyoulook™

SVP Test and Calibration certificate

Valid for surface use*

SVP Type :	SVP70
SVP Serial No.	4314061

Date of issue :	15-07-2021

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 °C
Point 2:	16.6 °C
Point 3:	25.5 °C

	RMS Speed of Sound Errors
Temperature Validation :	0.0259 m/s

Calibration & Final Function Test : Sign : [signature]

QA Signature : Inits : [initials]

* Surface use: 0 to 20m water depth.

TELEDYNE-RESON A/S, Fabriksvangen 13, DK-3550 Slangerup
Fax: +45 4738 0066, Phone: +45 4738 0022

Appendix E

USBL Calibration Report

USBL Calibration

Table 1: Project details

Project Name	G220011_PD_Ports
Project Number	G220011_PD_Ports_1_SK_USBLCAL
Data Logged Between	19 Feb 2022, 16:03:48+00:00 and 19 Feb 2022, 16:54:02+00:00
Vessel	SK
Client	Orsted
Project Type	Positioning

Calibration

Table 2: Calibration settings

Position Sensor	SPK-Pri-Starfix.G4 Plus-31002-Nmea filter
Motion Sensor	Applanix PosMV - Leverarm_2.Pitch Roll (C-O: Pitch=0.00°, Roll=0.00°, Heading=-0.30°)
Heading Sensor	Applanix PosMV - Leverarm_2.Azimuth (C-O: -0.30°)
USBL Sensor	Mini Ranger II (Offset: Mini Ranger, X=2.46 m, Y=2.15 m, Z=-3.27 m)
USBL Reference Location	Mini Ranger, X=2.46 m, Y=2.15 m, Z=-3.27 m
Orientation	North up, motion corrected
Beacon ID and/or Number	1
Scenario Name	Clover Pattern
Sound Velocity Profile	Profile summarized below (Ray tracing done in USBL Topside, not Starfix)
Error Estimation	Position=50.00 m, Depth=10.0 m and Speed of Sound=3.0 m/s
Calibration Results Will Be Applied In	Starfix (not applied in Usbl Processor)

Table 3: Calibration results

		Before Calibration (Initial Settings)	After Calibration (Clover Pattern)	Correction Applied
Beacon Position				
Easting		454 644.505 m E	454 644.200 m E ± 0.05 m	
Northing		534 765.004 m N	534 763.936 m N ± 0.05 m	
Depth [m]		25.000 ISS	25.047 ISS ± 0.10	
Transducer Offset Error				
Transducer to antenna [m]	X	N/A	N/A	N/A
	Y	N/A	N/A	N/A
	Z	N/A	N/A	N/A
Sound Velocity				
Observed or calculated [m/s]		1475.4	1470.6 ± 0.63	
Scale factor		1.000000000	0.996773915 ± 0.00	No
Attitude Corrections				
Pitch [°]		0.00	-1.38 ± 0.05	Yes
Roll [°]		0.00	-2.91 ± 0.13	Yes
Orientation [°]		0.00	2.00 ± 0.03	Yes
			Observations accepted: 444 Observations rejected: 281	

Table 4: Statistics of calculated horizontal beacon positions

	Before Calibration (Initial Settings)		After Calibration (Clover Pattern)	
Percentile [%]	Distance [m]	Percentage of Depth [%]	Distance [m]	Percentage of Depth [%]
39.4 (1 sigma)	1.58	6.30	0.42	1.69
86.5 (2 sigma)	4.46	17.83	0.94	3.76

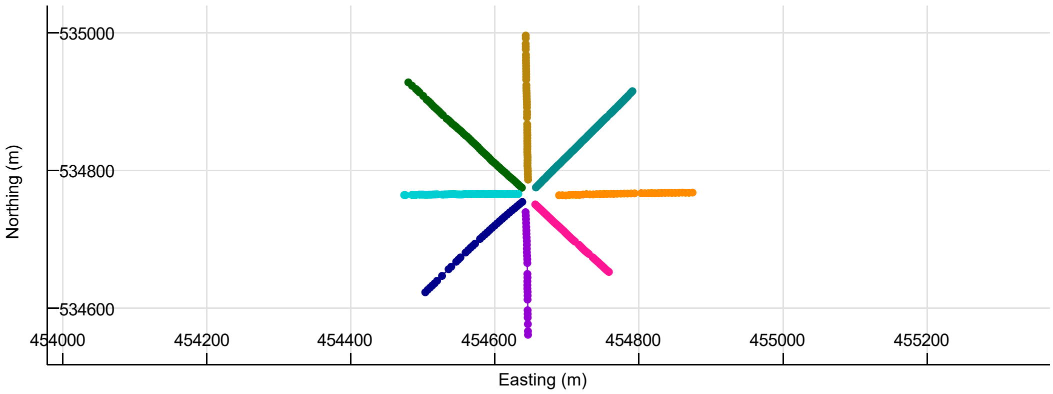

Figure 1: Position plot - vessel position

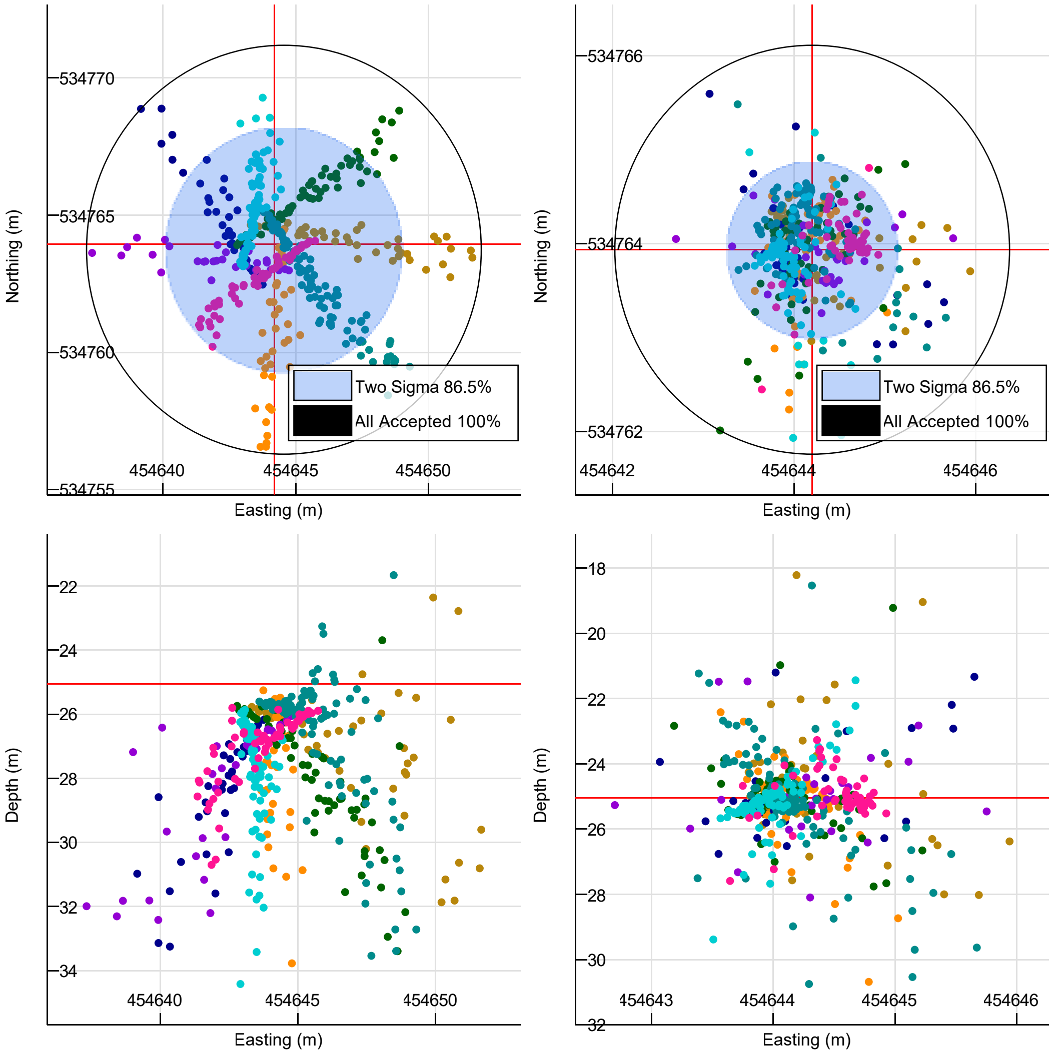

Figure 2: Scatter plots (before and after) - beacon position

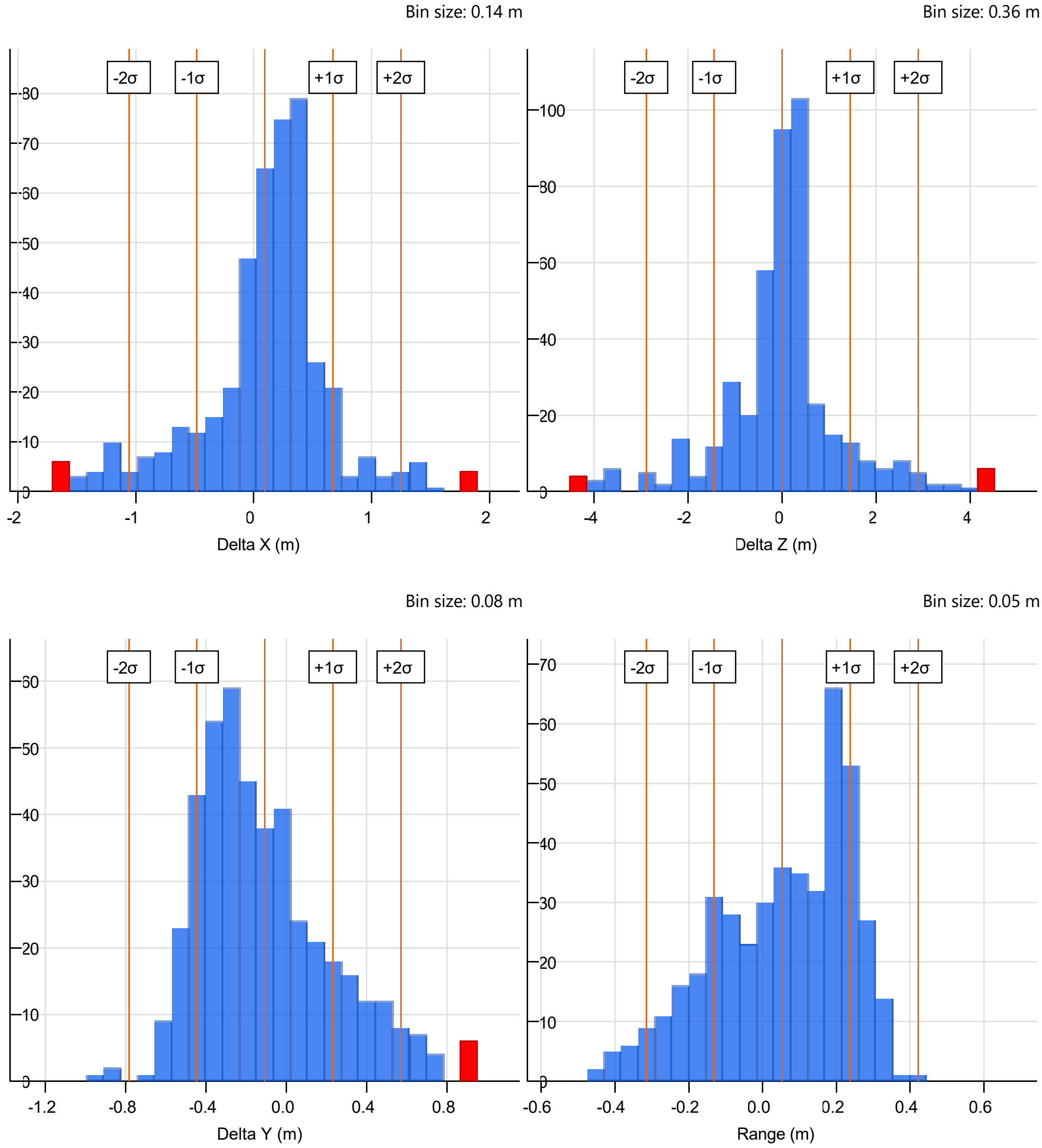

Figure 3: Range and delta residuals

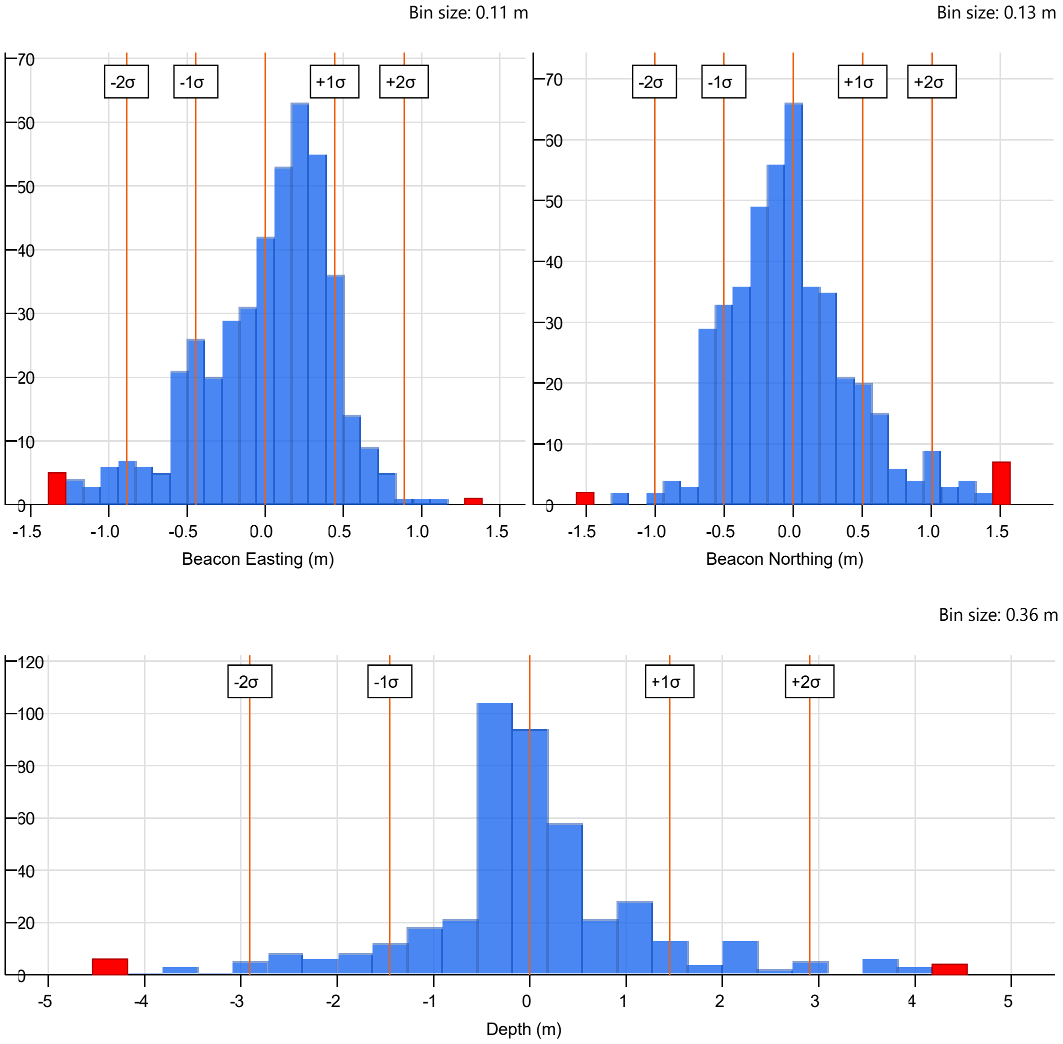

Figure 4: Position residuals

Table 5: Sound velocity profiles

Profile	Position WGS 84	Time	Average Sound Velocity [m/s]	Color
20220219_1420_SVP001_USBL	54° 42′ 17.78664″ N 001° 09′ 05.57622″ W	19 Feb 2022, 14:39:20+00:00	1475.4	

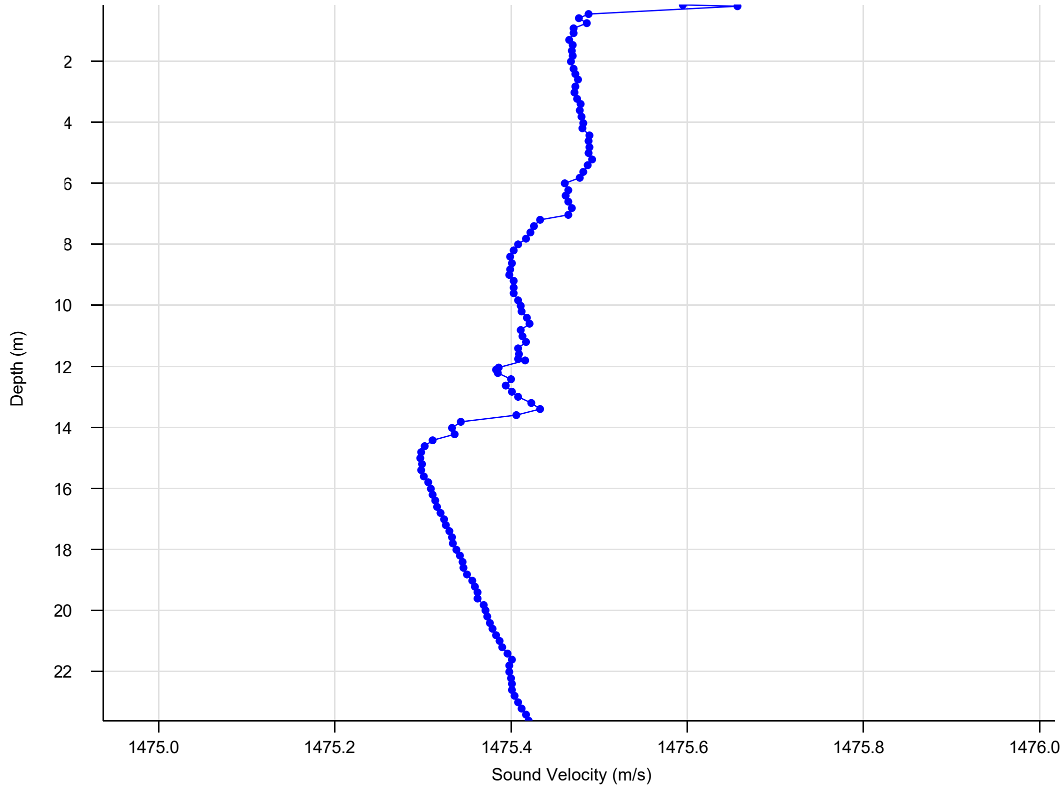

Figure 5: Sound velocity graph

Verification

No verification data recorded or calculation for this calibration session.

Peter Horobin
Party Chief
FGBML (Fugro Great Britain Marine Ltd.)

NA
Other
PDP

`

Appendix F

UHRS Mobilisation Report

Aramis - Geophysical Survey

UHRS Mobilization Acceptance tests

Document No.: REP22342

21 September 2022

DOCUMENT CONTROL

Project Title:	Aramis - Geophysical Survey
Document Title:	UHRS Mobilization Acceptance tests
Document Type:	Technical Report
Client Name:	TotalEnergies

Client Ref.:	22342
Document Ref.:	REP22342
Draft:	01
Date:	21 September 2022
Draft Status:	Draft

Revision History		Date	Author	Reviewed	Approved
01	Draft	21/09/2022	GM	MO	

Project team		
Abv.	Author	Position
HD	H. Duarte	Project Manager
DG	M. Oliveira	Deputy Project Manager
OM	O. Monrigal	Operations Manager (GMSS)
MO	M. Oliveira	Offshore Manager (GS)
GM	G. Moreira	Offline QC Processor (GS)
RJ	R. Joosten	Offshore Operator (GMSS)

SUMMARY

This document reports the analysis of the UHRS verification tests performed at the vicinity of Maasmond channel, Rotterdam, The Netherlands, and at sea onboard of the Fugro Seeker, within the scope of the Aramis Geophysical Survey. The tests were performed by Geomarine Survey Systems (GMSS) and Geosurveys (GS). The UHRS spread consisted on a single layer Geo-Source 400 tips LW sparker, two 2000XFO HV Geo-Spark power supplies, 24-channel streamer with 1+2 m group interval, a 24-channel recording system, a single element reference hydrophone and GMSS positioning systems for front buoy, tail buoy and source.

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FIGURES

TABLES

1. INTRODUCTION

From 6th of September to 11th of September 2022, several quayside and at sea tests were performed in order to assess if the UHRS equipment and the setup were fit for purpose within the scope of the Aramis Project, on board of Fugro Seeker. The tests were performed using a single layer Geo-Source 400 tips LW sparker, two 2000XFO HV Geo-Spark power supplies, 24-channel streamer with a 1+2 m group interval, a 24-channel recording system, a single element reference hydrophone and GNSS positioning systems for front buoy, tail buoy and source. Some of the alongside tests were conducted at port, whilst the offshore acceptance tests were performed on the Aramis survey area.

The geodetic datum and projection that is going to be used in the project is ED50 UTM 31 N and the vertical reference was defined as LAT.

2. 2D ULTRA HIGH-RESOLUTION SEISMIC SYSTEM

The UHRS system includes a single Geo-Source400 tips LW sparker, one 2000XFO HV Geo-Spark power supplies, 24-channel streamer with a 1+2 m group interval, a 24-channel recording system, a single element reference hydrophone and GNSS positioning systems for front buoy, tail buoy and source. Table 1 describes the UHRS equipment and the general acquisition parameters used in this project.

Table 1 - UHRS system and parameters.

Sources	1x Geo-Source 400 tips LW
Source Towing Depth	0.3 m
SP Interval	1 m
Operating Power	Source @ 400J
Power Supply	2 X Geo-Spark 2000FXO
CDP Bin Coverage	≈24 fold for 1 m CDP bin
Recorder	4x Multitrace24 – Geomarine Survey systems
Sample Rate	0.1 msec
Record Length	250 ms
Format	SEG-Y
Multichannel Streamer	Geo-Sense LW 24 channels
Streamer Depth	≈ 0.4 – 1.3 m
Group Interval	1+2m
Group Active Length	35 m
Reference hydrophone	Geo-Sense reference hydrophone – single element
Hydrophone Depth	5 m from the source (@ sparker skid)
Group Interval	Single element
Group Active Length	Point receiver

The seismic spread geometry used during the survey is presented in the Figure 1 with the respective measurements - offsets.

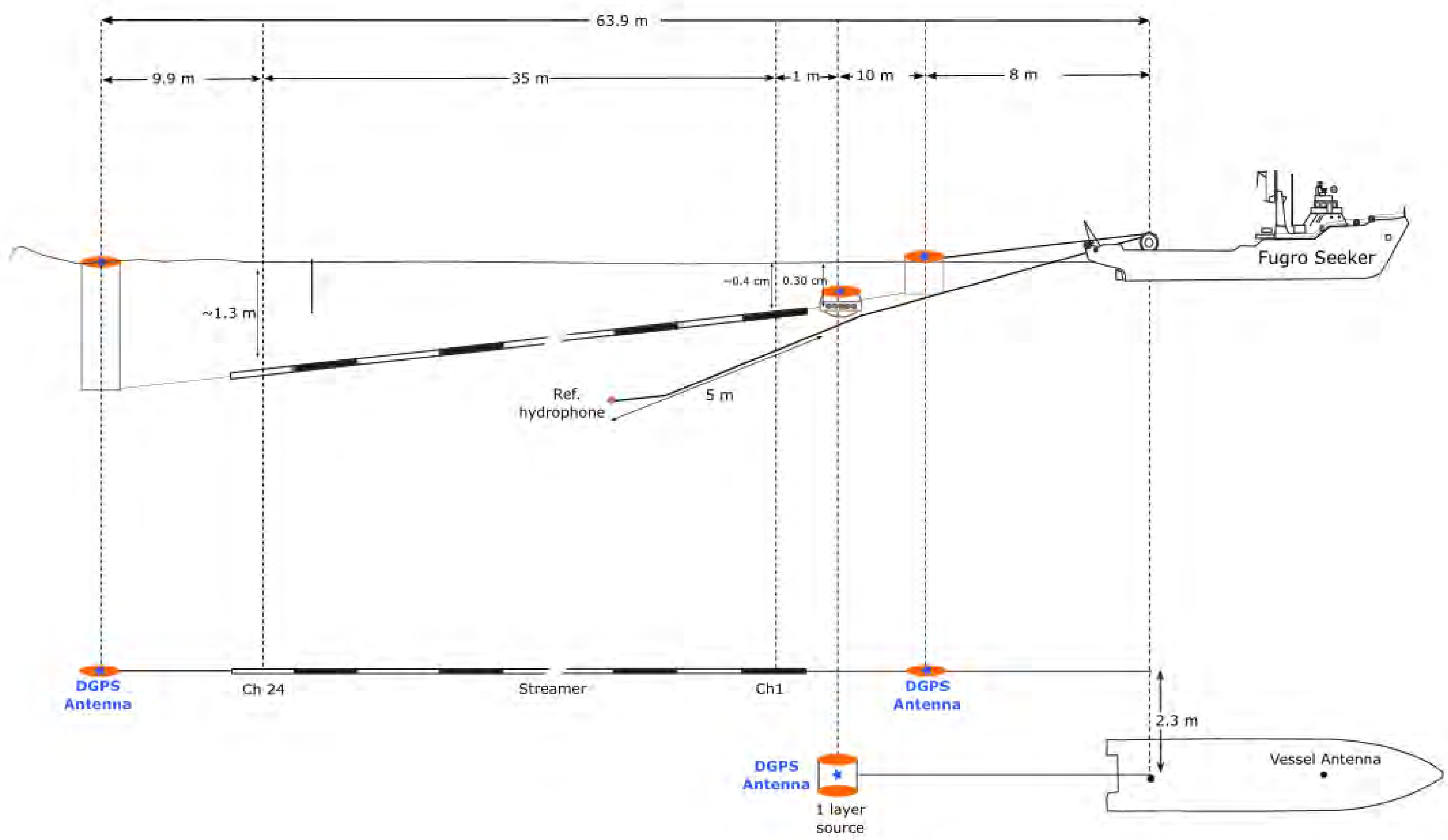


Figure 1 *- Vessel Layout and offset diagram to the seismic spread in cross section and in plant view (not to scale).*

3. QUAYSIDE TESTS

3.1. Q1 Source Test and Q7 integrated Seismic Spread Test

Although initially intended to be performed at the harbour, due to the harbour's and MMO's restrictions the sparker was deployed and only fired for a few shots. The test purpose was to determine the source resilience, in order to detect any possible malfunction. The test continued while on site, and the sparker fired for 2h with no malfunctions or power supplies overheating detected.

Charging times at 400J were around 270ms and at 600J were around 350ms, meaning that the pulsed power supplies are able to fully charge without dropping shots for survey speed around ~3.5-4kts while shooting at 1m interval.

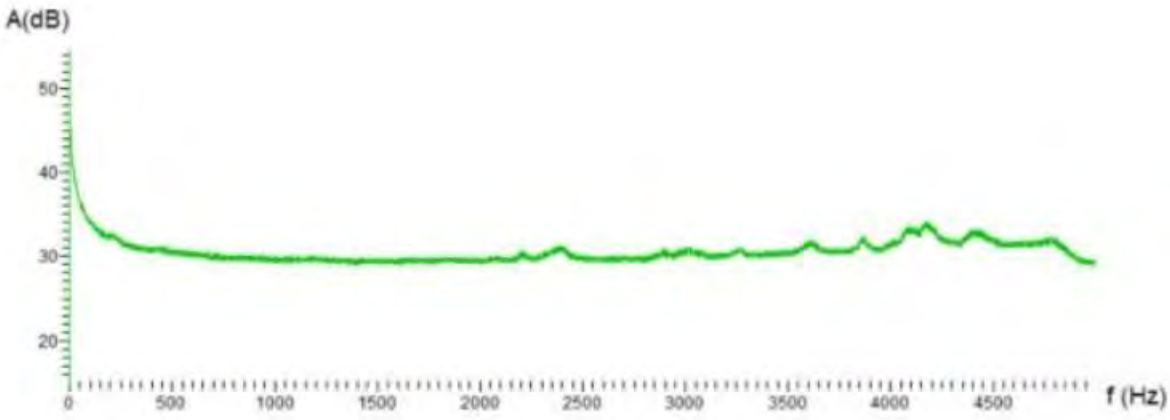
The data backup system is working as expected and also the Seg-y files and logs are being produced (Figure 2).

18662081	08/09/2022 11:37	File folder	
SEG-Y	08/09/2022 11:32	File folder	
UHRS_cal1_EOL	08/09/2022 11:38	File folder	
UHRS_cal1_SOL	08/09/2022 11:38	File folder	
.devorder	08/09/2022 08:50	DEVORDER File	1 KB
18662081.GRIF	08/09/2022 09:00	GRIF File	18 KB
18662081.GRLI	08/09/2022 09:00	GRLI File	1 KB
18662081.log	08/09/2022 09:00	LOG File	932 KB
errors.log	08/09/2022 09:00	LOG File	1 KB
LAN_TRIGGER_LOG.log	08/09/2022 09:00	LOG File	148 KB
name.txt	08/09/2022 08:50	TXT File	1 KB
navigation.p190	08/09/2022 09:00	P190 File	940 KB
RAW_LOG-DGPS buoy 3031_0.log	08/09/2022 09:00	LOG File	945 KB
RAW_LOG-DGPS buoy 3031_1.log	08/09/2022 09:00	LOG File	945 KB
RAW_LOG-DGPS buoy 3226_0.log	08/09/2022 09:00	LOG File	945 KB
RAW_LOG-DGPS buoy 3226_1.log	08/09/2022 09:00	LOG File	945 KB
RAW_LOG-DGPS buoy 3251_0.log	08/09/2022 09:00	LOG File	944 KB
RAW_LOG-DGPS buoy 3251_1.log	08/09/2022 09:00	LOG File	944 KB
RAW_LOG-Input 01.log	08/09/2022 09:00	LOG File	115 KB

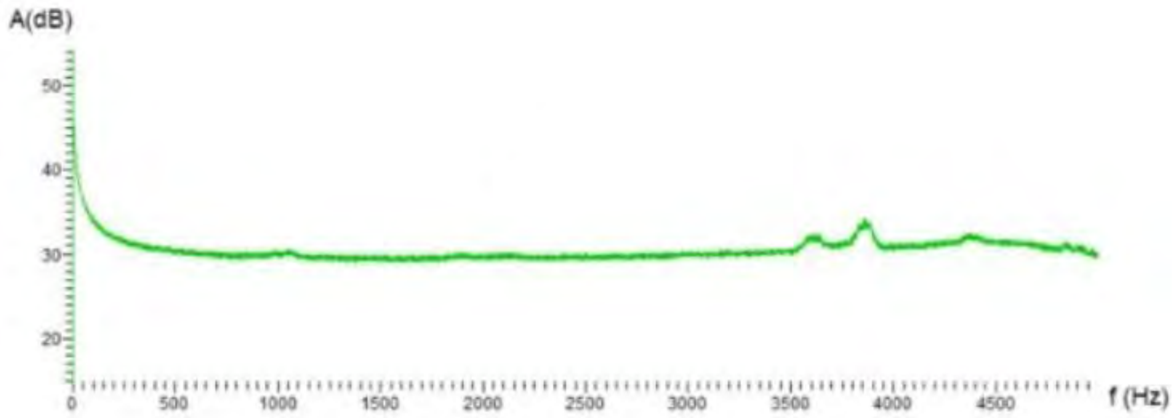
***Figure 2** - Raw data folder structure containing the SEGY and log files.*

3.2. Q2 Recording Unit Test

Without the streamer connected to the multi-trace unit, a test file was recorded. The recorded data was analysed for each multi-trace unit (main and spare). All the devices produced a white noise spectrum in the desirable frequencies, without any anomalous spikes (Figure 3).



(a)



(b)

Figure 3 *- White noise spectrum for the main (a) and spare (b) acquisition boards.*

3.3. Q3 Streamer Test and Q4 Auxiliary Hydrophone Test

With the streamer connected, the streamer's drum was tapped. Background noise was observed on every 24-channel streamer section and logged. A response for all the 24 channels was recorded, with no apparent dead or spiking channels (Figure 4). The same process was made for the reference hydrophone (Figure 5). No spare parts were tested duo to the fact that there was no space on board to carry the extra equipment. The spares were stored near the port.

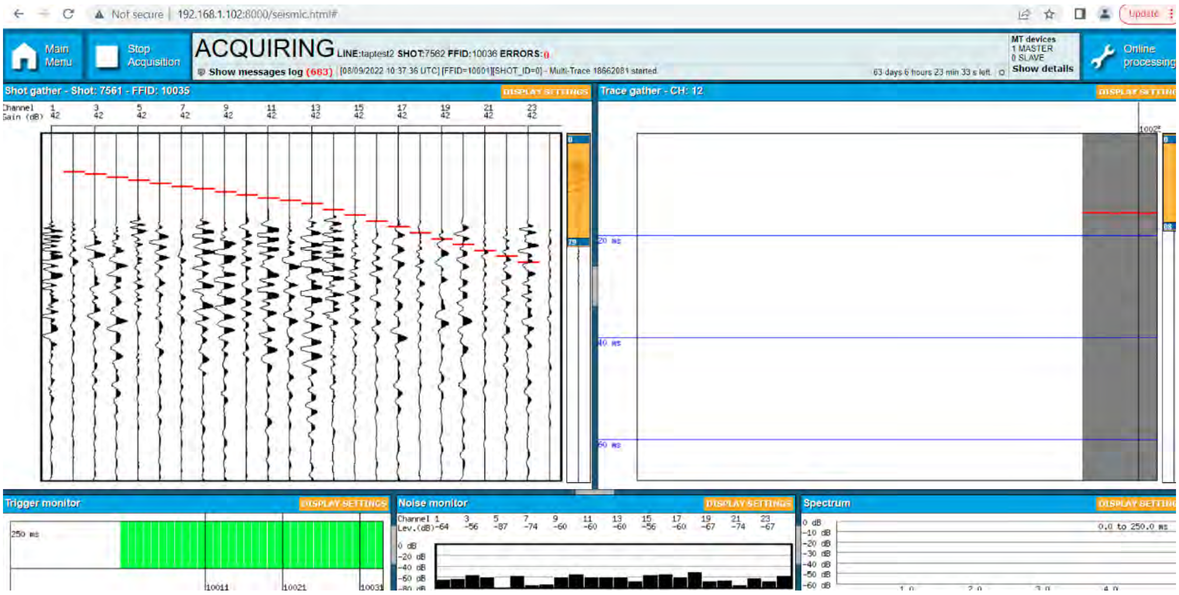


Figure 4 *- Main streamer tap test.*

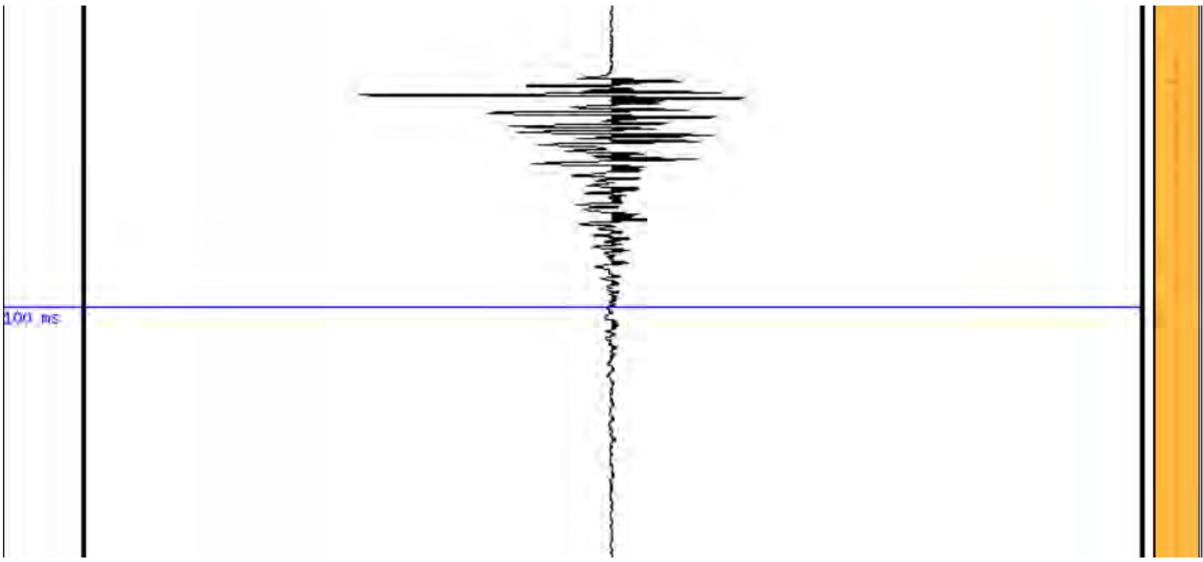


Figure 5 *- Reference hydrophone tap test.*

3.4. Q5 Navigation Recording Test

All positioning beacons, including the spare, were connected and were found to be working as expected (Figure 6). The verification was not done in the ideal test conditions since there was no open space area nearby. Nevertheless, wifi and battery levels were as per manufacturer specifications (greater than 30 dB in general, and above 3.3 V).

Vessel		DGPS buoy 3251		DGPS buoy 3226		DGPS buoy 3031	
Input	Input 01	Input	DGPS wireless	Input	DGPS wireless	Input	DGPS wireless
WiFi level	N/A	WiFi level	44 dB	WiFi level	32 dB	WiFi level	47 dB
Battery	N/A	Battery	3265 mV	Battery	3294 mV	Battery	3299 mV
Northing	5761850.20 N	Northing	5761847.84 N	Northing	5761827.17 N	Northing	5761842.57 N
Easting	572171.15 E	Easting	572187.05 E	Easting	572238.89 E	Easting	572195.78 E
Heading	289.2°	Heading	285.5°	Heading	287.5°	Heading	287.8°
Speed	4.42 knots	Speed	4.24 knots	Speed	4.48 knots	Speed	4.28 knots
Fix Quality	Unknown	Fix Quality	DGPS (#123)	Fix Quality	DGPS (#136)	Fix Quality	DGPS (#136)
Satellites	N/A	Satellites	7	Satellites	7	Satellites	7
Fix number	0	Fix number	0	Fix number	0	Fix number	0
Time	07:27:38.751	Time	07:27:38.800	Time	07:27:38.800	Time	07:27:38.800
Update rate	4 Hz	Update rate	5 Hz	Update rate	5 Hz	Update rate	5 Hz

Figure 6 – *DGPS buoys positioning information.*

The navigation data was logged in the P1/90 navigation file format, containing valid information for every shot, thus legible to be used to extract navigation data for QC and processing purposes (Figure 7).

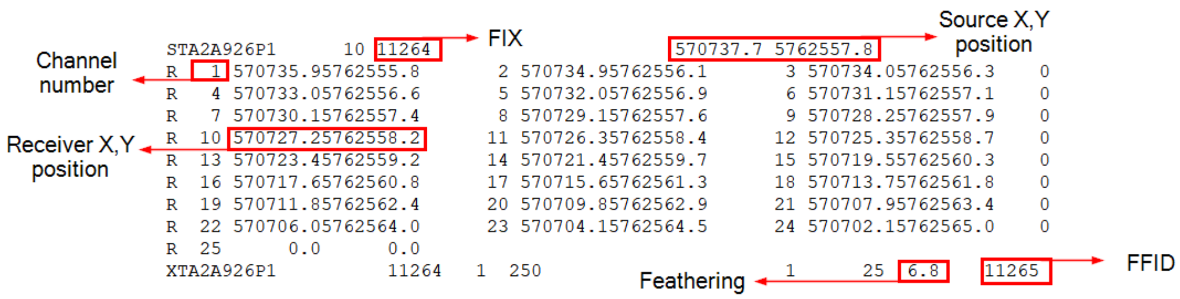


Figure 7 – *Example of a P1/90 for a test line with fields filled for every shot.*

3.5. Q6 External Navigation Input

The vessel positioning, FIX number, date and time stamps, tides, vessel speed and Sound Velocity information was successfully received and logged on the GeoMarine (GMSS software) – Georecorder (Figure 8).

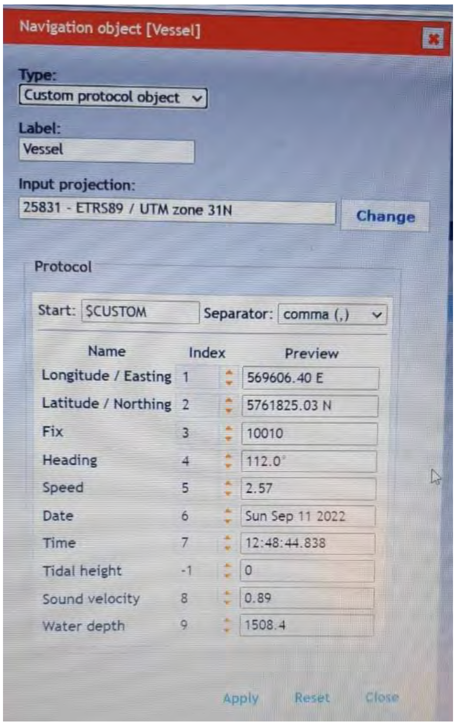


***Figure 8** – Navigation string: header position in the UHRS system.*

Figure 9 shows the custom string received from the navigation software used by Fugro (Starfix).

```
$CUSTOM,571365.26,5762176.04,10001,140.4,2.62,Thu Sep 08 2022,08:13:59.432,0.35,1514.4,-17.29,UHRS_cal2
$CUSTOM,571365.69,5762175.16,10002,139.4,2.63,Thu Sep 08 2022,08:14:00.200,0.35,1514.8,-17.19,UHRS_cal2
$CUSTOM,571366.08,5762174.26,10003,139.8,2.62,Thu Sep 08 2022,08:14:00.969,0.35,1515.2,-17.21,UHRS_cal2
$CUSTOM,571366.48,5762173.35,10004,140.0,2.61,Thu Sep 08 2022,08:14:01.715,0.35,1515.0,-17.27,UHRS_cal2
$CUSTOM,571366.97,5762172.49,10005,139.7,2.60,Thu Sep 08 2022,08:14:02.468,0.35,1514.8,-17.37,UHRS_cal2
$CUSTOM,571367.49,5762171.65,10006,139.1,2.59,Thu Sep 08 2022,08:14:03.237,0.35,1515.0,-17.42,UHRS_cal2
$CUSTOM,571367.96,5762170.77,10007,138.8,2.58,Thu Sep 08 2022,08:14:03.994,0.35,1514.9,-17.40,UHRS_cal2
$CUSTOM,571368.46,5762169.90,10008,139.0,2.57,Thu Sep 08 2022,08:14:04.748,0.35,1515.4,-17.30,UHRS_cal2
$CUSTOM,571368.97,5762169.02,10009,138.7,2.57,Thu Sep 08 2022,08:14:05.488,0.35,1515.6,-17.29,UHRS_cal2
$CUSTOM,571369.48,5762168.14,10010,138.7,2.57,Thu Sep 08 2022,08:14:06.225,0.35,1515.1,-17.37,UHRS_cal2
$CUSTOM,571369.97,5762167.27,10011,139.0,2.58,Thu Sep 08 2022,08:14:06.978,0.35,1515.0,-17.37,UHRS_cal2
$CUSTOM,571370.44,5762166.42,10012,139.1,2.58,Thu Sep 08 2022,08:14:07.746,0.35,1515.1,-17.30,UHRS_cal2
$CUSTOM,571370.96,5762165.61,10013,138.9,2.57,Thu Sep 08 2022,08:14:08.541,0.35,1514.7,-17.22,UHRS_cal2
$CUSTOM,571371.42,5762164.75,10014,138.3,2.55,Thu Sep 08 2022,08:14:09.333,0.35,1514.7,-17.24,UHRS_cal2
$CUSTOM,571371.87,5762163.85,10015,138.2,2.53,Thu Sep 08 2022,08:14:10.098,0.35,1514.9,-17.28,UHRS_cal2
```

Vessel X,Y position
FIX
Heading
Vessel Speed (Kts)
Date
Time
Tide Height
SVP Mean (m/s)
Water Depth (m)

***Figure 9** – Example of a custom string received from navigation software used by Fugro (Starfix).*

Synchronization times between both GMSS and navigation systems was also verified (Figure 10).

GMSS Server | Navigation system

```
11/ .796 UTC,VESSEL_X,569590.253405350, VESSEL_Y,5763015.990997942, VESSEL_FIX,10002, VESSEL_HDG,-0.367173833, VESSEL_SPEED,1.003073230, VESSEL_GPSTIME,11/ 58
11/ .732 UTC,VESSEL_X,569591.173562732, VESSEL_Y,5763015.606541175, VESSEL_FIX,10003, VESSEL_HDG,-0.381372492, VESSEL_SPEED,1.033163146, VESSEL_GPSTIME,11/ 59
11/09/2022 09:02:00.633 UTC,VESSEL_X,569592.107540202, VESSEL_Y,5763015.259221095, VESSEL_FIX,10004, VESSEL_HDG,-0.373060278, VESSEL_SPEED,1.056229996, VESSEL_GPSTIME,11/ 00
11/09/2022 09:02:01.511 UTC,VESSEL_X,569593.082432053, VESSEL_Y,5763015.038687824, VESSEL_FIX,10005, VESSEL_HDG,-0.335601955, VESSEL_SPEED,1.073383324, VESSEL_GPSTIME,11/09/2022 09:02:01
11/09/2022 09:02:02.449 UTC,VESSEL_X,569594.038997193, VESSEL_Y,5763014.800871017, VESSEL_FIX,10006, VESSEL_HDG,-0.304999767, VESSEL_SPEED,1.085723386, VESSEL_GPSTIME,11/09/2022 09:02:02
11/09/2022 09:02:03.362 UTC,VESSEL_X,569594.962332046, VESSEL_Y,5763014.429938072, VESSEL_FIX,10007, VESSEL_HDG,-0.301705594, VESSEL_SPEED,1.092307596, VESSEL_GPSTIME,11/09/2022 09:02:03
11/09/2022 09:02:04.257 UTC,VESSEL_X,569595.940569715, VESSEL_Y,5763014.257221468, VESSEL_FIX,10008, VESSEL_HDG,-0.257060689, VESSEL_SPEED,1.092882035, VESSEL_GPSTIME,11/09/2022 09:02:04
11/09/2022 09:02:05.138 UTC,VESSEL_X,569596.911673362, VESSEL_Y,5763013.799785597, VESSEL_FIX,10009, VESSEL_HDG,-0.311961722, VESSEL_SPEED,1.109322058, VESSEL_GPSTIME,11/09/2022 09:02:05
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11/09/2022 09:02:06.888 UTC,VESSEL_X,569598.743282289, VESSEL_Y,5763013.017736124, VESSEL_FIX,10011, VESSEL_HDG,-0.353042787, VESSEL_SPEED,1.144190146, VESSEL_GPSTIME,11/09/2022 09:02:06
11/09/2022 09:02:07.835 UTC,VESSEL_X,569599.660420310, VESSEL_Y,5763012.816036493, VESSEL_FIX,10012, VESSEL_HDG,-0.363464813, VESSEL_SPEED,1.114864403, VESSEL_GPSTIME,11/09/2022 09:02:07
11/09/2022 09:02:08.809 UTC,VESSEL_X,569600.604272654, VESSEL_Y,5763012.447646528, VESSEL_FIX,10013, VESSEL_HDG,-0.345951166, VESSEL_SPEED,1.071502152, VESSEL_GPSTIME,11/09/2022 09:02:08
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11/09/2022 09:02:10.621 UTC,VESSEL_X,569602.534718446, VESSEL_Y,5763011.815834102, VESSEL_FIX,10015, VESSEL_HDG,-0.306779078, VESSEL_SPEED,1.066103411, VESSEL_GPSTIME,11/09/2022 09:02:10
```

***Figure 10** – Time synchronization between GMSS and vessel navigation system.*

4. AT SEA TESTS

4.1. Noise Test for basic UHRS tow configuration

The noise tests were conducted during the sea trials, at the survey area. Due to the small size of the vessel, it was not possible to install an outrigger to tow the seismic spread away from the vessel wash. The sparker was towed at the stern and the streamer towed from the stern 2.3 meters towards starboard side (Figure 11).

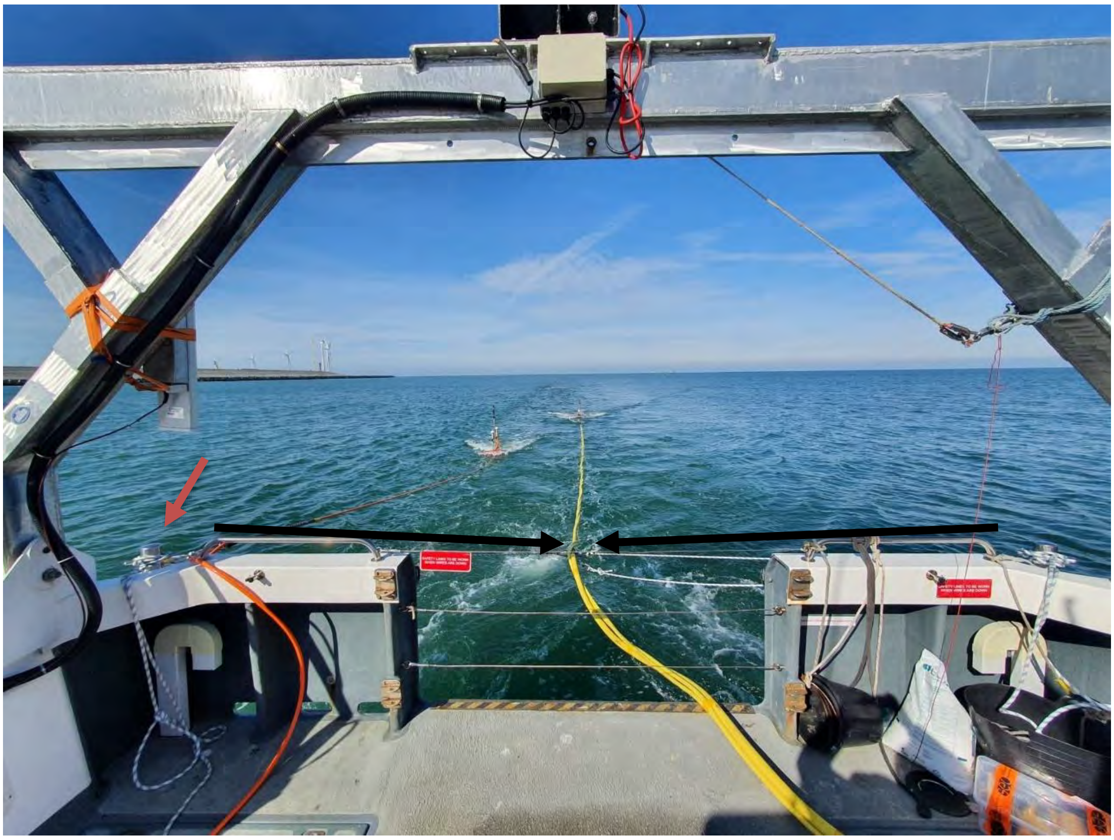


Figure 11 *- Seismic spread deployed. Red arrow: streamer tow points; Black arrows: sparker tow points.*

Pitch is fixed and the vessel was working at around 700 RPM. Tests were performed at a 0.5-0.7m significant wave height seas and 12-20kts S wind direction. Noise records were done for two lines with opposite direction, at around 3.5-4 knots speed through water. Figure 12 shows the noise tests diagram for the two lines.

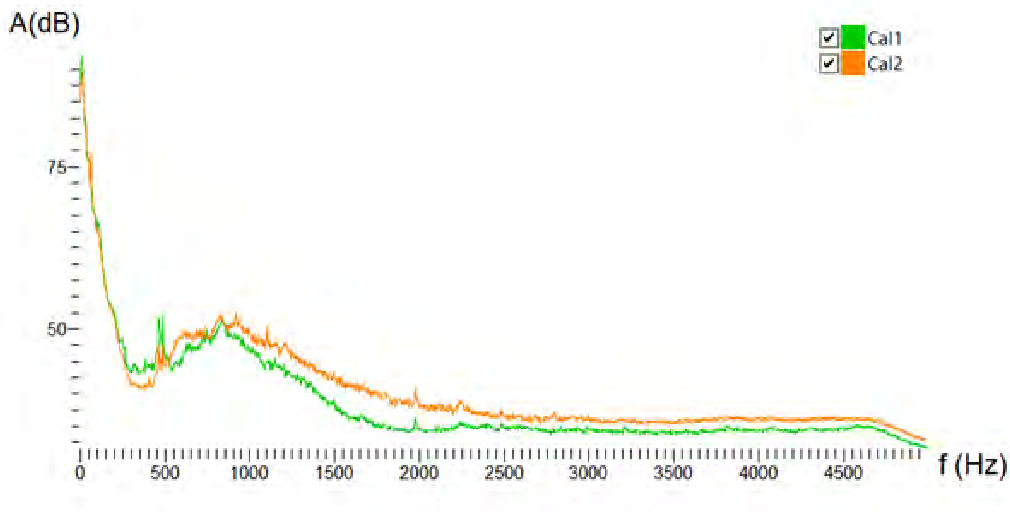
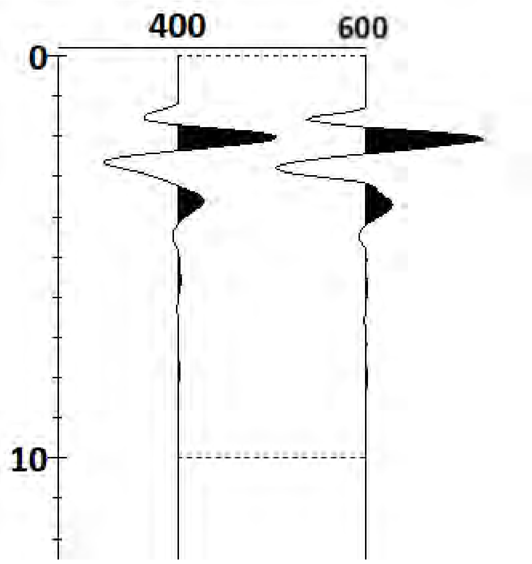


Figure 12 *- General noise spectrum with different energies configurations performed.*

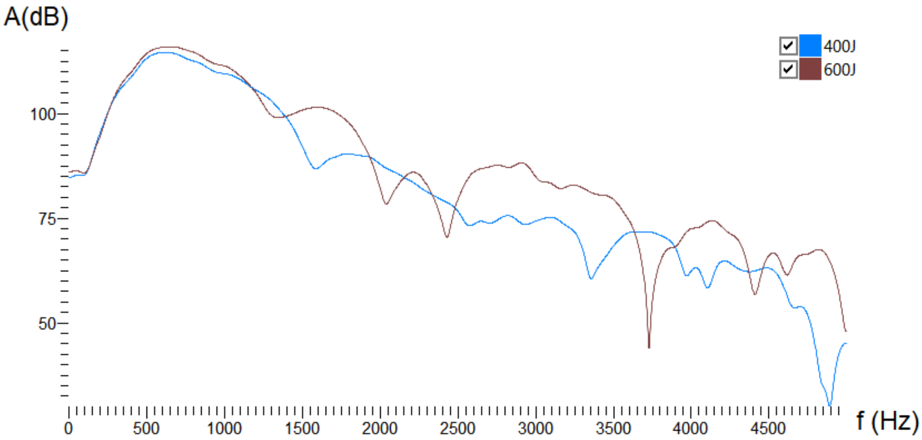
There is a spike on the noise levels around 500Hz. The source of the noise seems to be related with the vessel engine, however it has no impact on the UHRS data quality. The vessel is recommended to work at a survey speed over ground higher than 3.5 kts and not above 4 kts.

4.2. S1 Signature test

The reference hydrophone was deployed 8m under the sparker to perform the signature test. Figure 13 (a) displays the best pulse for each energy setting. For a source tow depth of 30 cm (single layer sparker). These tests were performed at sea due to permit limitations at port. Note that the seabed was picked for all these tests, to minimize the impact of any deconstructive/misaligned wavelet.



(a)



(b)

***Figure 13** – (a) Signatures for each tested energy and (b) Spectrum comparison between each energy setting.*

From the above-mentioned energy settings, 400J of energy provides a good and stable pulse and amplitude spectrum (Figure 13 (a) and Figure 13 (b)) and is enough to achieve the desired penetration with good seismic imaging results.

4.3. S2 Streamer working noise limit

With the streamer deployed on the mentioned towing position and at a survey speed of 3.5 knots SOG, a noise file was recorded with all other survey equipment running, except the sparker. No significant acoustic and/or electric interference was noticed on the UHRS streamer. As depicted on Figure 14, the noise levels observed during the test, have amplitude levels that should not interfere with the UHRS data, nevertheless the noise levels will be monitored on a line-by-line basis.

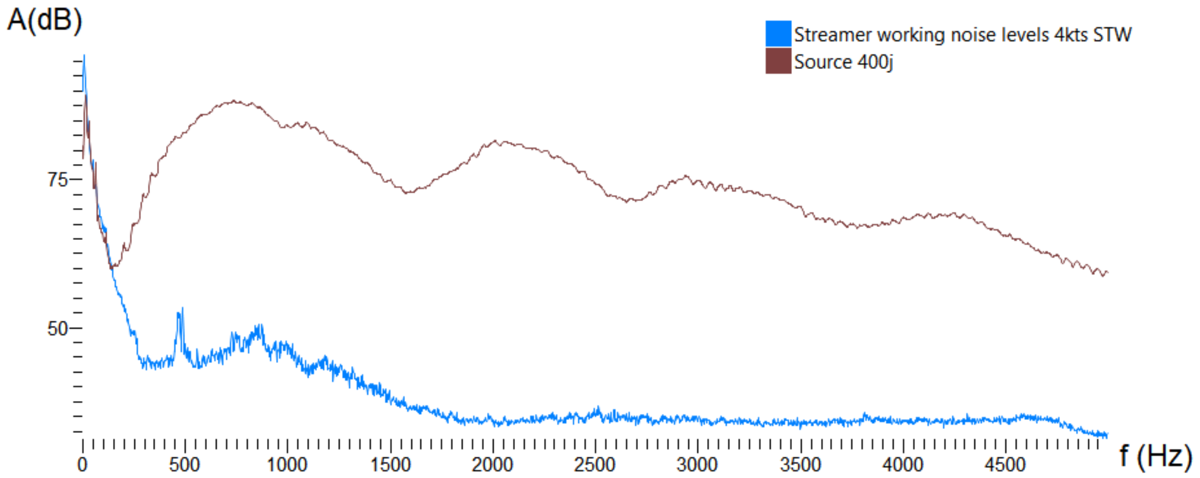


Figure 14 *- Source spectrum at 400J vs Streamer working noise levels.*

The main sources of noise identified during this test were (Figure 15):

- Vessel noise;
- Tail cable tugging noise.
- Thruster noise.

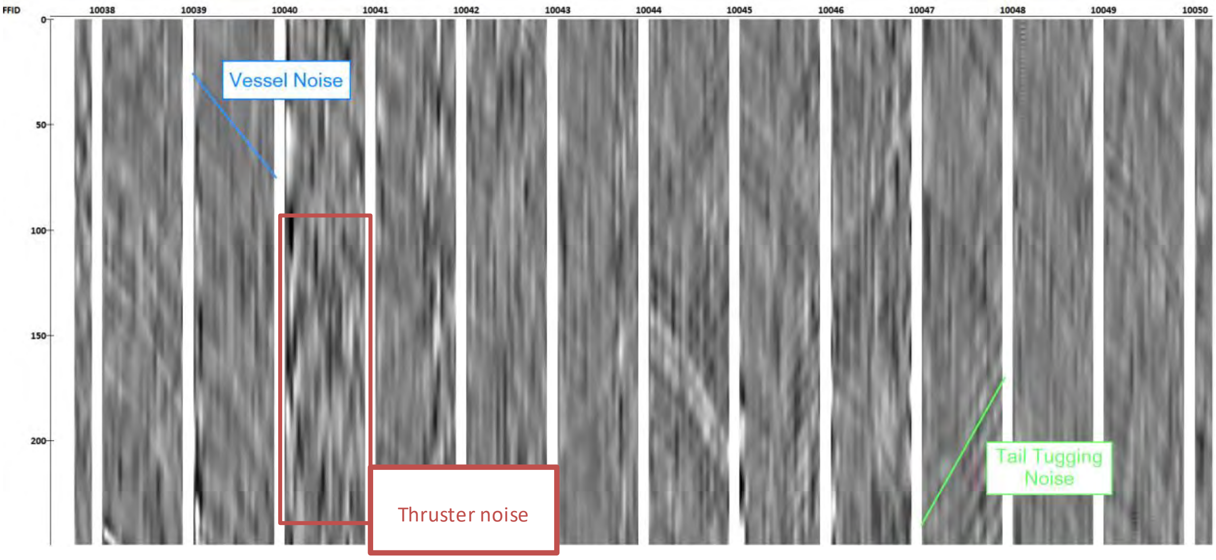


Figure 15 *– Noise sources identified in the working limit noise test: vessel acoustic noise (blue line) and tail tugging noise (green line) recorded by the M-UHRS streamer.*

4.4. S3 Streamer balancing and tow depth

The streamer was balanced for the survey speed range of 3.5-3.8 knots SOG. Along the streamer, several lead weights were placed in order to achieve the slant shape. To evaluate if the cable is properly slanted, a direct observation of the receiver ghost along all channels was done. From the observation, it was noticed that the streamer was too shallow, along all channels (Figure 16).

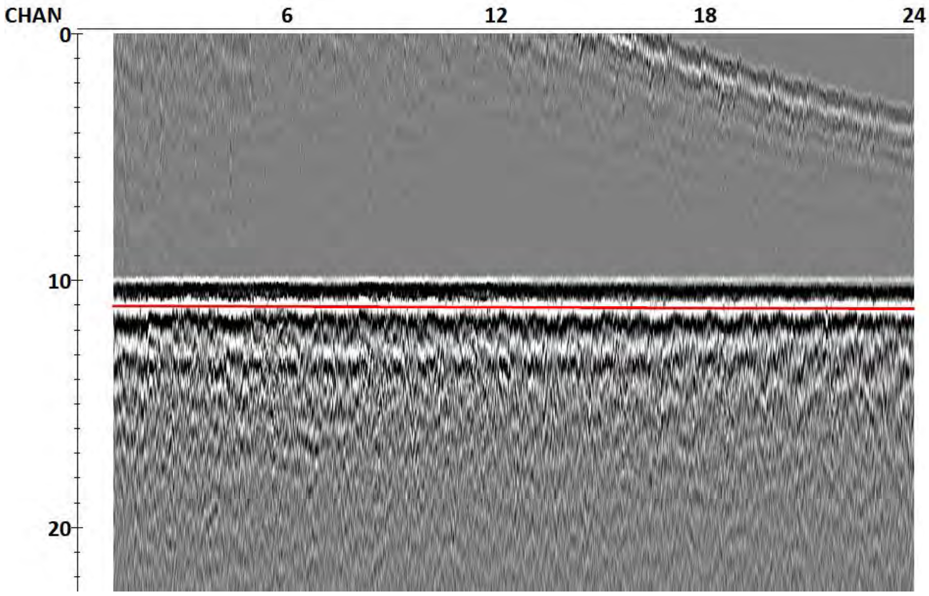
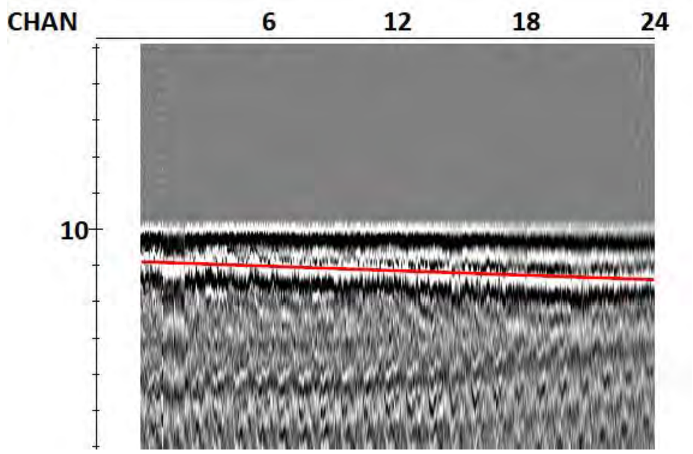


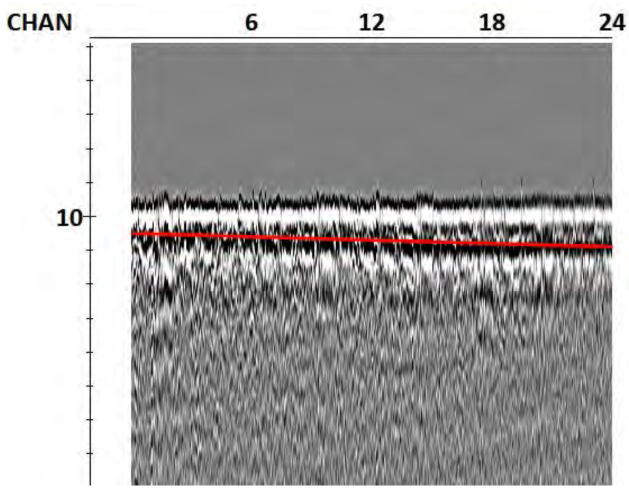
Figure 16 *– Streamer balancing: red line represents the streamer with a shallow behaviour.*

The rebalancing was done by adding weights to every other channel from channel 18 towards the end of the streamer. The result can be seen on Figure 17 bellow.

Two lines were acquired in two opposite directions to analyse the balancing (Figure 17). On the second line (acquired against the current), the streamer, although keeping the slant shape, still seems to be shallow. However, on the opposite direction, the streamer is deeper, with a slanted shape. This means that, due to strong currents, the slant configuration will vary depending on the currents.



(a)



(b)

Figure 17 *- Final streamer rebalancing results: Line acquired with the current (a) and line acquired against the current (b).*

4.5. S4 Positioning and Feathering

One line was acquired in opposite directions to verify the positioning of the 2D UHRS data and compare it against MBES. No horizontal misties were verified, meaning that the positioning is confirmed to be correct. Note that the MBES does not cover entirely the seismic data presented in Figure 18 because the sea trials were done just outside of the survey area to avoid strong currents present on site. Please note that the seismic section does not have tidal corrections applied.

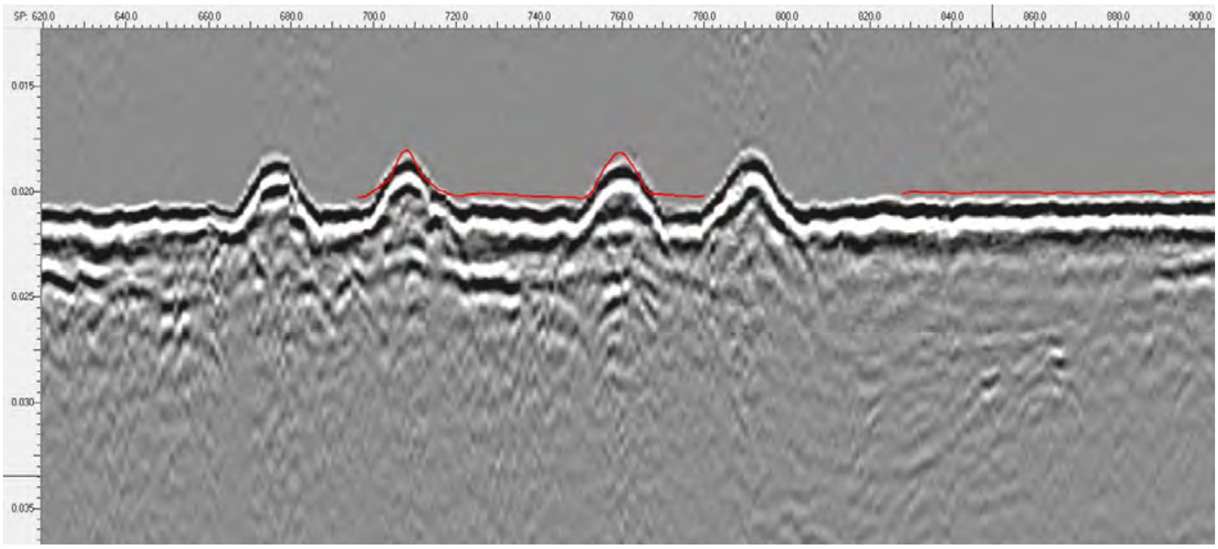
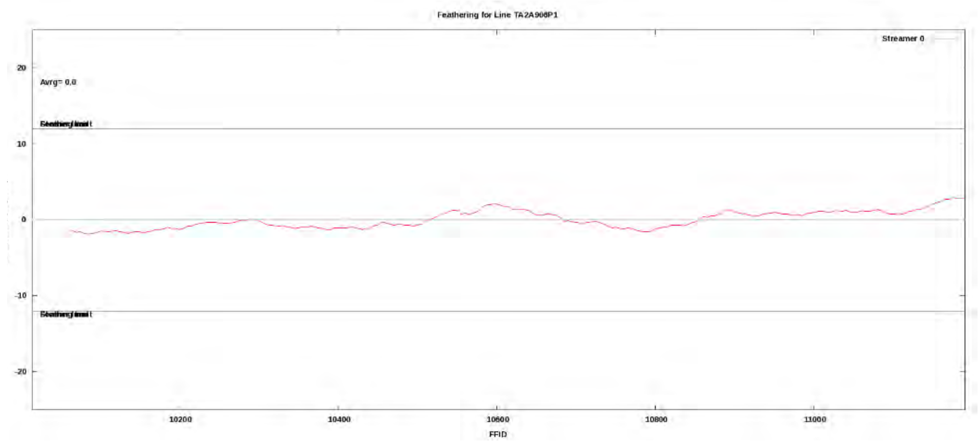
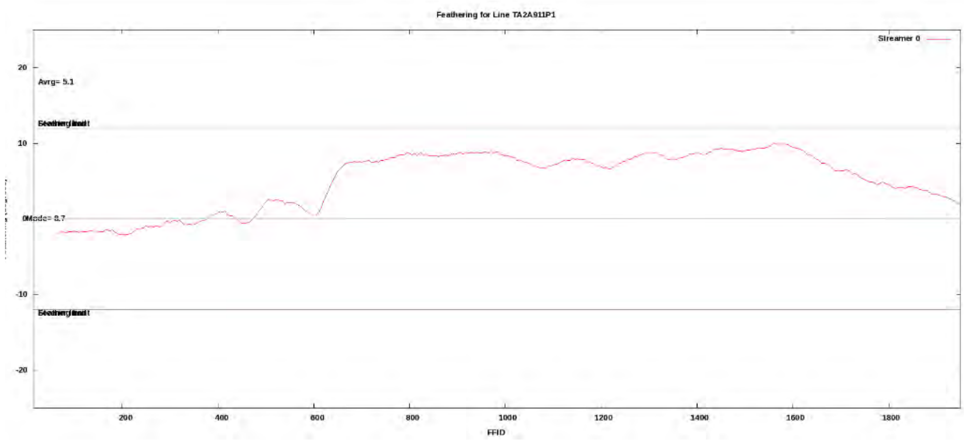


***Figure 18** – Positional check for line UHRS_Cal1 with the MBES grid on top (red line).*

The feathering angle was monitored using the head and tail antennas located, respectively, at the front and end of the 24 channels streamer for the verification lines (Figure 19). All lines presented acceptable feathering angle values (less than 12 degrees).



(a)

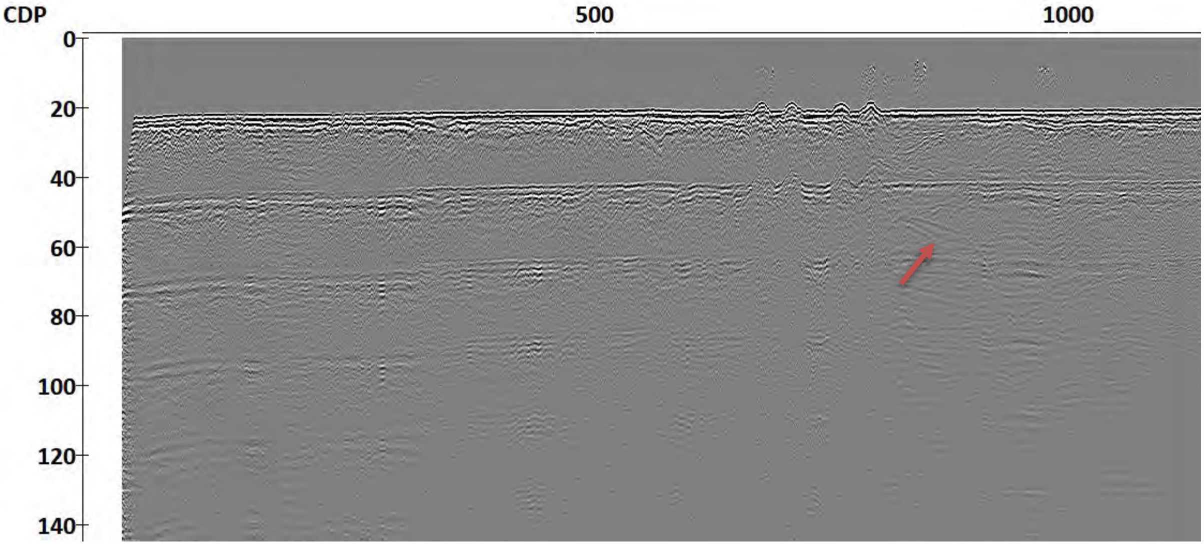


(b)

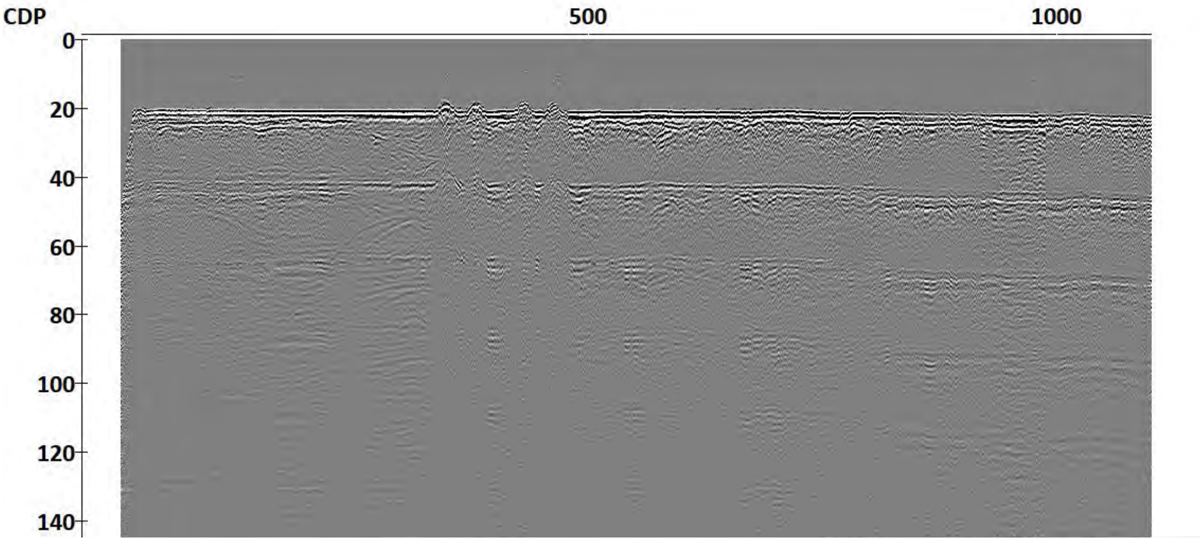
Figure 19 - *Feathering angle example for two lines.*

4.6. S5 Energy Selection

One of the box lines was acquired twice with different energy settings: 400J and 600J. Based on the results observed below and also from the signature test, 400J is the most suitable energy setting for the acquisition, as it presents more than the desired penetration (15m) and duo to the shallow nature of the survey area it's expected to have several multiples reflections of the seabed through the record length that are harder to remove on post processing with higher energies (Figure 20).



(a)



(b)

Figure 20 – *Energy selection: (a) – 400J, red arrow showing primary signal at around 80ms (TWT); (b) – 600J.*

4.7. S6 Geological Signal Assessment and Integrated test

A conventional box test was not done due to weather restrictions and, in order to expedite the tests, only two lines with approximately 1 km were acquired in both directions, crossed by two smaller perpendicular lines with approximately 300 m each. (Figure 21).

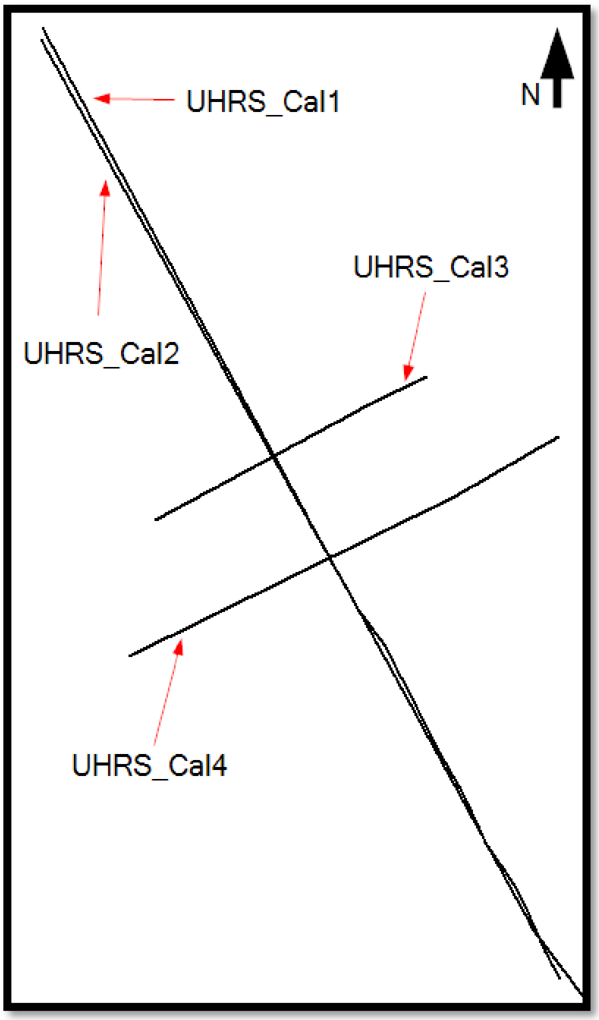


***Figure 21** – Lines acquired for the "box test".*

The test demonstrated that the requirements for data quality were met. No particular noise or artefact were identified on these lines. The penetration and resolution met the requirements, and all the produce files (LOGs, Raw, Deliverables) were correct and populated. No misties were observed between the crossing lines.

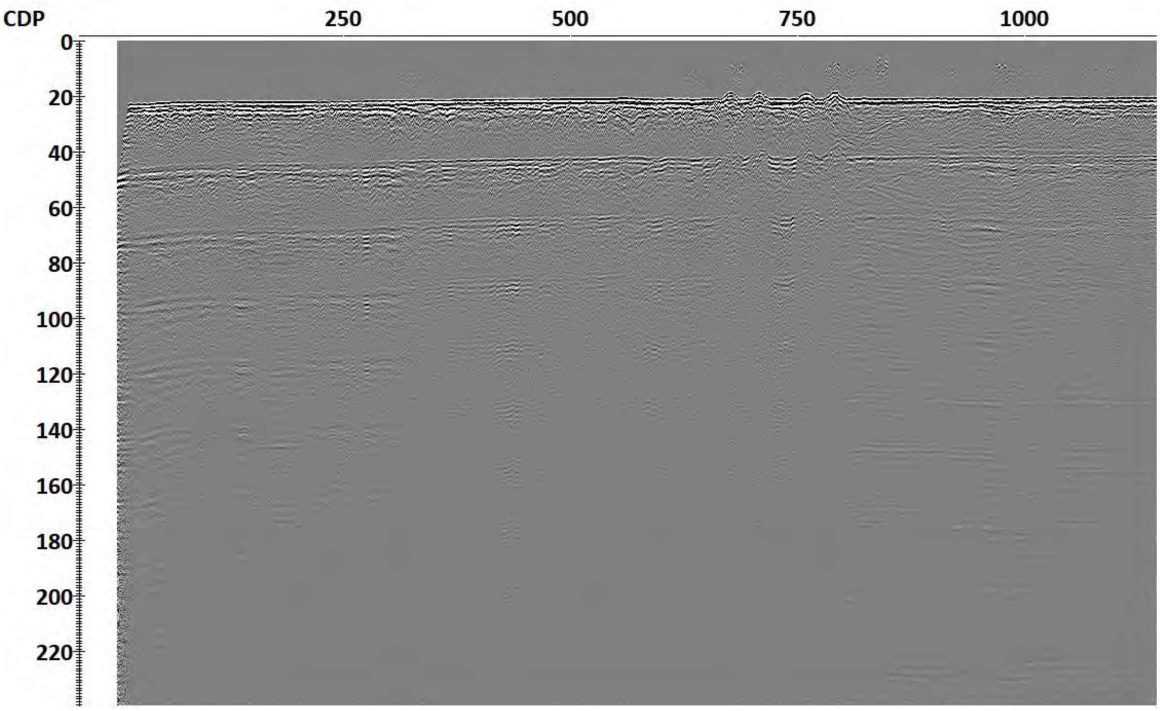


***Figure 22** – Brutestack result for one of the box lines. (Vertical scale in TWT (ms).*

21 September, 2022
On behalf of GeoSurveys and Geomarine Survey Systems,
Gil Moreira and Robert-Jan Joosten
(UHRS QC Processor) & (UHRS Operator)

Appendix G

GAMBAS Equipment Certifications

FLUTE FUGRO 24 HYDROPHONES NH95	**EMCI : 14-04135-1** FUGRO : 45111-003

CARACTERISTIQUES TECHNIQUES :

1) Caractéristiques de la flûtes :

24 Hydrophones 2 x NHD95 avec préamplificateur (Long. câble hydro = 35 cm)

Espacement variable : 1 à 8 = 0,5m - 8 à 12 = 1m - 12 à 20 = 2m - 20 à 24 = 4m - 5 m en tête

Longueur flûte : 39,5 + 5 = 44,5m - Surmoulage à froid pour hydro + préampli et 2 drisses

Frettage avant les hydrophones 1, 13 et 18

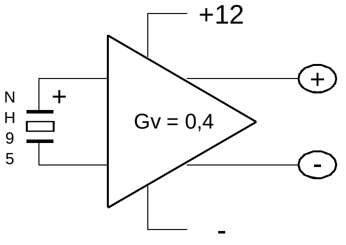
2) Caractéristiques des préamplificateurs :

Sorties différentielles.

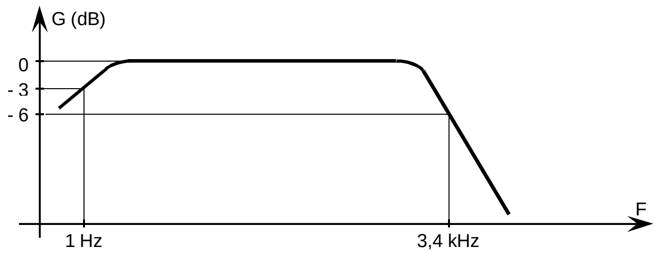
Alimentation : +15 V -15 V / Consommation < 200 mA

Remarques : Repère rouge sur câble avec fiches résinées avec bouchon, arrière EMCI et collier à oreilles

SYNOPTIQUE, COURBE DE REPONSE, PLAN DE CABLAGE :



PREAMPLIFICATEUR



COURBE DE REPONSE

PLAN DE CABLAGE : (Les couleurs sont données à titre indicatif) Flûte et ombilic

1) DONNÉES : (nouveau câblage flûte pour l'alimentation)

22.55S	26P Fils	Hydro.		Sens.
A	jaune	+	1	3,8
B	violet	-		V/bar
C	marron	+	2	5,5
D	vert	-		V/bar
E	bleu	+	3	5,1
F	violet	-		V/bar
G	bleu	+	4	5,8
H	vert	-		V/bar
J	bleu	+	5	6,6
K	marron	-		V/bar
L	bleu	+	6	5,4
M	jaune	-		V/bar
N	rouge	+	7	6,1
P	noir	-		V/bar
R	bleu	+	8	6,4
S	noir	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
T	jaune	+	9	6,6
U	noir	-		V/bar
V	marron	+	10	6,1
W	noir	-		V/bar
X	noir	+	11	5,9
Y	violet	-		V/bar
Z	vert	+	12	5,1
a	noir	-		V/bar
b	bleu	+	13	5,6
c	rouge	-		V/bar
d	violet	+	14	6,2
e	rouge	-		V/bar
f	vert	+	15	5,6
g	rouge	-		V/bar
h	blanc	+	16	6,2
i	rouge	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
j	blanc	+	17	5,5
k	bleu	-		V/bar
m	blanc	+	18	5,6
n	noir	-		V/bar
p	blanc	+	19	6,1
q	violet	-		V/bar
r	marron	+	20	5,5
s	rouge	-		V/bar
t	jaune	+	21	6,1
u	rouge	-		V/bar
v	marron	+	22	5,5
w	blanc	-		5,8
x	jaune	+	23	6,2
y	blanc	-		V/bar
z	vert	+	24	5,5
AA	blanc	-		V/bar
BB	jaune	0V		
	vert	tresse		
CC	jaune	jaune V+		
DD	marron	bleu V-		
22.55S	**26P Fils**	**Alim.**		

2) ALIMENTATIONS :

Fiche 12.3S sur boîtier alimentation

Embase 12.3P sur boîtier adaptateur

Fiche 22.55S	Câble 26P Fils	Alim.	Câble 2P Fils	Fiche 12.3	Câble 3 x 0,75
BB	jaune	0V	tresse (noir)	C	V/ J
	vert				
CC	jaune	V+	jaune	A	marron
DD	marron	V-	bleu	B	bleu

3) Câblage des Hydro EMCI :

Paire rouge (+) / blanc (-) : sortie préampli

Paire jaune (+) / bleu (-) tresse (0V) : alimentation

Test de la flûte le 15/08/22 (SM et DT) : test ok, RAS

Relevé de la sensibilité avec Sharp Hydrophone Checker.

Contrôle de la polarité des hydrophones : oscilloscope et Sharp Hydrophone Checker

Flûte MASW traces 1 à 24 avec flûte réfraction EMCI 09-05058 - Fugro 45040-003, traces 25 à 48

Trace 1 (25) de la flûte réfraction entre traces 23 et 24 de la flûte MASW

FLUTE FUGRO 24 HYDROPHONES NH95	EMCI : 14-09058 FUGRO : 45111-004

CARACTERISTIQUES TECHNIQUES : (Ex 14-06120-1)

1) Caractéristiques de la flûtes :

24 Hydrophones 2 x NHD95 avec préamplificateur (Long. câble hydro = 35 cm)

Espacement variable : 1 à 4 = 0,5m - 4 à 10 = 1m - 10 à 17 = 2m - 17 à 24 = 4m - 55 m en tête

Longueur flûte : 49,5 + 55 = 104,5m - Surmoulage à froid pour hydro + préampli et 2 drisses

Frettage avant les hydrophones 1, 11 et 16

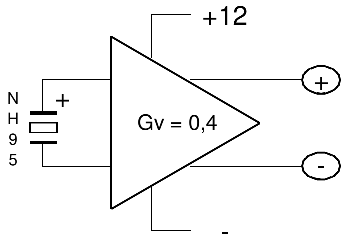
2) Caractéristiques des préamplificateurs :

Sorties différentielles.

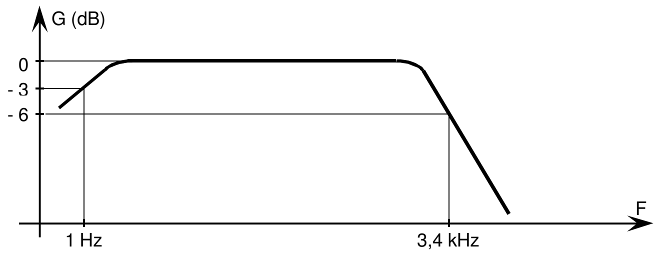
Alimentation : +15 V -15 V / Consommation < 200 mA

Remarques : Repère rouge sur câble avec fiches résinées avec bouchon, arrière EMCI et collier à oreilles

SYNOPTIQUE, COURBE DE REPONSE, PLAN DE CABLAGE :



PREAMPLIFICATEUR



COURBE DE REPONSE

PLAN DE CABLAGE : (Les couleurs sont données à titre indicatif) Flûte et ombilic

1) DONNÉES : (nouveau câblage flûte pour l'alimentation)

22.55S	26P Fils	Hydro.		Sens.
A	jaune	+	1	5
B	violet	-		V/bar
C	marron	+	2	5,6
D	vert	-		V/bar
E	bleu	+	3	5
F	violet	-		V/bar
G	bleu	+	4	5,5
H	vert	-		V/bar
J	bleu	+	5	5,5
K	marron	-		V/bar
L	bleu	+	6	4,6
M	jaune	-		V/bar
N	rouge	+	7	5,4
P	noir	-		V/bar
R	bleu	+	8	7,4
S	noir	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
T	jaune	+	9	6,2
U	noir	-		V/bar
V	marron	+	10	6,2
W	noir	-		V/bar
X	noir	+	11	5,3
Y	violet	-		V/bar
Z	vert	+	12	4,2
a	noir	-		V/bar
b	bleu	+	13	5,9
c	rouge	-		V/bar
d	violet	+	14	5,5
e	rouge	-		V/bar
f	vert	+	15	6,6
g	rouge	-		V/bar
h	blanc	+	16	6,7
i	rouge	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
j	blanc	+	17	5,4
k	bleu	-		V/bar
m	blanc	+	18	5,7
n	noir	-		V/bar
p	blanc	+	19	5,8
q	violet	-		V/bar
r	marron	+	20	6,1
s	rouge	-		V/bar
t	jaune	+	21	7,1
u	rouge	-		V/bar
v	marron	+	22	6
w	blanc	-		V/bar
x	jaune	+	23	6,2
y	blanc	-		V/bar
z	vert	+	24	6,1
AA	blanc	-		V/bar
BB	jaune	0V		
	vert	tresse		
CC	jaune	jaune V+		
DD	marron	bleu V-		
22.55S	**26P Fils**	**Alim.**		

2) ALIMENTATIONS :
Fiche 12.3S sur boîtier alimentation
Embase 12.3P sur boîtier adaptateur

Fiche 22.55S	Câble 26P Fils	Alim.	Câble 2P Fils	Fiche 12.3	Câble 3 x 0,75
BB	jaune vert	0V	tresse (noir)	C	V/ J
CC	jaune	V+	jaune	A	marron
DD	marron	V-	bleu	B	bleu

3) Câblage des Hydro EMCI :
Paire rouge (+) / blanc (-) : sortie préampli
Paire jaune (+) / bleu (-) tresse (0V) : alimentation

Test de la flûte le 09/08/22 (SM et DT) : test ok, RAS
Relevé de la sensibilité avec Sharp Hydrophone Checker.
Contrôle de la polarité des hydrophones : oscilloscope et Sharp Hydrophone Checker

Flûte traces 1 à 24 traces (flûte EMCI 14-09059 - Fugro 45116-004 = traces 25 à 48)

FLUTE FUGRO 24 HYDROPHONES NH95	EMCI : 14-09059 FUGRO : 45116-004

CARACTERISTIQUES TECHNIQUES :

1) Caractéristiques de la flûtes :

24 Hydrophones 2 x NHD95 avec préamplificateur (Long. câble hydro = 35 cm)

Espacement variable : 1 à 4 = 0,5m - 4 à 10 = 1m - 10 à 17 = 2m - 17 à 24 = 4m - 55 m en tête

Longueur flûte : 49,5 + 55 = 104,5m - Surmoulage à froid pour hydro + préampli et 2 drisses

Frettage avant les hydrophones 1, 11 et 16

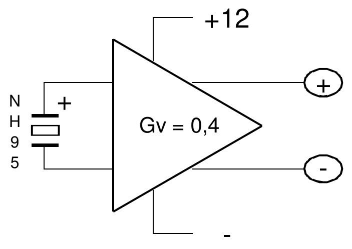
2) Caractéristiques des préamplificateurs :

Sorties différentielles.

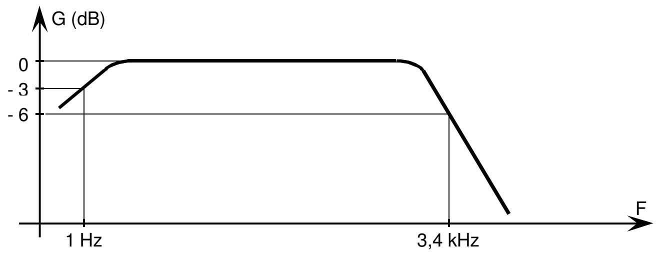
Alimentation : +15 V -15 V / Consommation < 200 mA

Remarques : Repère rouge sur câble avec fiches résinées avec bouchon, arrière EMCI et collier à oreilles

SYNOPTIQUE, COURBE DE REPONSE, PLAN DE CABLAGE :



PREAMPLIFICATEUR



COURBE DE REPONSE

PLAN DE CABLAGE : (Les couleurs sont données à titre indicatif) Flûte et ombilic

1) DONNÉES : (nouveau câblage flûte pour l'alimentation)

22.55S	26P Fils	Hydro.		Sens.
A	jaune	+	1	5
B	violet	-		V/bar
C	marron	+	2	5,6
D	vert	-		V/bar
E	bleu	+	3	5
F	violet	-		V/bar
G	bleu	+	4	5,5
H	vert	-		V/bar
J	bleu	+	5	5,5
K	marron	-		V/bar
L	bleu	+	6	4,6
M	jaune	-		V/bar
N	rouge	+	7	5,4
P	noir	-		V/bar
R	bleu	+	8	7,4
S	noir	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
T	jaune	+	9	6,2
U	noir	-		V/bar
V	marron	+	10	6,2
W	noir	-		V/bar
X	noir	+	11	5,3
Y	violet	-		V/bar
Z	vert	+	12	4,2
a	noir	-		V/bar
b	bleu	+	13	5,9
c	rouge	-		V/bar
d	violet	+	14	5,5
e	rouge	-		V/bar
f	vert	+	15	6,6
g	rouge	-		V/bar
h	blanc	+	16	6,7
i	rouge	-		V/bar

22.55S	26P Fils	Hydro.		Sens.
j	blanc	+	17	5,4
k	bleu	-		V/bar
m	blanc	+	18	5,7
n	noir	-		V/bar
p	blanc	+	19	5,8
q	violet	-		V/bar
r	marron	+	20	6,1
s	rouge	-		V/bar
t	jaune	+	21	7,1
u	rouge	-		V/bar
v	marron	+	22	6
w	blanc	-		V/bar
x	jaune	+	23	6,2
y	blanc	-		V/bar
z	vert	+	24	6,1
AA	blanc	-		V/bar

BB	jaune	0V
	vert	tresse
CC	jaune	jaune V+
DD	marron	bleu V-
22.55S	**26P Fils**	**Alim.**

2) ALIMENTATIONS :
Fiche 12.3S sur boîtier alimentation
Embase 12.3P sur boîtier adaptateur

Fiche 22.55S	Câble 26P Fils	Alim.	Câble 2P Fils	Fiche 12.3	Câble 3 x 0,75
BB	jaune vert	0V	tresse (noir)	C	V/ J
CC	jaune	V+	jaune	A	marron
DD	marron	V-	bleu	B	bleu

3) Câblage des Hydro EMCI :
Paire rouge (+) / blanc (-) : sortie préampli
Paire jaune (+) / bleu (-) tresse (0V) : alimentation

Test de la flûte le 09/08/22 (SM et DT) : test ok, RAS
Relevé de la sensibilité avec Sharp Hydrophone Checker.
Contrôle de la polarité des hydrophones : oscilloscope et Sharp Hydrophone Checker

Flûte traces 25 à 48 traces (flûte EMCI 14-09058 - Fugro 45111-004 = traces 1 à 24)

Flûte n° 09-05058 / 45040-003

Hydro MP24H1 (15V/bar - 12Hz - 76m - 160Ω)

Longueur en tête : 55 m, Espacement entre hydrophones : 5 m (LT = 170 m)

Fiche : 22.55S avec résine et bouchon métallique et repère gaine thermo. Rouge

T	F22 55S	Couleur des paires	Isol. MΩ	*Sens. V / bar*
1	A	jaune	200	*14,9*
	B	vert		
2	C	jaune	200	*13,5*
	D	marron		
3	E	jaune	200	*14,8*
	F	violet		
4	G	marron	200	*14,9*
	H	vert		
5	J	bleu	200	*15,5*
	K	violet		
6	L	bleu	200	*14,6*
	M	vert		
7	N	bleu	200	*14,4*
	P	marron		
8	R	bleu	200	*14,6*
	S	jaune		
9	T	rouge	100	*14,7*
	U	noir		
10	V	bleu	200	*13,9*
	W	noir		
11	X	jaune	200	*14,0*
	Y	noir		
12	Z	marron	200	*14,7*
	a	noir		

T	F22 55S	Couleur des paires	Isol. MΩ	*Sens. V / bar*
13	b	noir	200	*13,5*
	c	violet		
14	d	vert	200	*13,6*
	e	noir		
15	f	bleu	200	*13,7*
	g	rouge		
16	h	violet	200	*13,3*
	i	rouge		
17	j	vert	200	*13,5*
	k	rouge		
18	m	blanc	200	*15,0*
	n	rouge		
19	p	blanc	200	*13,0*
	q	bleu		
20	r	blanc	200	*13,7*
	s	noir		
21	t	blanc	200	*13,7*
	u	violet		
22	v	marron	200	*14,4*
	w	rouge		
23	x	jaune	200	*12,7*
	y	rouge		
24	z	marron	200	*13,3*
	AA	blanc		

Test de la flûte le 15/08/22 (SM et DT) : test ok, RAS

Relevé de la sensibilité avec Sharp Hydrophone Checker.

Contrôle de la polarité des hydrophones : oscilloscope et Sharp Hydrophone Checker

Mesure des tests en isolement : Mégohmmètre CA6513 (500V)

Flûte réfraction traces 25 à 48 avec flûte MASW EMCI 14-04135-1 - Fugro 45111-003, traces 1 à 24

Trace 1 (25) entre traces 23 et 24 de la flûte MASW

15/08/22

Appendix C

UHRS Field Report

Aramis - Geophysical Survey

2D UHRS Survey Field Report

Document No.: REP22342

11 October 2022

DOCUMENT CONTROL

Project Title:	Aramis - Geophysical Survey
Document Title:	Aramis Geophysical Survey – 2D UHRS Field Report
Document Type:	Field Report
Client Name:	TotalEnergies

Client Ref.:	22342
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Document Nº:	v01
Date:	11 October 2022
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Revision History		Date	Author	Reviewed	Approved
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Project team		
Abv.	Author	Position
HD	H. Duarte	R&D Manager
DG	M. Oliveira	Project Manager
OM	O. Monrigal	Operations Manager (GMSS)
MO	M. Oliveira	Offshore Manager (GS)
GM	G. Moreira	Offline QC Processor (GS)
RJ	Robert Joosten	Offshore Operator (GMSS)

SUMMARY

Fugro contracted Geosurveys and Geomarine Survey System to provide acquisition, offline QC and onshore processing of 2D UHR sparker multi-channel seismic data in the scope of the Aramis Offshore Wind Farm Geophysical Survey Project, carried out in the vicinity of Maasmond channel (North of Rotterdam), Netherlands. The survey was carried out on board of Survey Vessel Seeker from September 6th to September 24th.

This document reports the 2D-UHRS survey operations performed in the scope of this project, covering the equipment mobilization and acceptance tests, data acquisition, data quality control and assurance, and finally equipment demobilization.

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ABBREVIATIONS

CDP – Common Depth Point

DGPS – Differential Global Positioning System

GMSS – Geo Marine Survey Systems

GNSS - Global navigation satellite system

GS – GeoSurveys

HV – High Voltage

QA – Quality Analysis

QC – Quality Control

RMS –Root Mean Square

SEG-Y – convention from the society of exploration geophysicist (Seg) for pre-stack and post-stack seismic data

UHRS - Ultra High Resolution Seismic

1. INTRODUCTION

GeoSurveys (GS) and Geo Marine Survey Systems (GMSS) were contracted by Fugro to provide acquisition and offshore QC of multi-channel UHRS data for the Aramis project, carried out in the vicinity of Maasmond channel, Netherlands. Multi-channel acquisition was performed on board of Survey Vessel Fugro Seeker. The survey was performed from September 6th to September 24th.

The survey was intended to provide sufficient information to support studies and preparation for the construction of a pipe line for TotalEnergies. The main objective for M-UHRS was to record multi-channel seismic to a minimum depth of 15 m below the seafloor. The UHRS data was acquired by GMSS and quality-controlled by GS on board the survey vessel.

The Offline QC representatives onboard (Gil Moreira – 1st leg) was responsible for the evaluation of the UHRS data, offshore QA processes and signal troubleshooting. The Offline QC role was to ensure that UHRS data quality meets the contracted technical requirements.

1.1. SURVEY AREA LOCATION

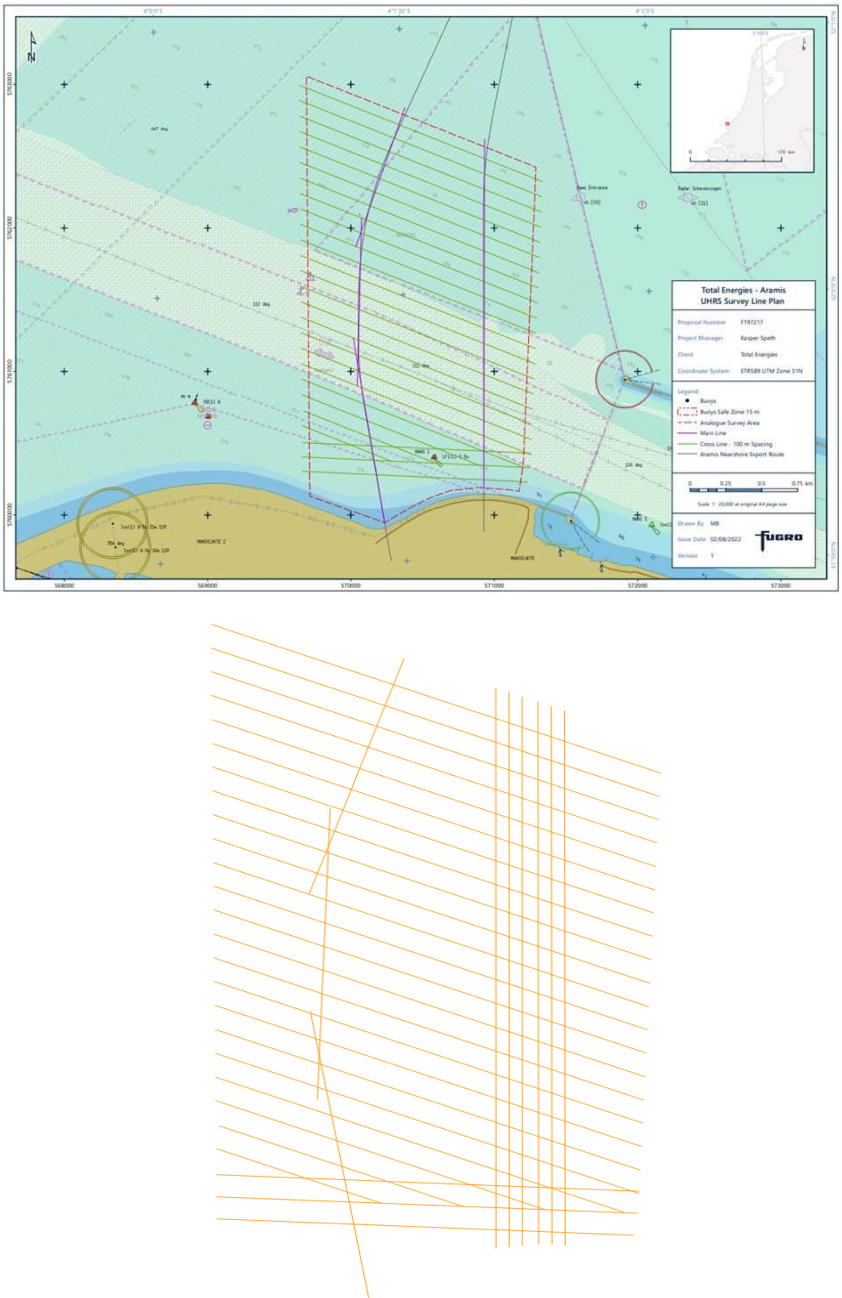
The survey area is located nearshore Maasmond channel which is the main access for the Rotterdam Europoort and industrial facilities, Netherlands (Figure 1). Water depths at site vary between 10 and 40 meters. Strong currents and extremely busy shipping conditions were a constant in the survey area.

The positioning and all acquired data are according to the projected coordinate system ETRS89 UTM 31N. All depths are relative to Mean Sea Level (MSL).

Figure 1 – *Aramis Project area location.*

1.2. LINE PLAN

Initially, a total of 30 lines were intended to be acquired at the Aramis Project site. The line plan was later updated and 35 lines were acquired with UHRS system (approximated 61 km total length), comprised of 26 lines with WNW-ESE orientation and 9 lines with N-S orientation. Figure 2 depicts the line plan for the multi-channel system.



(a)

(b)

Figure 2 – *Initial survey line plan for Aramis project (a), final line plan for Aramis project (b).*

2. 2D ULTRA HIGH-RESOLUTION SEISMIC SYSTEM

The seismic data acquisition was performed using an ultra-high-resolution seismic system including a single Geo-Source 400 tips LW sparker, two 2000XFO HV Geo-Spark power supplies, 24- channel streamer with a 1+2 m group interval, a 24-channel recording system, a single element reference hydrophone and GNSS positioning systems for the streamer's front buoy and tail buoy and source.

Table 1 describes the UHRS equipment and the general acquisition parameters used in this project.

Table 1 - UHRS system and parameters.

Sources	1x Geo-Source 400 tips LW
Source Towing Depth	0.3 m
SP Interval	1 m
Operating Power	Source @ 400J
Tuned delay	-
Power Supply	2 X Geo-Spark 2000XFO
CDP Bin Coverage	≈24 fold for 1 m CDP bin
Recorder	4x Multitrace24 – Geomarine Survey systems
Sample Rate	0.1 msec
Record Length	200 ms
Format	SEG-Y
Multichannel Streamer	Geo-Sense LW 24 channels
Streamer Depth	≈ 0.4 – 1.3 m
Group Interval	1+2m
Group Active Length	35 m
Reference hydrophone	Geo-Sense reference hydrophone – single element
Hydrophone Depth	5 m from the source
Group Interval	Single element
Group Active Length	Point receiver

The seismic spread geometry used during the survey is presented in the Figure 3 with the respective measurements - offsets.

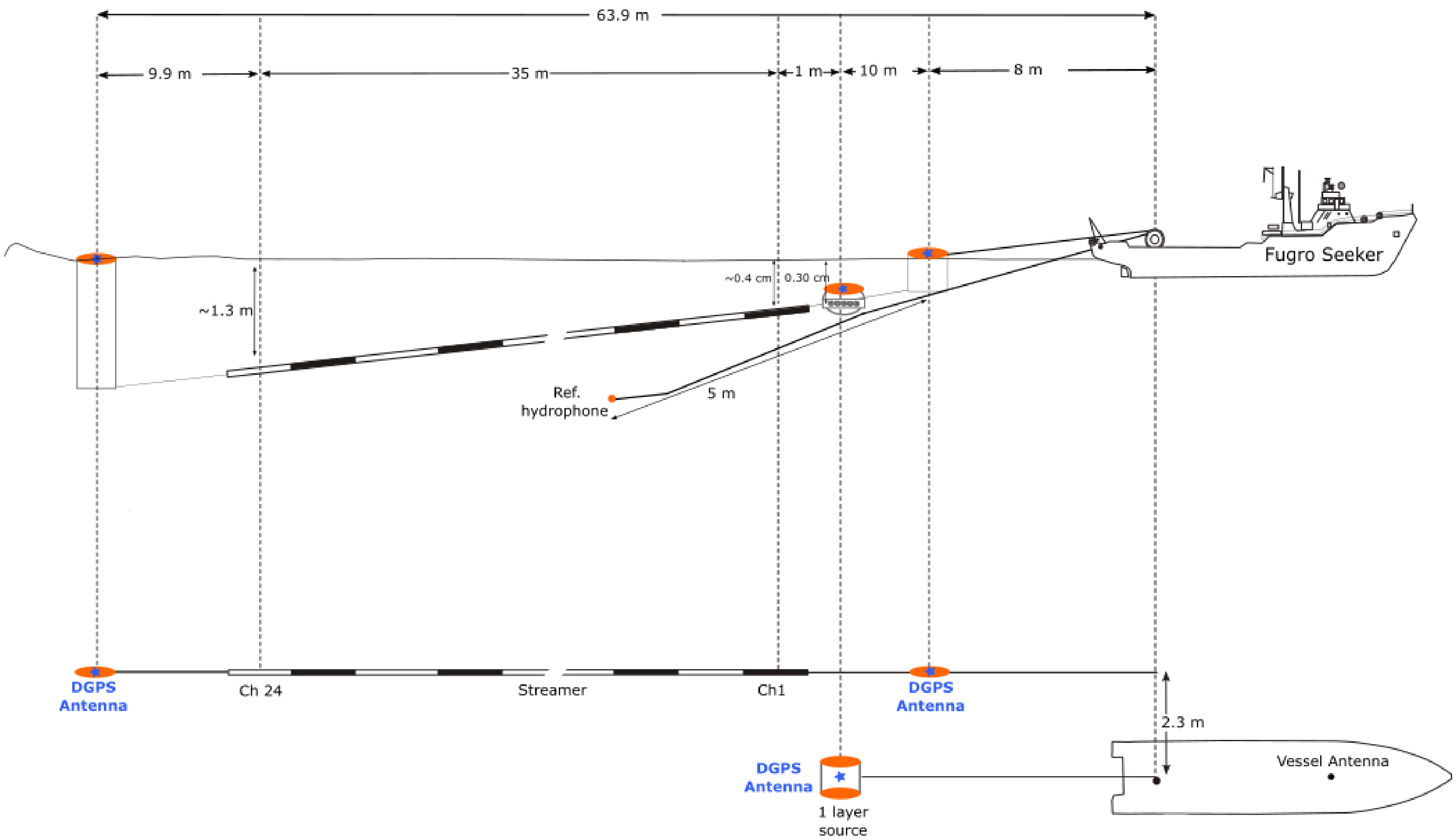


***Figure 3 -** Vessel Layout and offset diagram to the seismic spread in cross section and in plant view (not to scale).*

3. SURVEY PERFORMANCE AND OPERATIONS

3.1. SURVEYS TASKS

The main survey tasks are presented in Table 2 and described in the following sections.

Table 2 *- Description of the main survey tasks.*

TASK	*DATE*	*DESCRIPTION*
2D UHRS Mobilization	6th September – 11th September	Equipment mobilization. Calibration and Verification Tests. Integrated system validation.
2D UHRS survey	11th September - 24th September	Data acquisition. Offline QC.
2D UHRS Demobilization	24th September	Equipment demobilization.

3.1.1. UHRS Mobilization and Acceptance Tests

From September 6th to September 11th, 2022, several quaysides and at sea tests were performed in order to assess if the UHRS equipment and the setup were fit for purpose within the scope of the Aramis Offshore project, on board of R/V Fugro Seeker. Some of the alongside tests were conducted at Port of Scheveningen, Roterdam, Netherands, whilst the offshore acceptance tests were performed on the Aramis survey area.

The tests were performed by GMSS and GS using the equipment mentioned in chapter 2 and some spares equipment (for a more detailed explanation on the mobilization and acceptance tests please refer to UHRS MOB Report).

3.1.2. UHRS Data Acquisition and Quality Control

The data acquisition started on 11th of September and finished on 24th of September. Acquisition was carried out by GMSS and quality controlled by GS. The software used for data acquisition was the Georecorder from Geo Marine Survey Systems and the offline QC was performed using RadEx Pro (from Deco Geophysical).

Offline QC was performed by using in-house developed workflow that aimed to assess, but not limited to, the S/N ratio, resolution and signal penetration. The QC for each line is completed by exporting a set of deliverables, that are sent to the client for their assessment and respective acceptance. In order to share information between survey vessel and UHRS QC, the acquired data was sent line by line via "WeTransfer" to be QC'ed as fast as possible. More details on the quality control procedures can be found in chapter 4.

3.1.3. UHRS Demobilization

The demobilization was performed in the Port of Scheveningen on September 24th, 2022. After completion and acceptance of all 2D UHRS data, the full UHRS spread was recovered and secured. All equipment in the back deck and laboratory were removed and stored in their proper containers and pallets. At the end, all UHRS equipment was transported back to GMSS installations.

A copy of the UHRS data drop was hand carried by GeoSurveys personnel to the GeoSurveys office for final processing, and another copy was sent to the office by a courier company. Raw data backup will be kept in the systems servers to ensure redundancy.

3.2. TECHNICAL TEAM

The 2D-UHRS operations, data acquisition, online seismic observation and offline data quality control were performed by qualified GMSS and GS personnel, using workstations with all the necessary software. Surveyor tasks were carried out by Fugro personnel always in touch with the GMSS operators responsible for the acquisition. Table 3 shows the technical team involved in the UHRS operations.

***Table 3** - Technical team onboard Fugro Seeker during the survey.*

Role	Name	Leg	Description
Client Rep	Lindsay Millington	1st 2nd	Client representative onboard and overall data acceptance.
Party Chief	Reuben Mace	1st	Conduct of survey; Direct contact with the client rep; Data acceptance; Daily contact with all freelancers; Operation Manager and others.
	Peter Horobin	2nd	
UHRS Operator	Robert Joosten	1st 2nd	UHRS mobilization and demobilization; Calibration and acceptance tests; UHRS operation; Data acquisition.
UHRS Data Processor – Offline QC	Gil Moreira	1st 2nd	Offline quality control of 2D Multi-Channel UHRS data.

4. DATA ACQUISITION, DATA QUALITY ANALYSIS AND QUALITY CONTROL

4.1. ACQUISITION PARAMETERS

After all the mobilization tests, the acquisition parameters that best fit the objectives of the survey were defined and applied during the entire survey. Table 4 summarizes the acquisition parameters.

Table 4 *- Acquisition parameters.*

Energy Output	400J
Shooting Interval	1 m
Acquisition Speed	~3.5kts
Record Length	200 ms
Sampling Frequency	0.1 ms (10 KHz)
File Format	SEG-Y

4.2. LINE IDENTIFICATION

The line identification for the Aramis site is in accordance with the following:

- Prefix "TA2A9", followed by a unique 2-digit sequential number starting on "01" and tailed by a "P1" suffix for all virgin lines, where the last digit is sequential and starts at "1". See examples below:
  - TA2A905P1 (prime line);
  - TA2A931P2 (prime line).
- For the infills, the suffix was changed to "I1". See examples below:
  - TA2A931I1 (infill line for prime line TA2A931P1);
  - TA2A929I1 (infill line for prime line TA2A929P1).
- For the reruns, the suffix was changed to "R1". See examples below:
  - TA2A906R1 (rerun line of prime line TA2A906P1).

4.3. DATA QUALITY ANALYSIS

The offline UHRS QC is a processing service that ensures that the acquired UHRS data meets the contractual technical requirements.

Throughout the survey the data was QC'ed in terms of data resolution, signal penetration, data quality, streamer feathering and data CDP fold and made available for revision within 24 hours after acquisition. In this section is presented the QC and QA procedures applied to each line acquired during the survey.

4.3.1. Feathering and Triggering

The feathering (Figure 4) and trigger (Figure 5) plots were calculated using the "P1/90" log files and "Input00" files, respectively. Those files were generated during the acquisition of each line. A maximum feathering angle of 8º was initially established for steering and a maximum feathering angle of 13º for strong water currents. When the value was slightly surpassed, if the data quality was not affected and there were no significant dips in geology (since the channels or dipping events are more affected by feathering) the data was accepted. The lines significantly affected by feathering were flagged for infill/rerun.

For each acquired line a trigger plot was generated and analyzed in order to check for drops, gaps and irregular shooting rate (Figure 5).

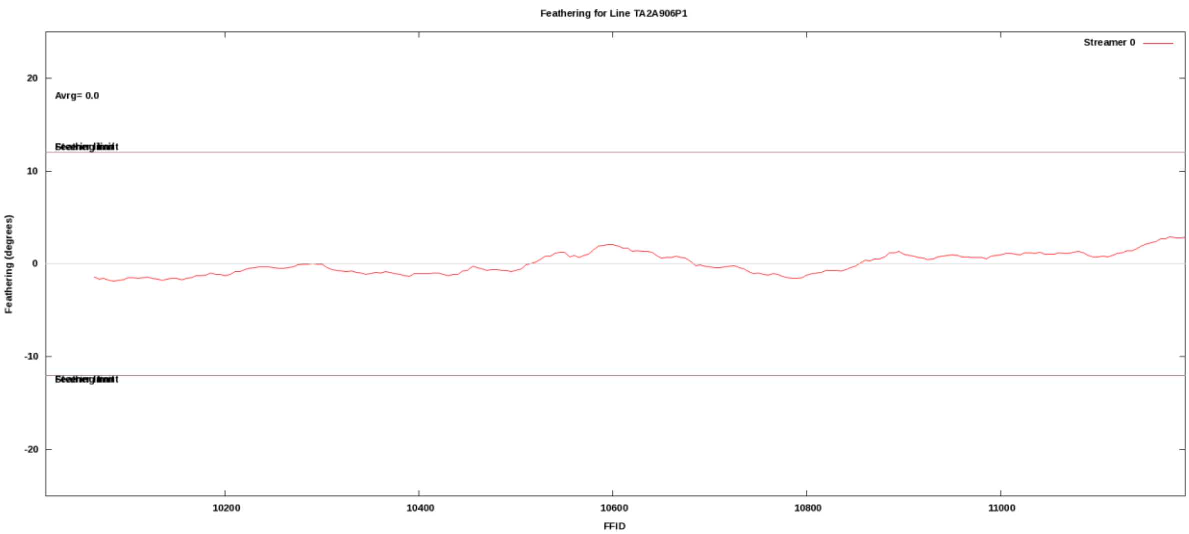


***Figure 4 -** Feathering plot – TA2A906P1. X - FFIDs, Y - Feathering angle.*

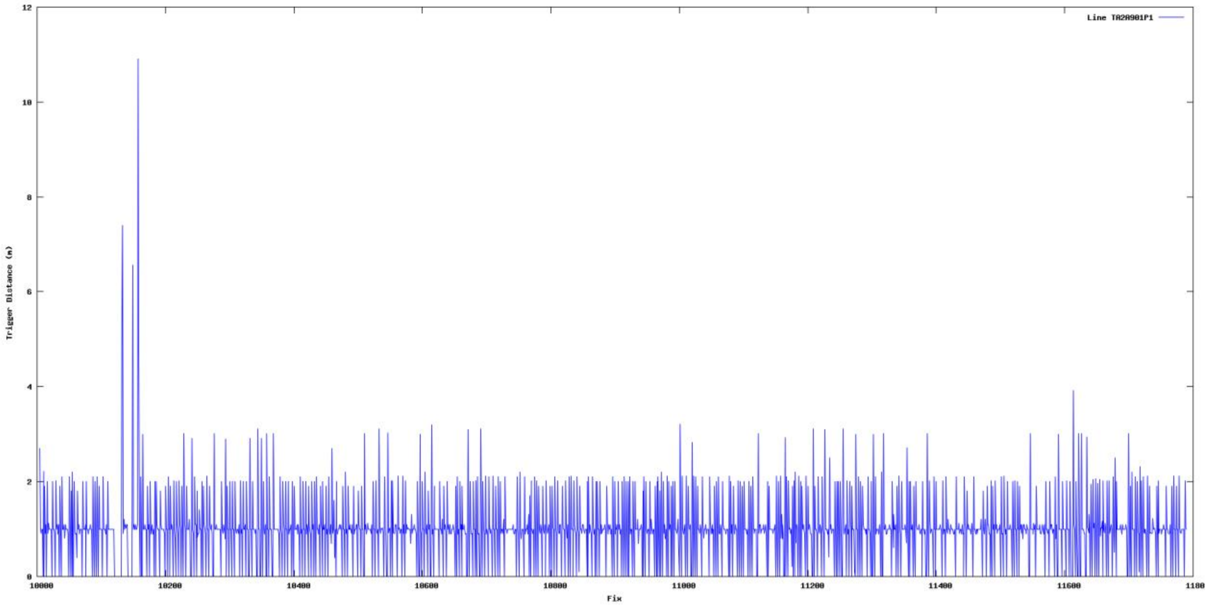


Figure 5 *- Trigger distance plot. X - Fix number, Y - Trigger Distance in meter. TA2A901P1.*

4.3.1. Noise Analysis

A noise file was recorded at the beginning and end of every seismic line (Figure 6 and Figure 7). The goal was to adequately identify excessive noise, and to troubleshoot the source of the noise (e.g. weather, vessel, electrical). The noise levels were constant and in-line with the results achieved in the noise tests done in the beginning of the project, the most common noise sources are described in the next section.

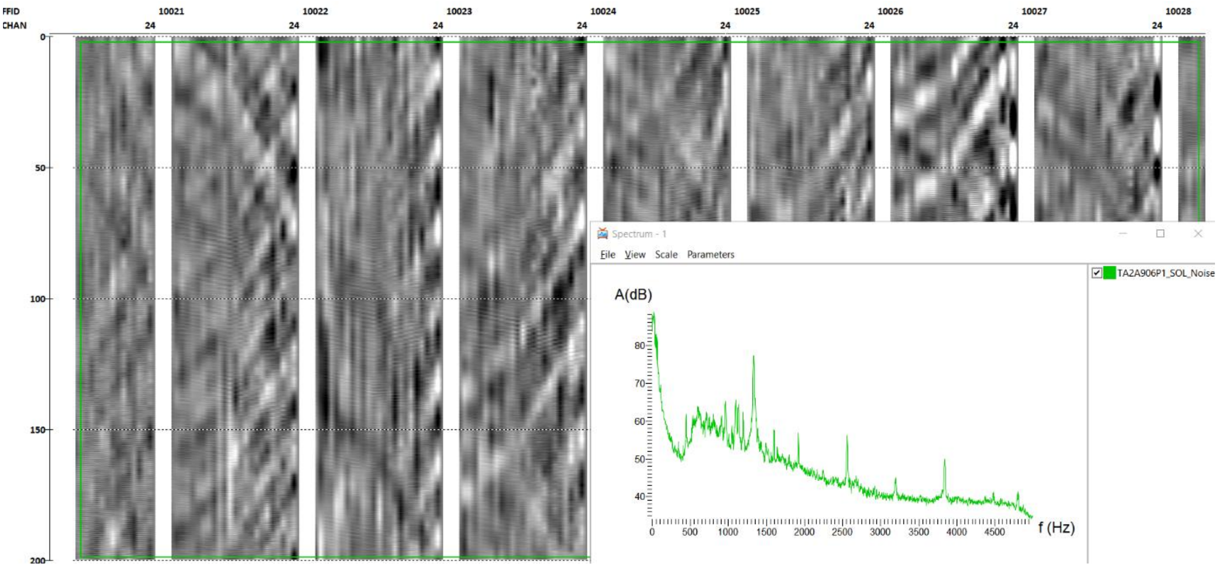


Figure 6 *- Start of line noise level for Line TA2A906P1. Vertical scale in milliseconds.*

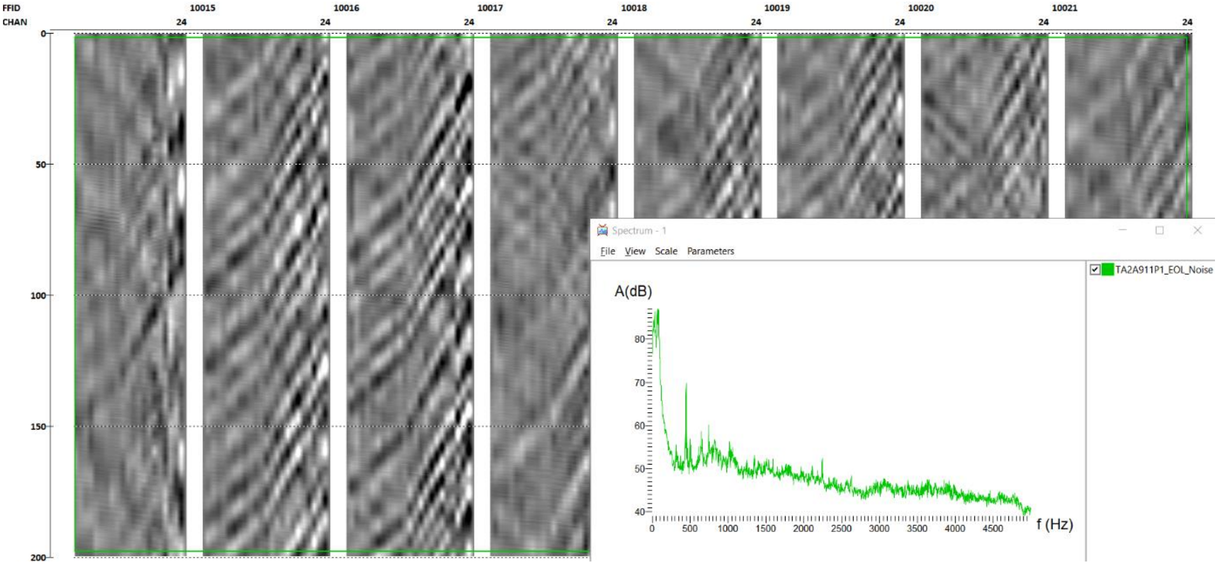


***Figure 7 -** End of line noise level for Line TA2A911P1. Vertical scale in milliseconds.*

The seismic data was inspected in shot and channel domain to assess noise types. The most significant types of noise recognized on the data were the following:

<u>Vessel operational noise</u>

This is a directional noise that can be removed/attenuated using processing techniques without negative impact on the primary seismic signal (Figure 8).

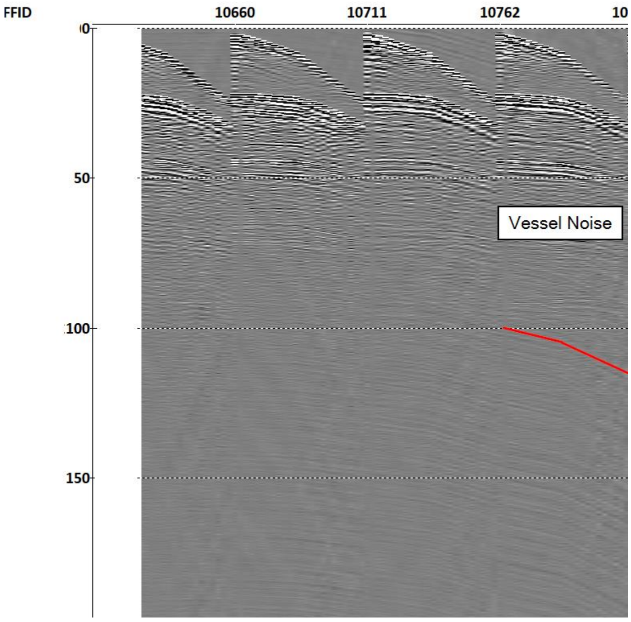


***Figure 8** - Directional noise from vessel operation in red lines. Line TA2A923P1. Vertical scale in milliseconds.*

Front and tail cable tugging noise

This type of noise is caused by the stress in the lead and tail buoys of the streamer. This is a low frequency, directional noise that can be removed/attenuated using processing techniques without negative impact on the primary seismic signal (Figure 9).

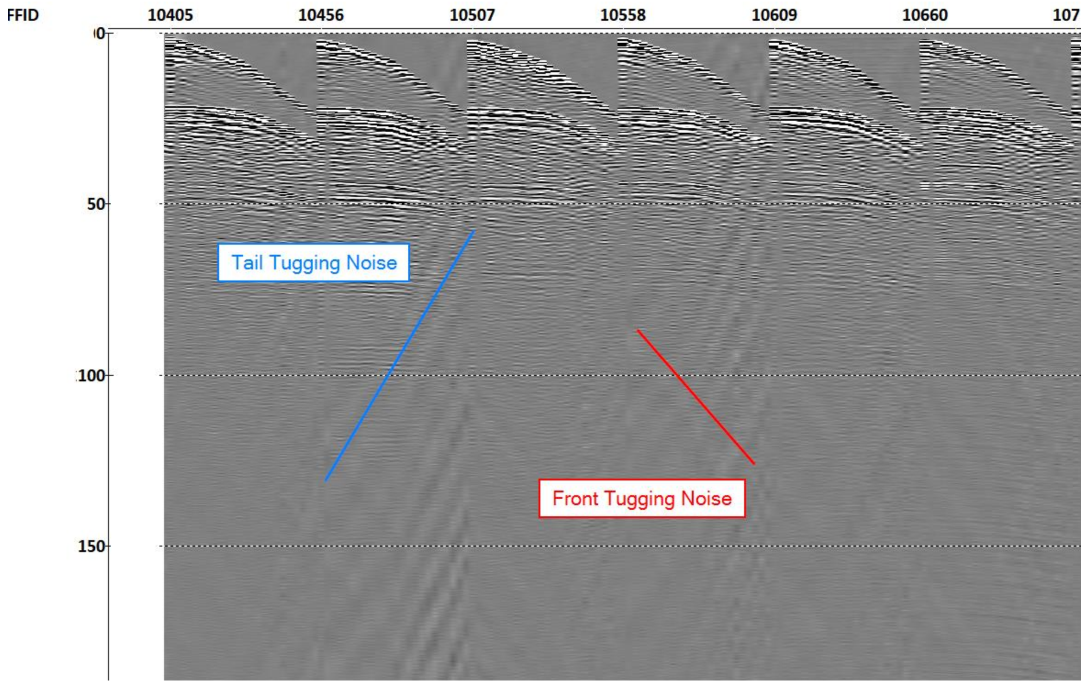


Figure 9 *- Front (red line) and Tail (blue line) cable tugging noise. Line TA2A932P1. Vertical scale in milliseconds.*

Burst noise

Burst noise was also identified on the data. This noise was generated due to streamer surfacing, mainly for lines acquired in choppier sea but also due to wash of vessels passing nearby (Figure 10). To attenuate this type of noise, tailored processing filters are required.

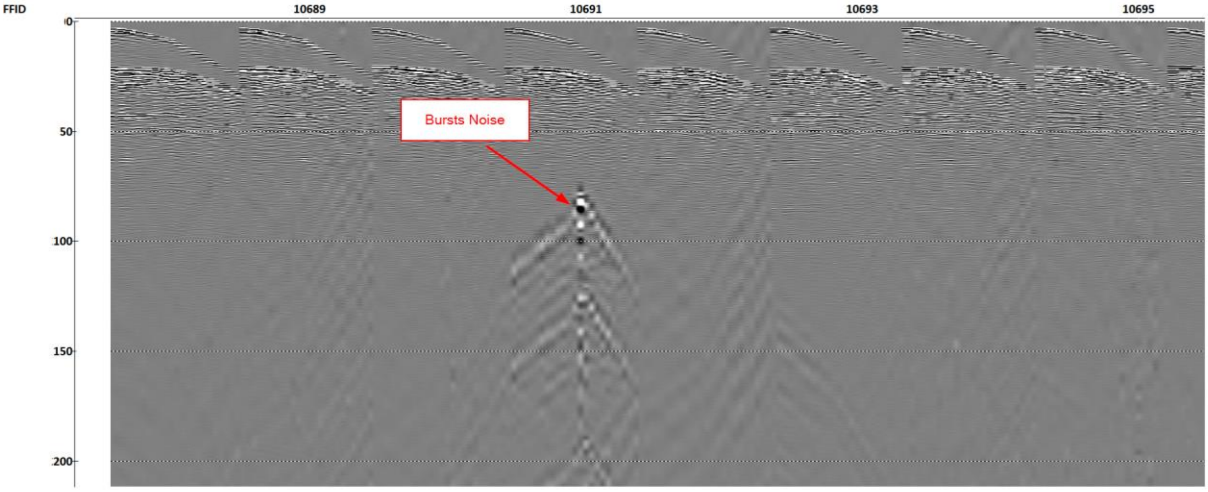


Figure 10 - *Burst noise due to streamer surface - red arrows. TA2A909P1. Vertical scale in milliseconds.*

EXTERNEL NOISE FROM OTHER VESSELS

Noise from passing vessels nearby was also detected and analyzed on some seismic data. Explained in more detail in chapter 5.2.

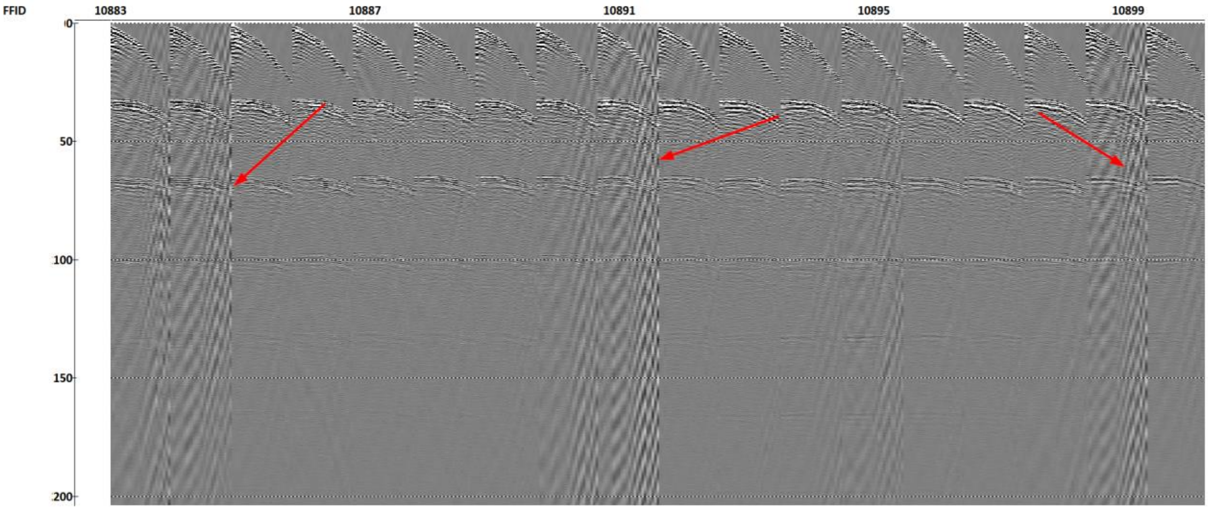


Figure 11 *- Noise from large vessels passing by. Line TA2A913P1. Vertical scale in milliseconds.*

All the above-mentioned types of noise were thoroughly analyzed. On a line-by-line basis, a noise check was performed before and after line acquisition, in order to assessment the noise level variations. Generally, a difference of +/- 20 dBs between sparker and noise was achieved (Figure 12). The noise levels did not represent a major risk for the 2D UHRS survey.

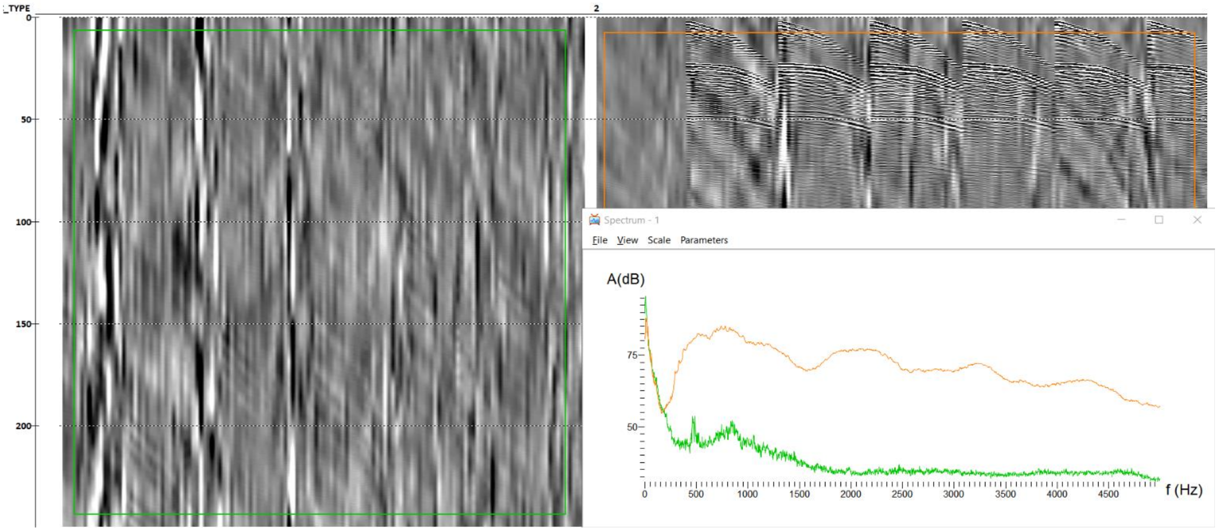


Figure 12 *- Frequency spectrum comparison between background noise (green) and sparker signal (orange).*

4.3.2. Source Spectra

Source spectrum was verified for each line in order to check if the sources were working without any malfunction (Figure 13). The sources proved to be resilient and worked as the specifications from the beginning until the end of project, no malfunction was detected.

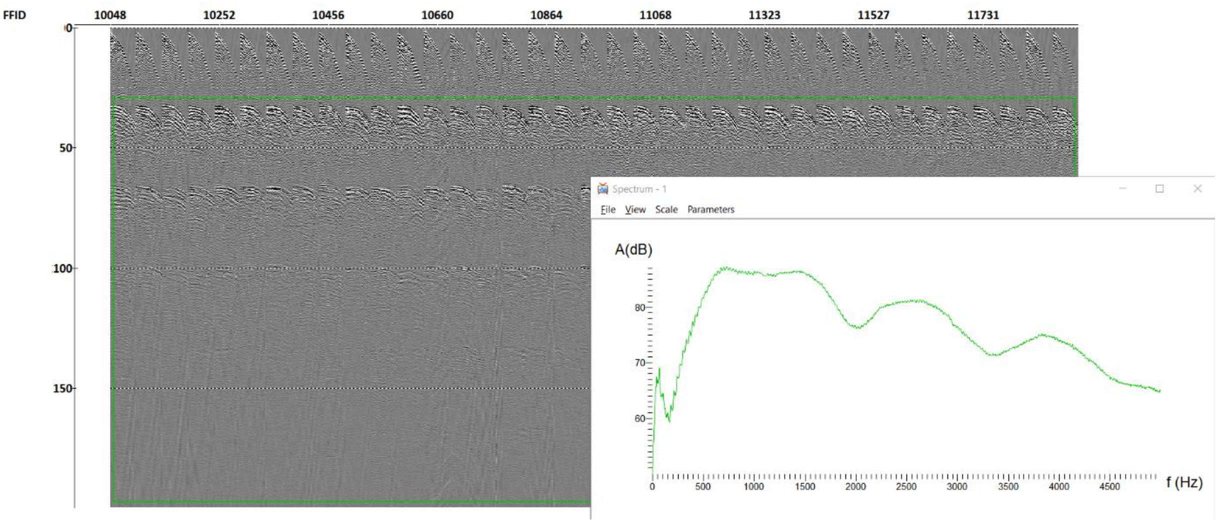


Figure 13 - *Source spectrum for Line TA2A908P1. Vertical scale in milliseconds.*

4.3.3. Source Receiver Offsets

Source and receiver positions and the relative offsets were calculated using the DGPS antennas located on top of the source and on the streamer front and tail buoys. Positioning was checked by comparing the offsets calculated from the source and receiver positions with direct arrival times (Figure 14 and Figure 15).

The majority of the lines showed an acceptable difference between offsets and direct arrivals, except when some DGPS antenna drop out occurred. Such occurrences were addressed by correcting the positioning using the navigation processing software “Geosuite NaviWorks” from GMSS. The drop out section was flagged for infill if the positioning was not successfully corrected using NaviWorks.

The figures below show the comparison between the offsets calculated with the positioning data provided by the DGPS antenna and the direct arrivals times. Figure 14 presents few FFIDs for all channels, whereas Figure 15 presents all FFIDs for the mid channel.

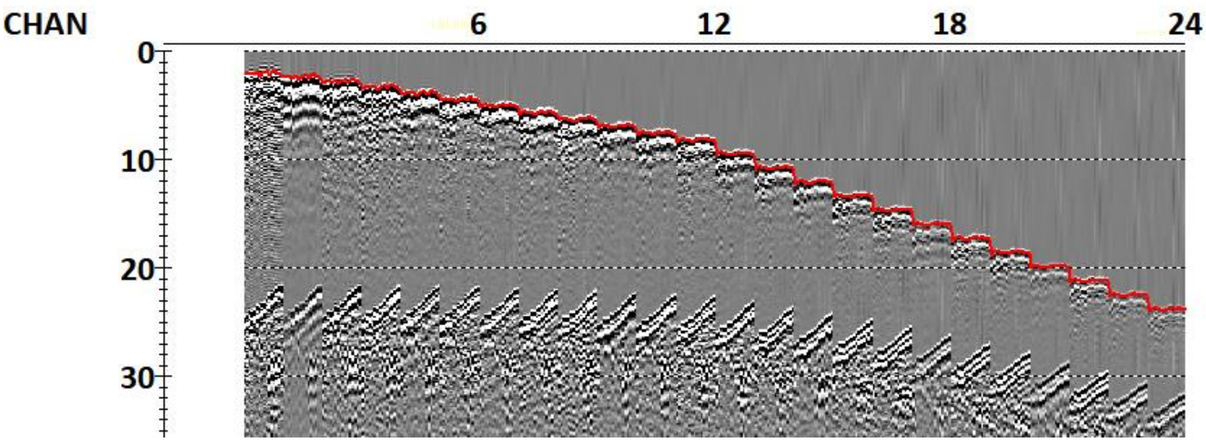


Figure 14 - *Offset QC for all the channels on a 100 FFIDs section for TA2A931P2. Vertical scale in milliseconds.*

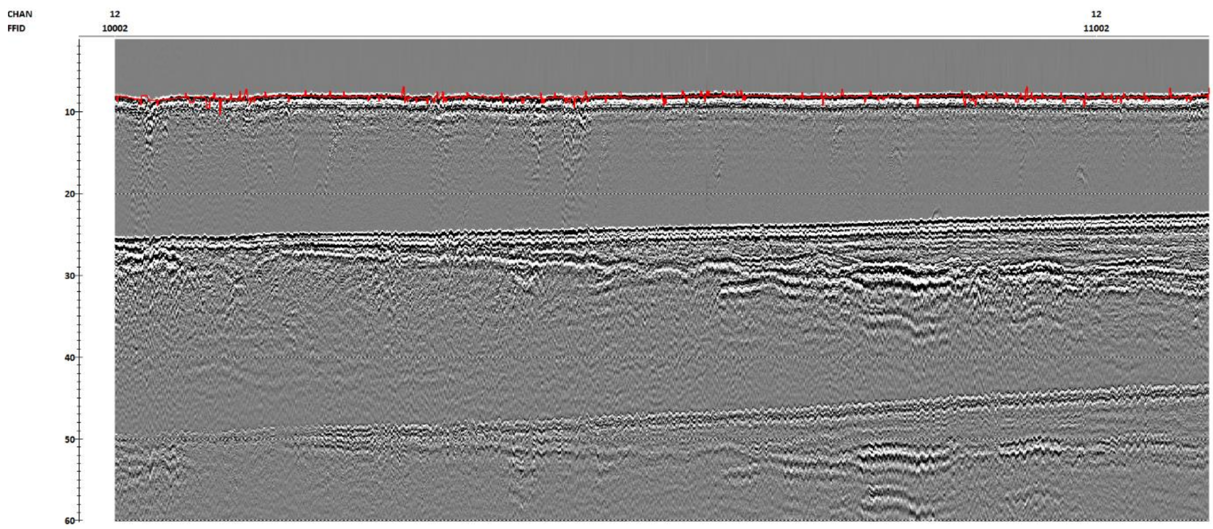


Figure 15 - *Mid channel offset QC for entire line TA2A931P2. Vertical scale in milliseconds.*

4.3.4. Streamer Balancing

Streamer balancing can vary depending on sea conditions, wave motion, vessel steering, surface currents, acquisition velocity, and minor modifications of the system geometry during equipment recovery and deployment operations. All these factors may have negative impact on the final UHRS data. Data processing procedures are particularly sensitive to improper streamer balancing.

By analyzing the receiver ghost, it was possible to evaluate if the streamer had the proper slanted configuration and desired depth along the line. Figure 16 shows that the depth of the channels is gradually increasing. However, due to strong currents in the survey area, it was very common to have the streamer very shallow in one of the directions (against the current) and deeper in the other - please refer to chapter **Error! Reference source not found.**, for more details. A very cautious assessment to t he streamer balancing was done on a line-by-line basis to make sure that this not have negative impact on the data, all the seismic profiles underwent QC/QA in order to assess the streamer balancing and to ensure that the data could be successfully processed.

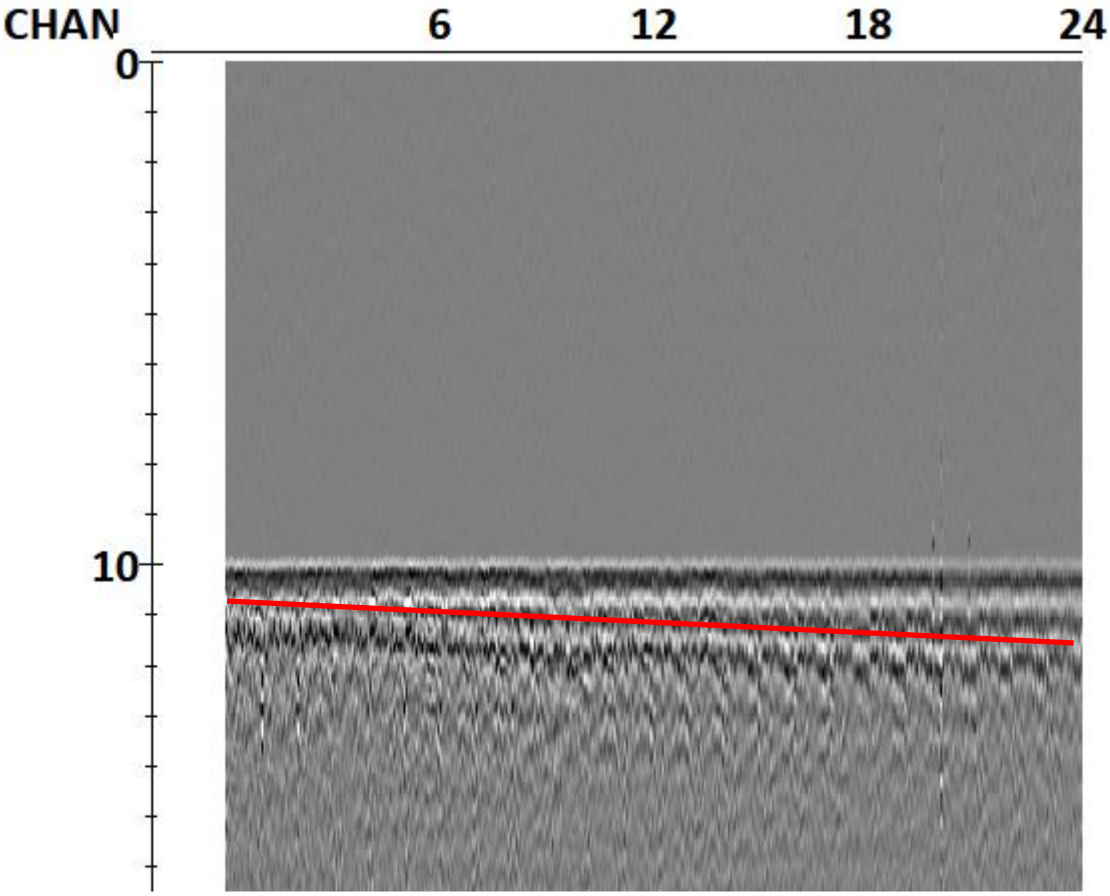


Figure 16 - *Streamer balance QC for TA2A913I2. Vertical scale in milliseconds.*

4.3.5. Interactive Velocity Analysis

During each line QC, supergathers were generated every 1000 CDP. RMS velocity curves were generated through the interactive velocity analysis for all lines and were used for brutestack NMO corrections (Figure 17).

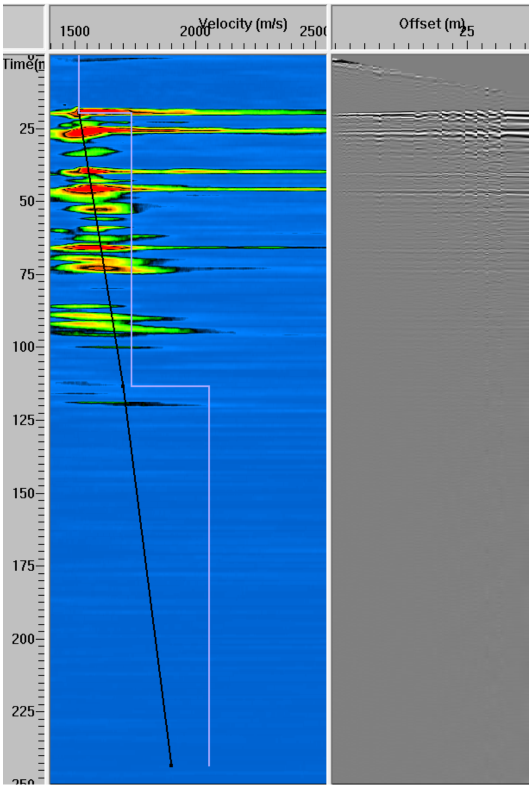


Figure 17 *- Interactive velocity analysis used for brutestack for Line TA2A935P1.*

4.3.6. CDP Fold

Impact of steering, feathering, navigation and bad shots on the CDP bin fold was assessed along the survey by using the CDP fold track plots (Figure 18 and Figure 19). CDP fold was expected to present a median value of 24. In general, the CDPs fold value is above the 80% of the nominal fold, as per the contractual requirements.

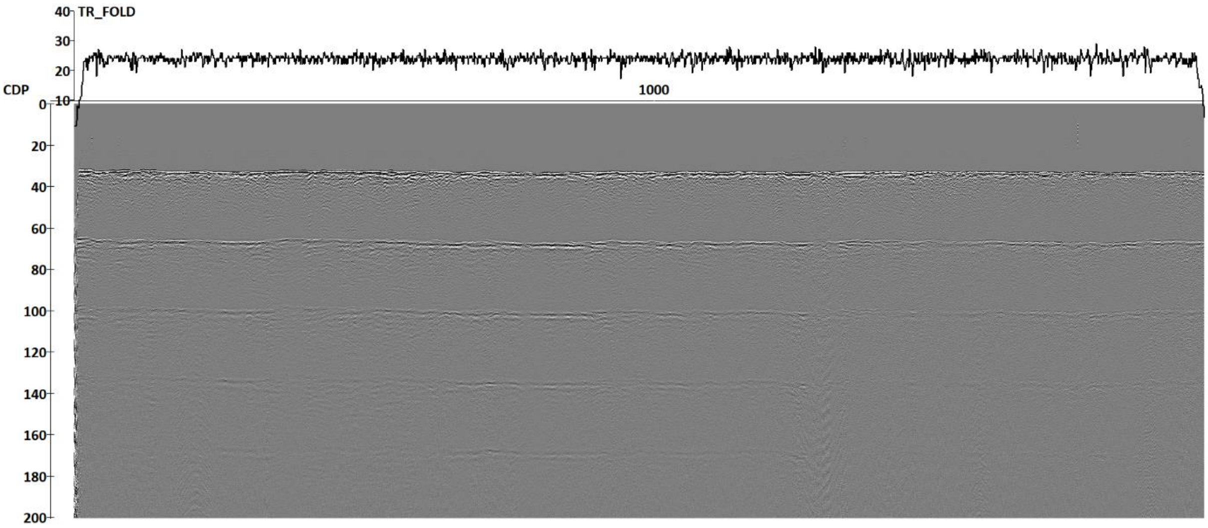


Figure 18 *- CDP fold and brutestack section for line TA2A912P1. Vertical scale in TWT (ms).*

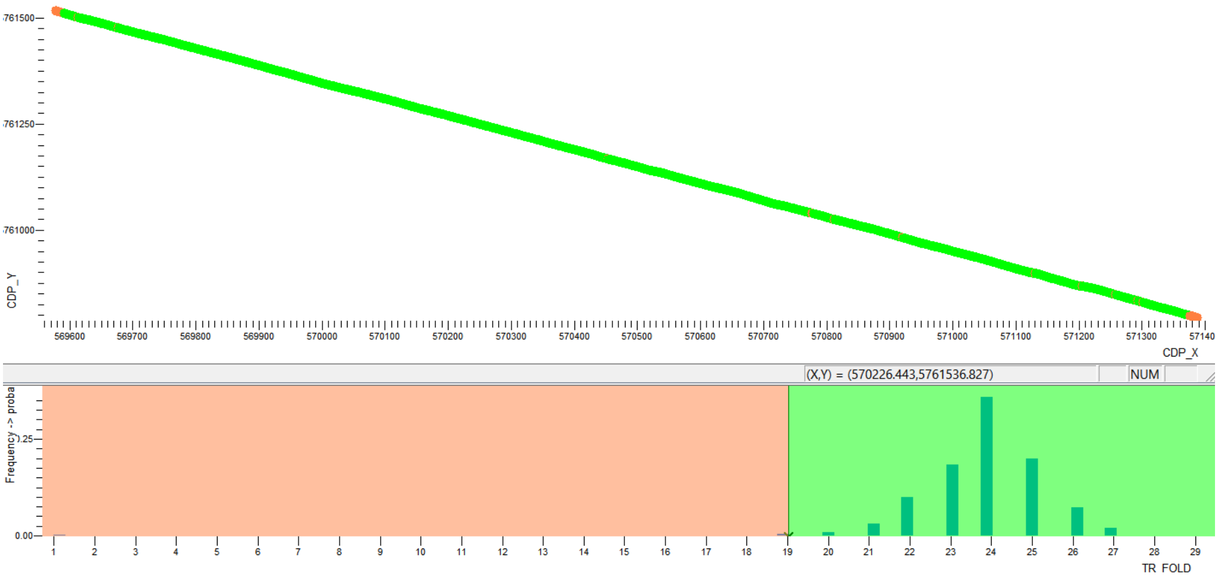


Figure 19 *- CDP fold and track plot for Line TA2A912P1.*

4.3.7. Brutestack

The offshore brutestack (Figure 20) of every seismic profile provided a quick image of the expectable data quality and signal penetration. The BruteStack was evaluated on the following parameters:

- Signal quality – verification of the existence of any artefacts on the seismic data;
- Signal penetration – Identification of correlative reflections in the brutestack on higher depths below seabed, fulfilling the required penetration;

- Coverage – confirm if there are no gaps in the seismic data, when compared with the planned line – verification done by Fugro;
- Line keeping/offtrack – verification of the steering of the vessel and trackplot file exportation to compare with line plan (trackplot exported by Offline Processor and analyzed by Fugro).

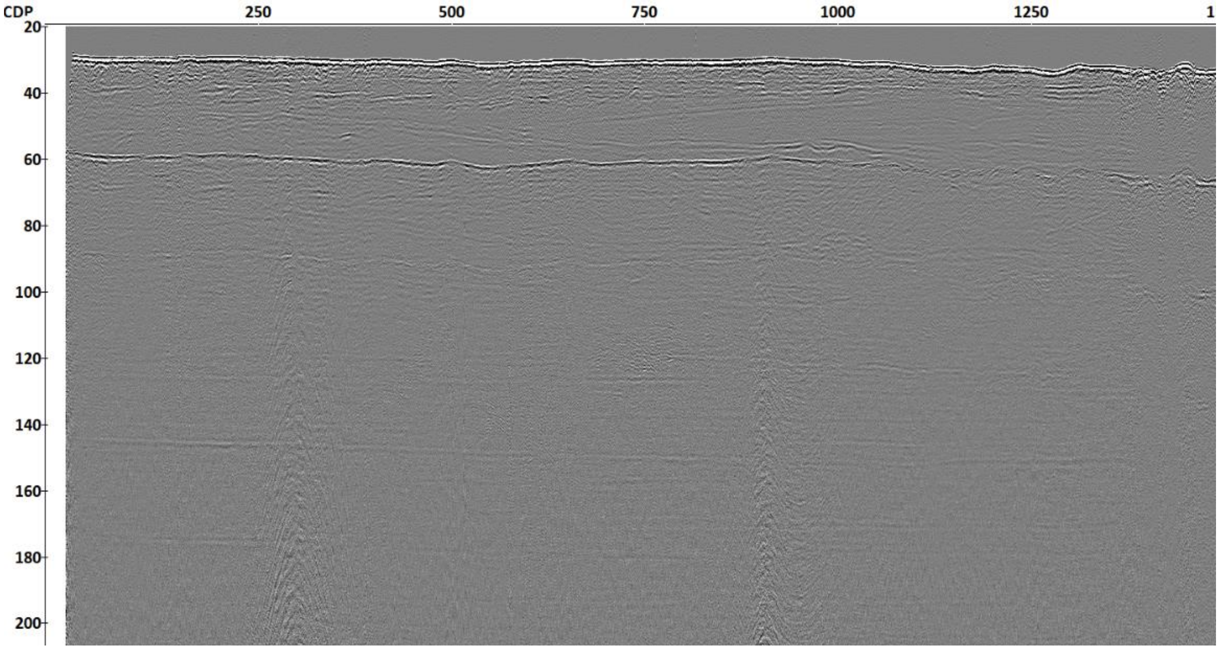


Figure 20 - *Brutestack for line TA2A915I1 showing good penetration until the end of record. Vertical scale in milliseconds.*

4.4. 2D UHRS Data Processing Sequence for QC

The assessment of the data quality of every acquired line was performed with in-house developed Offline QC processing flow shown in Figure 21 and with the processing software RadEx Pro (from Deco Geophysical).

The raw SEG-Y data acquired has the following main information in the headers:

- FFID number;
- Channel number;
- Source positions (SOU_X – Byte location 73, SOU_Y – Byte location 77);
- Receiver positions (REC_X – Byte location 81, REC_Y – Byte location 85);

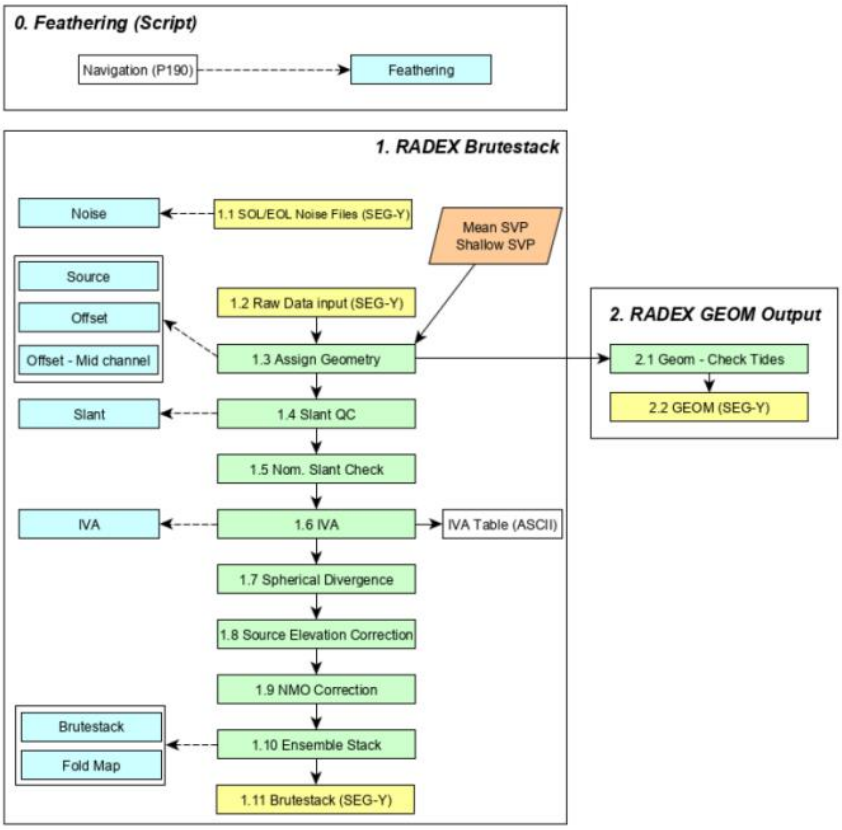


Figure 21 *- Processing sequence used for Offline QC onboard of Fugro Seeker.*

4.5. Deliverables

The following digital deliverables were produced onboard and delivered from the processor to Fugro for further analysis:

- Raw data (SEG-Y) – GMSS;
- Navigation file (ASCII – P190) - GMSS;
- Operations Log (xls) – GMSS;
- Offline QC Log (xls) - GS;
- Offshore QC plots - GS;
- Brutestack of every seismic profile in TWT (SEG-Y) - GS;
- Pre-stack Geom file in TWT (SEG-Y) - GS;
- Velocity Tables - GS;
- CDP Trackplots -GS;
- Mob Report (docx) – GS and GMSS;
- Field Report (docx) – GS and GMSS.

5. QUALITY CONTROL, ISSUES AND LESSONS LEARNED

This section outlines the main issues found during the survey, which impacts they have on the signal, how they were assessed and also the lessons learned from them.

5.1. SHALLOW GAS

Along the survey area, various indicators of shallow gas were identified in this area, including acoustic blanking, pockmarks and enhanced reflections. Acoustic blanking anomalies, the most common ones, are caused by absorption of acoustic energy due to the presence of gas, are seen in the range 3–200 ms TWT below seabed.

This fact compromises signal penetration in this location, where there are no evidences of seismic reflections underneath this gas layers. Some processing techniques will be endangered, such as, the deconvolution and demultiple techniques

Where there are no evidences of shallow gas, good data penetration is achieved along the lines, higher than 150 ms.

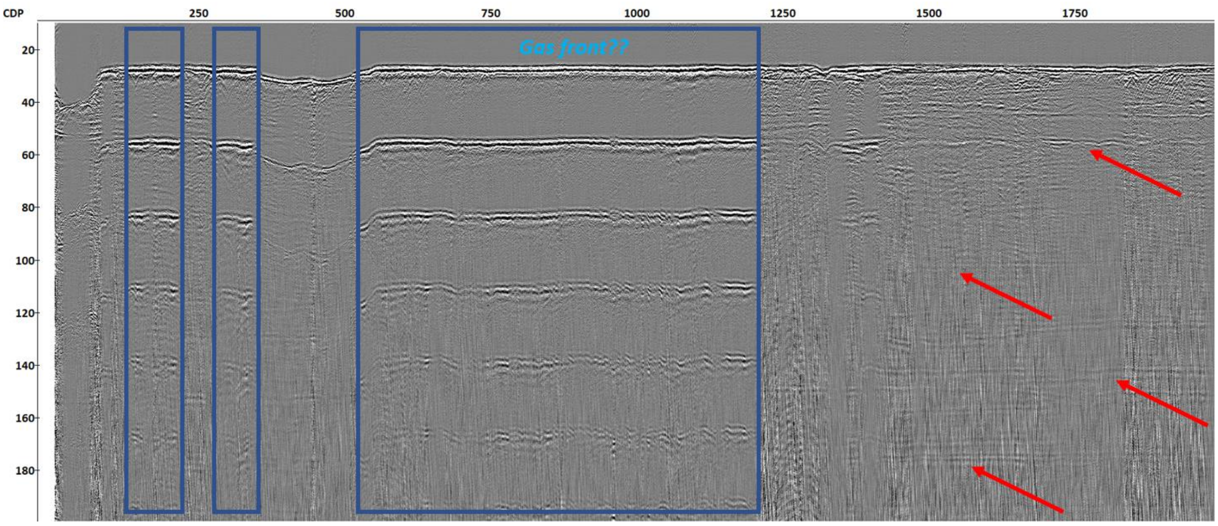


Figure 22 - Potential shallow gas highlighted in blue, in red primary signal is represented.

5.2. EXTERNAL NOISE FROM OTHER VESSELS

As show on Figure 23 vessels frequently passed by near the survey vessel. This was to be expected as the survey area is located near the entrance of the Maasmond channel. This type of noise presents variable direction along the line, as the direction varies with the relative position and distance of the noise source. Some tug and cargo vessels were seen during the survey. The wash resultant from their transit, caused the streamer to surface and consequently resulting in a noisier record, affecting the data, Figure 24.

All lines were carefully assessed before acceptance, thus some lines with vessels nearby were flagged for infill as the noise levels were significantly degrading the data. Nevertheless, the data was accepted if the noise levels were lower and not degrading considerably the stacked data.

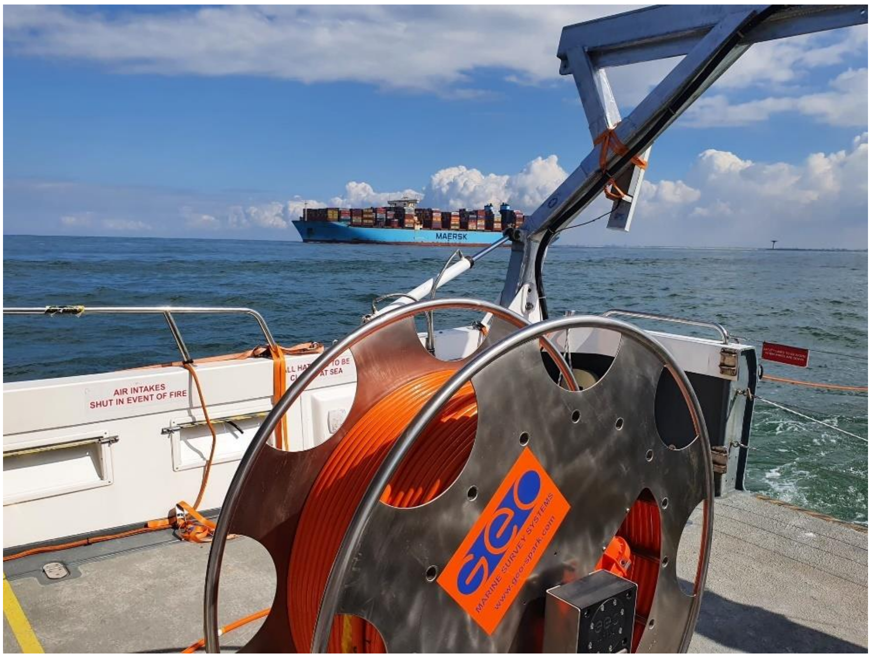


Figure 23 *– Large cargo vessel passing by near the Fugro Seeker during acquisition.*

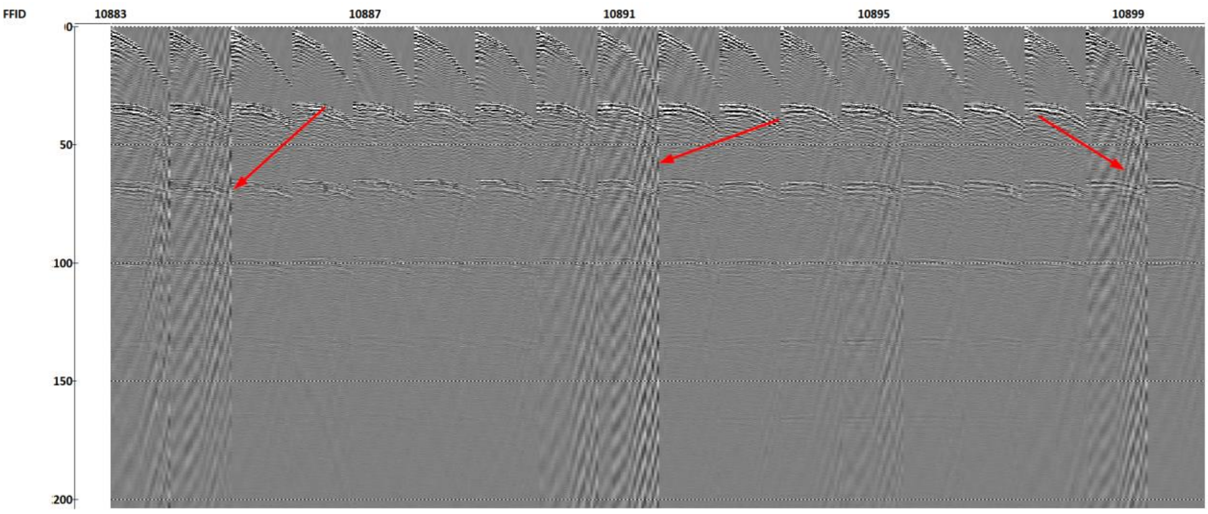


Figure 24 *- Noise from large vessels passing by. Line TA2A913P1. Vertical scale in milliseconds.*

5.3. CABLE SLANT ASSESSMENT

Due to strong currents in the survey area, it was very common to have the streamer very shallow in one of the directions (against the current) and with the desired depth in the opposite (Figure 25 and Figure 26).

A very cautious assessment of the streamer balancing was performed on a line-by-line basis to make sure that this not have negative impact on the data, all the seismic profiles underwent QC/QA in order to assess the streamer balancing and to ensure that the data could be successfully processed.

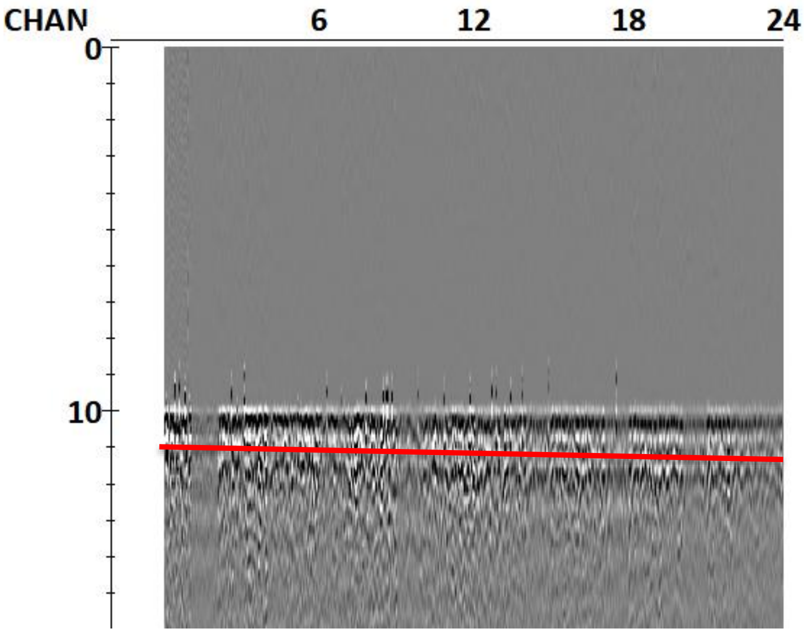


Figure 25 *- Shallow streamer along the line TA2A910P1 (acquired against the current). Vertical scale in TWT (ms).*

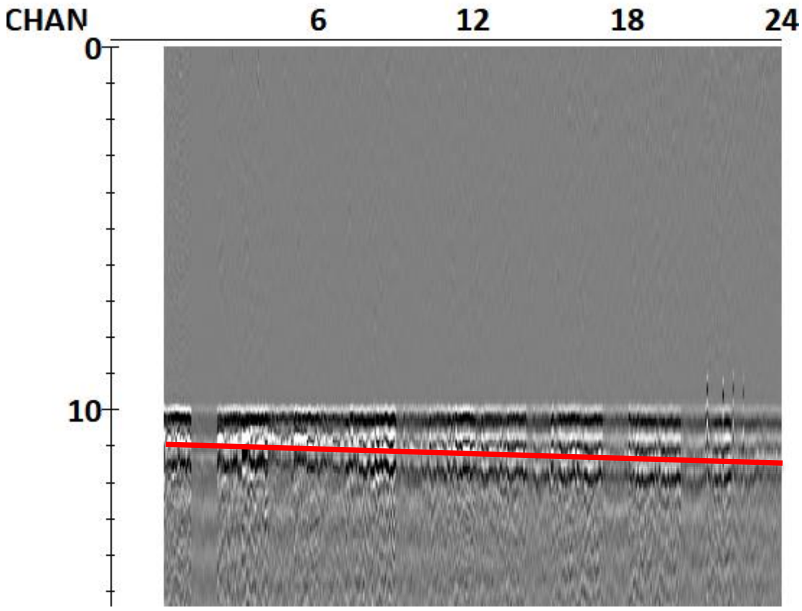


Figure 26 *- Slanted streamer along the line TA2A907P1 (acquired with the current). Vertical scale in TWT (ms).*

5.4. ONLINE QC SOFTWARE CRASH

GMSS acquisition software crashed during the acquisition of one main line. To overcome this issue, UHRS operator had to stop recording and restart the software, resulting in 2 sections generated for the same line. See example below (Figure 27).

TYPE	Exec. Order	Line Name
Prime	26	**TA2A931P1**
Prime	27	**TA2A931P2**

Figure 27 *- Two UHRS sections generated for the TA2A931P1 because of Online QC Software crash.*

5.5. WEAK CHANNEL

Channel 21 was not working properly, showing a weak signal compared to the others channels (Figure 28). GMSS operator checked and cleaned the connections, with no clear signs of damage. Air bubbles present inside the streamer, could be the cause for the attenuation. As the channel was not deemed dead and this phenomenon wasn't affecting the data significantly, there was no need to replace the streamer. If the channel was failing, lines were assessed to look for any signal degradation.

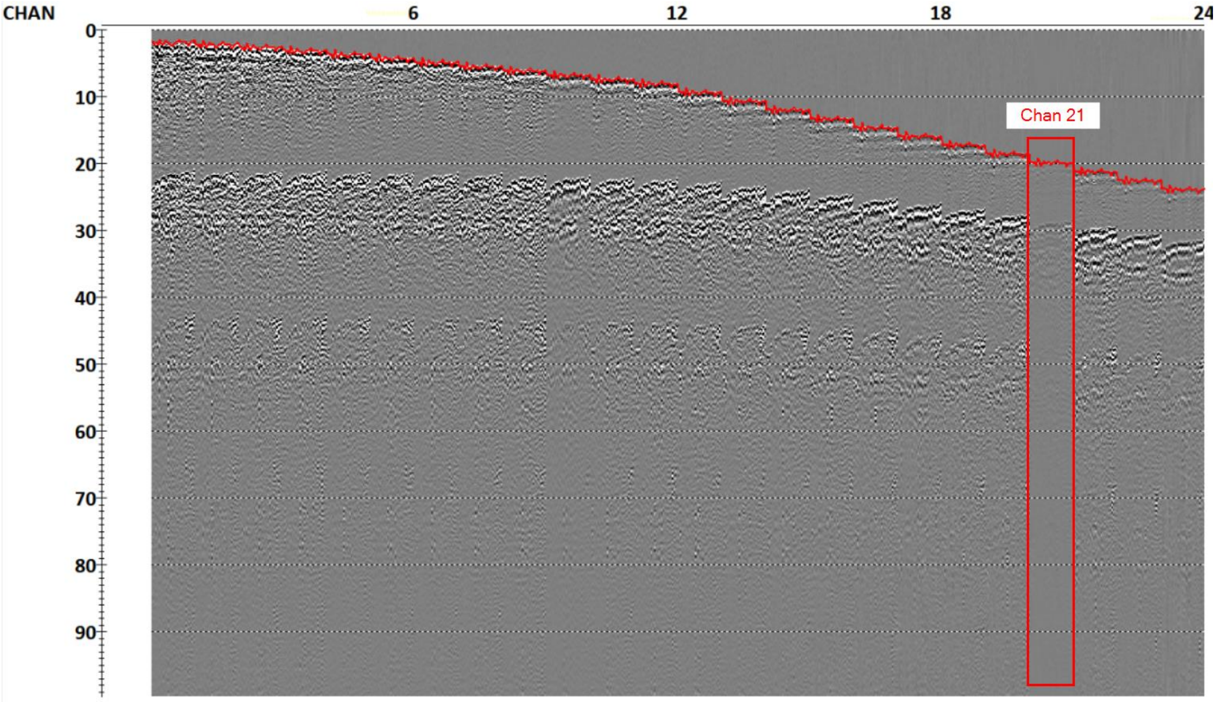


Figure 28 - *Channel 21 appearing weak during the acquisition of the line TA2A925P1. Vertical scale in TWT (ms).*

6. CONCLUSIONS

In general, the M-UHRS data presented a good signal to noise ratio, good resolution and penetration, fulfilling the client requirements. Each line was carefully assessed in order to ensure that the data was fit to the project purposes.

As shown in chapter 4, the data acquired presented good resolution, allowing the detection of different layers very close each other, and high penetration, with reflections in the brutestack on higher depths (until the end of the record when the geology allows). Despite the gas fronts and other geological constraints and issues reported in the previous chapter, UHRS system proved to be efficient and fulfilled the contract requirements throughout the survey.

Some lines were not acquired in the best survey conditions but presented a reasonable data quality and signal to noise ratio and, therefore, were accepted by the client. It is important to take into account that those lines may require a more extensive processing flow, resulting in extra processing time, mainly for the denoising, statics calculations and datum corrections. The processing of these lines represents a more extensive task than a line acquired in calm sea state.

11nd October, 2022
On behalf of GeoSurveys and Geomarine Survey Systems,
Gil Moreira
(UHRS QC Processor) & (UHRS Operator)

Appendix D

Nearshore Concession

Client Concession

Project number and name	197217 Aramis
Concession number	Nearshore - 001
Date:	10 October 2022
Description	UHRS Line not acquired

Overview

During the nearshore UHRS scope, line 902P1 was not acquired. 901P1 was acquired and, through human error, the navigation data for that line was reprocessed with the incorrect datum. On the coverage plot, 901P1 incorrectly appeared to be in the position of line 902P1. This resulted in incorrectly assuming the wrong line had been acquired, which led to 901P1 being acquired twice and 902P1 not being acquired. This was not discovered until after the UHRS mobilisation whilst the data was being processed.

We have confirmed that this is the only occurrence of this during the UHRS phase and have taken steps to ensure that this does not reoccur.

shows the UHRS line plan, coverage and missed line.

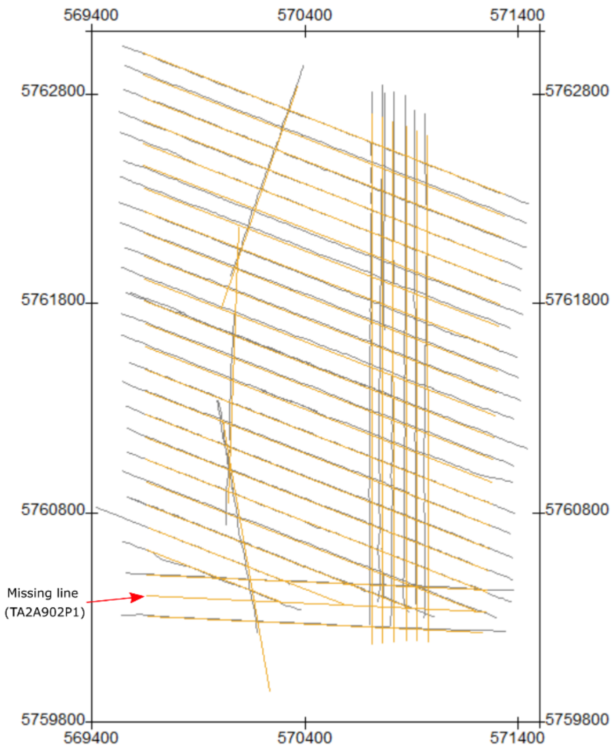


Figure 0.1: UHRS coverage showing missed lined TA2A902P1.

and below show the gas blanking on TA2A901P1 and TA2A903P1, the lines either side of the missed line. There is a large amount of gas blanking across the area that significantly decreases the interpretability of the area. The red boxes indicate the gas blanking on those lines.

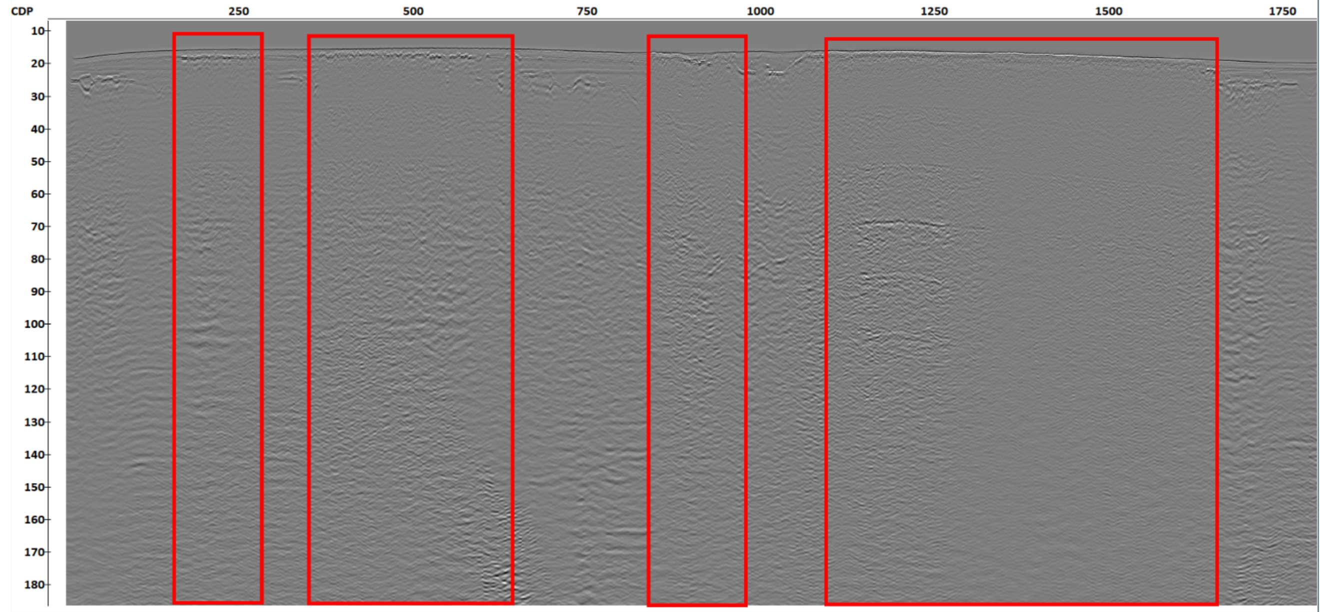


Figure 0.2: Gas blanking on line TA2A901P1

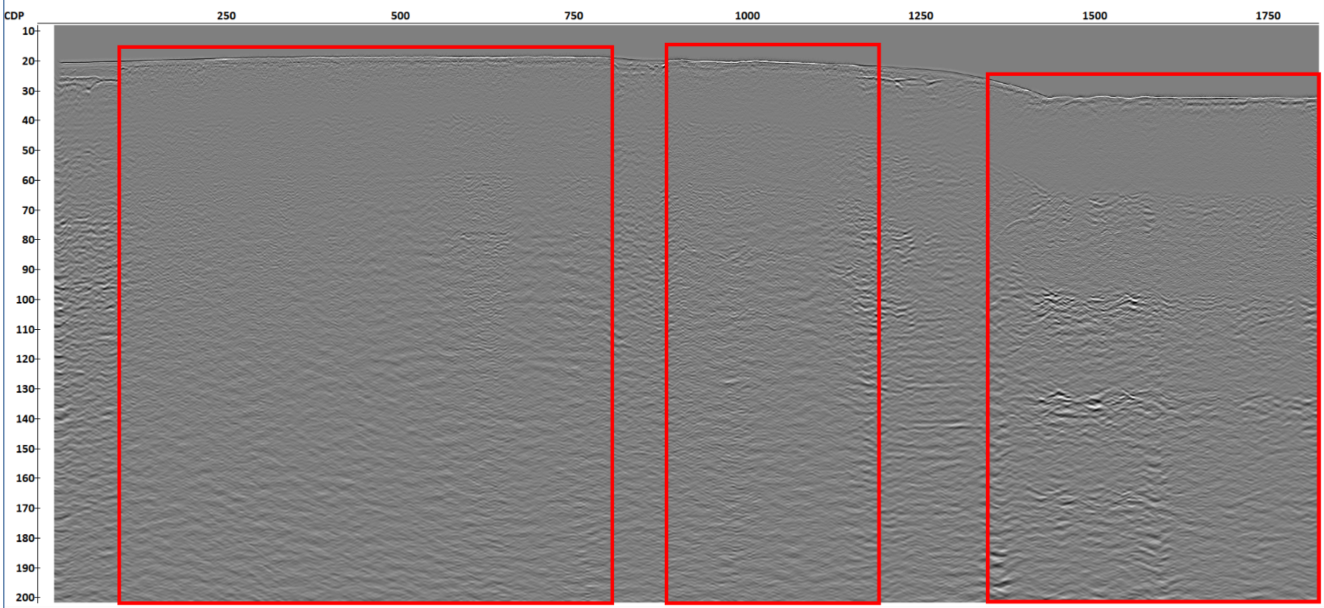


Figure 0.3: Gas blanking on line TA2A903P1

Figure 0.4 below shows the missed UHRS line (red) and the SBP lines (black) in the area. Those SBP lines are shown in Figure 0.5 to Figure 0.8 below. The light blue line indicates areas where interpretation of the horizon is possible. These images indicate large areas of shallow gas.

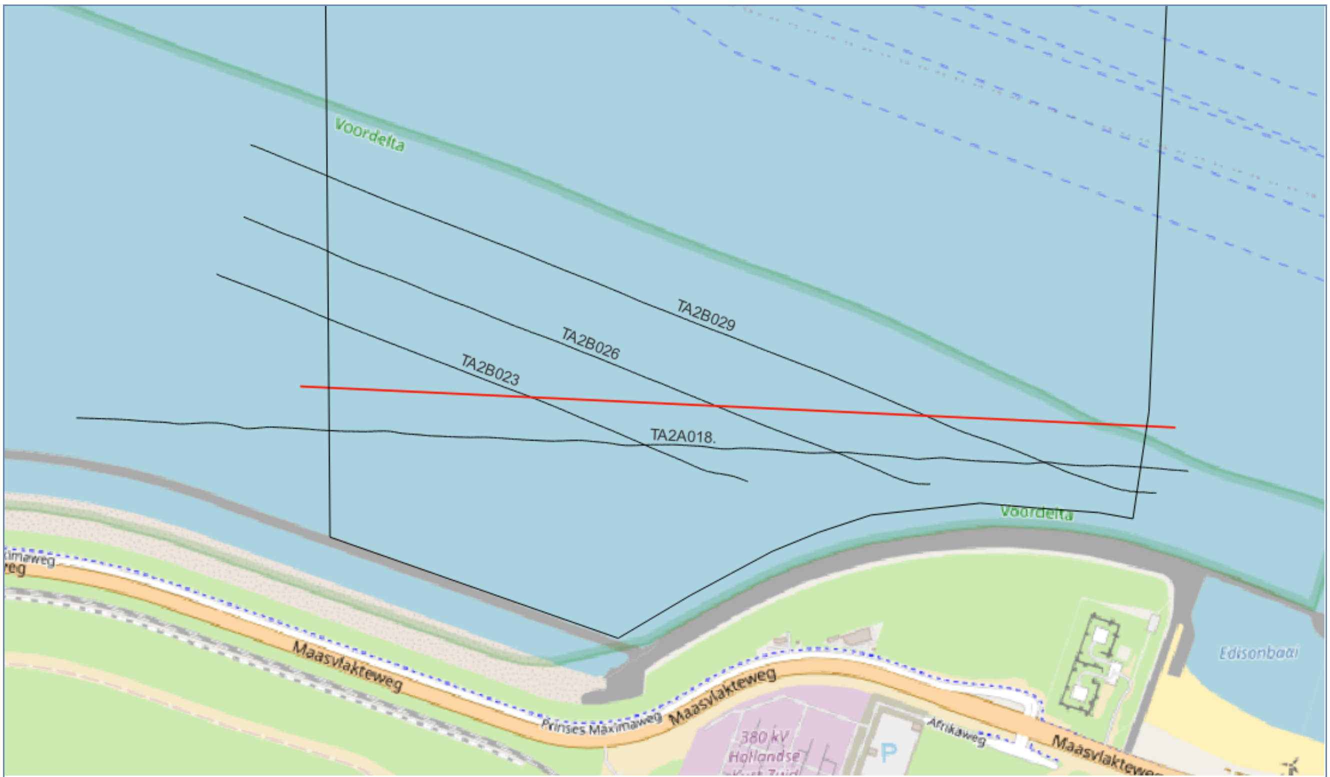


Figure 0.4: SBP lines (black) and UHRS line TA2A902P1 (red)

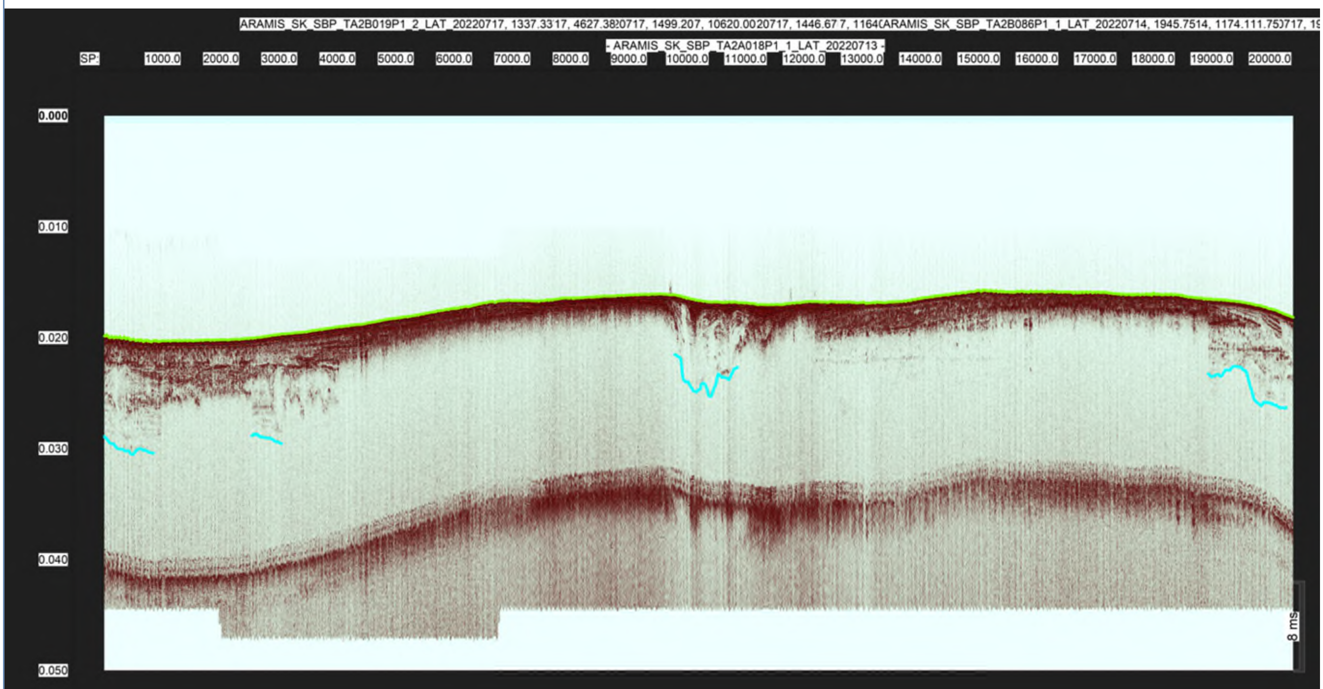


Figure 0.5: SBP line TA2B019P1

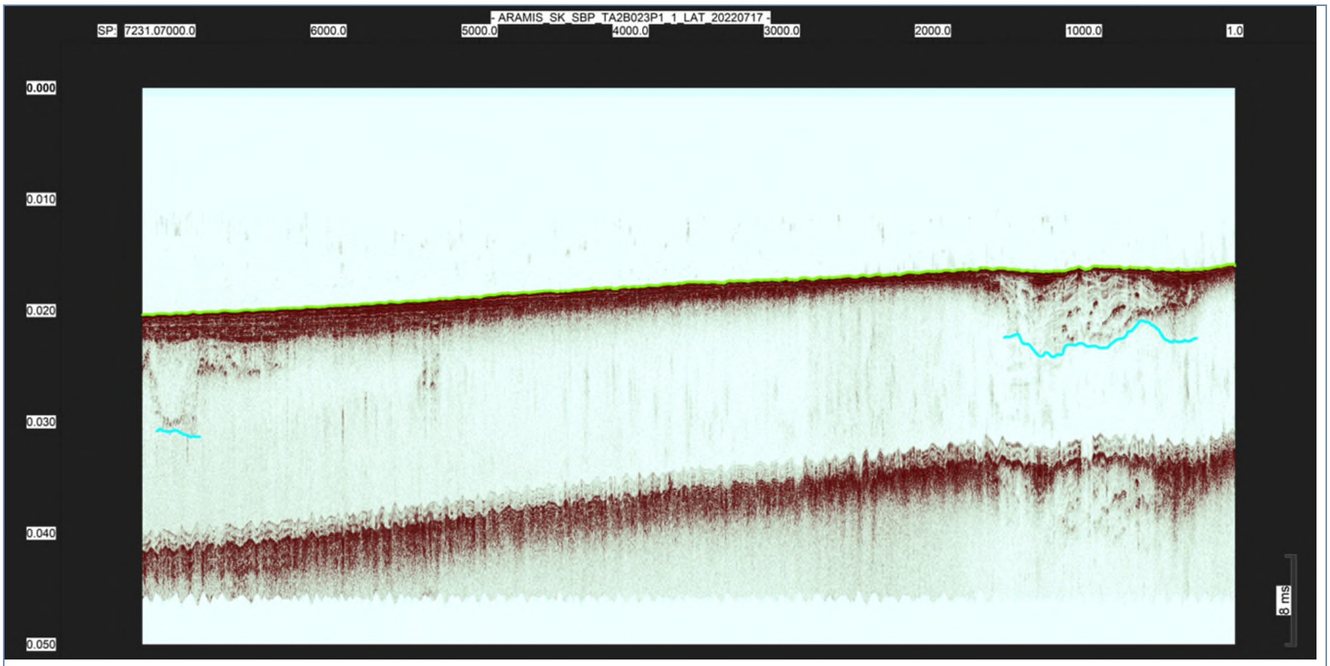


Figure 0.6: SBP line TA2B023P1

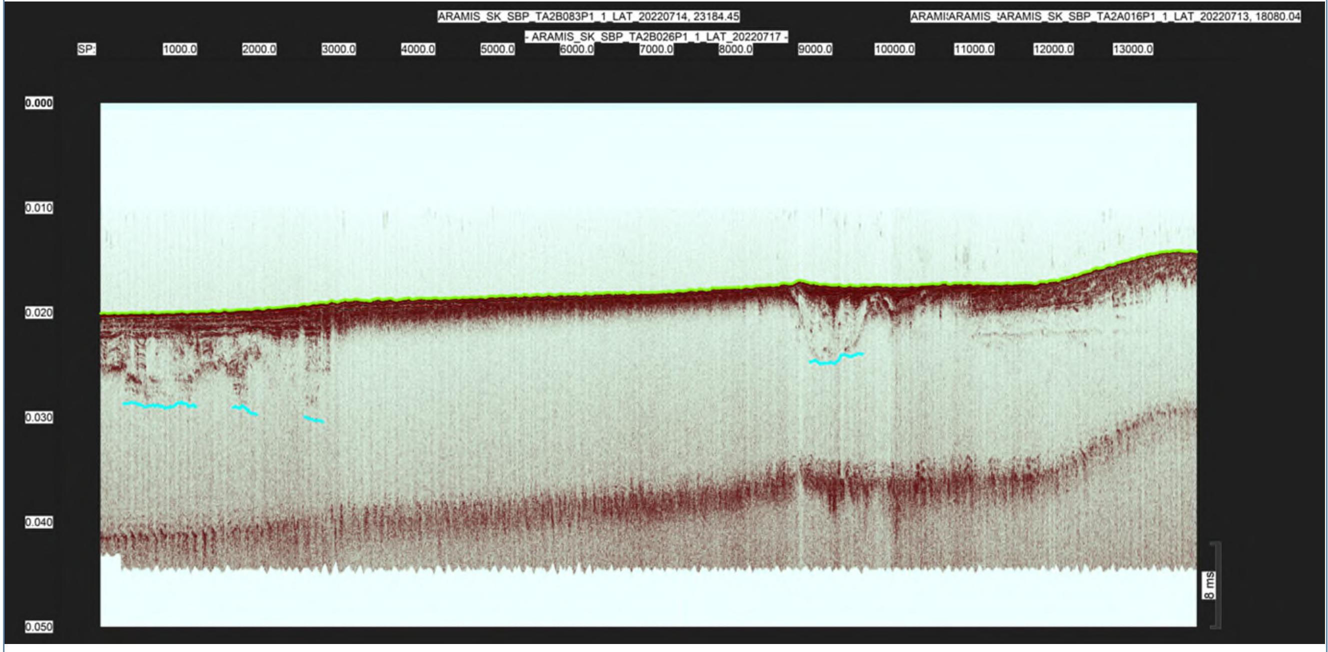


Figure 0.7: SBP line TA2B026P1

Figure 0.8: SBP line TA2B029P1

The missing line is believed to have limited consequences on the interpretation as extensive seismic blanking, possibly due to gas in soil, was observed on the neighbouring UHRS and SBP lines (see data examples Figure 0.2 to Figure 0.8). The gas blanking is highly prevalent in the south part of the nearshore area; because of this, the lines acquired are thought to provide limited interpretation. It is believed that the line not acquired would show similar gas blanking and therefore provide limited interpretation.

Names and signatures

Fugro Representative	TotalEnergies Representative
Helen Abbey 	Line can be removed as not useable for data interpretation. Time of operation and processing shall be put as downtime (not charged to Totalenergies).

Appendix E

URHS Results Report

GeoSurveys geophysical consultants

Aramis - Geophysical Survey

2D M-UHRS GEOPHYSICAL DATA PROCESSING

Document No.: REP22342

02/11/2022

DOCUMENT CONTROL

Project Title:	Aramis - Geophysical Survey
Document Title:	2D M-UHRS GEOPHYSICAL DATA PROCESSING
Document Type:	Technical Report
Client Name:	Fugro
Client Ref.:	22336
Document Ref.:	REP22342
Document:	V0
Date:	02/11/2022
Document Status:	

Revision History		Date	Author	Reviewed	Approved
01	V0	02/11/2022	IS/GM	DG	JM
02					
03					
04					

Project Processing team

Abv.	Team	Position
JM	J. Miranda	Project Manager / Processing Reviewer
DG	D. Gonçalves	Processing Reviewer
IS	I. Sousa	Team Coordinator / Principal Processor
GM	G. Moreira	Seismic Processor

SUMMARY

Fugro contracted GeoSurveys (GS) to provide offshore 2D M-UHRS offline QC services and to process the M-UHRS data acquired in the scope of the Aramis Offshore Geophysical Survey Project, carried out in the vicinity of Maasmond, Netherlands.

This document reports the data processing of 71.9 km of multi-channel seismic lines acquired with a multi-channel sparker system (41 seismic profiles, including re-runs and infills).

The M-UHRS processing was performed at GS office using RadexPro software and in-house developed processing flows. The processing workflow was divided into two main processing stages: TRIM Track and FINAL Track. The main purpose of the TRIM track was to compute a proper residual motion correction and the vertical statics needed for reducing data to a common vertical datum. The aim of the FINAL track processing was to create fully processed unmigrated and migrated seismic datasets in time (TWT) and depth.

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ABBREVIATIONS

ASCII – American standard code for information interchange;

CDP – Common depth point;

COSA – Common Offset Spatial Averaging;

DGPS – Differential global positioning system;

DPT – Depth migrated stack;

EBCDIC - Extended binary coded decimal interchange code;

ETRS89 - European Terrestrial Reference System 1989;

FFID – Field file identification number;

F-K – Frequency-wave number;

GMSS – Geo Marine Surveys System;

GNSS – Global Navigation Satellite System;

GPS – Global Positioning System;

GS – Geosurveys;

Hz – Hertz;

J – Joule;

LW – Lightweight;

MBES – Multibeam echosounder;

MSL – Mean Sea Level

MIG – Migrated stack;

MUL – Multiple attenuated stack;

M-UHRS – Multichannel Ultra-high resolution seismic;

NMO – Normal Moveout;

QA – Quality analysis;

QC – Quality control;

RMS – Root mean square;

SEG-Y – Convention from the society of exploration geophysicist (seg) for pre-stack and post-stack seismic data;

SRME – Surface-related multiple elimination;

SVP – Sound velocity profile;

TVBPF – Time variant bandpass filtering;

TWT – Two-way-time;

UHRS – Ultra-high resolution seismic;

UTM – Universal transverse Mercator.

1. INTRODUCTION

Fugro contracted GeoSurveys (GS) to provide offline QC and processing services on the 2D M-UHRS data acquired in the scope of the Aramis Geophysical Survey Project. The survey area is located in the vicinity of Maasmond channel, Netherlands (Figure 1), with water depths ranging from approximately 10 to 33 m.

Besides GeoSurveys, Fugro also contracted Geomarine Survey Systems (GMSS), responsible for offshore 2D M-UHRS data acquisition and online QC services. The survey was carried out by Fugro onboard the vessel Fugro Seeker between September 11st and September 24th, 2022.

This document reports the M-UHRS data processing of 41 seismic profiles (including re-runs and infills), making a total of 71.9 km of seismic data (Figure 1), carried out using RadExPro software from Deco Geophysical.

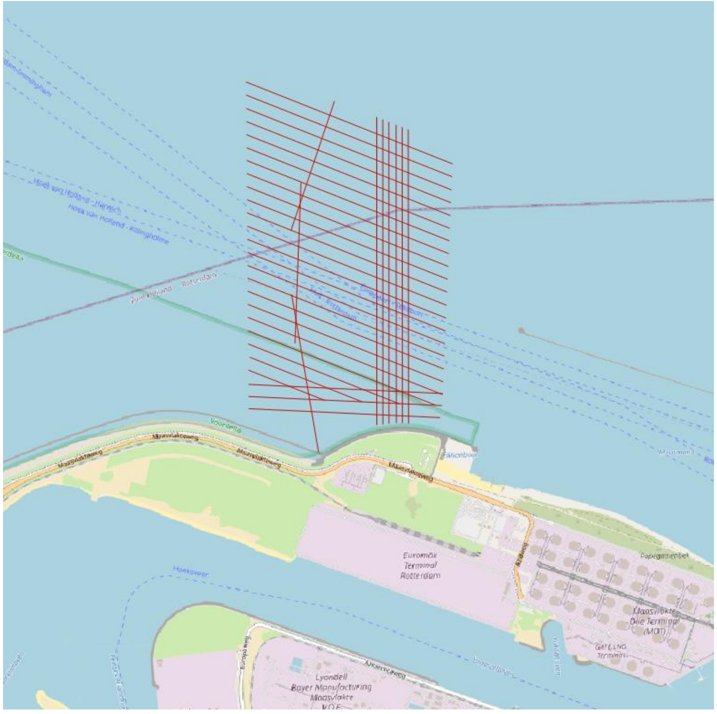


***Figure 1** – Survey site location.*

1.1. Line Plan

A total of 35 planned lines were acquired: 26 seismic profiles with WNW-ESE orientation and 9 with N-S orientation. Including infills and reruns, a total of 41 seismic sections were acquired and processed, making a total length of approximately 70.9 km of multi-channel data.

Along the project, 8 reference lines were selected as site-representative for 2D UHR seismic dataset (Table 1), and used to perform the processing tests (Figure 2).

Table 1 *– Reference lines identification.*

TA2A901P1A	TA2A922P1
TA2A907P1	TA2A925P1
TA2A910P1	TA2A928P1
TA2A916P1	TA2A934P1

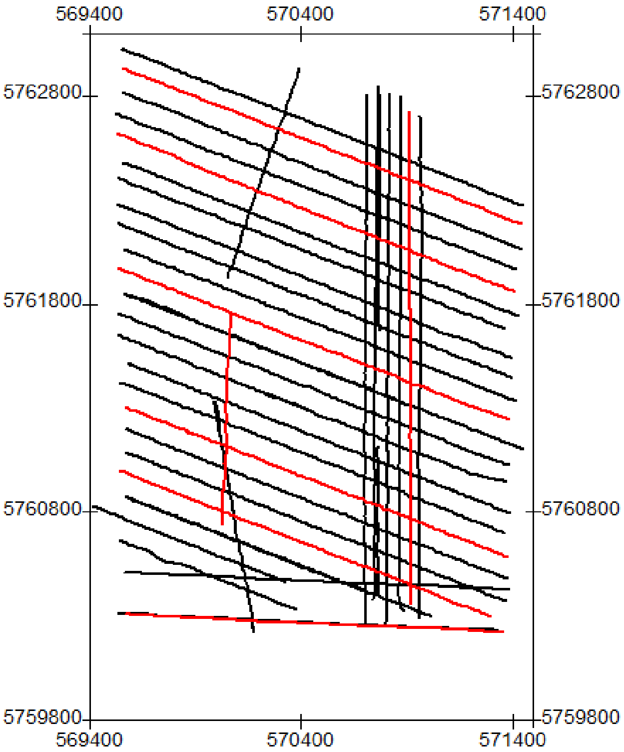


Figure 2 – Aramis survey multi-channel seismic lines in black and reference lines in red.

1.2. Purpose and Objectives of the Processing

The objective of the survey is to identify and delineate any possible constraints and hazards from man-made, natural and geological features which may affect the integrity of the exploration site/development area.

The primary objectives of the MCS data acquisition and processing are to:

- Define the uppermost approximately 100 m below seabed, within the array area;
- Provide accurate information on changes in sub-surface unit stratigraphy including lateral variability and thickness of units;
- Provide accurate information on sub-surface features, obstructions and geohazards (e.g., shallow gas) that may impact site design activities;
- Horizontal resolution/CDP bin maximum of 1.0 m;
- Vertical resolution: 0-40 meters below seabed: 0.3 m, >40 m below seabed: 1.0 m;

To make sure the goals were achieved and the necessary requirements were met, some quality control and processing solutions were specifically developed and tailored. The processing workflow was divided into two main processing stages:

- TRIM Track – flow steps to compute a proper residual motion correction and the vertical statics needed for reducing data to a common vertical datum;
- FINAL Track – this stage of processing included F-K filtering, deconvolution, pre-stack multiple attenuation, deghosting, post-stack multiple attenuation and migration. A Layer Cake velocity model, produced after several velocity iterations was used for NMO, migration and depth conversion.

2. DATA ACQUISITION

The multi-channel data acquisition was carried out onboard the vessel Fugro Seeker, between September 11st and 24th, 2022. The multi-channel seismic spread used for data acquisition is described herein as having the following specifications:

(a) A single Geo-Source 400 tips LW sparker, towed at 0.3 m, firing at 400 Joules and at 1.0 m interval;

(b) Two Geo-Spark 2000 X power supplies;

(c) A Geo-Sense multichannel streamer of 24 channels towed in slant configuration and with different group interval: 1 m between channel 1 and 12 and 2 m between channel 12 and 24;

(d) Four multi-trace 24, connected to each section of the streamer (24 channels section);

(e) Geo-Sense single channel reference hydrophone;

(f) Three DGPS for streamer front and tail buoys and source.

The sparker system was used in single layer configuration, that is characterized by the use of a single sparker source that discharge with an optimal output of 400 joules. The source depth is critical to achieve constructive interference between the primary pulse and its own sea-surface reflection (surface ghost).

The simultaneous use of the previous mentioned mode with the streamer in a slant configuration contributes to a wider signal frequency recovery and better ghost removal, as deeper channel geometry, with growing offset, usually implies a receiver ghost incoherent stack. Hence, overall better signal to noise ratio.

For a clearer perception, the vessel array layout and the used seismic spread offset is schematized in Figure 3 for the vessel Fugro Seeker.

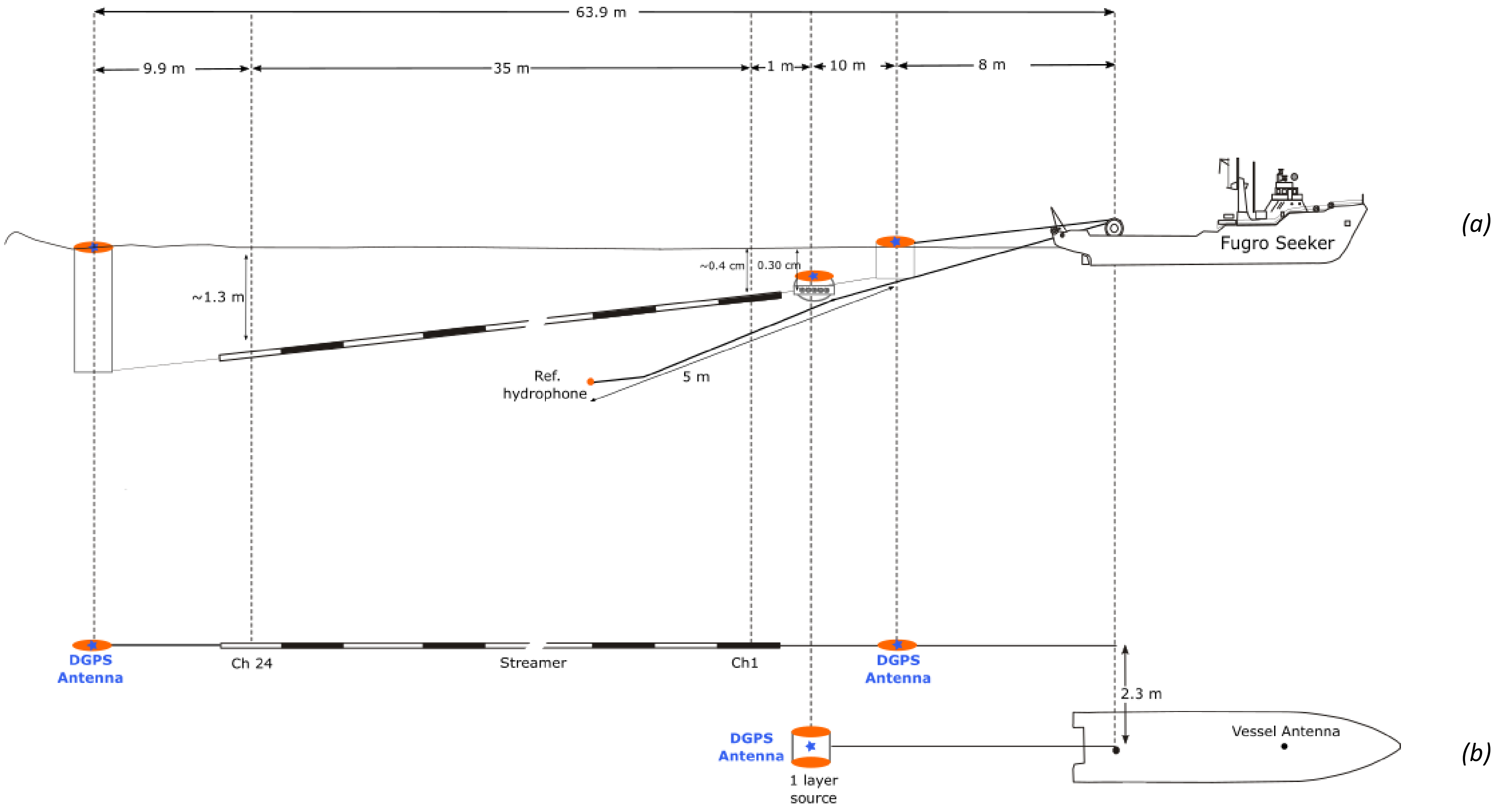


Figure 3 *– Vessel layout Fugro Seeker and offset diagram to the seismic spread for survey area in (a) cross section and (b) plan view (not to scale).*

2.1. Acquisition Parameters

The UHRS system includes a Geo-Spark 2000 X power supplies, a Geo-Source 400 tips LW sparker, a 24-channel streamer with different group interval (1 m between channel 1 and 12 and 2 m between channel 12 and 24), a Multitrace unit and a GMSS single element reference hydrophone. GNSS positioning systems are located at the front buoy, tail buoy and sparker source.

Table 2 describes the UHRS equipment and the general acquisition parameters used in this project.

Table 2 *– 2D UHRS system and Acquisition parameters.*

Sources	**1x Geo-Source 400 tips LW**
Source Towing Depth	0.3 m
SP Interval	1 m
Operating Power	Source @ 400J
Tuned delay	-
Power Supply	Geo-Spark 2000XFO
CDP Bin Coverage	≈24 fold for 1 m CDP bin
Recorder	Multitrace 24 – Geo Marine Survey Systems
Sample Rate	0.1 ms
Record Length	250 ms
Format	SEG-Y
Multichannel Streamer	Geo-Sense LW 24 channels
Streamer Depth	≈ 0.4 – 1.3 m
Group Interval	Chan1-12 @1m, Chan 12-24 @2m
Group Active Length	24 m
Reference hydrophone	Geo-Sense reference hydrophone – single element
Hydrophone Depth	5 m from the source
Group Interval	Single element
Group Active Length	Point receiver

2.2. Line Identification

The line Identification for the Aramis site is in accordance with the following:

- Prefix “TA2A9”, followed by a unique 2-digit sequential number starting on “01” and tailed by a “P1” suffix for all virgin lines, where the last digit is sequential and starts at “1”. See examples below:
  - TA2A905P1 (prime line);
  - TA2A931P2 (prime line).
- For the infills, the suffix was changed to “I1”. See examples below:
  - TA2A931I1 (infill line for prime line TA2A931P1);
  - TA2A919I1 (infill line for prime line TA2A921P1).
- For the reruns, the suffix was changed to “R1”. See examples below:
  - TA2A906R1 (rerun line of prime line TA2A906P1).

2.3. Navigation and Positioning

The navigation and positioning were carried out with a DGPS as a primary positioning system in 3 specific points of the seismic spread: the source, the streamer leading buoy and the streamer tail buoy. This particular arrangement allows the control and the positioning of the complete seismic spread. All positioning was referenced according to the projected coordinate system ETRS89, UTM Zone 31 North (Table 3). Depths are relative to Mean Sea Level (MSL).

Table 3 *– ETRS89, UTM Zone 31 North geodetic parameters.*

Datum	ETRS89
Ellipsoid	GRS 1980
Semi-major axis	6 378 137.000 m
Semi-minor axis	6 356 752.3142 m
Flattening (1/f)	298.257222101
EPGS	4258
Chart Projection	
Projection	Universal Transverse Mercator, Z31N
Latitude of Origin	0° N
Central Meridian	003° 00’ 00” East
Central Meridian Scale Factor	0.9996
EPGS	23031
Vertical reference	*MSL*

3. DATA QUALITY CONTROL

In addition to the offshore QC/QA, the seismic data underwent a second thorough assessment of the signal quality and geometry in order to ensure data could be successfully processed. These procedures are typically necessary to keep precise control of the static reduction for each seismic profile and overall quality of the final results.

3.1. Signal & Noise Analysis

The seismic data was inspected in shot and trace domain to assess noise types. The most significant types of noise recognized on the data were the following (Figure 4):

- Tugging noise: front and tail tugging. The front/tail tugging occurs when the front/tail streamer buoy is pulled by waves and currents (yellow/red dashed line in Figure 4). This is a low-frequency directional noise that can be removed by using a low-cut frequency filter or F-K filter;
- Burst noise, due to streamer surfacing, was also observed in the lines acquired in choppier sea (blue arrows in Figure 4);
- Vessel operation noise was observed in the data (Figure 5). This is a directional noise that can be attenuated using an F-K filter.

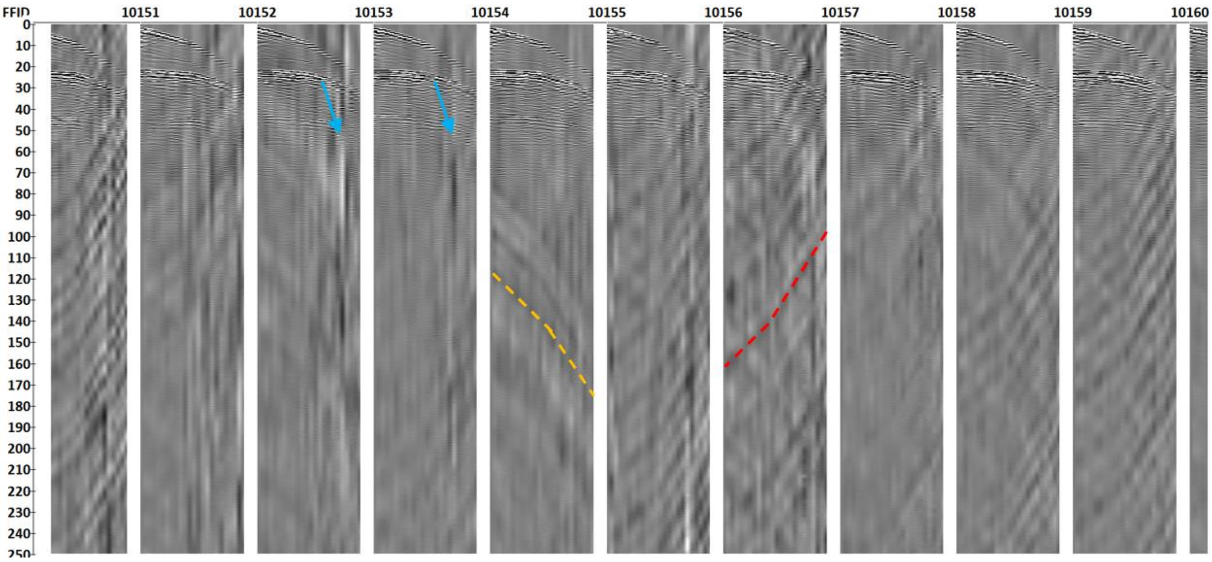


Figure 4 *– Shot gather for line TA2A922P1 showing tail tugging noise (red dashed lines), front tugging noise (orange dashed lines) and burst noise (blue arrows). Vertical scale in TWT (ms).*

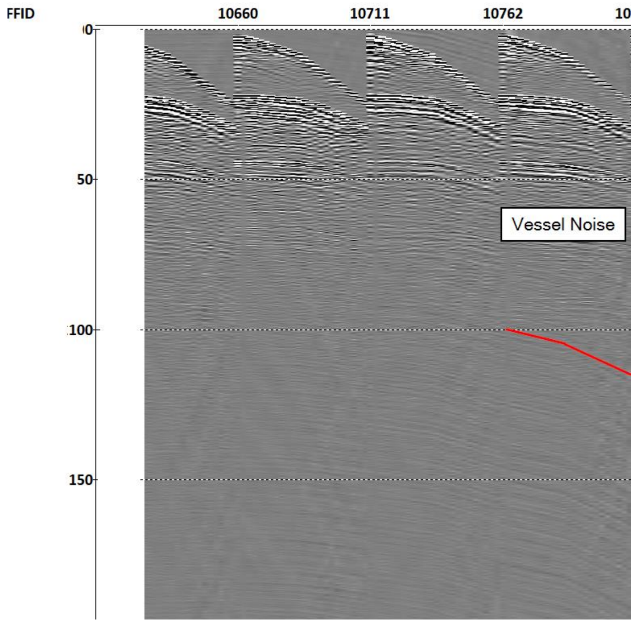


Figure 5 *- Shot gather for line TA2A923P1 vessel noise (red line). Vertical scale in TWT (ms).*

3.2. Source Receiver Offsets

Source and receiver positions and the relative offsets were initially calculated using the DGPS antennas located on top of the sources and on the streamer front and tail buoys. The accuracy of the source and receiver positioning was checked by comparing the offsets calculated from the source and receiver positions with direct arrival times (Equation 1). The offsets were estimated using the calculated distance between two points explained in Equation 1 and converted to time by dividing the obtained offset in meters by the measured water sound velocity (the sound velocity in the water was obtained from measured SVPs during the survey).

$$\boldsymbol{offset} = \sqrt{(\boldsymbol{Sou\_X} - \boldsymbol{Rec\_X})^2 + (\boldsymbol{Sou\_Y} - \boldsymbol{Rec\_Y})^2}$$

Equation 1 *– Equation used for calculating the offsets based on the positioning.*

On average the near channel in the streamer was located 1 m behind the source, see Figure 3. The source-receiver relative position was changing during the survey, probably due to surface currents, poor steering and also minor modifications of the geometry during equipment recovery and deployment operations.

In general, the offsets based on antenna position have a good match with the direct arrival. However, there are some cases where the match is not that perfect especially towards the far channels, due to strong variations on the sound velocity on the shallower portion of the water column or due to loss of differential corrections on the GPS positioning. In general, the difference between the direct arrival and calculated offsets was reasonable and most of the time below 2 ms (see Figure 6 and Figure 7).

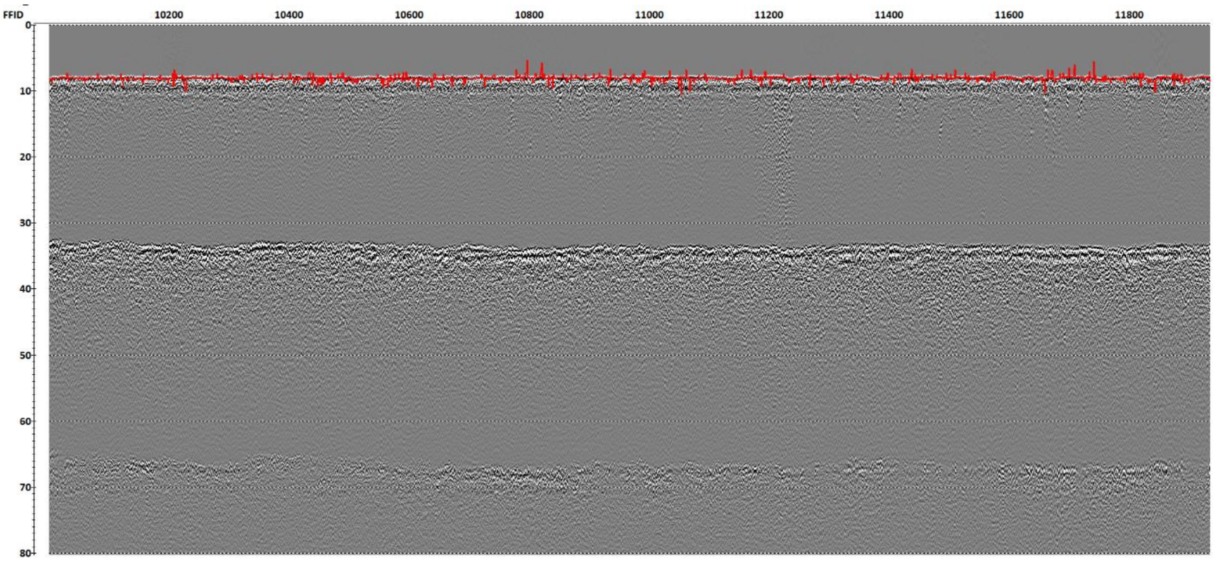


Figure 6 *– Channel domain showing the calculated offsets based on the DGPS positioning (red line) on top of the direct arrival, for channel 12, for line TA2A912P1. Vertical scale in TWT (ms).*

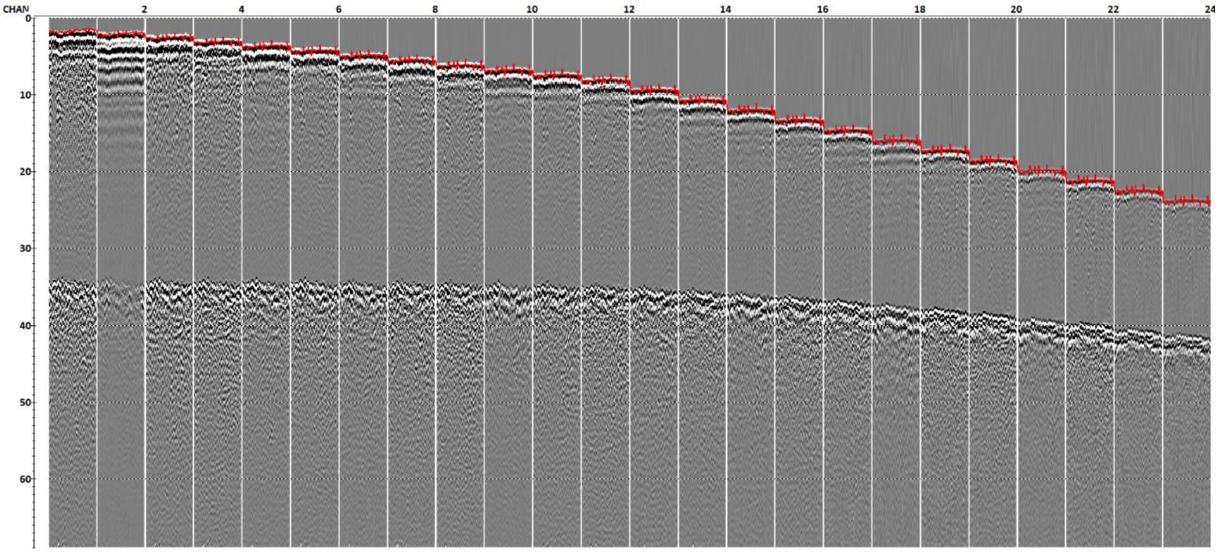


Figure 7 *– Few shots in channel domain showing the calculated offsets based on the DGPS positioning (red line) on top of the direct arrival, for all 24 channels, for line TA2A911P1. Vertical scale in TWT (ms).*

3.3. Source and Receiver Statics

Source/streamer geometry and motion can vary depending on sea conditions, wave motion, vessel steering, surface currents, acquisition velocity, and minor unintentional modifications of the system geometry during equipment recovery and deployment operations. Source, and mainly streamer geometry and balancing may have a negative impact on final UHRS data as these effects may add up.

In particular, processing procedures such as deghost and demultiple steps are very sensitive to poor streamer geometries.

All the seismic profiles underwent to an onshore QC/QA in order to assess the source and streamer balancing and to ensure that the data could be successfully processed. The seismic profiles were analysed regarding the following motion components of the equipment: source heave, cable heave and cable relative depth.

The source motion was always below 1 ms (blue line between -0.5 and 0.5 ms in Figure 8). The receiver motion component (green line in Figure 8) is usually smaller than the source motion due to the physical properties (weight and length) of the streamer. More information about the statics estimation and corrections is given in section 4.2.2. Whenever the raw source movement is greater than swell movements of +/- 1 m, corresponding to predefined acceptance threshold of 0.8 ms, the trace is flagged for removal (its value is changed to the constant arbitrary value of 1, represented as kill flag).

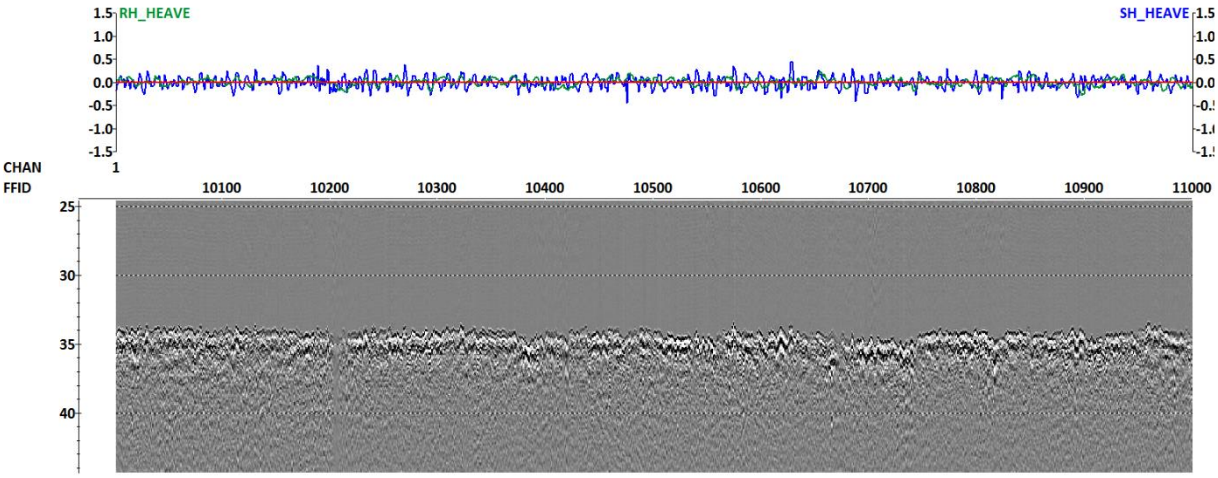
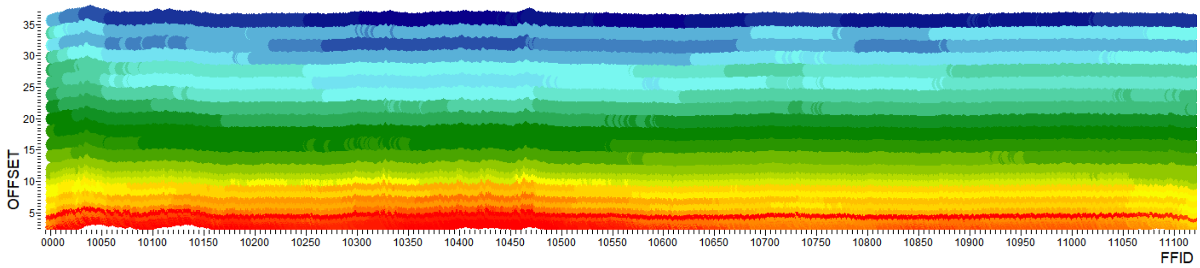
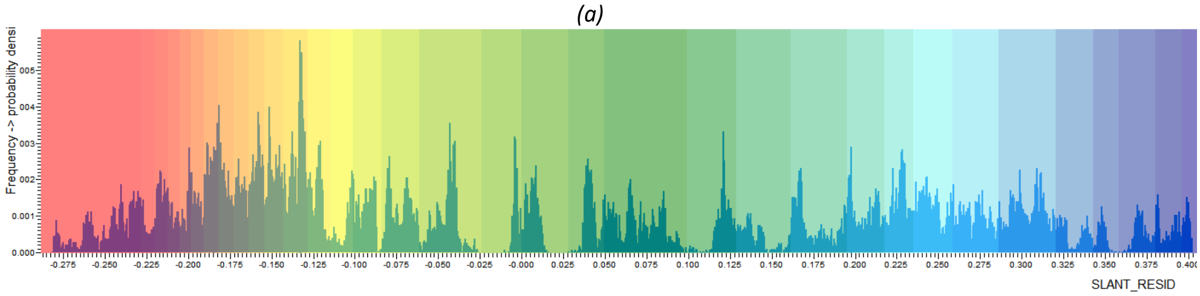


Figure 8 *– Source and receiver heave along profile TA2A911P1: source motion in blue and receiver motion in green. Vertical scales in TWT (ms).*

Although variable due to the strong currents of the site area, all the lines were acquired with a good streamer slant configuration. The far channels were towed ~1 m range deeper than near channels and in average 1.3 m deeper than channel 1. Figure 9 shows the streamer depth variation histogram (Figure 9 b) along an arbitrary seismic line (FFID) and for each channel the calculated relative cable depth (Figure 9 a). The new Common Offset Spatial Averaging (COSA) statics calculation uses the mean streamer depth as reference value and all the calculations for each channel are referenced to the streamer mean depth (zero value in the histogram). Hence, the histogram showing negative (shallower streamer section) and positive (deeper streamer section) values.



(a)



(b)

Figure 9 *– Example of streamer balancing along the profile TA2A931P2: (a) streamer depth variation per channel along the line (OFFSET represents the distance from the source to each channel) and (b) streamer depth histogram in milliseconds (TWT). The histogram (b) color scheme represents the streamer balancing upper image (a).*

3.4. CDP Fold

Impact of the steering, feathering and navigation on the CDP bin fold was assessed in a line-by-line basis with CDP fold track plots (Figure 10). With minor deviations, all processed lines show a mean CDP fold around 24. Trace fold header recorded values were used to assess the cumulative impact of steering & feathering, failed shots and missed records (i.e., bad shots) on the seismic data.

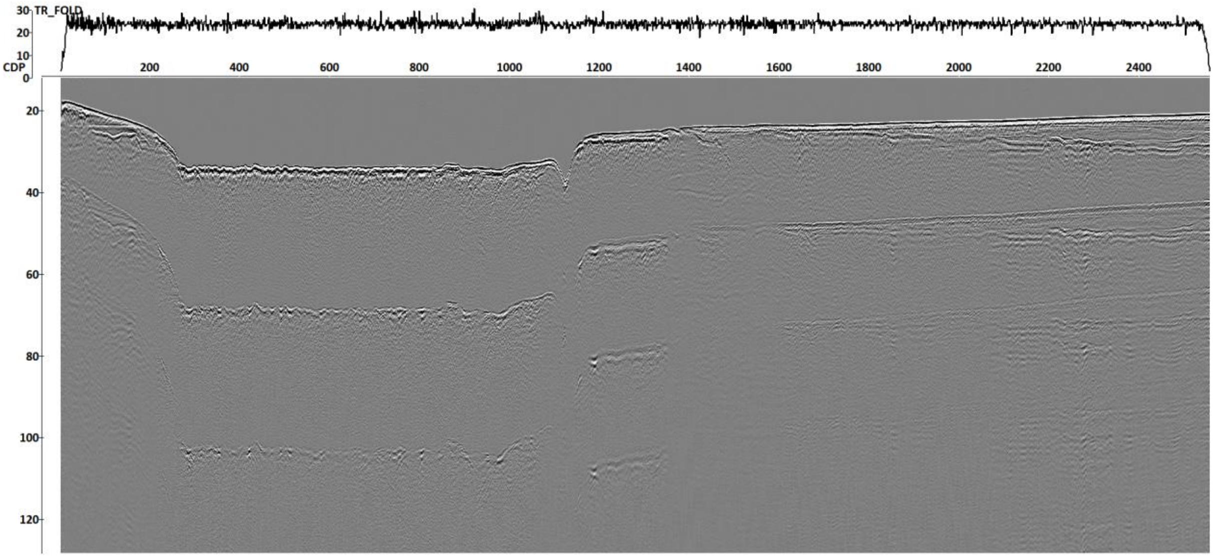


Figure 10 *– Trace fold values plotted on the top of stacked sections for line TA2A932R1. Vertical scale in TWT (ms).*

4. SEISMIC DATA PROCESSING SEQUENCE

Within the present chapter a detailed description of all processing flow track steps will be addressed.

4.1. Processing Sequence

The flow was divided into two main processing tracks: TRIM track and FINAL track (Figure 11). The main purpose of the TRIM track was to estimate a proper residual static correction for the swell, source and receiver groups motion. Another objective of the TRIM track stage is to output a depth converted dataset with the purpose of determining a set of vertical corrections (tidal corrections, mean streamer towing depth correction and seismic misties) for the seismic profiles in order to have the final dataset reduced to a common vertical datum (MSL). The procedure includes a series of diagnostic materials for concomitant quality control of the seismic processing steps, relevant to vertical datum reduction.

The aim of the FINAL track processing flow was to create fully processed seismic sections. FINAL track procedures included denoise, pre-stack deconvolution, pre-stack demultiple, receiver deghosting, NMO corrections and CDP ensemble stacking, post-stack multiple attenuation using zero-offset demultiple procedure, post-stack migration using Kirchhoff time migration to recover the true geometry of primary reflections, Time Variant BandPass Filter (TVBPF) and amplitude correction. Eight lines spread throughout the survey area with good signal penetration were used to perform the processing tests and to assign the Layer Cake velocity model.

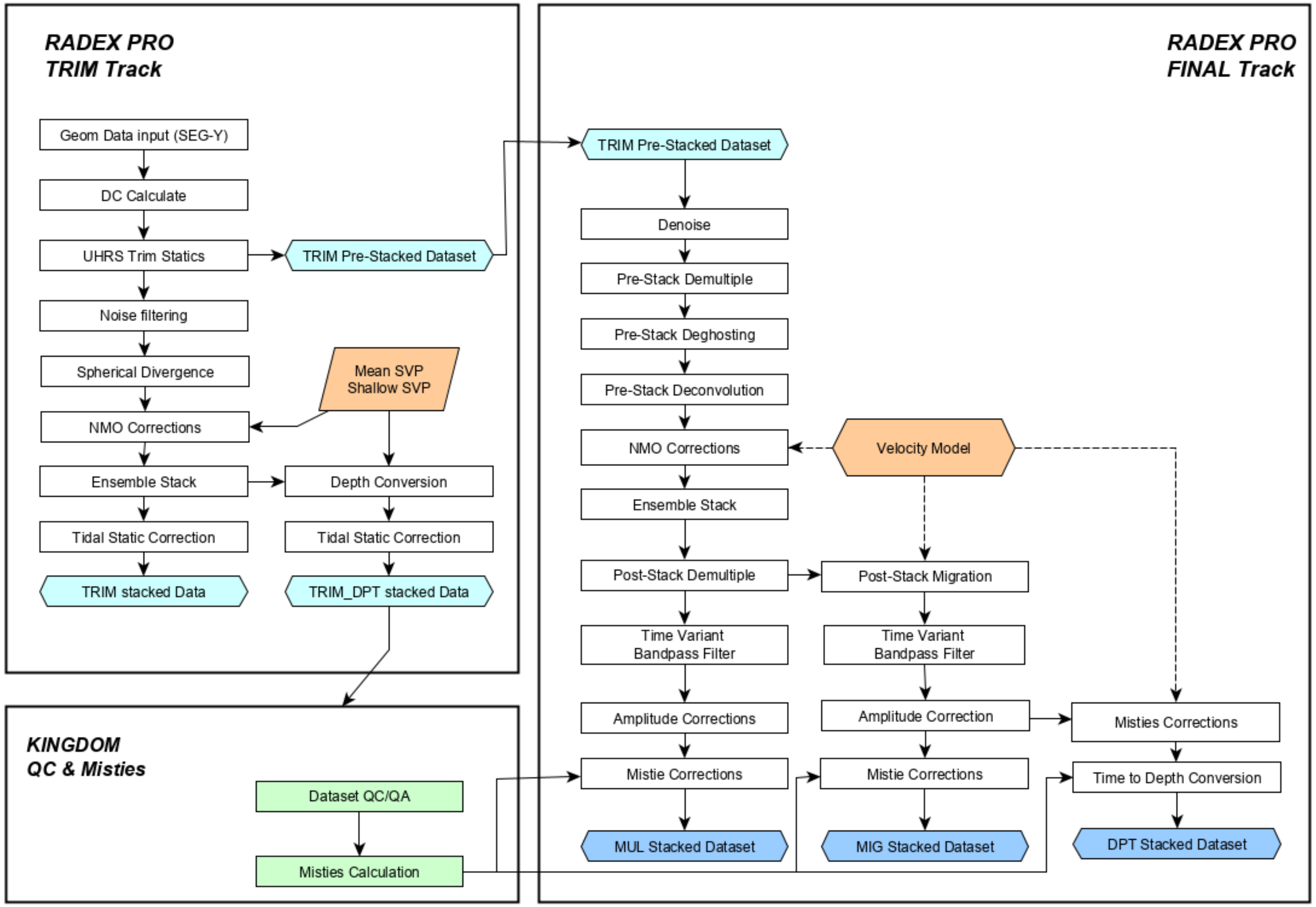


***Figure 11** – Processing workflow applied to all seismic lines.*

4.2. TRIM Track

The raw SEG-Y data acquired by GMSS had the following information on the headers:

- FFID number (Byte location 9);
- Channel number (Byte location 13);
- Source positions (SOU_X - Byte location 73, SOU_Y - Byte location 77);
- Receiver positions (REC_X - Byte location 81, REC_Y - Byte location 85).

The raw SEGY data was then imported into RadEx Pro (by GS personnel offshore) for data QC/QA, geometry assignment and tidal values import. The geometry was assigned using the crooked line method, with a bin size of 1 m. Crooked-line geometry assignment gives a truer picture of the subsurface when compared with other geometry assignment methods because it considers the angular relationships between the shots and their receivers.

After the geometry assignment on RadEx Pro, the positioning of all the nodes was checked by converting the positions into distances (offset). The offsets were converted into time using the measured water sound velocity (the sound velocity in the water was obtained from SVPs measured during the survey) and then compared to the direct arrival times (see Figure 6).

The GEOM SEGY dataset (raw data with filled headers - Linename_GEOM.sgy) was then exported with the additional headers filled:

- CDP number (CDP – Byte location 21);
- Source Receivers Offset (OFFSET – Byte location 37);
- CDP position (CDP_X – Byte location 181, CDP_Y – Byte location 185);
- Tide Height (TIDE_HGHT – Byte location 233).

The TRIM track is the first subroutine procedure used for the UHRS data processing.

4.2.1. DC removal

After loading the raw data, the DC removal was used to attenuate the DC bias of each channel. In this step the median DC bias is eliminated based on a moving average window which run per channel. The calculation window was limited between 100 and 190 ms.

4.2.2. UHRS TRIM Statics Estimation

The procedure to determine static corrections is an in-house-developed methodology and corresponds to a variation on the COSA method developed by Wardell *et al* (2002).

The data is reduced to a common local floating datum by deriving the main vertical relative motion components that affect the system:

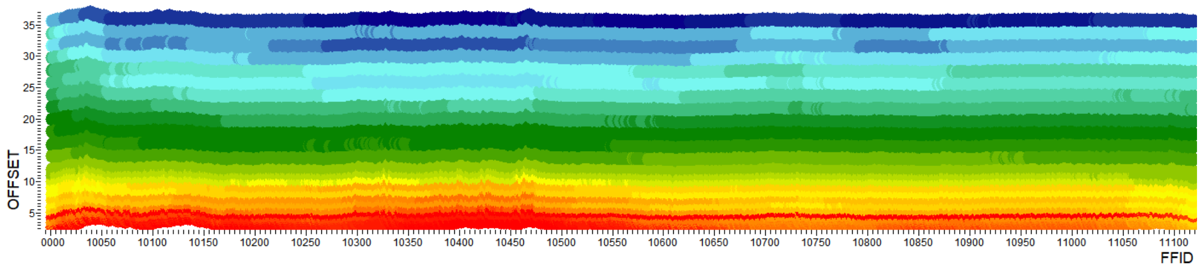
- Mean array depth;

- Mean cable slant;
- Source heave relative to mean array depth;
- Receiver heave relative to mean cable slant.

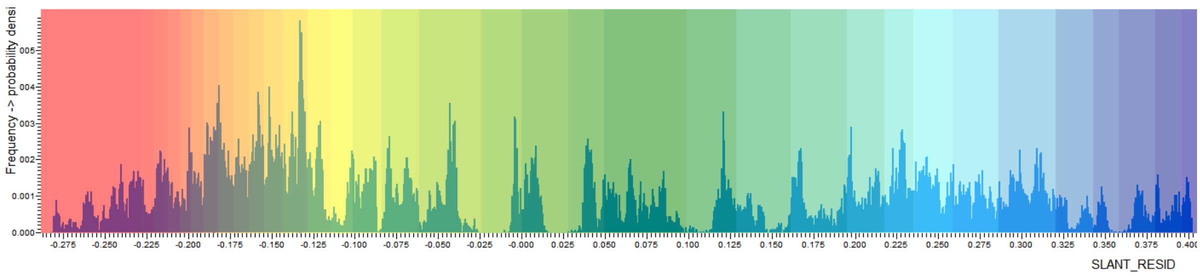
Static correction methodology calculates all the mentioned static components for every shot and every trace recorded and includes a trace-by-trace residual static correction procedure to compensate for the vertical motion of the towed equipment.

Mean Cable Depth

As previously mentioned, the mean cable slant is the mean of the depths of individual receivers relative to the mean array depth. This static component was used in order to assess the mean streamer depth variations during profile/acquisition (Figure 12) and to correct for the streamer depth.



(a)



(b)

Figure 12 *– Streamer depth relative to the mean array depth along the profile TA2A931P2: (a) streamer depth variation per offset along the seismic line and (b) histogram of the streamer depth relative to the mean array in milliseconds. The histogram values and colors correspond to a "color bar" for streamer relative depths – negative values correspond to channels that are shallower than mean array depth (warm colors - reddish) and positive values represent deeper channels (colder colors - purple).*

Source Heave and Receiver Heave

Source and receiver heave motion, among others, is a result of direct wave/swell action by lifting or lowering the towed equipment, source and the receiver, respectively. Therefore, source and receiver heave (Figure 13) corrections were applied to correct mainly for wave/swell related source and receiver motion during seismic data acquisition.

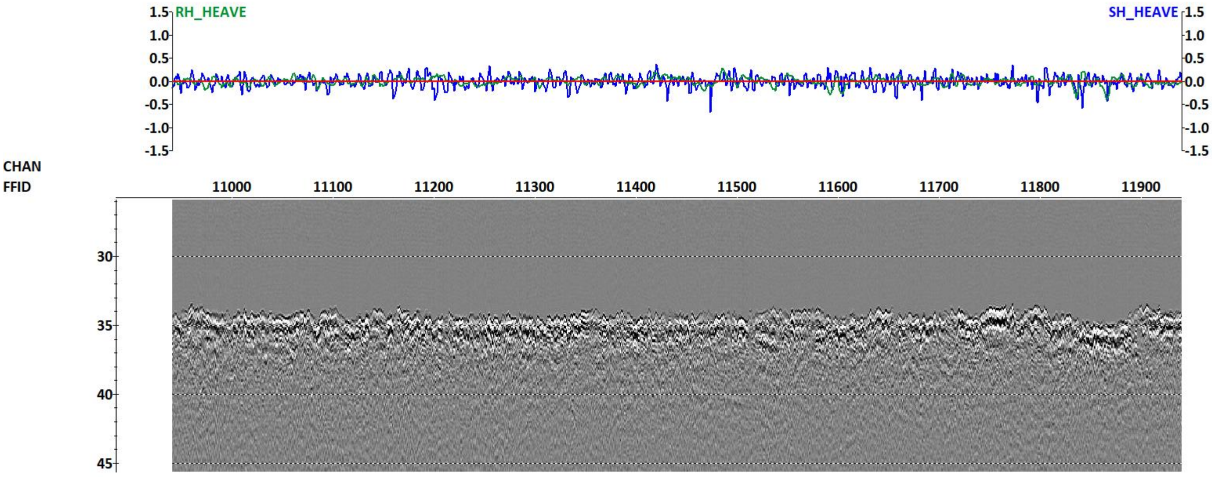
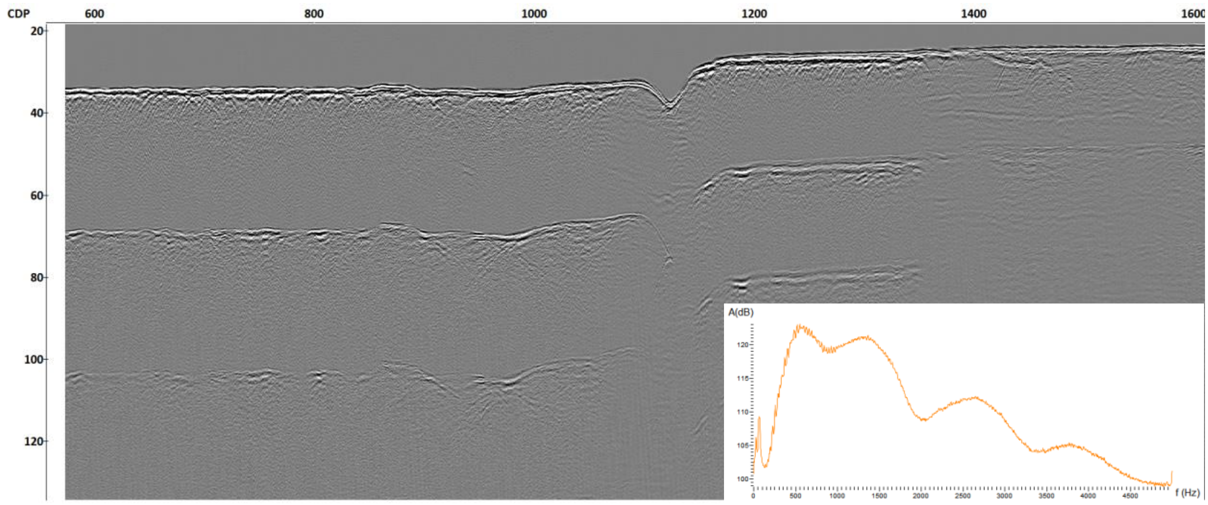
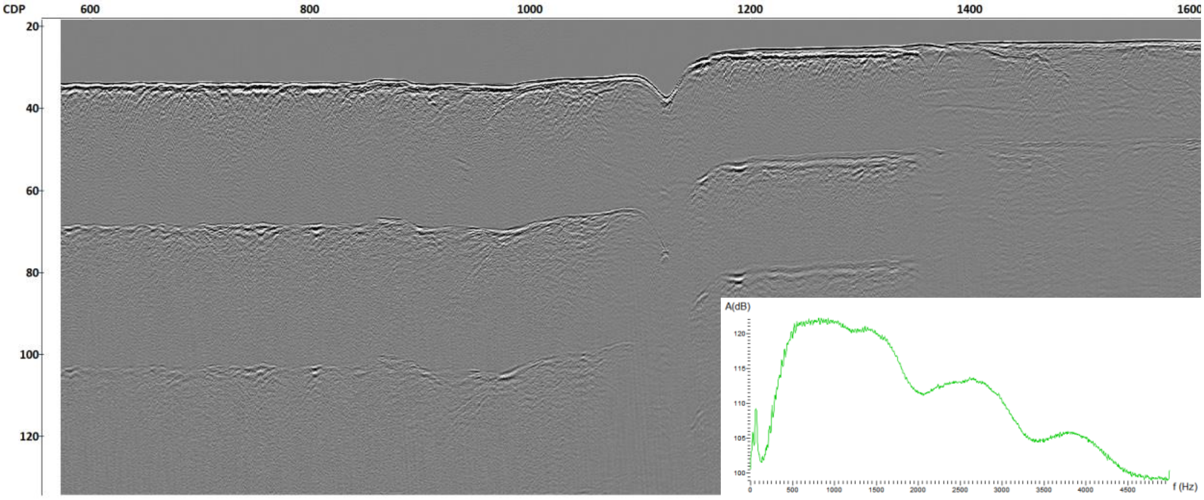


Figure 13 *– Source heave (blue) and receiver heave (green) for line TA2A911P1.*

Results from before and after the UHRS TRIM static corrections are shown in Figure 14 (a) and (b). As can be observed from Figure 14, greater detail is achieved as higher frequency components of the signal are stacked coherently.



(a)



(b)

Figure 14 *– Line TA2A932R1 (a) before and (b) after UHRS TRIM static corrections. Vertical scale in TWT (ms).*

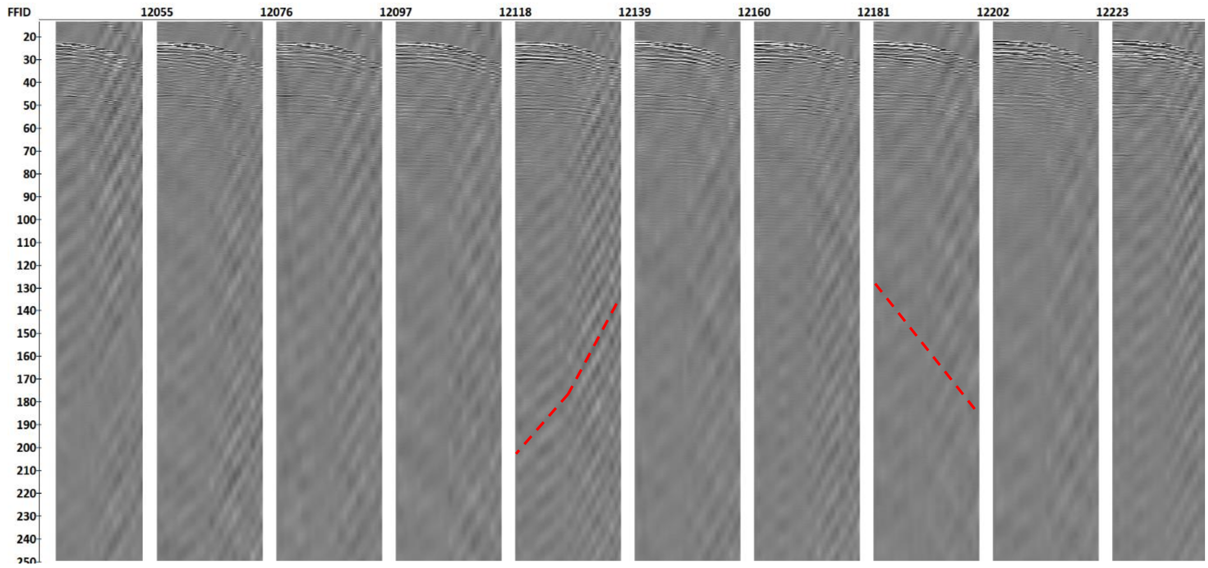
4.3. FINAL Track

Within the present chapter, a detailed description of the processing FINAL track flow steps will be addressed.

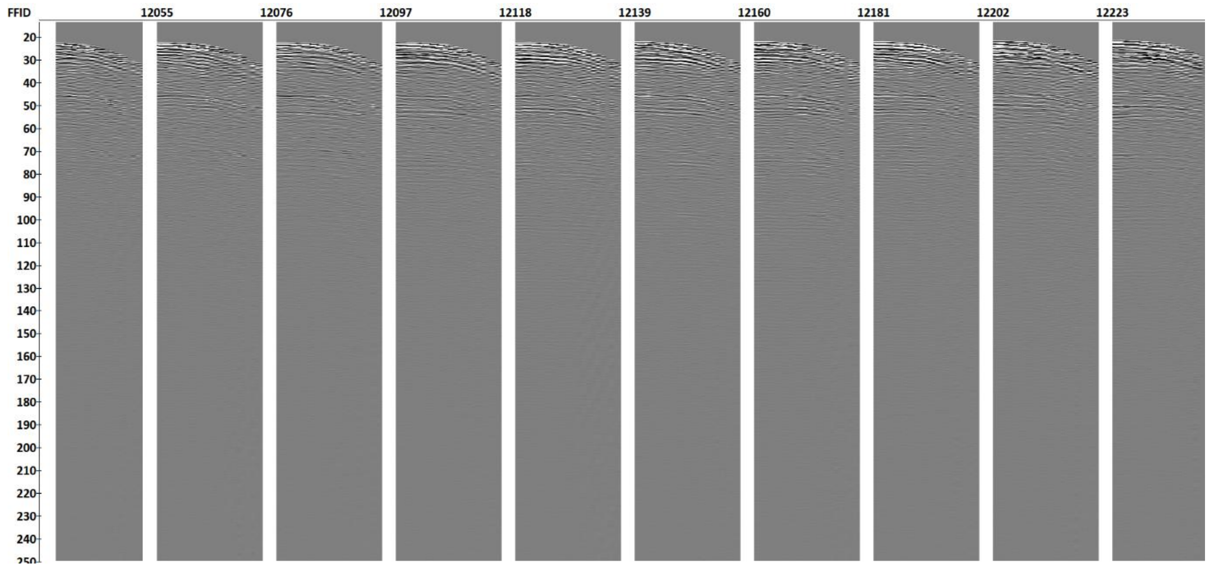
4.3.1. Noise Filtering

F-K filtering was used for directional noise removal/attenuation such as streamer tugging, vessel noise and low frequency burst noise. The F-K filter was tailored specifically for each type of data allowing a better overall S/N ratio result (Figure 15). On Figure 15 the red dash line shows the directional vessel and tugging noise before F-K filter.

In order to preserve the signal, the F-K filter was applied after NMO correction to ensure that none of the geological alignments were lost in the filtering process.



(a)

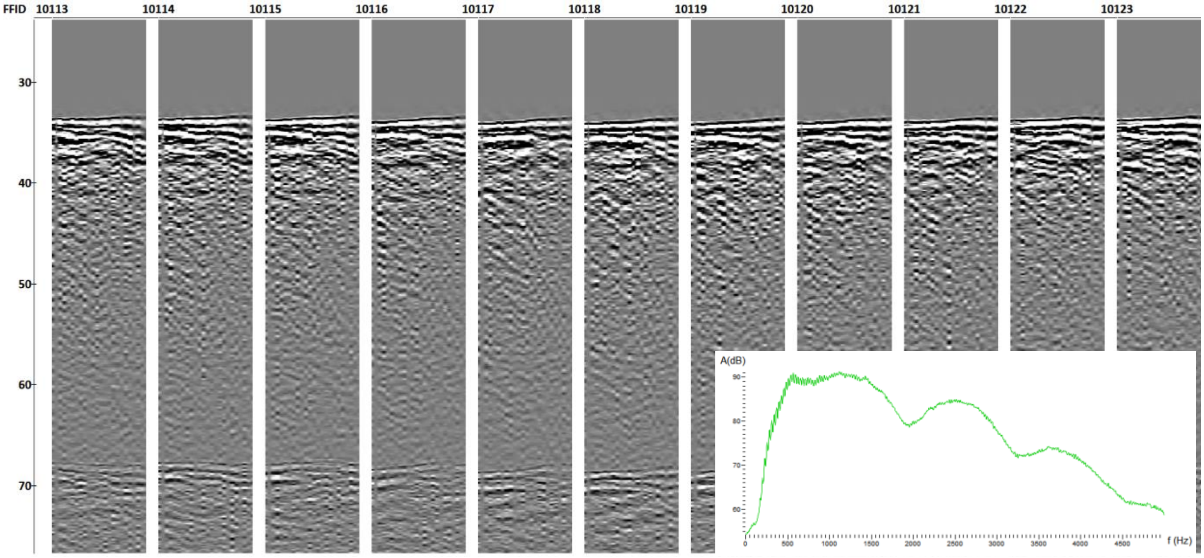


(b)

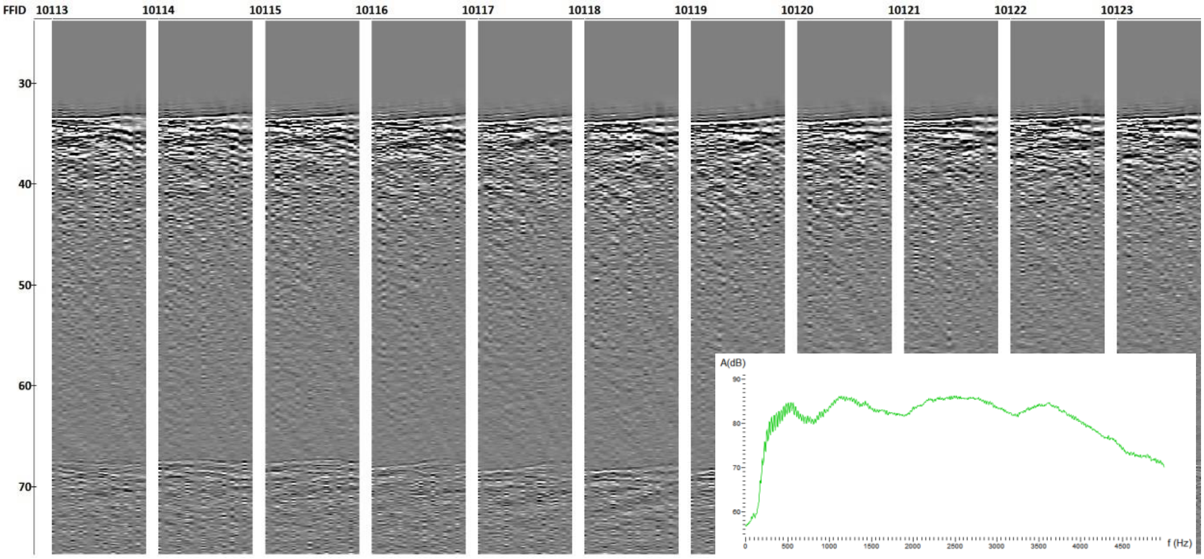
Figure 15 *– Shot gather of profile TA2A32R1: (a) before and (b) after F-K filtering. Vertical scale in TWT (ms).*

4.3.1. Pre-stack Deconvolution

A pre-stack source deconvolution was used to collapse the outgoing primary source pulse. The reference lines were used to generate the source signature, which was modelled using the seabed primary reflection. The deconvolution was performed using the "Custom Impulse Trace Transforms" module using the extracted signature. The deconvolution operation procedure was assessed for its effectiveness by comparing the same seismic data prior and after deconvolution (Figure 16 a) and b). It is noticeable a thinner seabed arrival and a flatter frequency spectrum. In general, results show a compression of the basic wavelet and an overall increase of vertical resolution of the seismic profile (Figure 16). Zero-phasing occurs at this stage of the processing flow.



(a)



(b)

***Figure 16** – Line TA2A911P1 in shot domain (a) before and (b) after pre-stack deconvolution. Vertical scale in TWT (ms).*

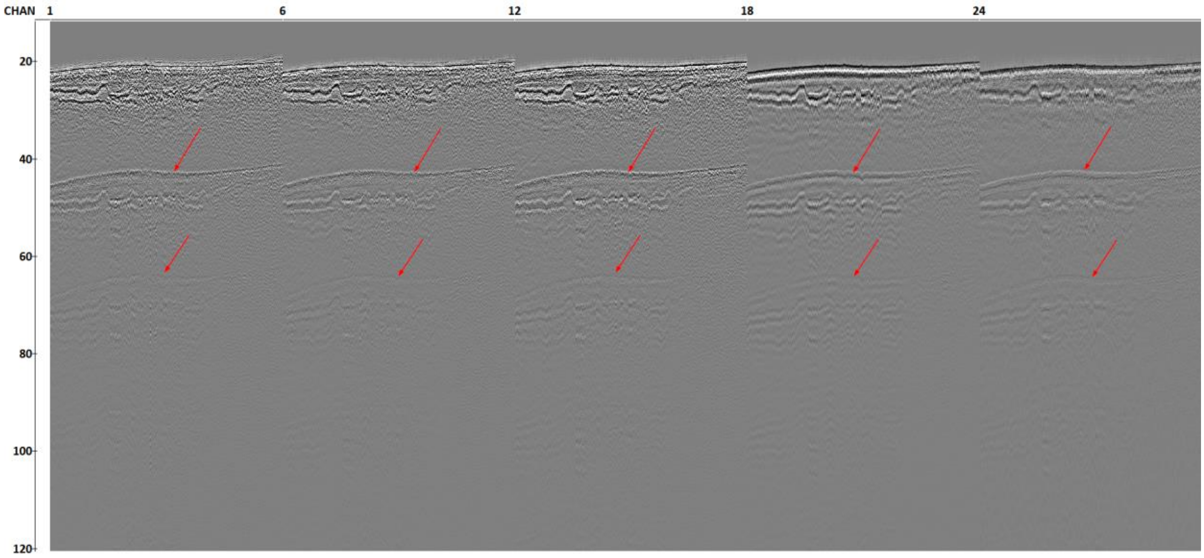
4.3.2. Pre-stack Multiple Attenuation (SRME & Tau-P domain)

Surface-related multiple elimination (SRME) was used to attenuate surface related multiples in the seismic data by utilizing the reflections in pre-stack seismic data to predict surface multiple models. SRME does not require subsurface information, but it predicts a model of the surface multiples from water surface information.

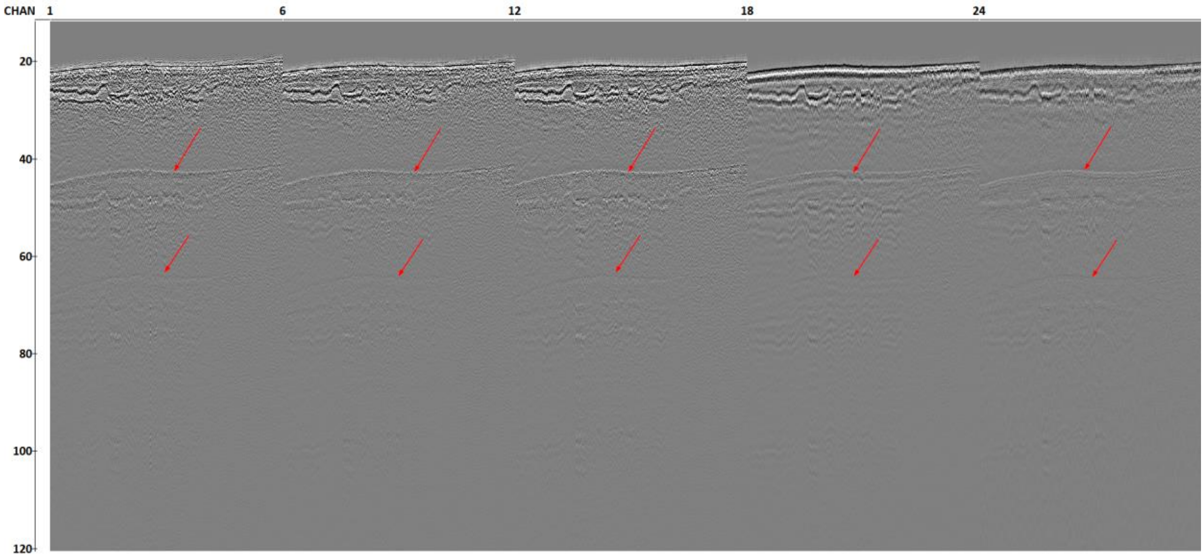
Pre-stack multiple attenuation specific procedure is based on the adaptive subtraction of the prementioned SRME model of multiples. A multiple attenuation technique named “Wave Field Subtraction” was used within the pre-stack multiple attenuation procedure to attenuate the seismic data multiple energies in order to improve geology imaging at multiple depths.

Besides the SRME, a Tau-P domain demultiple was applied in order to attenuate better the reminiscent multiple in the data without affecting primary energy.

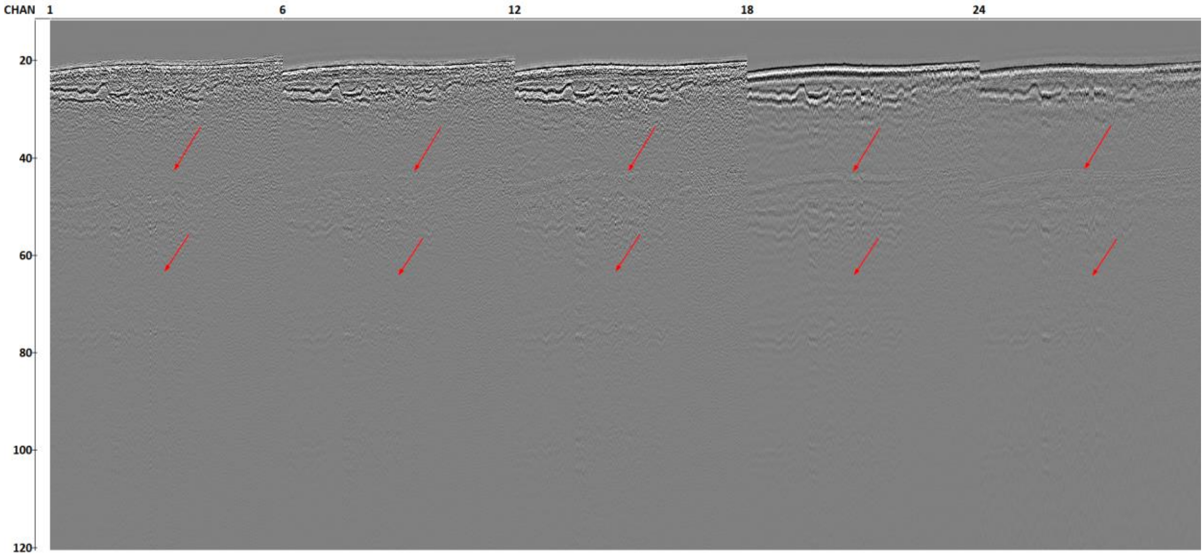
The processing parameters applied in the previous mentioned procedures were specifically tailored for this project in order to achieve the best possible results (Figure 17).



(a)



(b)

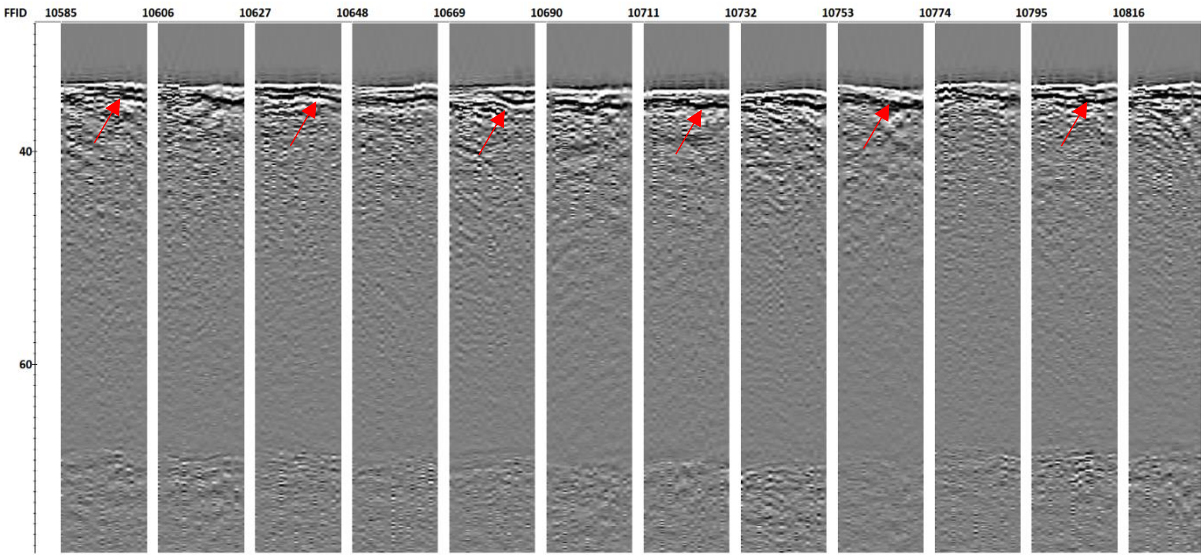


(c)

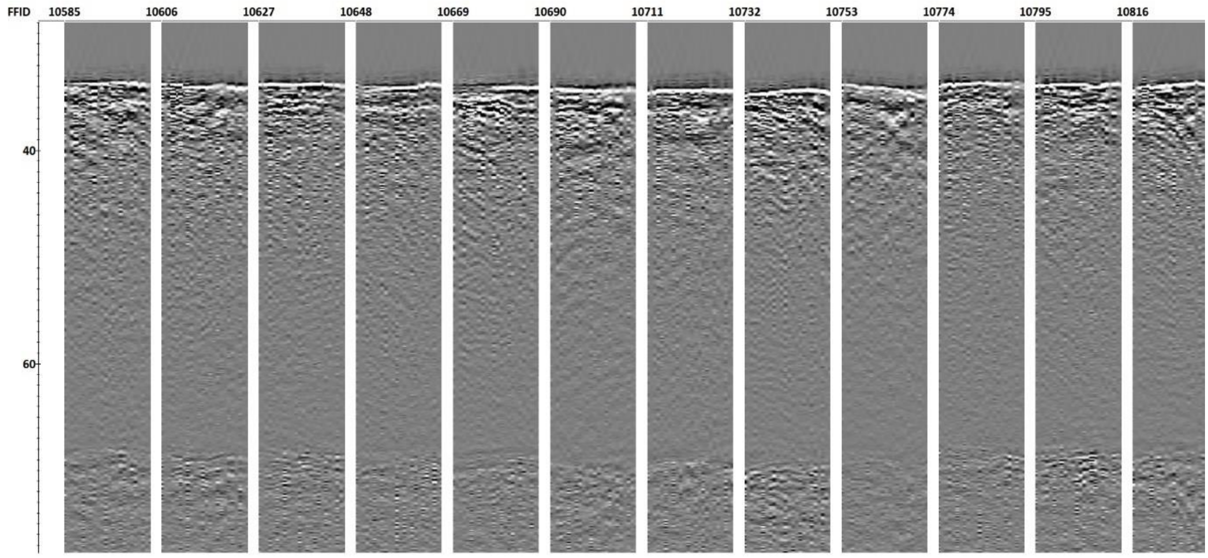
Figure 17 *– Line TA2A924P1 showing 500 shots for channels 1,6,12,18 and 24 (a) before, (b) after the SRME pre-stack multiple attenuation in shot domain, and (c) after the demultiple attenuation in Tau-P domain. Vertical scale in TWT (ms).*

4.3.3. Pre-Stack Deghosting

A pre-stack deghosting procedure was applied to the data, in order to further attenuate the receiver ghost present in the data. For that purpose, a RadexPro deghosting procedure, that consists on a forward and reverse time recursive filter, was implemented on the processing flow, to predict and subtract the receiver ghost wavefield in pre-stack domain, on the seabed and near seabed reflectors (Figure 18).



(a)



(b)

Figure 18 *– Shot gather of line TA2A911P1 showing few FFIDs (a) before and (b) after Pre-stack deghosting. Orange arrows point for the receiver ghost clearly attenuated after deghost. Vertical scale in TWT (ms).*

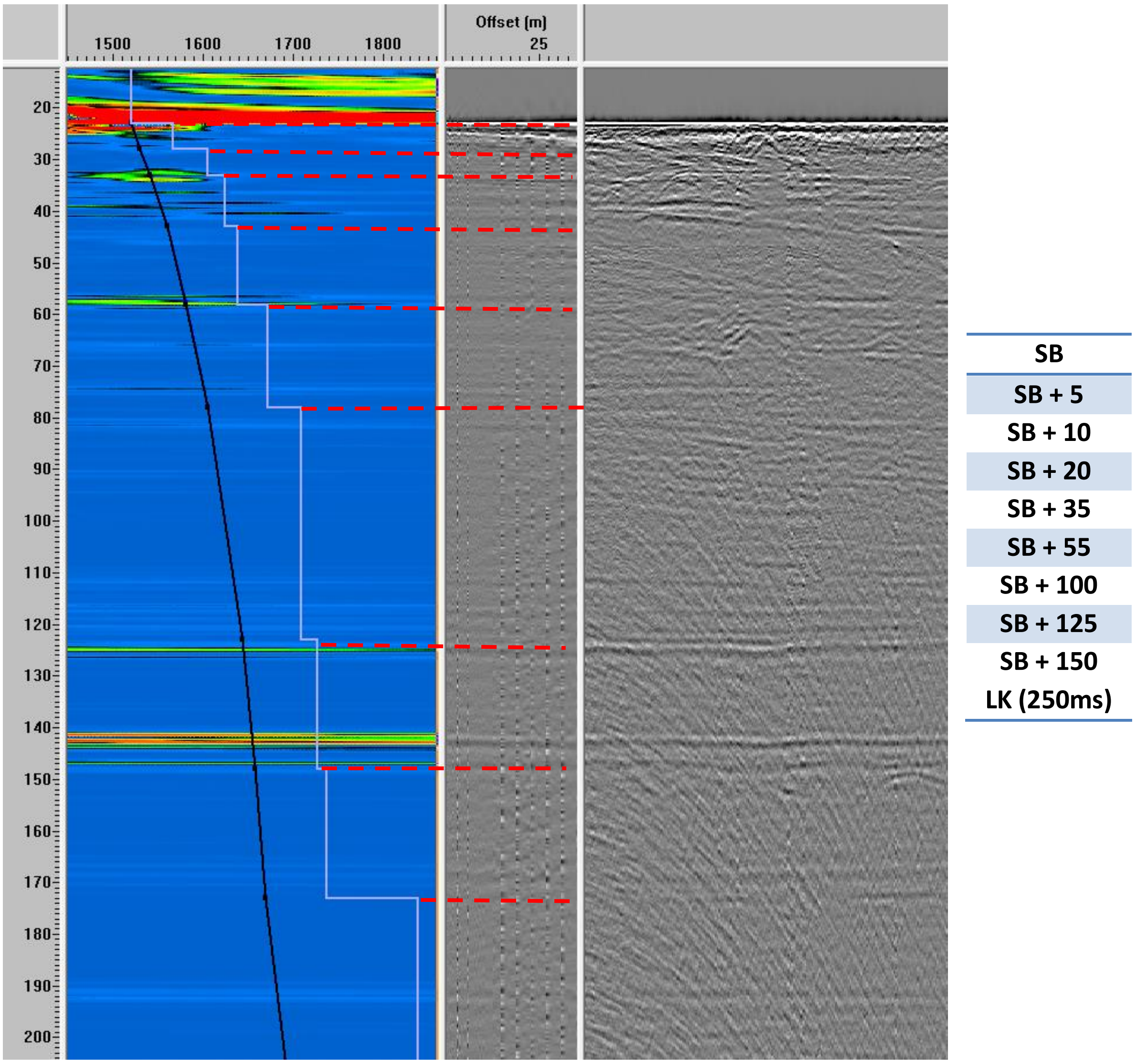
4.3.4. "Layer cake" velocity model

A good velocity model is the basis for: NMO and stacking (signal to noise ratio improvement), geometrical corrections (migration) and appropriate conversion from time to depth.

The velocity model used in this project is a "layer cake" model, shown in Table 4 and Figure 19:

- uses the seabed of each line as a reference;
- assumes a "layer cake" geological structure, therefore considers that all the layers/units are parallel to the seabed;
- the model is "closed" by using a last knee on 250 ms.

The "layer cake" velocity model was generated based on the interactive velocity analysis picked on the reference seismic profiles (Figure 19). This velocity model underwent to a series of iterations, adjustments to archive the best possible velocity model, keeping in mind that will be always a compromise between effectiveness and good adjustments.



(a) *(b)*

Figure 19 *– (a) Interactive Velocity Analysis for line TA2A918P1 (CDP 1850). Black line represents the RMS velocity and the grey line the interval velocity; (b) layers represented (values indicate position in ms below seabed).*

Table 4 *– Velocity model used for stacking and depth conversion.*

Layers (time below seabed - ms)	***Interval Velocity (m/s)***
SB	*Mean SVP*
5	*1567*
10	*1605*
20	*1624*
35	*1639*
55	*1672*
100	*1709*
125	*1727*
150	*1737*
LK (250 ms)	*1839*

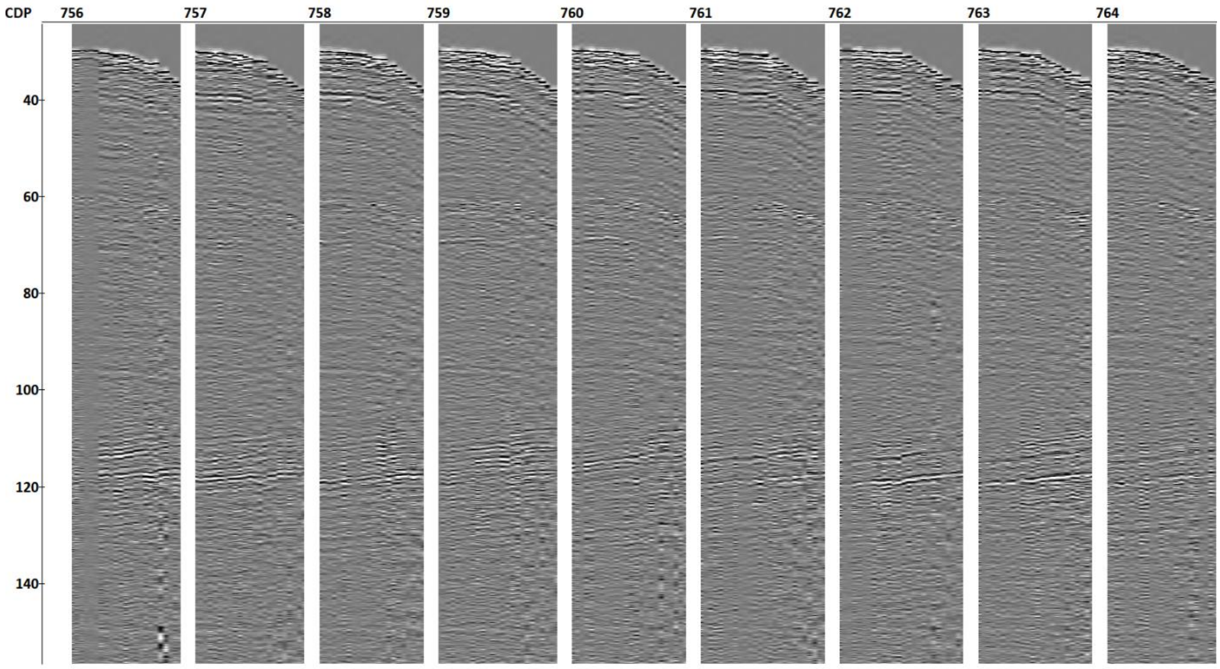
The presented velocity model flattens the seismic reflectors in most portions of the seismic lines. However, this method assumes a “layer cake” geology, which is not always the case, due to lateral seismic variations and depth differences of the same horizon/unit. Therefore, the assignment of a “layer cake” velocity model represents always a compromise. This velocity model was used to archive the final seismic sections in two-way time (for NMO and migration) and the depth converted seismic data. Although, those models are slightly different:

- Stacking velocity model - the velocity model used for stacking purposes used a different velocity for the water column per line, that corresponds to the SVP Mean of the respective seismic profile;
- Depth conversion velocity model - the velocity model used for depth conversion used a single velocity for the water column for all the seismic profiles, which corresponds to the SPV mean for all the surveyed area (1515.7 m/s).

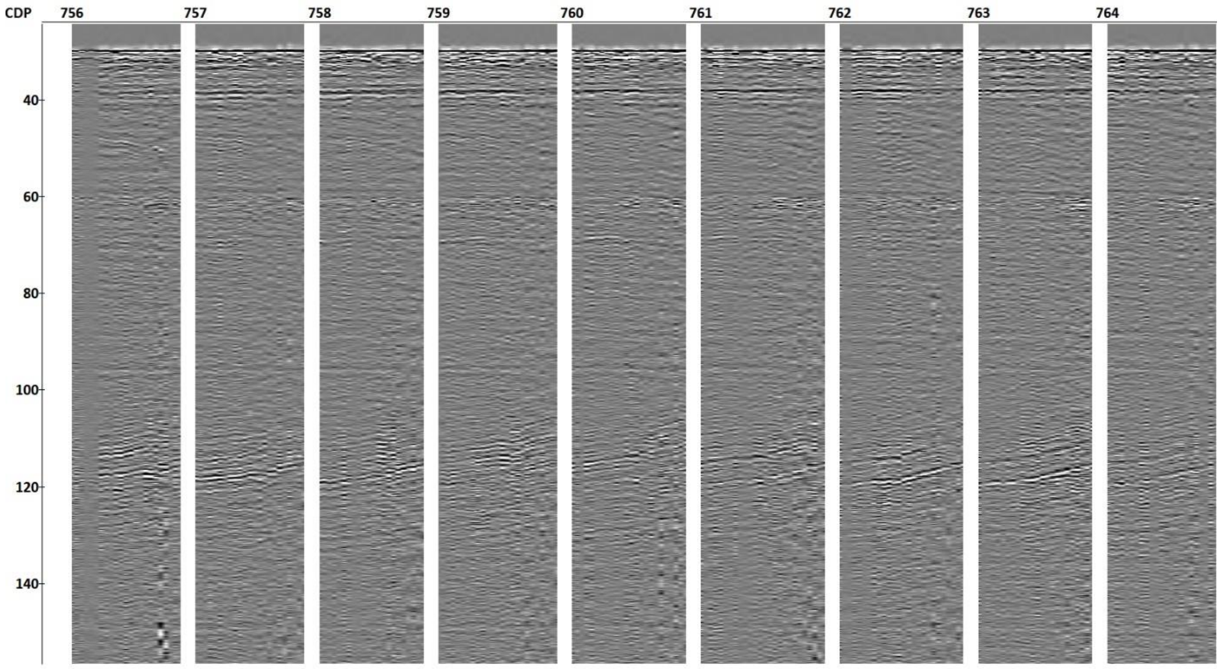
4.3.5. NMO Correction and Ensemble Stack

The RMS layer cake velocity model (for every individual CDP) was used to apply the NMO corrections to the CDP gathers. As it is shown in Figure 20 a) and b), the velocity model assigned for each seismic line flattens the reflectors in most portions of the seismic lines, showing that this methodology represents a good compromise.

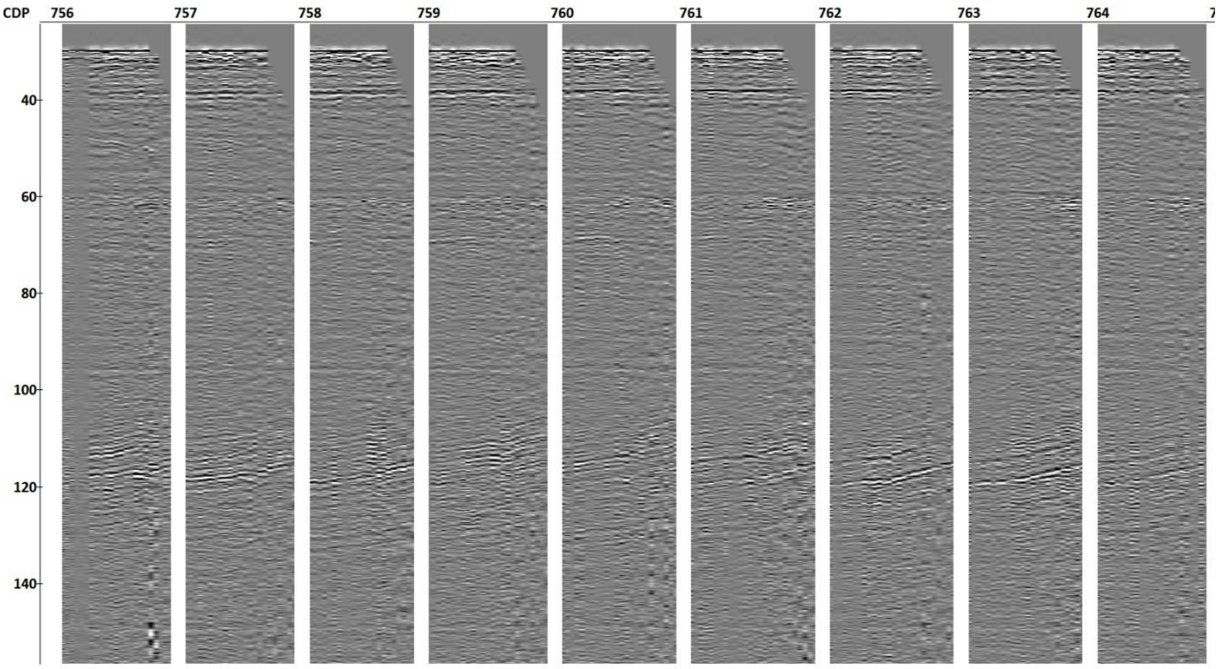
In order to optimize the offsets contributing to the stack near the seabed, the CDP gathers were stacked using a top muting window to remove data with ray path angles above 40° (Figure 20 c). An alpha trimmed mean with a rejection of 40% of the sample outliers were used for stacking as a mean to reject the occasional burst/spikes as well as to prevent the coherent stacking of the receiver ghost.


CDP
756
757
758
759
760
761
762
763
764
40
60
80
100
120
140

(a)


CDP
756
757
758
759
760
761
762
763
764
40
60
80
100
120
140

(b)



(c)

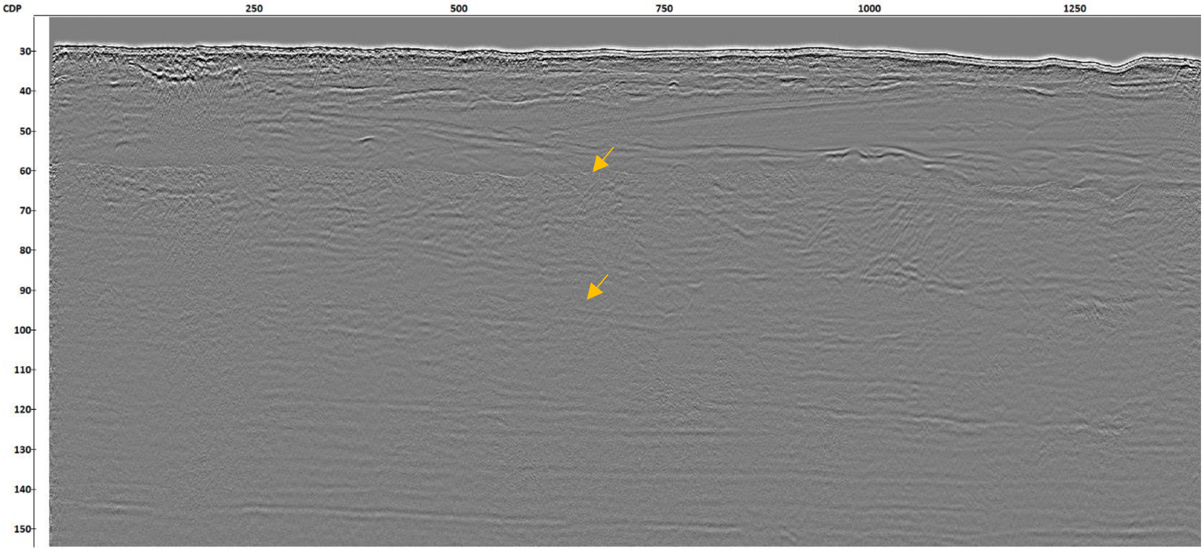
Figure 20 *– Shot gather for line TA2A915P1: (a) before NMO, (b) after NMO correction using the layer cake velocity model, and (c) after removing data with ray path angles above 40°to remove the far offsets close to the seabed. Vertical scale in TWT (ms).*

4.3.6. Post-stack Multiple Attenuation

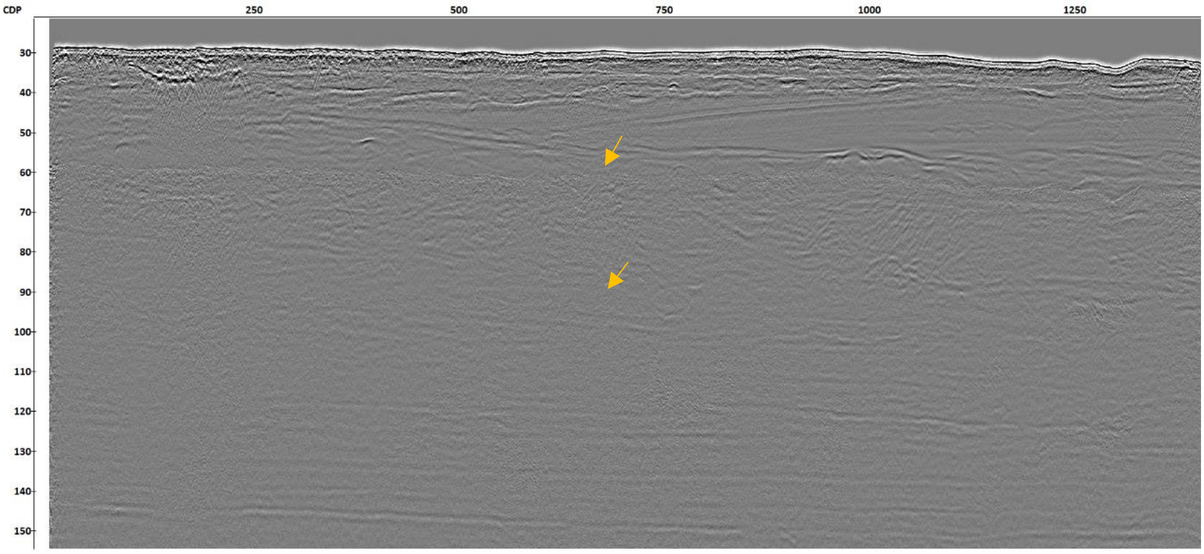
For an improved seismic imaging at multiple depths, the post-stack multiple attenuation procedure was applied using a surface-related multiple attenuation technique called “Zero-Offset DeMultiple”. This procedure modelled and attenuated the remaining multiple energy train, mainly the internal multiples, left after pre-stack demultiple.

The post-stack multiple attenuation is based on the adaptive subtraction of a model of multiples. The model of multiples was determined from the data itself by auto-convolution of the traces. This technique allowed for a fine-tuned search and attenuation of the data multiples.

Figure 21 outlines the before and after the post-stack demultiple. It is possible to observe multiples losing their relative significance (see orange arrows) and the recovery of otherwise concealed seismic information.



(a)



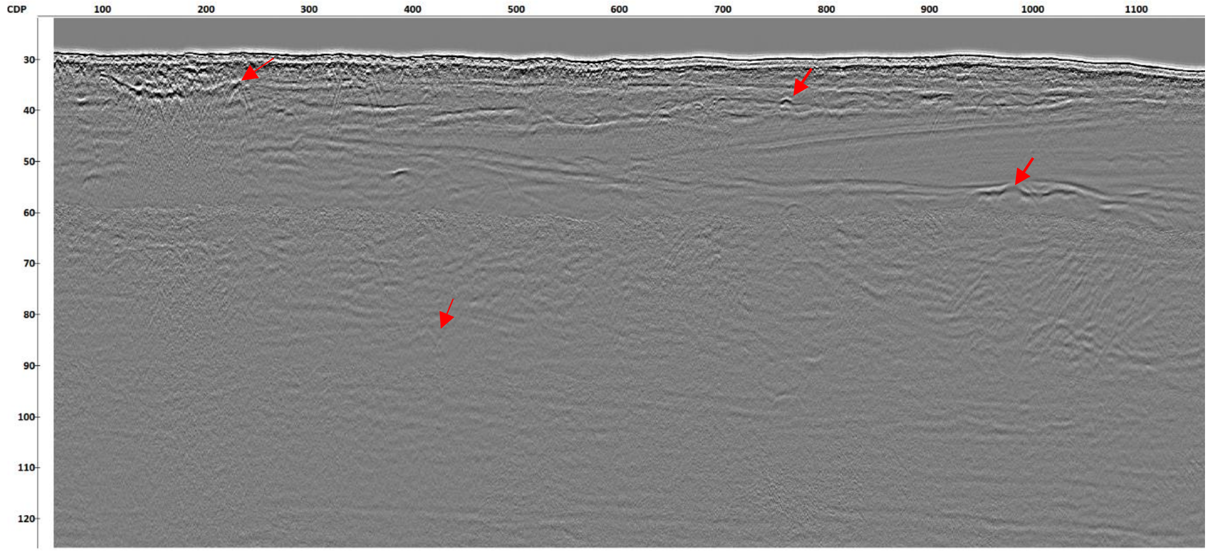
(b)

Figure 21 *– Line TA2A915P1 (a) before and (b) after post-stack multiple attenuation procedure. Vertical scale in TWT (ms).*

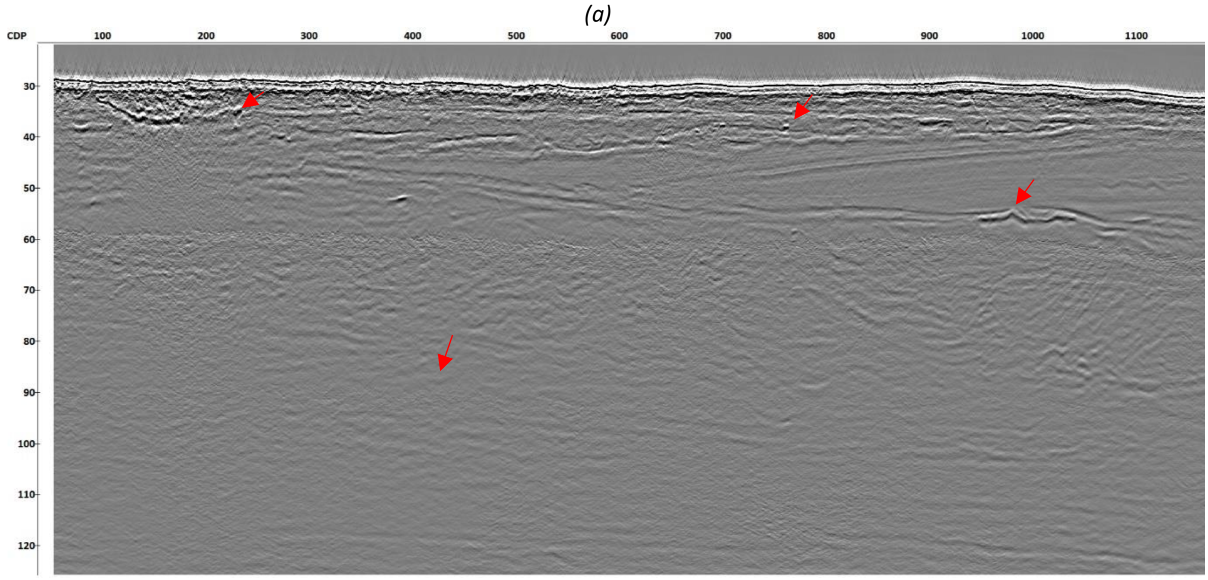
4.3.7. Spatial Interpolation and Post-stack Kirchhoff Time Migration

To prevent spatial aliasing during the migration procedure the stacked datasets were interpolated to a distance of 0.1 m between traces, as opposed to the initial 1 m spacing.

The post-stack Kirchhoff time migration is a time domain processing module used to migrate the seismic data. The layer cake velocity model was used to perform the Kirchhoff time migration, with a maximum frequency of 5000Hz. The aperture parameters were fine-tuned in order to achieve the best results according to the type of data. Best imaging was obtained with 2D shaping filter and no anti-aliasing filter. Results are shown in Figure 22, where red arrows highlight spots where the post-stack migration procedure is more visible.



(a)



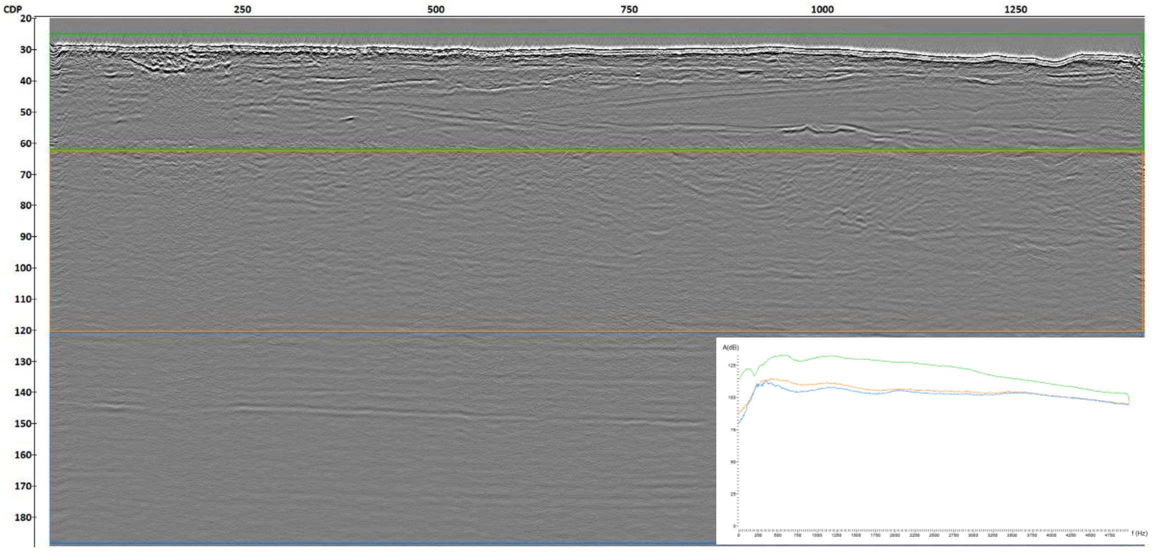
(b)

Figure 22 *– Line TA2A915P1 (a) before and (b) after Post-stack Kirchhoff time migration. Vertical scale in TWT (ms).*

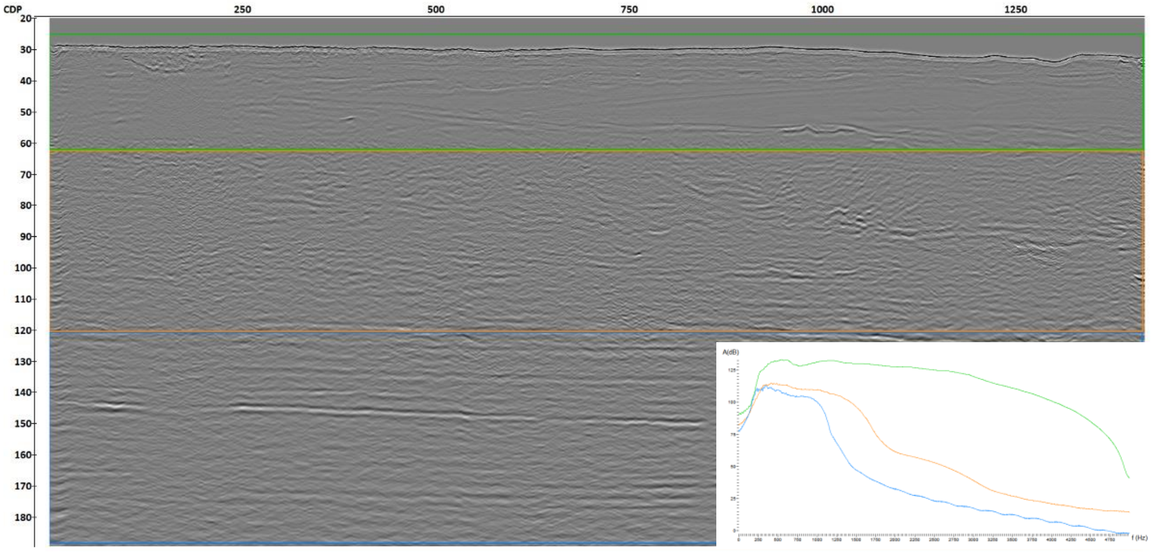
4.3.8. TVBPF Filtering and Amplitude Correction

In order to improve S/N at depth, without reducing the relevant spectrum bandwidth of the signal, an Ormsby Time Variant BandPass Filter (TVBPF) was applied to the data. Having the seabed as a reference, higher frequencies are filtered with increasing depth. A well-balanced frequency spectrum was achieved as high resolution is maintained over the recorded signal length.

The amplitude correction strives to provide a seismic section in which the seismic amplitudes accurately portray the values of the reflection coefficients at different depths trying to correct the loss of energy by different means, i.e., spherical divergence. An amplitude correction procedure was implemented in order to mitigate those losses. A gain curve was calculated for each trace and then applied to the dataset. The combined results of those processes TVBPF and amplitude correction are shown in Figure 23.



(a)



(b)

Figure 23 *– Line TA2A915P1 (a) before and (b) after applying TVBPF and amplitude correction. Vertical scale in TWT (ms).*

4.3.9. Tidal correction and MSL Reduction

Provided by Fugro, tidal values were derived from post-processing GNSS. The tidal values were imported into the UHRS data headers by GS during the offline QC procedure on board, using the seismic processing software RadEx Pro. This header was applied to the stacked sections and the velocity model in order to correct the tidal shift of the data, on a trace-by-trace basis.

When the tidal correction is applied, the data can be corrected in terms of misties, i.e., the small shift between lines that occurs due to swell, static corrections, feathering, among others. Once the misties are corrected and the data is all in the same “seismic datum” it was calculated the residual correction (bulk shift) to all data, necessary to reduce it to the required vertical datum (MSL). This procedure was performed in Kingdom Suite and was based on the bathymetric information (MBES) provided by Fugro.

4.3.10. Time-to-Depth Conversion (Layer Cake Velocity Model)

The TWT migrated sections were converted to depth, using the layer cake velocity model (see section 4.3.4). The depth conversion velocity model of each seismic line, in both RMS and interval velocities, were exported in SEG-Y and ASCII formats.

Due to the nonlinear relationship between time and space (a sample in time at shallow depths represents a much smaller distance than a sample in time at greater depth) and in order to preserve maximum resolution, the sample interval of the DPT datasets is half of the maximum graphical resolution of 10 cm that the system can achieve at shallow depths, i.e., 5 cm. Therefore, the data in depth has a greater number of samples than the datasets in time (MUL and MIG).

5. PROCESSED DATA QUALITY CONTROL

Quality control procedures were carried out throughout the processing scheme, as detailed within the present report. All processing steps were checked for the proper application of the seismic imaging enhancement. Several of these quality controls were delivered as part of this project submission, such as trace and offset QC; streamer slant check; source and receiver heave; image of the TRIM stack (including CDP trace fold) and stack image of the final unmigrated and migrated dataset (FINAL track).

Furthermore, at some stages, quality control supervision was carried out by the project's Principal Processor to ensure that the seismic processing was being properly applied as well as for troubleshooting purposes.

The most relevant issues, that presented a specific effect on processing and imaging, are addressed in the following sections.

5.1. External noise from other vessels

As show on Figure 24 vessels, mainly tug and cargo vessels, frequently passed by near the survey vessel. This was to be expected as the survey area is located near the entrance of the Maasmond channel. The vessel noise and the wash resultant from their transit, affects the data and introduces noise in the seismic records, caused by the vessel noise itself and the streamer being pulled by the wash (Figure 25 and Figure 26). This type of noise presents variable direction along the line, as the direction varies with the relative position and distance of the noise source and the seismic receivers, making it unfeasible to be removed/attenuated during post-processing.

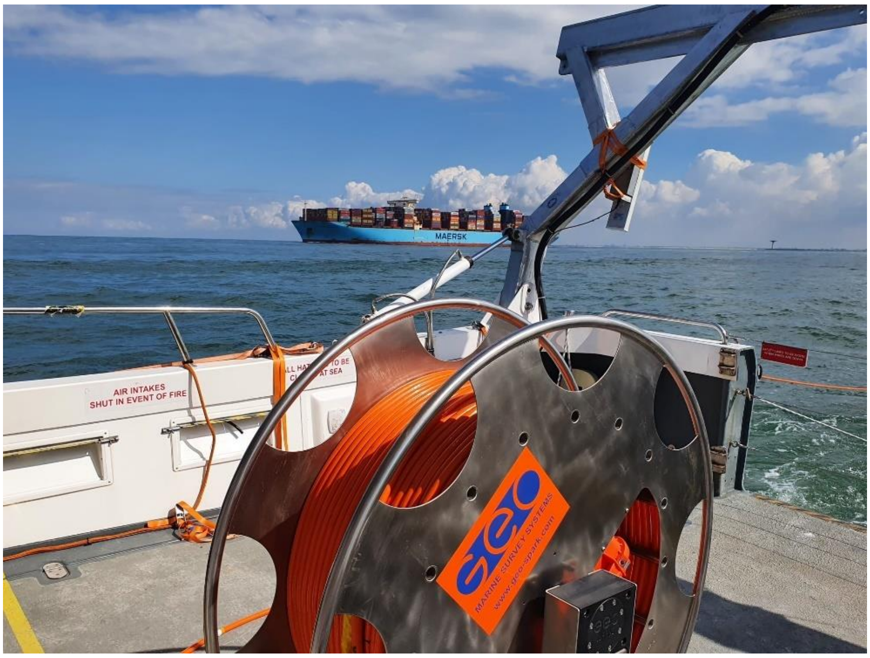
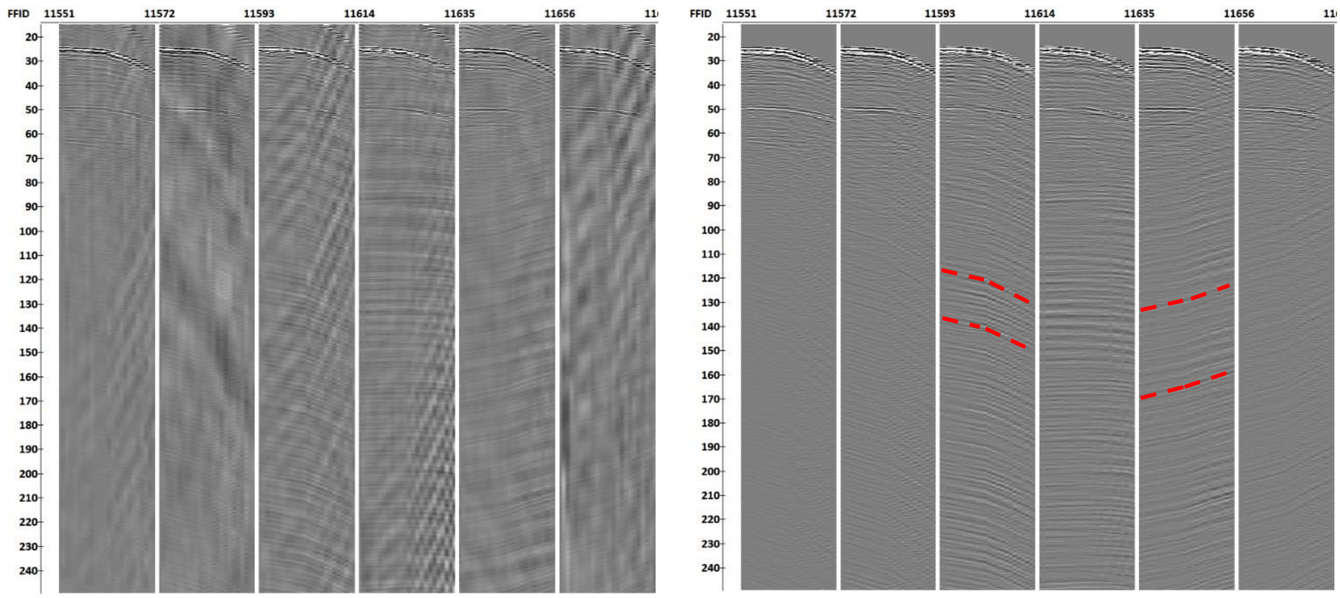


Figure 24 *– Large cargo vessel passing by near the Fugro Seeker during acquisition.*



(a) (b)

Figure 25 *– Shot gather (a) before noise filtering, (b) after noise filtering for the line TA2A907P1. Vertical scale in TWT (ms).*

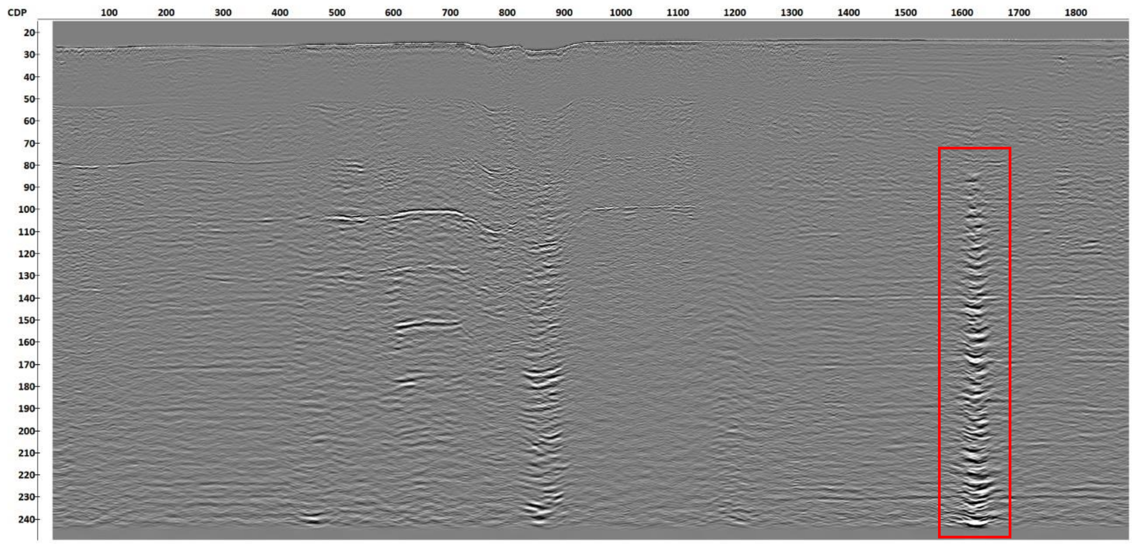


Figure 26 *–Staked image with noise from large vessels passing by for Line TA2A907P1. Vertical scale in TWT (ms).*

5.2. Shallow gas compromising signal penetration

Along the survey site, mainly on the south area, various indicators of shallow gas were identified in the data, including acoustic blanking and enhanced reflections. Acoustic blanking anomalies, the most common ones, are caused by absorption of acoustic energy due to the presence of gas and are seen in the range 3–200 ms (TWT) below seabed (blue boxes in Figure 27). This fact compromises signal penetration, where there are no evidences of seismic reflections underneath these gas layers.

Furthermore, some processing techniques are endangered, such as, the deconvolution and demultiple procedures.

Where there are no evidences of shallow gas, good data penetration is achieved along the lines, higher than 150 ms (red arrows in Figure 27).

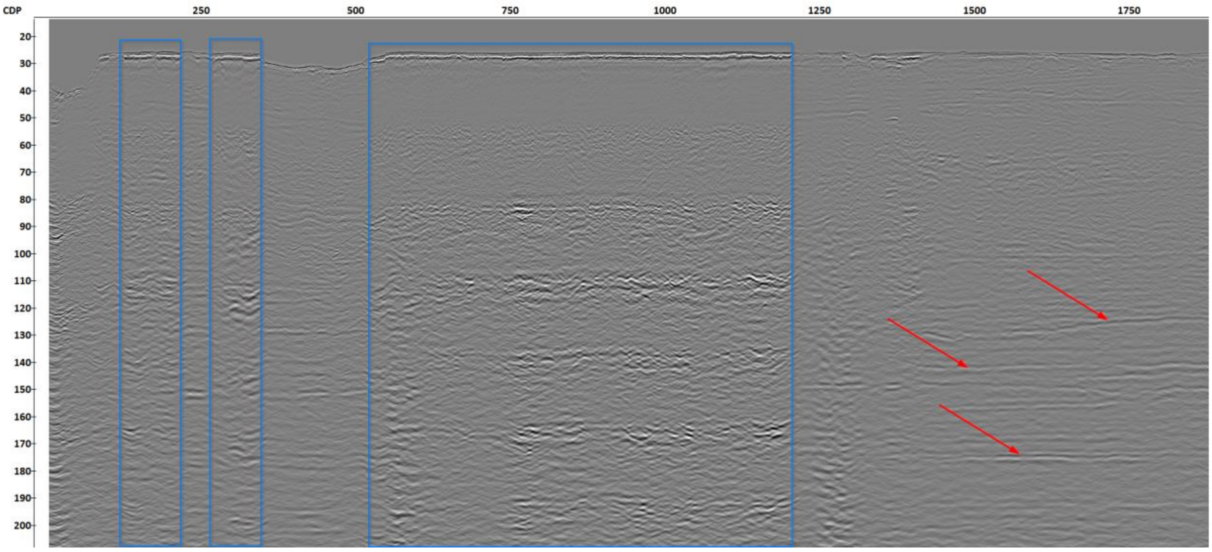


Figure 27 *– Line TA2A916P1 with potential shallow gas highlighted in blue and primary signal highlighted in red. Vertical scale in TWT (ms).*

6. DELIVERABLES

From the UHRS data and after the UHRS data processing scheme the following digital deliverables were produced:

1. Multiple attenuation stacks (SEGY file) – Linename_MUL.sgy;
2. Migrated stacks (SEGY file) – Linename_MIG.sgy;
3. Depth converted migrated stacks (SEG-Y file) – Linename_DPT.sgy;
4. Interval Velocity Model (SEGY file) – Linename_VEL_INT.sgy;
5. RMS Velocity Model (SEGY file) – Linename_VEL_RMS.sgy;
6. Interval Velocity Model (ASCII file) – Linename_VEL_INT.dat;
7. RMS Velocity Model (ASCII file) – Linename_VEL_RMS.dat;
8. QC plots from TRIM and FINAL track flows:
    a. Fig1_Linename_Trace&Offset_QC;
    b. Fig2_Linename_Source&Cable_Heave;
    c. Fig3_Linename_Slant_Check;
    d. Fig4_Linename_TRIM_STK;
    e. Fig5_Linename_FULL_MIG_TVBPF.
9. Processor Log.
10. Processing Report.

The EBCDIC headers of the delivered SEGYs (MUL, MIG, DPT, VEL_INT and VEL_RMS) were filled with information such as the acquisition and geometry parameters, coordinate system and the main processing steps used for each specific file type. A script was created to allow for batch process for the entire survey seismic profiles; this batch process was carried out separately for each dataset type as each dataset type has its unique EBCDIC header.

An example EBCDIC header for line TA2A914P1_MIG.sgy is here presented:

```
C 1 CLIENT: TotalEnergies; PROC. COMPANY: GEOSURVEYS; CONTRACTOR: FUGRO;
C 2 VESSEL: Fugro Seeker; AREA: Maasmond channel, Netherlands; SURVEY: Aramis;
C 3 LINE NAME: TA2A914P1
C 4 ACQ DATE: 21/09/2022
C 5 SPS:10003-11972  CDP:1-1985      SPV MEAN:1507m/s    PROC DATE: 29/09/2022
C 6 RECORD SYSTEM: Multitrace; RECORD FORMAT: SEG-Y
C 7 SAMPLE INTERVAL: 0.1 ms; SAMPLES PER TRACE: 2500 ; RECORD LENGTH: 250 ms
C 8 FILTERS: N/A
C 9 SRC TYPE: SPARKER; N.TIPS: 400; ENERGY: 400 Joules
C10 NBR OF SRC: 1; SRC DEPTH: 0.30 m;
C11 SHOT INT: 1m;
C12 LEAD BUOY DEPTH: 0.30m; LEAD BUOY OFFSET: 8.0m; TAIL BUOY DEPTH: 1.50m;
C13 STR ACT LENGTH: 35.00m; CHAN INT: 1-12@1m; 13-24@2m;
C14 NBR OF CHAN: 24; CMP/SHOT: 1;
C15 CMP INT: 1; CMP FOLD: Variable ~24;
C16 INLINE OFFSET: 1.00m; XLINE OFFSET: 2.30m;
C17 NAV SYSTEM: DGPS; GRID UNIT: METRES;
C18 PROJECTION TYPE: UTM Zone 31N; GEODETIC DATUM: ETRS89;
C19 VERTICAL DATUM: LAT; SCALE FACTOR: 1;
C20 DATASET TYPE: MIG; SORT ORDER: CDP; POLARITY: NORMAL; PHASE: ZERO;
C21 PROCESSING FLOW:
C22 01)GEOMETRY ASSIGNMENT; 02)UHRS TRIM STATICS; 03)DENOISE;
C23 04)PRE-STACK DECONVOLUTION;05)PRE-STK DEMULTIPLE (SRME);
C24 06)PRE-STACK DEMULTIPLE (TAU-P DOMAIN);07)PRE-STACK DEGHOSTING;
C25 08)VELOCITY MODEL; 09)ENSEMBLE STK;
C26 10)POST-STACK DEMULTIPLE; 11)POST-STACK MIGRATION; 12)TVBPF;
C27 13)AMPLITUDE CORRECTION; 14)MISTIE CORRECTION.
C28
C29 SEGY FORMAT : IBM Floating-Point
C30 HEADER         BYTE  FORMAT  MULT
C31 CDP_NUMBER      21     4I       1
C32 TIDE_HGHT (m)   57     4I     100
C33 CDP_X          181     4I     100
C34 CDP_Y          185     4I     100
C35
C36
C37
C38
C39
C40 END TEXTUAL HEADER ARAMIS SURVEY SEG Y VERSION 1.0.0
```

7. CONCLUDING NOTES

Approximately 71.9 km of multi-channel Ultra High-Resolution Seismic reflection data (sail length) were processed in the scope of this project. The processing flow carried out has several stages, each of them with specific goals, as detailed next:

1) In a first stage (TRIM track), a trace-by-trace residual static correction procedure to compensate for the vertical motions of the source and cable was estimated. Static corrections applied to the data can be divided into four major components: cable depth, source heave, cable heave and swell;
2) The second stage (FINAL track) was carried out in order to produce the final datasets: unmigrated, migrated, and migrated converted to depth seismic sections. FINAL track main procedures included denoise, pre-stack deconvolution, pre-stack multiple attenuation (both SRME and in Tau-P domain), pre-stack ghost attenuation, NMO and stacking using a layer cake velocity model, post-stack multiple attenuation, Kirchhoff time migration to recover true geometry of primary reflections also using the above mentioned velocity model, and time-to-depth conversion.

In general, the UHRS data processing focused on improving the seismic section resolution and signal quality mainly within the first 100 m below the seabed. Overall, the main concluding notes are:

- Geometry QC shows good CDP fold with a mean fold of ~24 in all lines;
- UHRS TRIM statics allowed for the correction for the motion of the towed equipment resulting in good consistency of the CDP gathers, greater seismic detail, as finer collapse of the overall seismic data is recognizable and in a broader frequency content;
- The stack preserved a broad frequency content between 250 and 4000 Hz, allowing for improved reflector lateral continuity and resolution;
- A good SRME multiple attenuation was achieved in the majority of the seismic profiles;
- The pre-stack deghost allows better imaging in the first 5 ms below the seabed;
- Presence of shallow gas, mainly in the south area of the survey site, compromises signal penetration.

On behalf of GeoSurveys, Aveiro, Portugal

Gil Moreira

(Geophysicist)

Appendix F

Contacts Listing – SSS

Contact_ID	Easting_m	Northing_m	Length_m	Width_m	Height_m	Shadow_m	Description	Line_Name	Conf	Comments	MAG_Corr
BA_FS_SSS_0001	570270.65	5759965.95	0.54	0.20	0.18	0.42	Boulder	TA2A002P1	Low		
BA_FS_SSS_0002	570233.58	5759989.60	0.54	0.28	0.27	1.08	Boulder	TA2A004P1	Medium	MBES	
BA_FS_SSS_0003	570222.66	5759993.25	0.82	0.35	0.23	0.78	Boulder	TA2A004P1	Medium	MBES	
BA_FS_SSS_0004	570293.00	5760039.87	1.45	0.43	0.21	1.18	Boulder	TA2A007P1	Medium	MBES	
BA_FS_SSS_0005	570290.02	5760044.26	1.21	0.47	0.23	1.20	Boulder	TA2A007P1	Medium	MBES	
BA_FS_SSS_0006	570310.58	5760046.11	0.72	0.33	0.08	0.59	Boulder	TA2A003P1	Low		
BA_FS_SSS_0007	570284.74	5760050.88	0.57	0.18	0.08	0.35	Boulder	TA2A007P1	Medium	MBES	
BA_FS_SSS_0008	570288.38	5760054.52	0.88	0.38	0.27	1.00	Boulder	TA2A007P1	Medium	MBES	
BA_FS_SSS_0009	570281.88	5760059.33	1.09	0.23	0.39	1.19	Boulder	TA2A007P1	Medium	MBES	
BA_FS_SSS_0010	570273.78	5760065.49	0.89	0.48	0.33	1.64	Boulder	TA2A008P1	Medium	MBES	
BA_FS_SSS_0011	570275.71	5760069.48	0.56	0.33	0.29	1.29	Boulder	TA2A008P1	Medium	MBES	
BA_FS_SSS_0012	570259.15	5760069.92	0.57	0.42	0.13	0.59	Boulder	TA2A008P1	Medium	MBES	
BA_FS_SSS_0013	570270.62	5760072.08	1.25	0.37	0.23	0.93	Suspected Debris	TA2A008P1	Medium	MBES	
BA_FS_SSS_0014	570266.60	5760072.50	2.05	0.58	0.24	0.97	Boulder	TA2A008P1	Medium	MBES	
BA_FS_SSS_0015	570268.14	5760074.73	0.53	0.46	0.26	0.98	Boulder	TA2A008P1	Medium	MBES	
BA_FS_SSS_0016	570076.89	5760089.59	0.63	0.13	0.11	0.49	Boulder	TA2A002P1	Low		
BA_FS_SSS_0017	570147.68	5760093.13	1.81	0.18	0.13	0.47	Boulder	TA2A006P1	Low		
BA_FS_SSS_0018	570423.40	5760132.26	1.47	0.57	0.10	0.65	Boulder	TA2A012P1	Low		
BA_FS_SSS_0019	570293.98	5760143.88	0.75	0.24	0.07	0.41	Boulder	TA2A012P1	Low		
BA_FS_SSS_0020	569856.83	5760140.59	1.13	0.64	0.17	1.06	Boulder	TA2A011P1	Low		
BA_FS_SSS_0021	570478.15	5760150.67	0.70	0.41	0.15	1.08	Boulder	TA2A009P1	Medium		
BA_FS_SSS_0022	569859.94	5760142.31	2.34	0.53	0.15	0.84	Suspected Debris	TA2A011P1	Low		
BA_FS_SSS_0023	570513.78	5760153.45	1.64	0.73	0.09	0.61	Boulder	TA2A009P1	Low		
BA_FS_SSS_0024	569832.90	5760153.64	2.16	0.48	0.38	1.06	Boulder	TA2A008P1	Low		
BA_FS_SSS_0025	569833.39	5760155.25	2.64	0.89	0.44	1.29	Boulder	TA2A008P1	Low		
BA_FS_SSS_0026	570107.17	5760162.88	2.31	0.41	0.28	1.37	Boulder	TA2A009P1	Medium	MBES	
BA_FS_SSS_0027	570196.61	5760189.70	1.06	0.60	0.15	0.98	Boulder	TA2A010P1	Medium	MBES	
BA_FS_SSS_0028	570110.70	5760222.31	1.88	0.35	0.11	0.63	Boulder	TA2A016P1	Medium	MBES	
BA_FS_SSS_0029	570104.31	5760222.62	1.50	0.39	0.12	0.68	Boulder	TA2A016P1	Medium		
BA_FS_SSS_0030	569898.89	5760220.69	0.68	0.50	0.09	0.65	Boulder	TA2A011P1	Medium		
BA_FS_SSS_0031	570428.14	5760229.09	1.04	0.40	0.14	0.57	Boulder	TA2A013P1	Low		
BA_FS_SSS_0032	570427.22	5760229.50	0.94	0.40	0.13	0.59	Boulder	TA2A013P1	Low		
BA_FS_SSS_0033	570851.53	5760241.17	1.55	0.45	0.08	0.40	Boulder	TA2A018P1	Medium		
BA_FS_SSS_0034	569752.57	5760226.07	0.85	0.54	0.12	0.58	Boulder	TA2A015P1	Medium	MBES	
BA_FS_SSS_0035	570150.14	5760233.79	4.78	0.46	0.28	0.98	Suspected Debris	TA2A013P1	Medium	MBES	
BA_FS_SSS_0036	570261.50	5760248.23	2.18	0.33	0.10	0.56	Suspected Debris	TA2A017P1	Medium		
BA_FS_SSS_0037	571014.36	5760292.56	0.72	0.31	0.19	0.64	Boulder	TA2A018P1	Medium		
BA_FS_SSS_0038	570998.86	5760298.41	2.45	0.77	0.29	1.29	Boulder	TA2A018P1	Medium	MBES	
BA_FS_SSS_0039	571041.65	5760303.96	2.33	0.69	0.13	1.12	Boulder	TA2A017P1a	Medium		
BA_FS_SSS_0040	570265.38	5760309.06	0.79	0.29	0.08	0.35	Boulder	TA2A017P1	Medium		

Contact_ID	Easting_m	Northing_m	Length_m	Width_m	Height_m	Shadow_m	Description	Line_Name	Conf	Comments	MAG_Corr
BB_FS_SSS_0593	570153.79	5761938.32	1.29	0.90	0.42	2.42	Boulder	TA2B061P1	Medium	MBES	BB_FS_MAG_0222
BB_FS_SSS_0607	570320.25	5761956.11	1.20	0.77	0.17	0.90	Boulder	TA2B063P1	Medium		BB_FS_MAG_0247
BB_FS_SSS_0642	570388.44	5761973.41	0.60	0.43	0.18	0.90	Suspected Debris	TA2B064P1	Medium		BB_FS_MAG_0274
BB_FS_SSS_0884	570479.21	5762450.74	1.35	0.84	0.18	1.11	Boulder	TA2B076P1	Medium		BB_FS_MAG_0567
BB_FS_SSS_0916	570130.57	5762632.45	1.27	0.25	0.35	2.03	Boulder	TA2B077P1	Medium	MBES	BB_FS_MAG_0605
BB_FS_SSS_0929	570181.78	5762745.43	1.52	0.49	0.08	0.52	Boulder	TA2B078P1	Medium		BB_FS_MAG_0691
BB_FS_SSS_0946	569840.18	5762923.03	1.50	1.11	0.16	0.78	Boulder	TA2B081P1	Medium		BB_FS_MAG_0710
BB_FS_SSS_0001	570065.28	5760216.49	0.88	0.35	0.12	0.58	Boulder	TA2B020P1	Medium	MBES	
BB_FS_SSS_0002	570105.35	5760228.43	1.92	0.93	0.15	0.75	Boulder	TA2B019P1	Medium	MBES	
BB_FS_SSS_0003	570123.88	5760231.61	1.54	0.62	0.14	0.87	Boulder	TA2B019P1	Medium	MBES	
BB_FS_SSS_0004	570377.85	5760255.43	0.58	0.42	0.13	0.68	Boulder	TA2B024P1	Medium	MBES	
BB_FS_SSS_0005	570302.99	5760275.96	0.87	0.70	0.11	0.74	Boulder	TA2B024P1	Low		
BB_FS_SSS_0006	571000.33	5760289.32	2.26	1.10	0.18	1.66	Boulder	TA2B028P1	Medium	MBES	
BB_FS_SSS_0007	570229.90	5760285.80	1.78	0.74	0.19	1.52	Boulder	TA2B021P1	Medium	MBES	
BB_FS_SSS_0008	570629.42	5760295.95	0.53	0.60	0.29	2.13	Boulder	TA2B025P1	Low		
BB_FS_SSS_0009	570699.98	5760297.35	3.31	0.67	0.11	0.72	Boulder	TA2B026P1	Medium	MBES	
BB_FS_SSS_0010	570691.56	5760312.21	1.22	0.52	0.14	1.14	Boulder	TA2B026P1	Low		
BB_FS_SSS_0011	570085.41	5760331.81	1.04	0.64	0.13	0.69	Boulder	TA2B021P1	Low		
BB_FS_SSS_0012	570053.12	5760339.19	1.95	0.53	0.19	1.30	Boulder	TA2B021P1	Low		
BB_FS_SSS_0013	570126.48	5760348.11	1.77	0.26	0.10	0.34	Boulder	TA2B022P1	Low		
BB_FS_SSS_0014	570252.31	5760354.37	0.65	0.57	0.69	3.65	Boulder	TA2B025P1	Low		
BB_FS_SSS_0015	570266.88	5760355.17	1.52	0.74	0.30	1.25	Boulder	TA2B025P1	Low		
BB_FS_SSS_0016	569751.69	5760348.46	0.79	0.31	0.17	0.66	Boulder	TA2B020P1	Medium	MBES	
BB_FS_SSS_0017	570712.70	5760373.41	0.54	0.35	0.38	1.57	Boulder	TA2B028P1	Low		
BB_FS_SSS_0018	570766.05	5760379.50	2.17	1.10	0.59	1.37	Suspected Debris	TA2B029P1	Medium		
BB_FS_SSS_0019	570759.89	5760381.61	4.89	1.18	0.49	1.11	Suspected Debris	TA2B029P1	Medium	MBES	
BB_FS_SSS_0020	570968.07	5760384.99	1.96	0.58	0.18	1.19	Boulder	TA2B030P1	Medium		
BB_FS_SSS_0021	570829.51	5760384.54	2.18	0.70	0.08	0.55	Boulder	TA2B029P1	Low		
BB_FS_SSS_0022	570901.65	5760391.64	2.02	0.81	0.14	0.66	Boulder	TA2B030P1	Low		
BB_FS_SSS_0023	569872.21	5760386.11	1.21	0.54	0.08	0.84	Boulder	TA2B020P1	Medium	MBES	
BB_FS_SSS_0024	570094.11	5760438.59	0.68	0.25	0.12	0.37	Boulder	TA2B024P1	Low		
BB_FS_SSS_0025	570852.78	5760453.07	7.90	1.06	0.21	1.49	Suspected Debris	TA2B033P1	Medium	MBES	
BB_FS_SSS_0026	570332.89	5760448.47	1.68	0.52	0.15	0.84	Boulder	TA2B028P1	Medium	MBES	
BB_FS_SSS_0027	570332.65	5760455.01	1.21	0.51	0.14	0.65	Boulder	TA2B028P1	Medium	MBES	
BB_FS_SSS_0028	571008.90	5760505.50	1.57	0.92	0.05	0.35	Boulder	TA2B036P1	Low		
BB_FS_SSS_0029	571117.50	5760518.58	1.55	0.56	0.20	1.28	Boulder	TA2B037P1	Medium	MBES	
BB_FS_SSS_0030	570377.73	5760527.40	0.98	0.50	0.46	0.85	Boulder	TA2B029P1	Medium	MBES	
BB_FS_SSS_0031	570232.63	5760526.15	1.22	0.31	0.12	0.79	Boulder	TA2B029P1	Low		
BB_FS_SSS_0032	570585.90	5760532.51	1.64	0.35	0.16	1.48	Boulder	TA2B030P1	Low		
BB_FS_SSS_0033	569860.78	5760522.69	0.52	0.51	0.17	0.44	Boulder	TA2B024P1	Low		
BB_FS_SSS_0034	570378.76	5760532.60	1.09	0.27	0.22	0.68	Boulder	TA2B030P1	Medium	MBES	
BB_FS_SSS_0035	570481.85	5760537.81	2.01	0.92	0.29	0.98	Boulder	TA2B030P1	Medium	MBES	
BB_FS_SSS_0036	570117.44	5760537.25	0.79	0.28	0.09	0.61	Boulder	TA2B028P1	Low		
BB_FS_SSS_0037	570247.30	5760544.84	1.08	0.57	0.09	0.75	Boulder	TA2B027P1	Low		
BB_FS_SSS_0038	570265.67	5760549.74	1.14	0.54	0.07	0.49	Boulder	TA2B030P1	Low		

BB_FS_SSS_0039	570730.57	5760561.82	2.53	0.60	0.09	0.55	Boulder	TA2B032P1	Low		
BB_FS_SSS_0040	570373.89	5760558.28	0.99	0.46	0.14	0.86	Boulder	TA2B029P1	Low		
BB_FS_SSS_0041	570792.40	5760566.83	2.45	0.69	0.13	0.80	Boulder	TA2B035P1	Medium		
BB_FS_SSS_0042	570256.47	5760562.07	1.34	0.47	0.09	0.53	Boulder	TA2B028P1	Low		
BB_FS_SSS_0043	570101.69	5760574.45	0.65	0.16	0.07	0.35	Boulder	TA2B027P1	Low		
BB_FS_SSS_0044	570759.43	5760594.82	1.99	0.63	0.22	0.90	Boulder	TA2B035P1	Low		
BB_FS_SSS_0045	570743.12	5760606.45	1.85	0.65	0.29	1.03	Boulder	TA2B035P1	Low		
BB_FS_SSS_0046	570842.55	5760608.53	0.80	0.36	0.51	0.78	Boulder	TA2B035P1	Medium	MBES	
BB_FS_SSS_0047	570943.41	5760625.99	1.21	0.80	0.10	0.59	Boulder	TA2B038P1	Low		
BB_FS_SSS_0048	570324.20	5760622.10	1.78	0.34	0.16	0.78	Boulder	TA2B032P1	Low		
BB_FS_SSS_0049	571024.15	5760633.12	0.92	0.49	0.11	0.85	Boulder	TA2B039P1	Low		
BB_FS_SSS_0050	570685.18	5760659.16	1.59	0.38	0.12	0.64	Boulder	TA2B034P1	Low		
BB_FS_SSS_0051	570944.45	5760695.60	0.89	0.18	0.18	0.51	Boulder	TA2B039P1	Medium	MBES	
BB_FS_SSS_0052	569916.01	5760690.41	0.60	0.19	0.14	0.75	Boulder	TA2B028P1	Low		
BB_FS_SSS_0053	570613.96	5760710.35	2.32	0.57	0.17	1.08	Boulder	TA2B037P1	Low		
BB_FS_SSS_0054	569868.55	5760701.27	1.69	0.94	0.40	0.89	Boulder	TA2B029P1	Low		
BB_FS_SSS_0055	570387.62	5760711.48	0.86	0.27	0.15	0.73	Boulder	TA2B033P1	Low		
BB_FS_SSS_0056	571112.10	5760731.15	0.93	0.19	0.09	0.63	Suspected Debris	TA2B042P1	Low		
BB_FS_SSS_0057	570807.19	5760728.96	1.77	0.33	0.16	0.75	Boulder	TA2B037P1	Low		
BB_FS_SSS_0058	570796.11	5760736.83	1.44	0.43	0.13	0.65	Boulder	TA2B037P1	Low		
BB_FS_SSS_0059	570821.11	5760739.00	1.39	0.47	0.06	0.40	Boulder	TA2B037P1	Low		
BB_FS_SSS_0060	570702.52	5760740.88	1.10	0.39	0.13	0.50	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0061	571030.04	5760789.91	0.56	0.28	0.22	0.80	Boulder	TA2B042P1	Low		
BB_FS_SSS_0062	570212.66	5760793.37	0.82	0.30	0.20	1.34	Boulder	TA2B035P1	Low		
BB_FS_SSS_0063	569895.47	5760794.43	1.28	0.31	0.12	0.70	Boulder	TA2B032P1	Low		
BB_FS_SSS_0064	570095.18	5760804.09	0.77	0.29	0.22	1.33	Boulder	TA2B032P1	Low		
BB_FS_SSS_0065	571103.48	5760829.60	0.66	0.21	0.11	0.71	Boulder	TA2B044P1	Low		
BB_FS_SSS_0066	570598.48	5760825.49	1.59	0.56	0.09	0.54	Boulder	TA2B037P1	Medium		
BB_FS_SSS_0067	570396.97	5760835.63	1.14	0.44	0.29	1.88	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0068	570408.53	5760837.63	1.15	0.26	0.27	1.74	Boulder	TA2B038P1	Low		
BB_FS_SSS_0069	570415.65	5760839.00	0.99	0.50	0.28	1.63	Boulder	TA2B038P1	Low		
BB_FS_SSS_0070	570398.80	5760843.41	1.24	0.30	0.20	1.14	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0071	571089.09	5760872.44	0.86	0.31	0.13	0.80	Boulder	TA2B043P1	Low		
BB_FS_SSS_0072	570357.68	5760875.99	1.35	0.51	0.33	1.22	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0073	570517.31	5760879.46	1.45	0.52	0.27	0.98	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0074	570394.69	5760879.32	0.91	0.43	0.35	0.64	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0075	571173.04	5760893.49	0.91	0.74	0.28	1.48	Boulder	TA2B046P1	Low		
BB_FS_SSS_0076	570543.69	5760884.57	2.45	0.50	0.18	0.94	Boulder	TA2B038P1	Low		
BB_FS_SSS_0077	570520.84	5760889.18	0.64	0.17	0.23	1.13	Boulder	TA2B038P1	Low		
BB_FS_SSS_0078	570531.67	5760893.16	1.39	0.53	0.21	0.98	Boulder	TA2B040P1	Medium		
BB_FS_SSS_0079	571030.03	5760902.55	1.39	0.57	0.14	1.06	Boulder	TA2B043P1	Low		
BB_FS_SSS_0080	570564.35	5760896.76	1.14	0.60	0.14	1.35	Boulder	TA2B041P1	Medium	MBES	
BB_FS_SSS_0081	570530.97	5760901.66	1.47	0.95	0.40	2.80	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0082	570471.91	5760902.67	0.99	0.55	0.21	1.48	Boulder	TA2B040P1	Low		
BB_FS_SSS_0083	570195.58	5760899.67	0.90	0.30	0.45	0.69	Boulder	TA2B036P1	Low		
BB_FS_SSS_0084	570140.64	5760902.03	2.28	0.73	0.12	0.68	Boulder	TA2B035P1	Low		

BB_FS_SSS_0085	570254.83	5760905.04	0.91	0.26	0.14	0.68	Boulder	TA2B036P1	Medium	MBES	
BB_FS_SSS_0086	570573.28	5760911.69	1.26	0.41	0.79	5.69	Suspected Debris	TA2B041P1	Low		
BB_FS_SSS_0087	570216.39	5760907.82	0.71	0.30	0.14	0.55	Boulder	TA2B036P1	Low		
BB_FS_SSS_0088	570836.09	5760919.28	0.91	0.55	0.20	0.66	Boulder	TA2B043P1	Medium	MBES	
BB_FS_SSS_0089	570558.91	5760918.00	0.72	0.58	0.18	1.05	Boulder	TA2B041P1	Low		
BB_FS_SSS_0090	570367.74	5760919.82	0.73	0.41	0.63	0.97	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0091	570103.28	5760918.85	2.12	0.56	0.10	0.63	Boulder	TA2B037P1	Low		
BB_FS_SSS_0092	569937.14	5760916.94	2.24	0.36	0.08	0.53	Boulder	TA2B033P1	Low		
BB_FS_SSS_0093	570590.01	5760926.29	0.57	0.26	0.32	0.84	Boulder	TA2B040P1	Low		
BB_FS_SSS_0094	570156.76	5760921.12	1.25	0.41	0.27	0.67	Boulder	TA2B036P1	Medium	MBES	
BB_FS_SSS_0095	570199.60	5760924.11	1.11	0.40	0.08	0.42	Boulder	TA2B036P1	Medium		
BB_FS_SSS_0096	570154.11	5760923.50	1.17	0.48	0.32	0.86	Boulder	TA2B036P1	Medium	MBES	
BB_FS_SSS_0097	570610.63	5760933.77	0.80	0.59	0.16	0.75	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0098	570350.13	5760933.27	0.80	0.27	0.20	0.51	Boulder	TA2B038P1	Low		
BB_FS_SSS_0099	570598.58	5760940.69	0.65	0.28	0.23	1.11	Boulder	TA2B040P1	Low		
BB_FS_SSS_0100	570595.88	5760940.74	0.68	0.31	0.30	1.42	Boulder	TA2B040P1	Low		
BB_FS_SSS_0101	570597.36	5760940.84	0.74	0.40	0.25	1.20	Boulder	TA2B040P1	Low		
BB_FS_SSS_0102	570290.53	5760936.59	2.14	0.67	0.34	1.99	Boulder	TA2B039P1	Low		
BB_FS_SSS_0103	571046.84	5760949.40	1.09	0.48	0.27	1.15	Boulder	TA2B046P1	Low		
BB_FS_SSS_0104	570348.80	5760956.66	1.42	0.40	0.26	1.20	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0105	570539.43	5760962.48	0.89	0.36	0.10	0.57	Boulder	TA2B042P1	Medium	MBES	
BB_FS_SSS_0106	569806.08	5760952.82	3.22	1.09	0.13	0.48	Boulder	TA2B033P1	Low		
BB_FS_SSS_0107	570626.70	5760965.10	0.67	0.28	0.16	0.70	Boulder	TA2B041P1	Medium	MBES	
BB_FS_SSS_0108	570333.64	5760963.10	1.56	0.52	0.42	1.84	Boulder	TA2B038P1	Medium	MBES	
BB_FS_SSS_0109	570628.46	5760967.51	1.05	0.65	0.45	2.19	Boulder	TA2B041P1	Low		
BB_FS_SSS_0110	570670.09	5760968.80	2.01	0.46	0.12	0.56	Boulder	TA2B043P1	Medium	MBES	
BB_FS_SSS_0111	570630.42	5760971.49	0.92	0.54	0.16	0.88	Boulder	TA2B041P1	Medium	MBES	
BB_FS_SSS_0112	570309.19	5760968.32	0.99	0.42	0.22	0.80	Boulder	TA2B038P1	Medium		
BB_FS_SSS_0113	570183.46	5760971.28	1.18	0.67	0.12	0.89	Boulder	TA2B039P1	Low		
BB_FS_SSS_0114	570582.94	5760977.38	1.92	0.84	0.30	1.21	Boulder	TA2B041P1	Medium		
BB_FS_SSS_0115	570298.25	5760974.15	1.12	0.55	0.22	0.88	Boulder	TA2B038P1	Low		
BB_FS_SSS_0116	570624.07	5760978.78	1.18	0.70	0.20	1.41	Boulder	TA2B043P1	Low		
BB_FS_SSS_0117	569989.22	5760972.06	2.01	0.92	0.17	0.84	Boulder	TA2B037P1	Low		
BB_FS_SSS_0118	570401.73	5760978.97	1.23	0.36	0.23	1.46	Suspected Debris	TA2B041P1	Low		
BB_FS_SSS_0119	571033.20	5760988.78	0.78	0.27	0.15	1.26	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0120	570587.99	5760984.24	0.62	0.17	0.23	1.67	Boulder	TA2B043P1	Low		
BB_FS_SSS_0121	570284.98	5760982.73	0.77	0.48	0.17	1.00	Boulder	TA2B040P1	Low		
BB_FS_SSS_0122	570183.26	5760981.43	0.79	0.72	0.17	0.90	Boulder	TA2B039P1	Low		
BB_FS_SSS_0123	570143.40	5760981.10	0.74	0.42	0.34	1.12	Boulder	TA2B037P1	Low		
BB_FS_SSS_0124	570232.67	5760983.92	0.95	0.39	0.42	1.19	Boulder	TA2B038P1	Medium	MBES	
BB_FS_SSS_0125	569893.01	5760981.71	1.18	0.25	0.30	0.99	Boulder	TA2B036P1	Low		
BB_FS_SSS_0126	570590.43	5760991.88	0.61	0.27	0.25	1.44	Boulder	TA2B043P1	Low		
BB_FS_SSS_0127	570141.26	5760990.14	1.16	0.42	0.26	1.66	Boulder	TA2B039P1	Low		
BB_FS_SSS_0128	570117.72	5760992.72	0.76	0.44	0.20	0.72	Boulder	TA2B037P1	Low		
BB_FS_SSS_0129	570135.63	5760993.17	0.86	0.32	0.25	1.70	Boulder	TA2B039P1	Low		
BB_FS_SSS_0130	570775.16	5761007.80	2.97	0.76	0.07	0.41	Boulder	TA2B043P1	Low		

BB_FS_SSS_0131	570370.28	5761003.73	0.74	0.58	0.23	0.99	Boulder	TA2B041P1	Low			
BB_FS_SSS_0132	569984.45	5760998.78	0.52	0.19	0.16	1.23	Boulder	TA2B038P1	Low			
BB_FS_SSS_0133	570918.34	5761012.36	0.55	0.28	0.26	0.90	Boulder	TA2B045P1	Low			
BB_FS_SSS_0134	570612.43	5761014.05	0.55	0.33	0.17	0.70	Boulder	TA2B042P1	Low			
BB_FS_SSS_0135	570007.85	5761019.54	1.32	0.76	0.41	1.57	Boulder	TA2B038P1	Medium			
BB_FS_SSS_0136	570740.70	5761031.21	0.61	0.28	0.33	1.07	Boulder	TA2B045P1	Low			
BB_FS_SSS_0137	569957.74	5761024.11	0.65	0.32	0.13	0.74	Boulder	TA2B036P1	Low			
BB_FS_SSS_0138	570568.04	5761033.66	0.92	0.34	0.15	0.64	Boulder	TA2B042P1	Low			
BB_FS_SSS_0139	570428.55	5761032.20	0.73	0.30	0.11	0.30	Boulder	TA2B041P1	Low			
BB_FS_SSS_0140	571224.06	5761047.94	0.76	0.46	0.11	0.78	Boulder	TA2B048P1	Medium			
BB_FS_SSS_0141	570405.28	5761039.00	0.53	0.16	0.15	0.49	Boulder	TA2B042P1	Low			
BB_FS_SSS_0142	569943.48	5761034.81	1.02	0.55	0.20	0.99	Boulder	TA2B038P1	Medium			
BB_FS_SSS_0143	571214.74	5761053.17	0.63	0.36	0.13	0.58	Boulder	TA2B050P1_SSS_INFA	Medium			
BB_FS_SSS_0144	569879.97	5761036.12	1.27	0.42	0.26	0.67	Boulder	TA2B036P1	Medium			
BB_FS_SSS_0145	569916.12	5761039.36	1.95	0.78	0.50	2.72	Boulder	TA2B038P1	Medium			
BB_FS_SSS_0146	570106.67	5761042.37	1.39	0.30	0.18	0.74	Boulder	TA2B038P1	Medium			
BB_FS_SSS_0147	569907.40	5761040.79	6.50	0.93	0.38	2.35	Suspected Debris	TA2B038P1	Medium	MBES		
BB_FS_SSS_0148	570469.44	5761048.89	0.90	0.43	0.21	0.99	Boulder	TA2B043P1	Low			
BB_FS_SSS_0149	570110.57	5761047.36	1.86	0.45	0.20	1.19	Boulder	TA2B040P1	Low			
BB_FS_SSS_0150	569918.18	5761045.27	1.81	0.53	0.32	1.48	Boulder	TA2B038P1	Medium			
BB_FS_SSS_0151	571186.78	5761064.85	0.87	0.32	0.15	0.66	Boulder	TA2B050P1_SSS_INFA	Medium			
BB_FS_SSS_0152	570899.62	5761069.45	1.63	0.63	0.09	0.64	Boulder	TA2B048P1	Low			
BB_FS_SSS_0153	571114.27	5761072.63	1.15	0.77	0.18	1.15	Boulder	TA2B050P1	Medium			
BB_FS_SSS_0154	571118.40	5761074.23	0.90	0.81	0.12	0.72	Boulder	TA2B050P1	Medium			
BB_FS_SSS_0155	570475.22	5761065.56	0.71	0.65	0.23	0.97	Boulder	TA2B042P1	Medium	MBES		
BB_FS_SSS_0156	570339.18	5761069.40	1.19	0.70	0.08	0.69	Boulder	TA2B040P1	Low			
BB_FS_SSS_0157	570453.69	5761075.43	1.70	0.31	0.13	0.89	Boulder	TA2B044P1	Low			
BB_FS_SSS_0158	570274.95	5761076.43	0.73	0.51	0.19	0.88	Boulder	TA2B042P1	Low			
BB_FS_SSS_0159	571081.25	5761089.23	0.55	0.28	0.12	0.80	Boulder	TA2B050P1_SSS_INFA	Medium			
BB_FS_SSS_0160	570213.90	5761086.34	1.04	0.59	0.17	0.81	Boulder	TA2B042P1	Low			
BB_FS_SSS_0161	570450.05	5761090.05	0.95	0.37	0.14	0.88	Boulder	TA2B042P1	Low			
BB_FS_SSS_0162	570952.91	5761099.88	1.39	0.57	0.12	0.85	Boulder	TA2B047P1	Medium			
BB_FS_SSS_0163	570660.32	5761098.28	0.65	0.39	0.18	0.83	Boulder	TA2B046P1	Low			
BB_FS_SSS_0164	570269.78	5761093.15	0.78	0.53	0.32	0.76	Boulder	TA2B041P1	Low			
BB_FS_SSS_0165	570545.32	5761097.18	2.87	1.14	0.71	5.66	Boulder	TA2B043P1	Low			
BB_FS_SSS_0166	571068.41	5761105.77	0.58	0.35	0.09	0.52	Boulder	TA2B050P1	Low			
BB_FS_SSS_0167	570536.01	5761098.25	2.85	1.40	0.42	3.00	Boulder	TA2B043P1	Low			
BB_FS_SSS_0168	570651.88	5761102.09	0.70	0.30	0.09	0.66	Boulder	TA2B044P1	Medium	MBES		
BB_FS_SSS_0169	570126.45	5761096.10	1.31	0.36	0.20	0.93	Boulder	TA2B041P1	Low			
BB_FS_SSS_0170	570448.20	5761102.10	1.01	0.48	0.20	1.57	Boulder	TA2B042P1	Low			
BB_FS_SSS_0171	570446.46	5761102.21	0.67	0.32	0.13	0.98	Boulder	TA2B042P1	Low			
BB_FS_SSS_0172	570120.37	5761098.93	1.09	0.52	0.30	1.28	Boulder	TA2B041P1	Low			
BB_FS_SSS_0173	570839.34	5761109.26	1.35	0.68	0.30	1.47	Boulder	TA2B048P1	Medium	MBES		
BB_FS_SSS_0174	570148.62	5761100.05	1.18	0.52	0.24	0.64	Boulder	TA2B040P1	Medium			
BB_FS_SSS_0175	570435.19	5761104.75	0.90	0.55	0.34	0.77	Boulder	TA2B043P1	Medium	MBES		
BB_FS_SSS_0176	570413.56	5761104.72	0.89	0.34	0.13	0.71	Boulder	TA2B042P1	Low			

BB_FS_SSS_0177	570522.70	5761109.90	3.85	1.00	0.35	2.88	Boulder	TA2B043P1	Low		
BB_FS_SSS_0178	570624.67	5761113.61	0.89	0.51	0.28	1.93	Boulder	TA2B044P1	Low		
BB_FS_SSS_0179	570143.54	5761107.39	1.09	0.39	0.23	0.87	Boulder	TA2B040P1	Low		
BB_FS_SSS_0180	571025.89	5761120.87	0.56	0.28	0.15	0.89	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0181	570452.28	5761118.11	1.36	0.56	0.29	1.50	Boulder	TA2B043P1	Medium	MBES	
BB_FS_SSS_0182	570175.81	5761118.82	0.65	0.46	0.40	1.56	Boulder	TA2B042P1	Low		
BB_FS_SSS_0183	570986.02	5761130.49	1.04	0.37	0.07	0.45	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0184	571078.01	5761132.14	0.72	0.55	0.11	0.68	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0185	570520.01	5761125.85	1.11	0.56	0.33	0.85	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0186	570082.65	5761120.26	0.79	0.37	0.31	0.57	Boulder	TA2B040P1	Low		
BB_FS_SSS_0187	570802.66	5761131.92	1.11	0.44	0.12	0.93	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0188	570124.17	5761122.44	1.11	0.65	0.20	1.20	Boulder	TA2B042P1	Low		
BB_FS_SSS_0189	570554.64	5761131.86	0.97	0.62	0.32	1.94	Boulder	TA2B044P1	Low		
BB_FS_SSS_0190	570045.92	5761126.66	0.51	0.23	1.00	0.76	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0191	570139.03	5761129.12	0.74	0.81	0.11	0.79	Boulder	TA2B040P1	Low		
BB_FS_SSS_0192	570171.20	5761131.35	0.58	0.38	0.04	0.38	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0193	569778.28	5761130.09	1.15	0.51	0.22	0.93	Boulder	TA2B037P1	Low		
BB_FS_SSS_0194	570817.94	5761148.26	1.13	0.70	0.24	1.43	Boulder	TA2B049P1	Medium	MBES	
BB_FS_SSS_0195	570027.00	5761138.79	0.82	0.33	0.24	0.95	Boulder	TA2B041P1	Low		
BB_FS_SSS_0196	569817.25	5761136.30	1.50	0.46	0.22	1.39	Boulder	TA2B037P1	Medium		
BB_FS_SSS_0197	569898.37	5761139.55	1.13	0.33	0.27	1.35	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0198	569893.97	5761139.81	0.54	0.46	0.10	0.54	Boulder	TA2B040P1	Low		
BB_FS_SSS_0199	570998.71	5761155.81	0.80	0.21	0.11	0.82	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0200	570060.15	5761143.63	1.68	0.62	0.52	1.96	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0201	571021.96	5761157.47	0.91	0.37	0.14	0.83	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0202	569774.68	5761139.98	1.74	1.03	0.35	1.86	Boulder	TA2B037P1	Medium	MBES	
BB_FS_SSS_0203	569769.88	5761140.75	1.80	0.84	0.43	2.24	Boulder	TA2B037P1	Medium	MBES	
BB_FS_SSS_0204	569806.20	5761141.38	1.20	0.60	0.22	0.96	Boulder	TA2B039P1	Low		
BB_FS_SSS_0205	570057.46	5761145.17	1.19	0.60	0.36	1.34	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0206	570406.27	5761151.33	0.80	0.37	0.16	1.31	Boulder	TA2B043P1	Low		
BB_FS_SSS_0207	569755.85	5761143.90	1.11	0.42	0.49	2.69	Boulder	TA2B037P1	Medium	MBES	
BB_FS_SSS_0208	570979.57	5761162.41	0.56	0.34	0.26	0.66	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0209	570042.52	5761153.02	0.74	0.41	0.38	1.46	Boulder	TA2B040P1	Low		
BB_FS_SSS_0210	570989.83	5761168.71	0.85	0.31	0.09	0.53	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0211	570183.00	5761157.50	1.02	0.50	0.31	2.21	Boulder	TA2B041P1	Medium	MBES	
BB_FS_SSS_0212	570709.16	5761165.68	1.15	0.81	0.17	1.10	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0213	569743.06	5761152.33	2.56	0.50	0.45	2.29	Boulder	TA2B037P1	Medium	MBES	
BB_FS_SSS_0214	570566.12	5761164.42	2.28	0.54	0.12	0.84	Boulder	TA2B047P1	Medium	MBES	
BB_FS_SSS_0215	570188.23	5761159.23	1.86	0.65	0.17	1.00	Boulder	TA2B043P1	Medium	MBES	
BB_FS_SSS_0216	571108.84	5761173.57	0.74	0.40	0.15	0.97	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0217	571081.09	5761173.89	0.60	0.22	0.14	1.09	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0218	570025.66	5761159.30	0.99	0.40	0.23	0.83	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0219	571075.34	5761175.09	0.51	0.27	0.09	0.44	Boulder	TA2B050P1_SSS_INFA	Low		
BB_FS_SSS_0220	570024.68	5761161.97	1.06	0.25	0.28	1.05	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0221	571100.08	5761177.37	0.58	0.33	0.12	0.70	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0222	571201.67	5761180.63	1.46	0.23	0.11	0.69	Boulder	TA2B053P1_SSS_INF	Medium	MBES	

BB_FS_SSS_0223	570154.29	5761166.03	0.77	0.46	0.15	0.87	Boulder	TA2B041P1	Low		
BB_FS_SSS_0224	570011.58	5761166.10	0.71	0.61	0.32	1.21	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0225	571137.54	5761182.14	1.50	0.32	0.27	0.79	Boulder	TA2B052P1	Low		
BB_FS_SSS_0226	571006.13	5761181.99	0.55	0.45	0.14	1.22	Boulder	TA2B049P1	Medium		
BB_FS_SSS_0227	570958.88	5761181.63	0.63	0.40	0.06	0.38	Boulder	TA2B049P1	Low		
BB_FS_SSS_0228	570220.52	5761174.84	1.55	0.69	0.18	1.26	Boulder	TA2B044P1	Low		
BB_FS_SSS_0229	570617.11	5761180.65	1.55	0.72	0.12	0.99	Boulder	TA2B048P1	Low		
BB_FS_SSS_0230	570217.96	5761175.60	1.29	0.55	0.15	1.04	Boulder	TA2B044P1	Low		
BB_FS_SSS_0231	570215.64	5761179.23	1.73	0.72	0.19	1.08	Boulder	TA2B044P1	Low		
BB_FS_SSS_0232	571131.20	5761197.86	0.60	0.48	0.16	0.65	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0233	570418.05	5761187.95	0.52	0.23	0.26	1.43	Boulder	TA2B044P1	Low		
BB_FS_SSS_0234	570362.87	5761187.81	1.08	0.48	0.30	0.90	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0235	571195.15	5761201.10	0.68	0.51	0.13	0.50	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0236	571138.41	5761203.69	0.87	0.27	0.18	0.93	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0237	571136.90	5761204.02	0.59	0.33	0.17	0.84	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0238	571098.33	5761204.41	0.52	0.27	0.20	0.66	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0239	571035.99	5761205.38	1.90	0.57	0.11	0.78	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0240	570939.54	5761205.35	1.92	0.88	0.95	1.54	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0241	570273.90	5761197.04	1.41	0.43	0.17	1.13	Boulder	TA2B043P1	Low		
BB_FS_SSS_0242	570990.43	5761209.25	0.60	0.27	0.09	0.50	Boulder	TA2B050P1	Medium		
BB_FS_SSS_0243	570558.29	5761204.48	0.77	0.52	0.11	0.90	Boulder	TA2B048P1	Low		
BB_FS_SSS_0244	570827.50	5761209.11	0.92	0.48	0.10	0.70	Boulder	TA2B048P1	Medium	MBES	
BB_FS_SSS_0245	570552.27	5761208.45	1.34	0.56	0.26	1.01	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0246	570981.79	5761215.22	0.74	0.36	0.10	0.48	Boulder	TA2B050P1_SSS_INFA	Medium		
BB_FS_SSS_0247	570952.35	5761216.66	0.76	0.30	0.23	0.74	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0248	569779.65	5761202.36	0.54	0.39	0.22	0.73	Boulder	TA2B040P1	Low		
BB_FS_SSS_0249	570145.21	5761208.14	0.72	0.25	0.14	0.68	Boulder	TA2B042P1	Low		
BB_FS_SSS_0250	570121.53	5761208.33	0.90	0.28	0.12	0.49	Boulder	TA2B042P1	Medium	MBES	
BB_FS_SSS_0251	569745.16	5761203.66	0.88	0.45	0.19	0.97	Boulder	TA2B040P1	Low		
BB_FS_SSS_0252	570971.55	5761221.52	1.11	0.57	0.09	0.55	Boulder	TA2B050P1	Medium		
BB_FS_SSS_0253	569847.13	5761206.95	1.20	0.68	0.70	0.73	Boulder	TA2B040P1	Medium		
BB_FS_SSS_0254	569956.27	5761208.69	1.06	0.34	0.07	0.49	Boulder	TA2B040P1	Low		
BB_FS_SSS_0255	570445.77	5761215.77	1.66	0.61	0.10	0.55	Boulder	TA2B045P1	Low		
BB_FS_SSS_0256	570571.60	5761218.13	1.39	0.48	0.12	0.63	Boulder	TA2B048P1	Low		
BB_FS_SSS_0257	570580.55	5761219.48	1.03	0.80	0.10	0.43	Boulder	TA2B048P1	Low		
BB_FS_SSS_0258	570933.33	5761225.27	1.04	0.51	0.15	0.55	Suspected Debris	TA2B050P1	Medium	MBES	
BB_FS_SSS_0259	570098.04	5761215.57	0.59	0.40	0.27	1.14	Boulder	TA2B042P1	Low		
BB_FS_SSS_0260	570222.92	5761217.44	0.85	0.54	0.18	1.27	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0261	570213.18	5761217.47	1.71	0.89	0.31	2.32	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0262	569725.99	5761212.74	0.53	0.13	0.34	1.33	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0263	570250.33	5761221.64	0.74	0.39	0.40	1.91	Boulder	TA2B045P1	Low		
BB_FS_SSS_0264	570471.61	5761225.90	1.51	0.67	0.51	1.04	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0265	570115.70	5761223.50	0.80	0.62	0.14	0.81	Boulder	TA2B042P1	Low		
BB_FS_SSS_0266	570879.89	5761236.24	0.97	0.79	0.24	0.79	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0267	570213.43	5761227.26	0.80	0.39	0.22	1.36	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0268	570079.83	5761227.06	2.13	0.40	0.37	2.53	Boulder	TA2B044P1	Medium		

BB_FS_SSS_0269	570846.26	5761238.42	0.78	0.42	1.42	1.03	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0270	570841.19	5761240.96	0.59	0.54	0.16	0.92	Boulder	TA2B049P1	Medium		
BB_FS_SSS_0271	570001.56	5761232.25	1.41	0.57	0.14	0.94	Suspected Debris	TA2B041P1	Medium	MBES	
BB_FS_SSS_0272	570913.43	5761245.30	0.66	0.55	0.14	0.69	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0273	570213.08	5761235.47	1.08	0.70	0.25	1.26	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0274	570080.20	5761233.95	2.46	0.70	0.18	1.10	Boulder	TA2B044P1	Medium		
BB_FS_SSS_0275	569844.88	5761231.29	0.72	0.35	0.22	0.82	Boulder	TA2B040P1	Low		
BB_FS_SSS_0276	570359.92	5761241.25	1.21	0.57	0.18	0.79	Boulder	TA2B045P1	Low		
BB_FS_SSS_0277	570933.90	5761253.69	1.43	1.25	0.10	0.72	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0278	570007.46	5761240.73	0.97	0.72	0.31	1.06	Boulder	TA2B043P1	Medium	MBES	
BB_FS_SSS_0279	569826.44	5761238.34	2.29	0.73	0.42	1.65	Boulder	TA2B040P1	Medium	MBES	
BB_FS_SSS_0280	570957.62	5761255.27	0.50	0.19	0.14	0.47	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0281	570947.72	5761256.84	0.61	0.44	0.07	0.42	Boulder	TA2B050P1_SSS_INFA	Low		
BB_FS_SSS_0282	570449.59	5761250.83	0.53	0.34	0.07	0.55	Boulder	TA2B048P1	Low		
BB_FS_SSS_0283	570039.54	5761245.87	0.78	0.28	0.26	1.02	Boulder	TA2B042P1	Low		
BB_FS_SSS_0284	570230.60	5761252.86	0.83	0.28	0.13	0.65	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0285	570901.17	5761264.26	1.39	0.68	0.16	0.76	Boulder	TA2B052P1	Medium	MBES	
BB_FS_SSS_0286	570223.95	5761255.49	0.86	0.22	0.24	1.04	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0287	570945.91	5761267.49	1.29	0.81	0.28	1.11	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0288	570215.84	5761257.27	1.03	0.94	0.38	2.19	Boulder	TA2B046P1	Low		
BB_FS_SSS_0289	570952.97	5761268.81	0.87	0.80	0.26	1.29	Boulder	TA2B053P1_SSS_INF	Low		
BB_FS_SSS_0290	570895.87	5761268.83	1.28	1.57	0.17	1.11	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0291	570014.64	5761256.99	1.09	0.45	0.23	1.44	Boulder	TA2B044P1	Low		
BB_FS_SSS_0292	570881.99	5761269.37	0.81	0.86	0.27	1.44	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0293	570206.90	5761261.96	1.53	0.47	0.24	1.15	Boulder	TA2B044P1	Low		
BB_FS_SSS_0294	570210.53	5761262.45	1.24	0.52	0.18	1.03	Boulder	TA2B046P1	Low		
BB_FS_SSS_0295	570953.68	5761274.71	0.80	0.87	0.16	0.99	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0296	570028.68	5761261.79	0.74	0.31	0.15	0.84	Boulder	TA2B042P1	Low		
BB_FS_SSS_0297	570454.18	5761270.82	1.29	0.31	0.11	0.48	Boulder	TA2B048P1	Low		
BB_FS_SSS_0298	570210.17	5761269.25	0.94	0.69	0.22	1.08	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0299	570208.77	5761270.05	1.26	1.20	1.03	5.84	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0300	569873.71	5761268.88	0.78	0.33	0.11	0.57	Boulder	TA2B041P1	Low		
BB_FS_SSS_0301	570895.95	5761284.63	0.55	0.34	0.11	0.39	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0302	570913.24	5761288.68	0.59	0.24	0.14	0.60	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0303	570945.23	5761289.28	0.75	0.44	0.14	0.93	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0304	570938.44	5761289.31	0.65	0.35	0.11	0.65	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0305	569940.61	5761277.13	1.13	0.45	0.13	1.04	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0306	569903.13	5761277.99	0.68	0.40	0.59	1.40	Boulder	TA2B042P1	Low		
BB_FS_SSS_0307	570280.94	5761284.32	0.84	0.42	0.35	2.12	Boulder	TA2B045P1	Low		
BB_FS_SSS_0308	570423.19	5761286.52	0.50	0.22	0.19	0.75	Boulder	TA2B048P1	Low		
BB_FS_SSS_0309	570907.23	5761293.52	3.07	2.55	0.55	3.36	Boulder	TA2B053P1	Medium	MBES	
BB_FS_SSS_0310	570944.00	5761297.63	0.52	0.34	0.10	0.31	Boulder	TA2B053P1	Medium		
BB_FS_SSS_0311	570953.66	5761298.19	0.57	0.56	0.21	0.67	Boulder	TA2B052P1	Medium	MBES	
BB_FS_SSS_0312	570922.98	5761299.01	2.21	2.82	0.42	2.35	Boulder	TA2B053P1	Medium	MBES	
BB_FS_SSS_0313	570905.89	5761300.01	0.74	0.49	0.24	1.42	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0314	569946.31	5761290.38	0.54	0.32	0.15	0.86	Boulder	TA2B044P1	Low		

BB_FS_SSS_0315	570960.00	5761310.58	0.50	0.45	0.17	0.84	Boulder	TA2B054P1_SSS_INF	Medium		
BB_FS_SSS_0316	569925.82	5761298.10	1.02	0.45	0.14	0.85	Boulder	TA2B044P1	Low		
BB_FS_SSS_0317	570894.05	5761312.99	0.62	0.39	0.13	0.95	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0318	569943.83	5761299.95	0.61	0.33	0.10	0.65	Boulder	TA2B042P1	Low		
BB_FS_SSS_0319	570917.15	5761314.19	0.74	0.72	0.20	0.73	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0320	570434.50	5761307.76	0.86	0.56	0.13	0.79	Boulder	TA2B047P1	Medium		
BB_FS_SSS_0321	569916.19	5761301.93	0.70	0.38	0.41	2.23	Boulder	TA2B042P1	Low		
BB_FS_SSS_0322	570030.17	5761304.06	2.89	0.85	0.18	1.33	Boulder	TA2B043P1	Low		
BB_FS_SSS_0323	570933.16	5761317.77	0.57	0.31	0.13	0.65	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0324	570924.93	5761319.00	1.99	0.77	0.81	4.07	Boulder	TA2B052P1	Medium	MBES	
BB_FS_SSS_0325	569839.73	5761310.79	0.66	0.27	0.27	0.85	Boulder	TA2B042P1	Low		
BB_FS_SSS_0326	570953.10	5761329.52	0.89	0.34	0.14	0.48	Boulder	TA2B054P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0327	570931.85	5761330.05	0.57	0.25	1.35	0.50	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0328	570768.52	5761328.60	0.66	0.72	0.42	1.01	Boulder	TA2B051P1	Medium	MBES	
BB_FS_SSS_0329	569867.23	5761316.24	1.20	0.46	0.19	1.18	Boulder	TA2B044P1	Low		
BB_FS_SSS_0330	570947.97	5761332.70	0.82	0.38	0.26	0.75	Boulder	TA2B053P1	Medium		
BB_FS_SSS_0331	569842.16	5761317.42	1.41	0.36	0.10	0.44	Boulder	TA2B042P1	Low		
BB_FS_SSS_0332	570196.56	5761322.41	1.06	0.88	0.29	1.91	Boulder	TA2B045P1	Low		
BB_FS_SSS_0333	569859.13	5761317.92	1.57	0.51	0.11	0.73	Boulder	TA2B044P1	Low		
BB_FS_SSS_0334	570927.86	5761333.60	1.28	0.79	0.52	3.61	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0335	569870.09	5761319.69	0.86	0.42	0.19	1.22	Boulder	TA2B042P1	Low		
BB_FS_SSS_0336	570192.96	5761325.75	2.87	1.20	0.48	3.29	Boulder	TA2B045P1	Low		
BB_FS_SSS_0337	570192.46	5761327.63	0.73	0.47	0.14	0.96	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0338	569799.37	5761325.00	2.06	0.68	0.11	0.94	Boulder	TA2B041P1	Medium		
BB_FS_SSS_0339	570197.11	5761330.95	0.62	0.28	0.37	0.72	Boulder	TA2B046P1	Low		
BB_FS_SSS_0340	570955.35	5761341.80	0.67	0.25	0.30	0.70	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0341	570824.33	5761341.31	1.40	0.42	0.06	0.44	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0342	570908.24	5761342.52	0.59	0.77	0.08	0.62	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0343	570184.63	5761333.14	1.96	0.94	0.18	1.29	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0344	570200.84	5761333.67	0.78	0.53	0.29	2.43	Boulder	TA2B045P1	Low		
BB_FS_SSS_0345	570189.84	5761333.90	1.37	0.74	0.42	3.20	Boulder	TA2B045P1	Low		
BB_FS_SSS_0346	570200.39	5761335.14	0.55	0.22	0.37	0.96	Boulder	TA2B046P1	Low		
BB_FS_SSS_0347	570187.90	5761335.61	0.66	0.48	0.41	0.87	Boulder	TA2B046P1	Low		
BB_FS_SSS_0348	570199.35	5761335.94	0.65	0.43	0.28	0.76	Boulder	TA2B046P1	Low		
BB_FS_SSS_0349	570185.76	5761336.80	2.76	0.94	0.32	2.55	Boulder	TA2B045P1	Medium	MBES	
BB_FS_SSS_0350	569942.32	5761333.43	1.09	0.58	0.22	1.43	Boulder	TA2B043P1	Low		
BB_FS_SSS_0351	570276.80	5761339.19	0.57	0.40	0.15	0.93	Boulder	TA2B046P1	Low		
BB_FS_SSS_0352	570182.40	5761343.64	1.22	0.37	0.57	1.73	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0353	570692.98	5761351.37	0.55	0.24	0.16	0.62	Boulder	TA2B052P1	Low		
BB_FS_SSS_0354	570180.97	5761346.06	1.27	0.35	0.33	1.04	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0355	571007.78	5761357.88	0.89	0.45	0.49	1.36	Suspected Debris	TA2B055P1	Medium		
BB_FS_SSS_0356	570950.89	5761357.88	0.69	0.61	0.25	0.95	Suspected Debris	TA2B053P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0357	569782.37	5761341.54	1.21	0.37	0.20	1.03	Suspected Debris	TA2B042P1	Low		
BB_FS_SSS_0358	570180.43	5761347.77	1.61	0.39	0.58	2.06	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0359	569780.10	5761342.77	1.62	0.52	0.16	0.73	Suspected Debris	TA2B042P1	Medium	MBES	
BB_FS_SSS_0360	570651.00	5761356.06	0.74	0.28	0.17	1.00	Boulder	TA2B052P1	Low		

BB_FS_SSS_0361	571239.99	5761365.80	1.16	0.20	0.06	0.44	Suspected Debris	TA2B058P1	Medium	MBES	
BB_FS_SSS_0362	570751.35	5761358.87	0.58	0.55	0.15	0.80	Boulder	TA2B051P1	Low		
BB_FS_SSS_0363	570965.54	5761363.05	0.64	0.34	0.18	1.91	Boulder	TA2B053P1	Medium		
BB_FS_SSS_0364	569791.82	5761347.41	1.44	0.55	0.32	2.22	Boulder	TA2B044P1	Low		
BB_FS_SSS_0365	569899.94	5761349.78	0.67	0.21	0.07	0.50	Boulder	TA2B043P1	Low		
BB_FS_SSS_0366	570755.99	5761362.49	0.81	0.32	0.20	1.18	Boulder	TA2B051P1	Low		
BB_FS_SSS_0367	570555.57	5761360.34	0.62	0.42	0.04	0.34	Boulder	TA2B049P1	Medium		
BB_FS_SSS_0368	570747.34	5761363.18	0.59	0.38	0.13	0.79	Boulder	TA2B051P1	Low		
BB_FS_SSS_0369	570956.90	5761366.38	0.57	0.50	0.23	1.14	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0370	570999.76	5761369.06	1.17	0.61	0.22	1.81	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0371	570185.07	5761358.29	2.18	0.89	0.29	2.07	Boulder	TA2B048P1	Medium	MBES	
BB_FS_SSS_0372	570954.81	5761369.26	0.87	0.35	0.07	0.37	Boulder	TA2B053P1_SSS_INF	Medium		
BB_FS_SSS_0373	570170.35	5761359.05	0.68	0.87	0.33	1.46	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0374	570164.94	5761359.60	1.23	0.79	0.20	0.89	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0375	570169.59	5761361.06	1.27	0.62	0.22	1.04	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0376	570182.13	5761362.53	1.25	0.56	0.22	1.29	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0377	570167.06	5761362.45	0.76	0.91	0.27	1.29	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0378	570224.06	5761365.30	2.22	0.50	0.13	1.19	Boulder	TA2B049P1	Medium		
BB_FS_SSS_0379	570722.49	5761372.64	0.62	0.50	0.26	1.51	Boulder	TA2B051P1	Low		
BB_FS_SSS_0380	570214.34	5761366.81	1.05	0.47	0.50	4.32	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0381	570176.83	5761367.08	0.82	0.51	0.18	1.10	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0382	570173.08	5761368.93	1.09	0.86	0.22	1.35	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0383	570711.89	5761377.35	0.64	0.43	0.12	0.72	Boulder	TA2B051P1	Low		
BB_FS_SSS_0384	569723.71	5761365.15	0.85	0.36	0.15	0.60	Boulder	TA2B042P1	Low		
BB_FS_SSS_0385	570992.89	5761383.13	1.32	0.45	0.19	0.96	Boulder	TA2B054P1	Medium		
BB_FS_SSS_0386	569985.91	5761371.13	0.89	0.38	0.22	0.89	Boulder	TA2B046P1	Low		
BB_FS_SSS_0387	570721.27	5761384.55	0.56	0.41	0.26	0.74	Boulder	TA2B053P1	Medium		
BB_FS_SSS_0388	570598.48	5761383.63	0.52	0.31	0.09	0.40	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0389	569709.64	5761371.50	0.98	0.46	0.07	0.54	Boulder	TA2B044P1	Low		
BB_FS_SSS_0390	570165.32	5761380.87	0.71	0.53	0.19	1.43	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0391	571025.60	5761393.74	0.90	0.62	0.17	0.52	Boulder	TA2B056P1	Medium	MBES	
BB_FS_SSS_0392	570663.12	5761390.39	0.51	0.44	0.13	0.68	Boulder	TA2B051P1	Low		
BB_FS_SSS_0393	571055.44	5761396.90	0.97	0.43	0.12	0.56	Boulder	TA2B055P1	Medium	MBES	
BB_FS_SSS_0394	570150.05	5761384.85	0.93	0.71	0.17	1.25	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0395	570324.55	5761387.85	1.05	0.43	0.15	0.95	Boulder	TA2B048P1	Medium		
BB_FS_SSS_0396	570150.28	5761388.04	1.28	0.58	0.42	3.48	Boulder	TA2B046P1	Medium	MBES	
BB_FS_SSS_0397	570953.36	5761402.45	0.94	0.99	0.24	1.39	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0398	570638.00	5761402.29	0.51	0.32	0.16	0.94	Boulder	TA2B051P1	Low		
BB_FS_SSS_0399	570635.50	5761402.85	1.13	0.53	0.10	0.59	Boulder	TA2B051P1	Low		
BB_FS_SSS_0400	570646.48	5761403.96	0.70	0.22	0.13	0.81	Boulder	TA2B051P1	Low		
BB_FS_SSS_0401	570644.71	5761404.36	0.97	0.31	0.11	0.70	Boulder	TA2B051P1	Low		
BB_FS_SSS_0402	570640.86	5761405.77	0.51	0.25	0.15	0.93	Boulder	TA2B051P1	Low		
BB_FS_SSS_0403	569843.56	5761398.39	1.67	0.82	0.44	1.63	Boulder	TA2B044P1	Medium	MBES	
BB_FS_SSS_0404	569929.13	5761402.05	1.12	0.56	0.53	1.49	Boulder	TA2B045P1	Low		
BB_FS_SSS_0405	570636.81	5761412.72	0.73	0.26	0.25	0.75	Boulder	TA2B053P1	Low		
BB_FS_SSS_0406	570615.28	5761414.88	1.00	0.47	0.17	1.00	Boulder	TA2B051P1	Low		

BB_FS_SSS_0407	569917.34	5761409.25	0.79	0.20	0.58	1.94	Boulder	TA2B045P1	Low		
BB_FS_SSS_0408	570498.88	5761419.30	1.09	0.47	0.31	1.66	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0409	570461.30	5761420.28	1.13	0.46	0.08	0.61	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0410	570556.73	5761422.04	0.50	0.29	0.21	0.77	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0411	570616.37	5761425.35	0.82	0.25	0.36	0.99	Boulder	TA2B053P1	Low		
BB_FS_SSS_0412	571018.12	5761432.11	0.64	0.38	0.17	0.74	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0413	571017.86	5761435.50	0.97	1.01	0.45	2.04	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0414	570537.01	5761431.41	0.95	0.37	0.13	0.53	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0415	571021.27	5761438.39	0.93	0.33	0.25	0.92	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0416	571022.16	5761441.79	0.52	0.23	0.33	1.06	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0417	570589.62	5761438.56	0.93	0.34	0.13	0.96	Boulder	TA2B051P1	Low		
BB_FS_SSS_0418	571005.98	5761444.61	1.36	0.64	0.11	0.99	Boulder	TA2B055P1	Medium		
BB_FS_SSS_0419	570165.16	5761433.27	8.89	0.57	0.38	1.24	Suspected Debris	TA2B049P1	Medium	MBES	
BB_FS_SSS_0420	570893.07	5761444.50	0.53	0.31	0.18	0.64	Boulder	TA2B056P1	Medium	MBES	
BB_FS_SSS_0421	570894.82	5761445.76	0.72	0.52	0.60	2.07	Boulder	TA2B056P1	Medium	MBES	
BB_FS_SSS_0422	570423.96	5761442.13	0.89	0.70	0.14	0.89	Boulder	TA2B050P1	Medium		
BB_FS_SSS_0423	571016.88	5761455.56	0.95	1.14	0.32	1.91	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0424	570885.86	5761454.33	0.68	0.29	0.25	0.72	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0425	571033.51	5761456.96	0.52	0.28	0.15	0.79	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0426	571025.46	5761462.33	0.55	0.22	0.19	0.85	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0427	571024.29	5761462.35	0.77	0.42	0.46	2.08	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0428	570523.02	5761463.07	0.83	0.40	0.06	0.48	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0429	570355.76	5761466.95	0.78	0.66	0.09	0.62	Boulder	TA2B050P1	Medium		
BB_FS_SSS_0430	571010.11	5761476.28	0.60	0.27	0.30	1.19	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0431	571037.06	5761477.18	0.74	0.58	0.26	0.68	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0432	569980.07	5761463.02	1.19	0.78	0.04	0.37	Boulder	TA2B046P1	Medium		
BB_FS_SSS_0433	570710.63	5761481.22	4.32	2.42	0.28	2.38	Wreck	TA2B056P1	Medium	MBES	
BB_FS_SSS_0434	571049.93	5761486.40	0.89	0.51	0.34	0.38	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0435	571057.51	5761489.92	0.88	0.36	0.10	0.68	Boulder	TA2B059P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0436	570904.30	5761488.01	1.11	0.50	0.25	2.16	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0437	570982.33	5761489.32	0.75	0.56	0.21	0.81	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0438	569839.15	5761475.18	2.70	0.49	0.08	0.67	Boulder	TA2B048P1	Low		
BB_FS_SSS_0439	571029.26	5761492.51	0.67	0.35	0.49	0.59	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0440	570667.23	5761491.98	1.15	0.31	0.15	0.38	Boulder	TA2B054P1	Low		
BB_FS_SSS_0441	570973.41	5761498.06	0.83	0.54	0.22	0.78	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0442	571030.85	5761499.34	0.80	0.54	0.14	0.69	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0443	570397.67	5761491.31	0.51	0.49	0.13	0.61	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0444	570946.57	5761500.93	4.41	0.50	0.14	0.65	Suspected Debris	TA2B058P1	Medium	MBES	
BB_FS_SSS_0445	570697.71	5761499.87	0.90	0.35	0.08	0.56	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0446	571018.89	5761505.00	1.30	0.50	0.40	1.92	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0447	570978.01	5761504.45	0.81	0.49	0.23	0.54	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0448	570456.98	5761500.51	0.52	0.46	0.10	0.41	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0449	570453.05	5761501.20	0.84	0.37	0.22	0.47	Boulder	TA2B053P1	Low		
BB_FS_SSS_0450	570991.37	5761514.98	0.90	0.41	0.10	0.69	Boulder	TA2B059P1_SSS_INF	Medium		
BB_FS_SSS_0451	570181.94	5761504.46	0.73	0.43	0.48	1.92	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0452	570458.18	5761508.55	1.48	0.70	0.48	2.55	Boulder	TA2B052P1	Low		

BB_FS_SSS_0453	570659.39	5761514.84	2.95	0.60	0.24	1.60	Boulder	TA2B056P1	Medium	MBES	
BB_FS_SSS_0454	571247.09	5761527.02	1.82	0.44	0.13	0.42	Suspected Debris	TA2B060P1	Medium		
BB_FS_SSS_0455	569804.05	5761510.27	1.42	0.36	0.09	0.55	Boulder	TA2B048P1	Low		
BB_FS_SSS_0456	570663.16	5761529.59	0.51	0.29	0.18	0.81	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0457	570610.93	5761536.39	0.52	0.34	0.17	1.08	Boulder	TA2B056P1	Low		
BB_FS_SSS_0458	570948.05	5761542.28	1.46	0.31	1.63	1.38	Suspected Debris	TA2B058P1	Medium	MBES	
BB_FS_SSS_0459	570999.76	5761544.57	0.54	0.38	0.36	0.74	Boulder	TA2B059P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0460	570945.74	5761549.77	1.25	0.46	0.39	1.70	Fishing Gear	TA2B059P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0461	570605.92	5761545.35	0.99	0.20	0.13	0.72	Suspected Debris	TA2B056P1	Medium	MBES	
BB_FS_SSS_0462	570603.62	5761546.18	0.54	0.26	0.13	0.75	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0463	570614.01	5761550.01	0.63	0.67	0.23	1.04	Boulder	TA2B056P1	Medium	MBES	
BB_FS_SSS_0464	570609.41	5761550.56	0.56	0.29	0.17	0.82	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0465	569810.25	5761540.21	0.92	0.42	0.16	0.58	Boulder	TA2B047P1	Medium		
BB_FS_SSS_0466	570153.25	5761548.50	0.77	0.48	0.12	0.80	Boulder	TA2B050P1	Medium		
BB_FS_SSS_0467	571002.57	5761562.66	0.61	0.37	0.25	1.24	Boulder	TA2B060P1	Low		
BB_FS_SSS_0468	570293.74	5761557.24	0.83	0.58	0.17	0.51	Boulder	TA2B052P1	Low		
BB_FS_SSS_0469	570671.75	5761566.10	0.79	0.41	0.19	0.98	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0470	570573.02	5761571.45	0.75	0.48	0.60	1.42	Boulder	TA2B055P1	Medium	MBES	
BB_FS_SSS_0471	570158.19	5761567.46	2.40	1.31	0.15	1.39	Boulder	TA2B050P1	Medium	MBES	
BB_FS_SSS_0472	570303.85	5761569.62	0.54	0.34	0.12	0.63	Boulder	TA2B052P1	Low		
BB_FS_SSS_0473	570566.97	5761575.01	0.64	0.25	0.21	1.89	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0474	570562.60	5761575.70	0.89	0.36	0.09	0.88	Boulder	TA2B057P1	Low		
BB_FS_SSS_0475	570653.93	5761578.47	2.12	0.68	0.08	0.73	Boulder	TA2B055P1	Medium		
BB_FS_SSS_0476	570281.90	5761575.38	0.51	0.47	0.15	0.70	Boulder	TA2B052P1	Low		
BB_FS_SSS_0477	570631.32	5761580.86	0.79	0.46	0.20	0.96	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0478	570233.26	5761575.98	0.57	0.17	0.07	0.49	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0479	570231.21	5761578.64	0.51	0.31	0.09	0.63	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0480	570956.11	5761589.78	0.80	1.10	0.31	1.14	Suspected Debris	TA2B060P1	Medium		
BB_FS_SSS_0481	570153.65	5761582.99	6.02	2.16	0.13	0.86	Suspected Debris	TA2B053P1	Medium		
BB_FS_SSS_0482	570896.38	5761594.06	0.50	0.18	0.16	0.97	Boulder	TA2B060P1	Low		
BB_FS_SSS_0483	570582.72	5761590.01	0.93	0.30	0.20	1.23	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0484	570575.70	5761590.32	0.76	0.31	0.13	0.64	Boulder	TA2B055P1	Medium	MBES	
BB_FS_SSS_0485	570574.50	5761595.80	1.18	0.28	0.11	0.63	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0486	570231.69	5761594.79	1.34	0.47	0.13	0.61	Boulder	TA2B052P1	Low		
BB_FS_SSS_0487	571002.28	5761611.42	0.64	0.46	0.15	1.03	Boulder	TA2B059P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0488	570923.08	5761612.58	0.80	0.30	0.07	0.64	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0489	570244.74	5761605.93	0.76	0.46	0.20	0.98	Boulder	TA2B054P1	Medium		
BB_FS_SSS_0490	570735.28	5761622.84	0.76	0.44	0.10	0.44	Fishing Gear	TA2B059P1	Medium		
BB_FS_SSS_0491	570510.83	5761620.02	1.25	0.48	0.17	1.07	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0492	570710.34	5761623.58	2.00	0.78	1.23	1.59	Fishing Gear	TA2B058P1	Medium	MBES	
BB_FS_SSS_0493	570491.85	5761627.99	0.60	0.41	0.09	0.57	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0494	570507.52	5761628.25	2.34	0.71	0.19	1.01	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0495	570488.76	5761629.65	0.63	0.49	0.15	0.96	Boulder	TA2B057P1	Medium	MBES	
BB_FS_SSS_0496	570814.17	5761641.26	1.00	0.46	0.34	1.62	Fishing Gear	TA2B060P1	Medium	MBES	
BB_FS_SSS_0497	570686.42	5761642.49	1.18	0.38	0.37	1.74	Boulder	TA2B059P1	Medium	MBES	
BB_FS_SSS_0498	570431.37	5761645.82	0.58	0.41	0.10	0.49	Boulder	TA2B055P1	Medium		

BB_FS_SSS_0499	570628.72	5761656.78	0.61	0.38	0.16	0.91	Boulder	TA2B059P1	Medium		
BB_FS_SSS_0500	570565.78	5761659.38	0.72	0.29	0.18	0.66	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0501	571102.77	5761667.19	0.58	0.26	0.12	0.36	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0502	570635.87	5761666.42	1.40	0.31	0.21	0.86	Boulder	TA2B059P1	Medium	MBES	
BB_FS_SSS_0503	570932.42	5761673.00	1.58	1.32	0.39	1.89	Suspected Debris	TA2B060P1	Medium	MBES	
BB_FS_SSS_0504	570330.43	5761663.50	2.90	0.26	0.12	0.56	Suspected Debris	TA2B056P1	Medium		
BB_FS_SSS_0505	570778.49	5761672.98	1.16	0.37	0.13	0.43	Fishing Gear	TA2B059P1	Medium		
BB_FS_SSS_0506	570876.68	5761681.54	1.20	0.50	0.19	1.37	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0507	570589.92	5761678.18	0.53	0.30	0.09	0.57	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0508	570457.10	5761677.70	1.10	0.43	0.09	0.45	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0509	570690.30	5761690.43	1.07	0.95	0.24	1.14	Boulder	TA2B060P1	Medium	MBES	
BB_FS_SSS_0510	571102.58	5761697.21	0.89	0.23	0.06	0.42	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0511	570314.93	5761689.67	0.97	0.23	0.15	1.28	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0512	570429.17	5761696.54	0.52	0.28	0.10	0.55	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0513	569956.07	5761690.71	0.61	0.51	0.21	0.65	Boulder	TA2B052P1	Medium	MBES	
BB_FS_SSS_0514	570454.63	5761699.31	0.56	0.29	0.14	0.53	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0515	570664.44	5761716.05	0.58	0.24	0.12	0.39	Boulder	TA2B059P1_SSS_INF	Medium		
BB_FS_SSS_0516	569915.84	5761714.06	1.17	0.43	0.03	0.30	Boulder	TA2B051P1	Low		
BB_FS_SSS_0517	570490.33	5761723.46	1.03	0.24	0.07	0.45	Boulder	TA2B057P1	Low		
BB_FS_SSS_0518	569856.99	5761715.70	0.72	0.29	0.13	0.90	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0519	569958.74	5761718.69	0.81	0.51	0.10	0.75	Boulder	TA2B052P1	Low		
BB_FS_SSS_0520	569949.49	5761719.51	0.79	0.42	0.05	0.38	Boulder	TA2B052P1	Low		
BB_FS_SSS_0521	570224.82	5761723.71	1.66	0.41	0.11	0.81	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0522	569757.18	5761720.76	0.73	0.35	0.13	0.52	Boulder	TA2B052P1	Medium	MBES	
BB_FS_SSS_0523	571167.63	5761757.03	0.73	0.54	0.19	0.88	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0524	570619.55	5761751.56	0.51	0.43	0.12	0.77	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0525	570739.51	5761755.33	0.83	0.67	0.18	1.26	Boulder	TA2B060P1	Medium	MBES	
BB_FS_SSS_0526	569905.48	5761744.35	1.07	0.50	0.11	0.47	Boulder	TA2B054P1	Medium		
BB_FS_SSS_0527	571200.72	5761767.43	0.56	0.28	0.15	0.96	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0528	570722.99	5761761.45	0.67	0.57	1.12	1.13	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0529	570467.65	5761764.68	0.75	0.56	0.39	1.74	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0530	569751.37	5761761.54	1.66	0.31	0.08	0.44	Boulder	TA2B051P1	Medium		
BB_FS_SSS_0531	571160.12	5761785.23	0.54	0.29	0.25	1.09	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0532	570939.76	5761783.33	1.86	0.38	0.09	0.32	Suspected Debris	TA2B063P1	Medium		
BB_FS_SSS_0533	570290.66	5761779.41	0.64	0.42	0.08	0.84	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0534	571247.19	5761795.18	0.79	0.33	0.16	0.79	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0535	570296.06	5761785.77	1.16	0.55	0.14	0.69	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0536	570284.93	5761788.68	1.74	0.51	0.20	1.20	Boulder	TA2B059P1	Medium		
BB_FS_SSS_0537	569813.40	5761782.89	0.98	0.36	0.13	1.15	Boulder	TA2B052P1	Medium		
BB_FS_SSS_0538	571156.65	5761802.47	0.59	0.22	0.26	1.11	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0539	571159.08	5761802.86	0.59	0.25	0.18	0.75	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0540	571225.39	5761803.92	0.71	0.43	0.46	0.42	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0541	571151.22	5761804.52	0.67	0.27	0.26	1.55	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0542	570764.34	5761802.79	0.79	0.54	0.17	1.65	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0543	571200.18	5761810.48	0.71	0.47	0.15	0.69	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0544	570277.26	5761799.82	0.59	0.54	0.12	0.58	Boulder	TA2B059P1	Medium	MBES	

BB_FS_SSS_0545	571179.15	5761818.44	0.75	0.27	0.32	0.44	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0546	571146.60	5761826.00	0.56	0.31	0.44	0.89	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0547	571157.47	5761826.88	0.60	0.17	0.24	1.92	Boulder	TA2B068P1_SSS_INF	Medium		
BB_FS_SSS_0548	569706.18	5761810.98	0.52	0.40	0.15	1.01	Boulder	TA2B052P1	Low		
BB_FS_SSS_0549	570731.74	5761834.96	0.77	0.38	0.42	2.24	Boulder	TA2B064P1	Medium	MBES	
BB_FS_SSS_0550	570194.63	5761831.08	0.76	0.61	0.18	0.97	Boulder	TA2B059P1	Medium		
BB_FS_SSS_0551	570346.31	5761835.65	1.37	0.48	0.07	0.66	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0552	570481.53	5761848.49	0.86	0.34	0.17	0.96	Boulder	TA2B060P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0553	570094.90	5761847.62	0.98	0.26	0.11	0.40	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0554	570007.53	5761846.44	1.94	0.59	0.27	2.16	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0555	570624.45	5761865.48	0.54	0.24	0.37	1.52	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0556	570791.58	5761869.46	1.59	0.73	0.14	0.98	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0557	570815.14	5761872.11	1.52	0.56	0.14	1.20	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0558	570048.41	5761871.63	0.58	0.54	0.17	1.63	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0559	570396.83	5761877.71	1.24	0.29	0.07	0.54	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0560	570273.29	5761878.08	2.36	1.32	0.25	1.81	Boulder	TA2B061P1	Low		
BB_FS_SSS_0561	570308.81	5761884.29	1.46	0.44	0.09	0.54	Boulder	TA2B059P1	Medium		
BB_FS_SSS_0562	570450.71	5761888.45	0.61	0.30	0.28	0.71	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0563	570141.80	5761890.45	0.80	0.42	0.17	0.70	Boulder	TA2B058P1	Medium	MBES	
BB_FS_SSS_0564	571031.17	5761907.23	1.00	0.46	0.08	0.73	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0565	570628.05	5761902.80	1.27	0.33	0.10	0.78	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0566	570041.49	5761894.74	0.93	0.38	0.09	0.52	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0567	570799.29	5761905.63	1.30	0.51	0.57	0.76	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0568	569952.95	5761896.11	1.22	0.39	0.18	0.85	Suspected Debris	TA2B058P1	Medium	MBES	
BB_FS_SSS_0569	570786.33	5761908.07	0.67	0.33	0.11	0.66	Boulder	TA2B064P1	Low		
BB_FS_SSS_0570	570779.76	5761911.12	0.85	0.32	0.13	0.80	Boulder	TA2B064P1	Low		
BB_FS_SSS_0571	570359.40	5761907.52	0.59	0.42	0.25	1.79	Boulder	TA2B060P1_SSS_INF	Low		
BB_FS_SSS_0572	570804.52	5761913.98	0.60	0.19	0.23	0.63	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0573	570730.35	5761914.29	0.63	0.45	0.23	0.95	Boulder	TA2B064P1	Medium		
BB_FS_SSS_0574	570347.20	5761910.83	0.79	0.42	0.33	1.68	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0575	570726.41	5761916.88	0.53	0.41	0.15	0.63	Boulder	TA2B064P1	Medium		
BB_FS_SSS_0576	570023.71	5761909.03	1.06	0.88	0.22	1.62	Boulder	TA2B057P1	Medium		
BB_FS_SSS_0577	569907.64	5761909.01	1.94	0.24	0.05	0.39	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0578	570426.13	5761919.41	0.61	0.28	0.14	0.69	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0579	570442.20	5761922.40	1.83	0.54	0.21	0.87	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0580	570195.73	5761919.52	0.82	0.56	0.14	0.82	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0581	570423.83	5761922.97	0.64	0.44	0.12	0.57	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0582	569918.40	5761916.61	0.71	0.46	0.11	0.97	Boulder	TA2B056P1	Medium		
BB_FS_SSS_0583	570337.76	5761922.77	0.58	0.51	0.15	0.57	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0584	571253.31	5761937.24	0.77	0.74	0.26	1.27	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0585	570379.64	5761927.24	1.62	0.56	0.20	0.90	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0586	570138.25	5761924.69	0.83	0.54	0.05	0.43	Boulder	TA2B058P1	Medium		
BB_FS_SSS_0587	570542.57	5761930.77	2.20	0.75	0.13	1.12	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0588	570284.93	5761927.17	1.12	0.79	0.14	0.78	Boulder	TA2B060P1_SSS_INF	Low		
BB_FS_SSS_0589	570311.99	5761927.93	0.66	0.23	0.14	0.65	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0590	570712.20	5761936.73	0.83	0.47	0.09	0.47	Boulder	TA2B066P1_SSS_INF	Low		

BB_FS_SSS_0591	570298.91	5761932.01	0.77	0.47	0.07	0.35	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0592	570339.06	5761934.80	0.89	0.28	0.28	2.04	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0594	570384.51	5761942.29	1.59	0.64	0.32	1.29	Suspected Debris	TA2B063P1	Medium	MBES	
BB_FS_SSS_0595	570338.54	5761943.84	2.06	0.46	0.16	1.01	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0596	570324.73	5761944.30	0.52	0.26	0.13	0.95	Boulder	TA2B063P1	Low		
BB_FS_SSS_0597	570388.55	5761945.48	1.01	0.39	0.13	1.10	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0598	570390.51	5761945.67	1.25	0.46	0.24	1.92	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0599	570324.54	5761948.86	1.96	0.42	0.20	1.32	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0600	570376.56	5761949.73	1.28	0.74	0.17	1.18	Suspected Debris	TA2B061P1	Medium	MBES	
BB_FS_SSS_0601	570249.85	5761948.11	1.04	0.52	0.13	0.87	Boulder	TA2B060P1_SSS_INF	Low		
BB_FS_SSS_0602	570414.77	5761950.58	1.38	0.40	0.32	2.14	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0603	570381.25	5761950.29	0.69	0.37	0.07	0.61	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0604	570407.23	5761953.51	1.25	0.21	0.15	0.95	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0605	570350.05	5761953.76	0.91	0.36	0.16	1.39	Boulder	TA2B064P1	Medium	MBES	
BB_FS_SSS_0606	570387.29	5761956.92	1.16	0.51	0.23	1.60	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0608	570534.13	5761959.13	0.75	0.44	0.18	1.01	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0609	570363.69	5761956.96	1.94	0.75	0.21	1.53	Suspected Debris	TA2B061P1	Medium		
BB_FS_SSS_0610	570290.80	5761956.51	0.82	0.69	0.25	1.82	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0611	570501.15	5761959.61	1.04	0.86	0.11	0.84	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0612	570405.12	5761959.00	0.61	0.50	0.23	1.36	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0613	570430.14	5761959.47	0.62	0.34	0.15	0.72	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0614	570427.72	5761959.54	2.57	0.20	0.07	0.34	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0615	570376.69	5761958.97	0.73	0.36	0.13	0.97	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0616	570277.64	5761957.88	0.69	0.38	0.15	1.18	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0617	570498.68	5761961.28	0.53	0.27	0.17	0.69	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0618	570501.11	5761961.80	1.12	0.69	0.53	3.83	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0619	570385.09	5761961.70	0.53	0.30	0.15	0.91	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0620	570363.62	5761961.42	4.12	0.44	0.31	2.40	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0621	570393.76	5761962.13	0.92	0.60	0.20	1.21	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0622	570409.08	5761962.45	2.80	0.32	0.29	1.59	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0623	570302.58	5761961.43	0.61	0.60	0.14	0.69	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0624	570263.19	5761961.04	1.05	0.52	0.40	1.21	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0625	570506.78	5761964.52	0.66	0.43	0.12	0.59	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0626	570393.30	5761964.55	0.58	0.49	0.21	1.25	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0627	570276.21	5761963.34	0.73	0.41	0.18	1.27	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0628	570390.07	5761965.16	0.78	0.15	0.10	0.62	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0629	570406.49	5761966.47	1.11	0.36	0.25	1.21	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0630	570377.90	5761966.17	2.31	0.78	0.75	4.97	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0631	570399.58	5761966.48	1.44	0.31	0.09	0.50	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0632	570470.87	5761968.43	0.63	0.25	0.20	0.67	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0633	570480.94	5761968.59	1.42	0.33	0.11	0.78	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0634	570367.39	5761967.82	1.15	0.47	0.41	0.71	Suspected Debris	TA2B063P1	Medium		
BB_FS_SSS_0635	570396.13	5761968.58	1.43	0.61	0.36	1.94	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0636	570387.53	5761968.89	1.66	0.42	0.39	2.22	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0637	570479.80	5761971.57	1.27	0.42	0.11	0.77	Suspected Debris	TA2B065P1	Medium		
BB_FS_SSS_0638	570368.12	5761971.42	1.22	0.53	0.38	2.42	Suspected Debris	TA2B064P1	Medium	MBES	

BB_FS_SSS_0639	570405.10	5761972.11	0.80	0.25	0.14	0.61	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0640	570791.79	5761978.47	0.61	0.39	0.12	0.88	Boulder	TA2B068P1_SSS_INF	Medium		
BB_FS_SSS_0641	570370.43	5761972.59	1.68	0.56	0.31	1.82	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0643	570476.60	5761976.93	0.62	0.20	0.14	0.88	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0644	570394.34	5761976.69	0.58	0.37	0.20	0.88	Suspected Debris	TA2B064P1	Low		
BB_FS_SSS_0645	571010.90	5761985.66	0.71	0.30	0.15	0.98	Boulder	TA2B070P1_SSS_INF	Low		
BB_FS_SSS_0646	570244.68	5761974.96	1.10	0.46	0.15	1.06	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0647	571047.79	5761986.75	1.91	0.33	0.10	0.83	Boulder	TA2B068P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0648	570402.09	5761977.78	1.29	0.44	0.21	2.06	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0649	570379.87	5761978.65	1.23	0.79	0.17	0.83	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0650	570434.44	5761980.75	0.51	0.32	0.34	0.67	Boulder	TA2B064P1	Medium		
BB_FS_SSS_0651	570382.43	5761980.29	1.19	0.41	0.24	1.07	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0652	570392.05	5761980.73	0.67	0.26	0.28	1.12	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0653	570365.54	5761980.86	1.54	1.06	0.21	1.07	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0654	570410.09	5761983.14	0.77	0.44	0.19	0.41	Boulder	TA2B063P1	Low		
BB_FS_SSS_0655	570780.07	5761988.52	0.73	0.40	0.13	0.67	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0656	570372.40	5761983.76	1.29	0.54	0.30	1.39	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0657	570418.77	5761985.20	0.59	0.27	0.38	0.82	Boulder	TA2B064P1	Medium	MBES	
BB_FS_SSS_0658	570470.60	5761986.06	1.98	1.02	0.28	1.47	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0659	570363.50	5761984.83	0.93	0.35	0.10	0.49	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0660	570403.39	5761985.59	1.04	0.43	0.09	0.81	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0661	570356.50	5761985.55	0.57	0.31	0.04	0.25	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0662	570384.36	5761986.31	1.32	0.50	0.54	0.80	Suspected Debris	TA2B063P1	Medium		
BB_FS_SSS_0663	570370.84	5761986.20	1.29	0.61	0.17	0.74	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0664	570385.73	5761986.66	1.69	0.48	0.44	0.70	Suspected Debris	TA2B063P1	Medium		
BB_FS_SSS_0665	570380.29	5761987.22	0.95	0.35	0.12	0.47	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0666	570200.07	5761985.54	1.05	0.97	0.29	2.20	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0667	570386.70	5761988.54	1.10	0.28	0.25	0.81	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0668	570403.14	5761989.22	0.57	0.29	0.22	0.54	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0669	570408.80	5761990.57	0.75	0.39	0.10	0.32	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0670	570373.42	5761990.40	1.01	0.32	0.35	3.42	Suspected Debris	TA2B065P1	Medium		
BB_FS_SSS_0671	570383.30	5761990.68	1.44	0.41	0.70	1.45	Suspected Debris	TA2B063P1	Medium	MBES	
BB_FS_SSS_0672	570430.48	5761993.07	1.22	0.49	0.19	1.23	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0673	570401.52	5761993.08	1.59	0.31	0.21	1.64	Suspected Debris	TA2B065P1	Medium	MBES	
BB_FS_SSS_0674	570382.69	5761993.32	1.13	0.20	0.14	0.42	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0675	570103.15	5761990.11	1.48	0.38	0.08	0.61	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0676	570388.40	5761994.17	1.43	0.43	0.44	1.14	Suspected Debris	TA2B064P1	Medium	MBES	
BB_FS_SSS_0677	570425.80	5761996.27	0.90	0.37	0.10	0.61	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0678	570397.06	5761996.28	31.86	20.45	1.59	15.39	Wreck	TA2B065P1	High	MBES	BB_FS_MAG_0298
BB_FS_SSS_0679	571133.12	5762007.09	1.52	0.55	0.12	1.06	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0680	570438.37	5761998.95	0.64	0.21	0.12	0.65	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0681	570071.21	5761994.52	0.60	0.35	0.11	0.99	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0682	570077.78	5761995.22	0.78	0.60	0.06	0.48	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0683	570382.90	5762000.27	1.15	0.46	0.25	0.51	Suspected Debris	TA2B064P1	Medium		
BB_FS_SSS_0684	570389.45	5762001.00	4.29	0.61	0.39	3.03	Suspected Debris	TA2B065P1	Medium		
BB_FS_SSS_0685	571102.23	5762017.01	0.88	0.39	0.12	1.06	Boulder	TA2B072P1	Medium		

BB_FS_SSS_0686	570838.14	5762015.42	1.19	0.45	0.23	1.36	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0687	570987.71	5762020.15	1.90	0.68	0.12	0.96	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0688	570076.32	5762010.74	0.82	0.46	0.07	0.41	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0689	570838.30	5762022.24	0.73	0.43	0.27	1.10	Boulder	TA2B069P1	Medium	MBES	
BB_FS_SSS_0690	570237.62	5762014.17	2.10	0.76	0.14	1.03	Boulder	TA2B064P1	Low		
BB_FS_SSS_0691	570808.39	5762023.31	0.65	0.51	0.25	1.33	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0692	570374.70	5762017.92	2.58	1.79	0.23	1.41	Suspected Debris	TA2B065P1	Medium	MBES	
BB_FS_SSS_0693	570093.35	5762016.99	0.65	0.43	0.17	0.70	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0694	570223.27	5762025.20	1.08	0.58	0.08	0.51	Boulder	TA2B064P1	Medium		
BB_FS_SSS_0695	570674.35	5762031.79	0.81	0.45	0.10	0.59	Boulder	TA2B068P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0696	571022.78	5762037.98	1.15	0.48	0.10	1.06	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0697	570230.01	5762027.67	1.06	0.55	0.19	1.09	Boulder	TA2B064P1	Low		
BB_FS_SSS_0698	570302.05	5762029.72	1.56	0.68	0.10	0.83	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0699	569896.78	5762028.52	1.34	0.77	0.17	1.19	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0700	569860.22	5762029.07	2.15	0.37	0.15	0.50	Suspected Debris	TA2B060P1	Medium	MBES	
BB_FS_SSS_0701	570644.45	5762043.21	0.66	0.46	0.18	1.13	Boulder	TA2B068P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0702	570535.06	5762046.68	0.61	0.45	0.12	0.64	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0703	570643.34	5762050.17	0.70	0.53	0.60	0.53	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0704	570009.70	5762042.06	1.14	0.86	0.11	0.76	Suspected Debris	TA2B060P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0705	569990.48	5762045.72	7.29	0.89	0.23	1.53	Suspected Debris	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0706	570027.79	5762047.13	1.35	0.64	0.12	1.00	Suspected Debris	TA2B060P1_SSS_INF	Medium		
BB_FS_SSS_0707	569986.81	5762046.75	1.29	0.41	0.07	0.48	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0708	570949.79	5762061.31	2.09	0.76	0.15	0.67	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0709	570522.35	5762055.38	0.64	0.51	0.19	1.28	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0710	570512.54	5762055.36	0.83	0.34	0.07	0.45	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0711	570988.40	5762062.46	1.72	0.40	0.10	0.87	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0712	570224.51	5762052.04	1.36	0.32	0.11	1.00	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0713	569901.19	5762047.60	0.56	0.35	0.27	1.08	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0714	570413.01	5762054.91	1.32	0.44	0.07	0.43	Boulder	TA2B064P1	Low		
BB_FS_SSS_0715	570639.37	5762058.66	1.12	0.37	0.28	2.50	Boulder	TA2B069P1	Medium	MBES	
BB_FS_SSS_0716	569878.82	5762053.92	0.88	0.28	0.22	1.02	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0717	571000.59	5762077.38	1.97	0.82	0.18	1.02	Boulder	TA2B072P1	Low		
BB_FS_SSS_0718	570480.85	5762074.38	1.53	0.60	0.09	0.63	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0719	570241.03	5762071.06	0.86	0.54	0.13	0.74	Boulder	TA2B065P1	Low		
BB_FS_SSS_0720	570020.38	5762068.64	0.51	0.51	0.09	0.59	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0721	570441.62	5762074.59	0.75	0.54	0.12	0.81	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0722	570445.54	5762077.49	1.60	0.68	0.15	0.79	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0723	570573.70	5762079.89	0.98	0.44	0.14	0.72	Boulder	TA2B068P1_SSS_INF	Low		
BB_FS_SSS_0724	569936.76	5762071.04	0.80	0.38	0.09	0.48	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0725	569718.86	5762068.22	0.90	0.50	0.12	0.73	Boulder	TA2B060P1	Low		
BB_FS_SSS_0726	570141.50	5762076.08	0.80	0.84	0.10	0.70	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0727	570440.23	5762083.81	1.67	0.68	0.07	0.40	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0728	570205.44	5762081.97	0.69	0.52	0.08	0.46	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0729	570184.78	5762083.39	1.10	0.41	0.12	0.89	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0730	569801.92	5762078.05	0.63	0.20	0.16	1.03	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0731	571182.10	5762098.45	1.24	0.48	0.15	1.19	Boulder	TA2B072P1	Low		

BB_FS_SSS_0732	570449.41	5762088.15	0.78	0.26	0.15	0.69	Boulder	TA2B067P1	Low		
BB_FS_SSS_0733	570227.95	5762090.10	0.75	0.37	0.10	0.69	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0734	570085.83	5762088.17	1.30	0.47	0.11	0.60	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0735	571182.36	5762105.25	2.57	0.87	0.17	1.49	Boulder	TA2B072P1	Low		
BB_FS_SSS_0736	570084.97	5762090.15	1.27	0.48	0.10	0.60	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0737	569935.77	5762088.57	0.63	0.33	0.04	0.36	Boulder	TA2B060P1	Medium		
BB_FS_SSS_0738	570433.16	5762096.55	2.09	0.56	0.08	0.64	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0739	569781.48	5762087.60	0.73	0.34	0.06	0.31	Boulder	TA2B059P1	Low		
BB_FS_SSS_0740	570017.09	5762093.09	0.85	0.54	0.07	0.54	Boulder	TA2B061P1	Medium		
BB_FS_SSS_0741	570096.77	5762100.28	0.56	0.37	0.05	0.42	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0742	571150.65	5762116.07	2.13	0.63	0.13	1.09	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0743	571123.32	5762117.26	0.64	0.63	0.11	0.82	Boulder	TA2B072P1	Low		
BB_FS_SSS_0744	571111.13	5762119.23	2.05	0.57	0.14	1.01	Boulder	TA2B072P1	Low		
BB_FS_SSS_0745	570595.57	5762112.52	1.82	0.51	0.12	0.80	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0746	569708.27	5762102.13	0.54	0.33	0.15	0.25	Boulder	TA2B060P1	Medium	MBES	
BB_FS_SSS_0747	569860.88	5762105.22	0.62	0.37	0.06	0.52	Boulder	TA2B060P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0748	570067.07	5762110.73	0.96	0.62	0.09	0.68	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0749	570973.99	5762123.70	0.87	0.60	0.16	0.94	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0750	570426.82	5762121.96	0.63	0.44	0.75	0.89	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0751	570300.51	5762123.71	1.14	0.46	0.10	0.77	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0752	570959.92	5762136.78	1.32	0.36	0.09	0.58	Boulder	TA2B071P1	Low		
BB_FS_SSS_0753	570845.71	5762135.88	0.90	0.80	0.14	0.74	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0754	569741.61	5762121.00	0.51	0.30	0.22	0.78	Boulder	TA2B061P1	Medium	MBES	
BB_FS_SSS_0755	569787.99	5762122.06	0.99	0.53	0.07	0.49	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0756	570170.05	5762130.12	0.88	0.66	0.13	1.04	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0757	570562.21	5762136.90	0.89	0.36	0.07	0.55	Boulder	TA2B067P1	Low		
BB_FS_SSS_0758	570795.31	5762142.74	1.25	0.69	0.12	0.82	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0759	570031.39	5762132.28	0.63	0.47	0.07	0.64	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0760	570806.53	5762143.39	0.87	0.44	0.11	0.75	Boulder	TA2B072P1	Low		
BB_FS_SSS_0761	570896.59	5762146.03	1.05	0.77	0.14	0.96	Boulder	TA2B073P1	Low		
BB_FS_SSS_0762	570084.65	5762135.92	1.62	0.71	0.13	0.68	Boulder	TA2B063P1	Medium	MBES	
BB_FS_SSS_0763	570888.35	5762150.02	1.59	0.58	0.11	0.72	Boulder	TA2B073P1	Low		
BB_FS_SSS_0764	570138.60	5762141.25	1.30	0.61	0.12	1.05	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0765	569776.01	5762136.65	0.69	0.31	0.13	0.65	Boulder	TA2B062P1_SSS_INF	Low		
BB_FS_SSS_0766	570491.87	5762148.71	0.71	0.49	0.13	0.76	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0767	569994.92	5762142.84	0.79	0.58	0.08	0.70	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0768	570164.32	5762149.33	0.67	0.45	0.08	0.49	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0769	570092.85	5762151.85	1.61	0.34	0.08	0.62	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0770	569714.63	5762146.57	0.61	0.20	0.04	0.19	Boulder	TA2B060P1	Medium		
BB_FS_SSS_0771	571196.61	5762167.71	0.67	0.28	0.16	0.97	Boulder	TA2B076P1	Low		
BB_FS_SSS_0772	570762.06	5762162.16	2.92	0.63	0.16	0.93	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0773	570181.83	5762156.63	0.79	0.62	0.11	0.77	Boulder	TA2B064P1	Low		
BB_FS_SSS_0774	569698.06	5762152.20	0.99	0.50	0.10	0.76	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0775	570822.01	5762168.83	1.80	0.76	0.16	1.22	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0776	570659.90	5762166.93	2.44	0.68	0.16	0.94	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0777	570762.69	5762168.67	1.44	0.45	0.12	0.58	Boulder	TA2B072P1	Medium	MBES	

BB_FS_SSS_0778	570162.95	5762161.30	1.43	0.45	0.09	0.60	Boulder	TA2B064P1	Medium	MBES	
BB_FS_SSS_0779	569924.78	5762158.21	0.79	0.53	0.07	0.44	Boulder	TA2B062P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0780	569700.50	5762156.03	0.98	0.73	0.14	1.01	Boulder	TA2B062P1_SSS_INF	Medium		
BB_FS_SSS_0781	569955.46	5762163.05	1.35	0.47	0.09	0.74	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0782	570830.02	5762176.91	1.14	1.12	0.15	0.89	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0783	570134.18	5762168.28	0.66	0.62	0.07	0.31	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0784	570416.32	5762176.30	2.51	0.54	0.21	1.25	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0785	570857.12	5762182.80	1.21	0.82	0.13	0.84	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0786	570922.84	5762185.62	0.87	0.56	0.18	1.07	Boulder	TA2B074P1	Low		
BB_FS_SSS_0787	570053.74	5762174.72	0.65	0.55	0.07	0.57	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0788	569954.77	5762173.33	1.77	0.66	0.11	0.76	Boulder	TA2B065P1	Medium	MBES	
BB_FS_SSS_0789	570730.36	5762185.13	1.74	0.52	0.19	0.90	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0790	569968.88	5762174.48	2.45	0.54	0.15	0.97	Boulder	TA2B065P1	Medium		
BB_FS_SSS_0791	570133.93	5762177.23	0.64	0.41	0.21	0.69	Boulder	TA2B066P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0792	570171.32	5762179.18	0.82	0.33	0.11	0.77	Boulder	TA2B067P1	Low		
BB_FS_SSS_0793	569963.47	5762178.86	0.70	0.36	0.11	0.55	Boulder	TA2B063P1	Medium		
BB_FS_SSS_0794	570092.23	5762181.30	0.96	0.44	0.12	0.60	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0795	570076.68	5762190.97	0.62	0.42	0.12	0.58	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0796	570160.37	5762193.91	1.02	0.39	0.10	0.57	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0797	570067.47	5762193.85	0.92	0.47	0.10	0.51	Boulder	TA2B066P1_SSS_INF	Medium		
BB_FS_SSS_0798	570443.50	5762200.48	1.50	0.38	0.11	0.76	Boulder	TA2B070P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0799	570725.10	5762204.50	0.68	0.36	0.41	1.12	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0800	570599.44	5762204.36	0.96	0.28	0.08	0.65	Boulder	TA2B069P1	Medium	MBES	
BB_FS_SSS_0801	570105.03	5762206.87	0.88	0.49	0.13	0.82	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0802	570159.09	5762207.97	0.66	0.46	0.14	0.54	Boulder	TA2B067P1	Medium	MBES	
BB_FS_SSS_0803	570736.28	5762222.48	1.12	0.74	0.18	0.91	Boulder	TA2B073P1	Medium		
BB_FS_SSS_0804	570023.22	5762212.62	0.96	0.48	0.14	0.69	Boulder	TA2B066P1_SSS_INF	Low		
BB_FS_SSS_0805	570661.67	5762224.30	1.51	0.40	0.19	0.67	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0806	570003.05	5762218.96	0.86	0.61	0.14	0.76	Boulder	TA2B066P1_SSS_INF	Low		
BB_FS_SSS_0807	570000.21	5762219.70	0.61	0.70	0.14	0.78	Boulder	TA2B066P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0808	570953.13	5762236.11	1.28	0.45	0.16	1.55	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0809	570160.43	5762225.09	0.80	0.59	0.14	1.07	Boulder	TA2B068P1_SSS_INF	Medium		
BB_FS_SSS_0810	570186.55	5762225.59	1.20	0.58	0.08	0.51	Boulder	TA2B068P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0811	570522.60	5762231.03	2.09	0.73	0.10	0.74	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0812	570065.63	5762224.94	0.68	0.54	0.09	0.56	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0813	570064.07	5762225.94	1.05	0.61	0.09	0.57	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0814	570949.05	5762241.38	1.48	0.73	0.10	0.96	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0815	569904.33	5762229.73	0.84	0.47	0.14	1.22	Boulder	TA2B066P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0816	570462.79	5762240.60	1.31	0.58	0.13	0.93	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0817	570369.61	5762240.79	1.16	0.52	0.07	0.41	Boulder	TA2B070P1_SSS_INF	Medium	MBES	
BB_FS_SSS_0818	571036.68	5762256.49	2.07	0.84	0.12	1.03	Boulder	TA2B077P1	Medium	MBES	
BB_FS_SSS_0819	571003.49	5762257.12	0.67	0.52	0.13	0.88	Boulder	TA2B074P1	Low		
BB_FS_SSS_0820	570512.34	5762252.11	1.84	0.70	0.11	0.82	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0821	570929.17	5762262.85	2.82	0.78	0.12	0.89	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0822	570416.48	5762259.06	1.80	0.49	0.16	1.03	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0823	570491.71	5762268.05	2.22	0.75	0.11	0.70	Boulder	TA2B072P1	Low		

BB_FS_SSS_0824	570333.16	5762266.73	1.86	0.42	0.18	1.83	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0825	571158.67	5762279.40	0.86	0.47	0.10	0.76	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0826	570489.47	5762270.30	1.56	0.52	0.20	1.22	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0827	570475.12	5762272.13	1.44	0.90	0.20	1.32	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0828	570355.47	5762276.02	1.26	0.62	0.08	0.65	Boulder	TA2B071P1	Low		
BB_FS_SSS_0829	570694.08	5762285.71	1.12	0.40	0.19	1.03	Boulder	TA2B072P1	Low		
BB_FS_SSS_0830	570416.45	5762281.99	1.07	0.45	0.12	0.95	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0831	570704.42	5762289.78	1.88	0.64	0.18	1.60	Boulder	TA2B075P1	Low		
BB_FS_SSS_0832	569875.90	5762284.52	3.45	1.79	0.44	3.55	Suspected Debris	TA2B067P1	Medium	MBES	
BB_FS_SSS_0833	570353.26	5762292.99	0.99	0.28	0.08	0.59	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0834	571056.86	5762304.02	1.32	0.90	0.17	1.13	Boulder	TA2B078P1	Low		
BB_FS_SSS_0835	569874.42	5762289.15	4.09	1.17	0.28	2.13	Suspected Debris	TA2B067P1	Medium	MBES	
BB_FS_SSS_0836	570305.44	5762299.79	0.58	0.30	0.07	0.51	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0837	570301.88	5762302.03	0.83	0.86	0.10	0.71	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0838	570911.35	5762314.45	3.35	0.49	0.06	0.40	Suspected Debris	TA2B077P1	Low		
BB_FS_SSS_0839	570757.21	5762312.57	2.05	1.17	0.13	0.87	Boulder	TA2B073P1	Low		
BB_FS_SSS_0840	570290.74	5762308.97	1.38	0.74	0.09	0.57	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0841	570680.83	5762315.52	0.99	1.13	0.15	1.01	Boulder	TA2B075P1	Medium	MBES	
BB_FS_SSS_0842	570184.39	5762311.10	3.89	0.59	0.19	1.09	Suspected Debris	TA2B068P1_SSS_INF	Medium		
BB_FS_SSS_0843	570278.66	5762313.55	0.75	0.63	0.16	1.08	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0844	570302.33	5762316.03	1.71	0.59	0.15	1.19	Boulder	TA2B069P1	Medium	MBES	
BB_FS_SSS_0845	571281.06	5762330.53	1.78	0.80	0.14	1.29	Boulder	TA2B078P1	Low		
BB_FS_SSS_0846	570301.99	5762320.02	1.09	0.36	0.08	0.67	Boulder	TA2B069P1	Medium		
BB_FS_SSS_0847	570763.97	5762328.10	1.55	0.97	0.13	1.14	Boulder	TA2B073P1	Low		
BB_FS_SSS_0848	571130.31	5762337.44	0.72	0.52	0.77	1.35	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0849	571131.47	5762337.85	0.71	0.36	0.66	1.20	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0850	570245.29	5762327.36	1.81	0.52	0.12	0.86	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0851	570024.34	5762333.26	0.88	0.29	0.16	0.90	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0852	570816.42	5762345.91	1.16	0.75	0.12	0.96	Boulder	TA2B074P1	Low		
BB_FS_SSS_0853	570193.05	5762338.98	2.16	0.69	0.10	0.88	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0854	570287.93	5762346.38	1.55	0.62	0.17	1.08	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0855	570295.05	5762350.43	0.96	0.68	0.13	0.78	Boulder	TA2B072P1	Low		
BB_FS_SSS_0856	570943.85	5762360.55	1.30	0.93	0.17	1.13	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0857	570282.47	5762351.27	0.95	0.45	0.15	0.94	Boulder	TA2B072P1	Low		
BB_FS_SSS_0858	570282.42	5762351.28	0.90	0.36	0.17	1.02	Boulder	TA2B072P1	Low		
BB_FS_SSS_0859	570285.24	5762352.65	2.04	0.58	0.12	0.68	Boulder	TA2B072P1	Low		
BB_FS_SSS_0860	570262.53	5762365.89	1.80	0.71	0.14	0.76	Boulder	TA2B072P1	Low		
BB_FS_SSS_0861	570261.19	5762367.43	1.35	0.57	0.18	0.92	Boulder	TA2B072P1	Low		
BB_FS_SSS_0862	570255.17	5762371.04	1.50	0.78	0.18	0.91	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0863	569712.03	5762366.98	0.87	0.40	0.11	0.67	Boulder	TA2B067P1	Medium		
BB_FS_SSS_0864	570124.09	5762373.73	1.69	0.53	0.15	1.04	Boulder	TA2B071P1	Medium	MBES	
BB_FS_SSS_0865	570253.16	5762375.61	0.95	0.62	0.12	0.53	Boulder	TA2B072P1	Medium	MBES	
BB_FS_SSS_0866	570017.87	5762380.77	1.10	0.60	0.15	0.72	Boulder	TA2B070P1	Medium	MBES	
BB_FS_SSS_0867	570276.68	5762391.93	1.96	0.60	0.17	1.32	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0868	569968.49	5762388.43	0.60	0.52	0.11	0.53	Boulder	TA2B068P1_SSS_INF	Low		
BB_FS_SSS_0869	570106.95	5762394.16	0.56	0.44	0.06	0.49	Boulder	TA2B069P1	Medium	MBES	

BB_FS_SSS_0870	570088.27	5762394.29	1.28	0.68	0.16	1.01	Boulder	TA2B069P1	Medium	MBES	
BB_FS_SSS_0871	570538.99	5762409.13	1.43	0.44	0.21	1.89	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0872	570672.56	5762412.82	2.77	1.05	0.11	0.82	Boulder	TA2B077P1	Medium	MBES	
BB_FS_SSS_0873	571022.51	5762422.70	1.39	0.56	0.09	0.68	Boulder	TA2B078P1	Low		
BB_FS_SSS_0874	570330.24	5762413.00	1.35	0.87	0.29	1.81	Boulder	TA2B074P1	Medium		
BB_FS_SSS_0875	571019.43	5762427.89	1.21	0.52	0.07	0.53	Boulder	TA2B078P1	Low		
BB_FS_SSS_0876	570099.45	5762423.90	0.91	0.65	0.14	0.93	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0877	570099.16	5762426.09	1.17	0.81	0.27	1.70	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0878	570422.02	5762431.05	1.03	0.66	0.15	0.86	Boulder	TA2B075P1	Low		
BB_FS_SSS_0879	570098.70	5762427.50	1.02	0.82	0.17	1.06	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0880	569925.42	5762427.23	0.54	0.24	0.07	0.35	Boulder	TA2B068P1	Low		
BB_FS_SSS_0881	571137.05	5762445.51	1.61	0.53	0.13	0.71	Boulder	TA2B082P1	Medium	MBES	
BB_FS_SSS_0882	571076.35	5762447.87	1.56	0.85	0.11	0.89	Boulder	TA2B079P1	Medium	MBES	
BB_FS_SSS_0883	570111.78	5762442.24	1.08	0.52	0.15	0.54	Boulder	TA2B072P1	Medium		
BB_FS_SSS_0885	571079.02	5762461.97	1.80	0.56	0.08	0.74	Boulder	TA2B079P1	Medium	MBES	
BB_FS_SSS_0886	571087.35	5762469.93	0.87	0.33	0.13	0.61	Boulder	TA2B082P1	Low		
BB_FS_SSS_0887	569934.02	5762455.05	0.68	0.16	0.07	0.53	Boulder	TA2B069P1	Low		
BB_FS_SSS_0888	570361.28	5762463.87	1.41	1.14	0.24	1.19	Boulder	TA2B075P1	Medium	MBES	
BB_FS_SSS_0889	569797.18	5762465.89	0.68	0.29	0.07	0.36	Boulder	TA2B070P1	Medium		
BB_FS_SSS_0890	569780.27	5762466.31	0.56	0.33	0.06	0.30	Boulder	TA2B068P1_SSS_INF	Medium		
BB_FS_SSS_0891	570327.42	5762484.44	1.53	0.67	0.09	0.65	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0892	570664.94	5762490.79	0.93	0.44	0.15	1.20	Boulder	TA2B079P1	Medium	MBES	
BB_FS_SSS_0893	569824.27	5762482.38	0.85	0.40	0.09	0.77	Boulder	TA2B071P1	Medium		
BB_FS_SSS_0894	570180.80	5762490.28	0.56	0.35	0.17	0.74	Boulder	TA2B074P1	Medium	MBES	
BB_FS_SSS_0895	569711.95	5762489.10	0.52	0.29	0.12	0.59	Boulder	TA2B068P1_SSS_INF	Low		
BB_FS_SSS_0896	569753.11	5762493.33	1.35	0.32	0.16	0.64	Boulder	TA2B070P1	Medium		
BB_FS_SSS_0897	570540.32	5762514.55	0.86	0.64	0.12	0.69	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0898	570185.78	5762515.79	3.16	0.83	0.21	1.46	Suspected Debris	TA2B075P1	Medium	MBES	
BB_FS_SSS_0899	571011.93	5762528.04	1.79	0.45	0.09	0.75	Boulder	TA2B080P1	Low		
BB_FS_SSS_0900	569918.11	5762513.98	0.81	0.51	0.10	0.62	Boulder	TA2B070P1	Medium	MBES	
BB_FS_SSS_0901	569880.61	5762514.56	1.18	0.49	0.08	0.47	Boulder	TA2B072P1	Low		
BB_FS_SSS_0902	570185.34	5762521.86	0.84	0.91	0.14	0.73	Boulder	TA2B073P1	Medium	MBES	
BB_FS_SSS_0903	570213.32	5762548.39	0.77	0.70	0.21	0.78	Boulder	TA2B074P1	Medium	MBES	
BB_FS_SSS_0904	570215.78	5762551.72	0.86	0.72	0.14	1.05	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0905	570165.11	5762551.54	1.34	0.80	0.33	3.23	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0906	569981.71	5762553.29	2.35	0.57	0.35	1.26	Suspected Debris	TA2B072P1	Medium		
BB_FS_SSS_0907	569761.52	5762559.38	0.75	0.23	0.13	1.00	Boulder	TA2B072P1	Low		
BB_FS_SSS_0908	569955.61	5762569.74	0.59	0.39	0.06	0.43	Boulder	TA2B074P1	Low		
BB_FS_SSS_0909	570358.19	5762576.44	1.69	0.67	0.14	1.07	Boulder	TA2B078P1	Low		
BB_FS_SSS_0910	569945.33	5762574.42	0.52	0.39	0.10	0.41	Boulder	TA2B072P1	Low		
BB_FS_SSS_0911	570342.49	5762587.48	1.55	0.63	0.15	1.08	Boulder	TA2B078P1	Low		
BB_FS_SSS_0912	569718.99	5762581.49	0.74	0.70	0.14	0.97	Boulder	TA2B072P1	Low		
BB_FS_SSS_0913	570193.68	5762600.25	0.98	0.81	0.18	1.23	Boulder	TA2B077P1	Medium	MBES	
BB_FS_SSS_0914	570715.82	5762615.62	0.70	0.25	0.11	0.48	Boulder	TA2B080P1	Low		
BB_FS_SSS_0915	569716.71	5762601.70	1.05	0.37	0.12	0.45	Boulder	TA2B072P1	Low		
BB_FS_SSS_0917	569838.66	5762649.27	0.89	0.35	0.15	1.08	Boulder	TA2B075P1	Low		

BB_FS_SSS_0918	569838.57	5762649.36	1.22	0.34	0.16	1.12	Boulder	TA2B075P1	Low		
BB_FS_SSS_0919	570229.01	5762664.95	0.82	0.61	0.26	0.69	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0920	570231.00	5762666.02	1.28	0.73	0.57	1.40	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0921	570228.37	5762666.85	0.78	0.33	0.42	1.01	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0922	570228.63	5762669.89	0.92	0.69	0.61	1.25	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0923	570227.51	5762670.54	1.15	0.76	0.54	1.07	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0924	569773.99	5762667.13	1.47	0.36	0.22	0.66	Suspected Debris	TA2B074P1	Medium	MBES	
BB_FS_SSS_0925	570130.52	5762693.95	2.10	0.40	0.30	1.26	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0926	570135.95	5762695.62	1.80	0.52	0.29	1.05	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0927	569948.16	5762700.97	0.53	0.33	0.07	0.35	Boulder	TA2B075P1	Low		
BB_FS_SSS_0928	570343.53	5762719.30	1.73	0.43	0.10	0.57	Boulder	TA2B081P1	Low		
BB_FS_SSS_0930	570180.23	5762746.37	0.85	0.45	0.10	0.65	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0931	570198.47	5762763.96	0.84	0.29	0.24	0.59	Boulder	TA2B080P1	Low		
BB_FS_SSS_0932	569911.81	5762767.53	1.25	0.58	0.31	1.89	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0933	569914.00	5762769.23	1.75	0.62	0.43	2.57	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0934	569821.56	5762794.99	0.78	0.54	0.12	0.88	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0935	569782.85	5762822.47	1.35	0.62	0.10	0.71	Boulder	TA2B076P1	Medium	MBES	
BB_FS_SSS_0936	569720.74	5762830.64	1.08	0.54	0.13	0.91	Boulder	TA2B078P1	Low		
BB_FS_SSS_0937	569718.53	5762832.14	7.20	0.64	0.18	1.17	Suspected Debris	TA2B078P1	Medium	MBES	
BB_FS_SSS_0938	569703.52	5762836.12	1.28	0.65	0.13	0.88	Boulder	TA2B078P1	Low		
BB_FS_SSS_0939	569702.71	5762839.94	0.91	0.38	0.12	0.75	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0940	569716.66	5762844.67	0.90	0.92	0.15	0.83	Boulder	TA2B076P1	Low		
BB_FS_SSS_0941	569713.39	5762854.00	1.20	0.53	0.14	0.91	Boulder	TA2B076P1	Low		
BB_FS_SSS_0942	569729.08	5762873.65	0.93	0.69	0.09	0.46	Boulder	TA2B077P1	Medium	MBES	
BB_FS_SSS_0943	569738.62	5762874.67	0.81	0.50	0.08	0.51	Boulder	TA2B077P1	Low		
BB_FS_SSS_0944	569726.92	5762874.70	1.09	0.48	0.09	0.47	Boulder	TA2B077P1	Medium	MBES	
BB_FS_SSS_0945	569800.16	5762885.34	2.54	0.32	0.08	0.40	Suspected Debris	TA2B078P1	Medium	MBES	
BB_FS_SSS_0947	569853.44	5762925.64	1.16	0.53	0.09	0.85	Boulder	TA2B082P1	Low		
BB_FS_SSS_0948	569705.80	5762934.92	0.73	0.89	0.13	0.74	Boulder	TA2B078P1	Medium	MBES	
BB_FS_SSS_0949	569766.21	5762963.97	0.58	0.31	0.57	0.90	Boulder	TA2B080P1	Medium	MBES	
BB_FS_SSS_0950	569736.29	5762976.89	1.08	0.83	0.13	0.80	Boulder	TA2B079P1	Low	MBES	
BB_FS_SSS_0951	569745.67	5762979.24	1.03	0.51	0.08	0.75	Boulder	TA2B082P1	Low		
BB_FS_SSS_0952	569729.45	5763003.83	1.34	0.87	0.10	0.63	Boulder	TA2B082P1	Medium	MBES	
BB_FS_SSS_0953	570545.32	5761626.91	0.65	0.24	0.21	0.60	Boulder	TA2B057P1	Medium	MBES	

Appendix G

Contacts Listing – Magnetic Targets

Unique_ID	Easting	Northing	Line_Name	Amplitude	Altitude	Wavelength	SSS_Corr
BA_FS_MAG_0001	570089.17	5760029.47	TA2A001P1	38.2	3.4	80.9	
BA_FS_MAG_0002	570134.75	5760010.3	TA2A001P1	16.5	3	9.5	
BA_FS_MAG_0003	570213.56	5759980.62	TA2A001P1	40.5	3.3	24.9	
BA_FS_MAG_0004	570155.13	5760001.04	TA2A001P1	24.3	3.7	13	
BA_FS_MAG_0005	570256.39	5759968.47	TA2A001P1	31.6	2.7	31.3	
BA_FS_MAG_0006	570109.95	5760018.79	TA2A002P1	36.5	3	63.3	
BA_FS_MAG_0007	570148.88	5760001.1	TA2A002P1	81.8	3.2	20.6	
BA_FS_MAG_0008	570208.90	5759982.31	TA2A002P1	25.5	2.5	129.5	
BA_FS_MAG_0009	570059.18	5760048.41	TA2A002P1	10.8	3.4	3.6	
BA_FS_MAG_0010	570076.42	5760036.61	TA2A002P1	43.6	3.6	10.7	
BA_FS_MAG_0011	570072.60	5760044.12	TA2A003P1	136	1.7	51	
BA_FS_MAG_0012	570141.18	5760009.97	TA2A003P1	12.5	3.6	31.3	
BA_FS_MAG_0013	570183.47	5760005.6	TA2A003P1	11.4	4	39.3	
BA_FS_MAG_0014	570054.25	5760044	TA2A004P1	48.5	4.4	184.3	
BA_FS_MAG_0015	570225.74	5760042.21	TA2A005P1	13.1	1.9	11.9	
BA_FS_MAG_0016	570246.79	5760041.59	TA2A005P1	17.8	1.7	13.8	
BA_FS_MAG_0017	569851.41	5760139.86	TA2A005P1	8.6	7.6	18.9	
BA_FS_MAG_0018	570034.29	5760054.24	TA2A005P1	46.3	2.6	145.2	
BA_FS_MAG_0019	570260.88	5760040.4	TA2A005P1	64.6	1.8	13.6	
BA_FS_MAG_0020	570360.33	5760036.42	TA2A005P1	5.5	2.3	25.3	
BA_FS_MAG_0021	569960.95	5760082.21	TA2A006P1	110.7	2.1	95	
BA_FS_MAG_0022	570013.40	5760073.79	TA2A006P1	12	3.2	19.6	
BA_FS_MAG_0023	570409.16	5760054.15	TA2A006P1	11.9	1.1	20	
BA_FS_MAG_0024	570257.47	5760061.79	TA2A006P1	22.1	2	16	
BA_FS_MAG_0025	569819.59	5760128.67	TA2A007P1	9.7	4.1	10.8	
BA_FS_MAG_0026	569928.85	5760099.12	TA2A007P1	35.8	4	28.6	
BA_FS_MAG_0027	569847.56	5760116.23	TA2A007P1	13.2	4.3	58.5	
BA_FS_MAG_0028	569762.14	5760158	TA2A007P1	9.6	4.4	20.4	
BA_FS_MAG_0029	569859.41	5760120.61	TA2A008P1	18.2	5.3	85.1	
BA_FS_MAG_0030	569763.87	5760149.98	TA2A008P1	6.7	6.3	63.8	
BA_FS_MAG_0031	570312.65	5760099.83	TA2A008P1	9.3	2.6	24.3	
BA_FS_MAG_0032	569737.60	5760148.18	TA2A009P1	30.4	6.2	38.5	

BA_FS_MAG_0033	569845.33	5760141.02	TA2A009P1	5.8	9.1	21.9	
BA_FS_MAG_0034	570128.66	5760127.46	TA2A009P1	12.2	2.9	18	
BA_FS_MAG_0035	570161.76	5760126.11	TA2A009P1	16.7	2.4	27.9	
BA_FS_MAG_0036	570068.28	5760131.21	TA2A009P1	5.5	3.3	23.2	
BA_FS_MAG_0037	570210.04	5760124.37	TA2A009P1	7.8	2.2	24.7	
BA_FS_MAG_0038	569767.29	5760163.74	TA2A010P1	9.3	5.8	33.5	
BA_FS_MAG_0039	570270.29	5760140.31	TA2A010P1	11.5	2.3	28.2	
BA_FS_MAG_0040	570343.48	5760157.51	TA2A011P1	11.7	2.7	27.9	
BA_FS_MAG_0041	570139.66	5760188.01	TA2A012P1	20.1	3.1	24.6	
BA_FS_MAG_0042	570628.15	5760161.99	TA2A012P1	6.7	2.1	39.5	
BA_FS_MAG_0043	569753.64	5760224.12	TA2A013P1	55.4	4.8	29.8	
BA_FS_MAG_0044	569910.21	5760218.86	TA2A013P1	5	4.7	21.2	
BA_FS_MAG_0045	570558.39	5760206.81	TA2A014P1	11.5	2.4	22.2	
BA_FS_MAG_0046	570983.01	5760192.69	TA2A014P1	11	2.3	36.1	
BA_FS_MAG_0047	571081.48	5760186.57	TA2A014P1	9.2	2.3	26.3	
BA_FS_MAG_0048	570932.20	5760194.41	TA2A014P1	10.4	2.2	40.5	
BA_FS_MAG_0049	571024.44	5760191.54	TA2A014P1	37	2.2	35.3	
BA_FS_MAG_0050	569737.03	5760247.54	TA2A014P1	5.4	2.6	22.6	
BA_FS_MAG_0051	570441.12	5760213.11	TA2A014P1	6.1	3.6	17.6	
BA_FS_MAG_0052	570842.72	5760194.64	TA2A014P1	5.4	2.4	27.2	
BA_FS_MAG_0053	570878.38	5760194.6	TA2A014P1	7.3	2.1	31.9	
BA_FS_MAG_0054	571110.69	5760181.17	TA2A014P1	7.4	1.6	26.9	
BA_FS_MAG_0055	570486.39	5760230.89	TA2A015P1	27.4	4.3	31.8	
BA_FS_MAG_0056	570397.61	5760233.46	TA2A015P1	345.4	3.5	42.4	
BA_FS_MAG_0057	570810.11	5760215.41	TA2A015P1	12.5	3.8	23.4	
BA_FS_MAG_0058	570636.11	5760244.86	TA2A016P1	12.5	2.1	20.4	
BA_FS_MAG_0059	570688.08	5760241.16	TA2A016P1	161.8	0.9	29.2	
BA_FS_MAG_0060	570894.19	5760231.89	TA2A016P1	5.1	2.8	8.8	
BA_FS_MAG_0061	570225.00	5760262.97	TA2A016P1	26.1	2.8	26.5	
BA_FS_MAG_0062	570896.12	5760251.92	TA2A017P1	5.6	3.7	22.3	
BA_FS_MAG_0063	570158.39	5760289.22	TA2A017P1	101.2	2.7	37.6	
BA_FS_MAG_0064	570415.28	5760273.72	TA2A017P1	7.4	3.5	29	
BA_FS_MAG_0065	570317.49	5760277.07	TA2A017P1_MAG_INFA	23.4	3.3	26.9	

BA_FS_MAG_0066	570358.17	5760274.37	TA2A017P1_MAG_INFA	40.7	3.2	40.2	
BA_FS_MAG_0067	570388.63	5760274.81	TA2A017P1_MAG_INFA	10.5	3.4	29	
BA_FS_MAG_0068	570531.11	5760267.5	TA2A017P1_MAG_INFA	15.7	3.6	34.7	
BA_FS_MAG_0069	570742.41	5760258.82	TA2A017P1_MAG_INFA	18.1	3.3	29.8	
BA_FS_MAG_0070	570895.91	5760249	TA2A017P1_MAG_INFA	10.2	3.5	21.8	
BA_FS_MAG_0071	570702.10	5760258.43	TA2A017P1_MAG_INFA	6.3	3.3	20.4	
BA_FS_MAG_0072	571044.53	5760243.92	TA2A017P1_MAG_INFB	7.8	4	15	
BA_FS_MAG_0073	570408.87	5760293.63	TA2A018P1	43.4	3.6	57.8	

Unique_ID	Easting	Northing	Line_Name	Amplitude	Altitude	Wavelength	SSS_Corr
BB_FS_MAG_0001	569886.41	5760320.52	TA2B020P1	6.7	2.1	23.7	
BB_FS_MAG_0002	569748.31	5760420.62	TA2B021P1	8.1	4.1	46.9	
BB_FS_MAG_0003	570154.07	5760300.67	TA2B022P1	101	2.6	24.8	
BB_FS_MAG_0004	570225.59	5760270.84	TA2B022P1	52.5	2.4	15.2	
BB_FS_MAG_0005	569873.92	5760457.20	TA2B023P1	8.1	3.9	49.2	
BB_FS_MAG_0006	570393.71	5760245.38	TA2B023P1	464.5	3.5	57.2	
BB_FS_MAG_0007	570305.30	5760282.56	TA2B023P1	28.1	3.7	43.2	
BB_FS_MAG_0008	569931.42	5760432.94	TA2B023P1	6.6	3.6	25.7	
BB_FS_MAG_0009	569765.51	5760499.96	TA2B023P1	5.2	4.7	59.7	
BB_FS_MAG_0010	570401.48	5760288.38	TA2B024P1	58.5	3.7	43.8	
BB_FS_MAG_0011	570409.09	5760330.08	TA2B025P1	9.7	4.4	38.1	
BB_FS_MAG_0012	570335.90	5760362.25	TA2B025P1	7.1	4.3	68.4	
BB_FS_MAG_0013	570520.34	5760327.26	TA2B026P1	9.9	3.4	37.3	
BB_FS_MAG_0014	570646.18	5760280.46	TA2B026P1	70.9	2.8	24.5	
BB_FS_MAG_0015	570419.24	5760367.81	TA2B026P1	9.1	3.6	24.3	
BB_FS_MAG_0016	569962.06	5760593.83	TA2B027P1	17.6	3.7	46.1	
BB_FS_MAG_0017	570424.47	5760409.91	TA2B027P1	13.5	3.6	113.9	
BB_FS_MAG_0018	570573.82	5760403.79	TA2B028P1	8.2	5.4	25.9	
BB_FS_MAG_0019	570825.18	5760333.92	TA2B029P1	11.4	4.5	91.9	
BB_FS_MAG_0020	570732.81	5760372.71	TA2B029P1	8.5	4.7	17.1	
BB_FS_MAG_0021	570416.53	5760499.07	TA2B029P1	9.7	4.3	104.7	
BB_FS_MAG_0022	570213.60	5760579.78	TA2B029P1	5.7	3	48.9	
BB_FS_MAG_0023	570267.86	5760598.48	TA2B030P1	11.2	3.4	30.1	
BB_FS_MAG_0024	570533.85	5760493.91	TA2B030P1	7.8	2.2	31	
BB_FS_MAG_0025	570780.07	5760397.38	TA2B030P1	7.8	4.3	34.8	
BB_FS_MAG_0026	570494.59	5760507.85	TA2B030P1	5	2.6	23.2	
BB_FS_MAG_0027	571170.22	5760244.70	TA2B030P1	5.3	3.2	23.1	
BB_FS_MAG_0028	570522.38	5760542.25	TA2B031P1	7.3	3.8	50.7	
BB_FS_MAG_0029	570452.10	5760568.46	TA2B031P1	7.3	5.7	69.7	
BB_FS_MAG_0030	570635.41	5760542.25	TA2B032P1	5.3	3.2	15.6	
BB_FS_MAG_0031	571112.30	5760389.44	TA2B033P1	14.7	5.4	32.5	
BB_FS_MAG_0032	570083.29	5760802.59	TA2B033P1	44.7	2.5	29.4	
BB_FS_MAG_0033	570508.04	5760633.53	TA2B033P1	9	4.4	58.6	

BB_FS_MAG_0034	569893.72	5760877.25	TA2B033P1	6	5.3	40.7	
BB_FS_MAG_0035	571079.06	5760452.74	TA2B034P1	14.6	4.1	24.1	
BB_FS_MAG_0036	570907.52	5760568.37	TA2B035P1	26.3	3.9	24.1	
BB_FS_MAG_0037	570644.77	5760668.36	TA2B035P1	30.9	3.4	34.5	
BB_FS_MAG_0038	570602.42	5760682.95	TA2B035P1	8	4.5	36.2	
BB_FS_MAG_0039	570093.64	5760886.28	TA2B035P1	18	1.9	28.1	
BB_FS_MAG_0040	571045.43	5760509.75	TA2B035P1	5.2	4.3	23.6	
BB_FS_MAG_0041	570527.36	5760708.09	TA2B035P1	5.8	4.1	52.2	
BB_FS_MAG_0042	569765.06	5761058.54	TA2B036P1	5.1	4.9	24.2	
BB_FS_MAG_0043	570800.46	5760690.34	TA2B037P1	10.6	4.3	30.9	
BB_FS_MAG_0044	570599.11	5760770.98	TA2B037P1	7	5.6	72.2	
BB_FS_MAG_0045	570360.81	5760908.04	TA2B038P1	94.5	4.2	35.1	
BB_FS_MAG_0046	570594.13	5760815.71	TA2B038P1	15.9	4.7	32	
BB_FS_MAG_0047	569768.86	5761142.70	TA2B038P1	6.3	4	23.2	
BB_FS_MAG_0048	570840.06	5760759.48	TA2B039P1	8.9	4.7	34.8	
BB_FS_MAG_0049	570021.44	5761078.91	TA2B039P1	17.7	3.8	34.6	
BB_FS_MAG_0050	570625.87	5760844.49	TA2B039P1	8.6	4.8	78.6	
BB_FS_MAG_0051	570666.80	5760916.51	TA2B041P1	8.1	3.8	63.8	
BB_FS_MAG_0052	570298.35	5761063.28	TA2B041P1	32.1	3.7	31.9	
BB_FS_MAG_0053	570390.29	5761069.33	TA2B042P1	10.5	4.4	26.4	
BB_FS_MAG_0054	570889.22	5760866.22	TA2B042P1	10.1	3	16.9	
BB_FS_MAG_0055	569989.02	5761227.76	TA2B042P1	8.7	4.3	28	
BB_FS_MAG_0056	570365.52	5761117.27	TA2B043P1	8.6	3.5	16.9	
BB_FS_MAG_0057	570704.12	5760990.69	TA2B043P1	10.2	3.6	74	
BB_FS_MAG_0058	570454.85	5761081.57	TA2B043P1	127.1	2.9	43.1	
BB_FS_MAG_0059	570534.39	5761053.27	TA2B043P1	6.1	3.7	28	
BB_FS_MAG_0060	569802.53	5761387.83	TA2B044P1	31	4.1	55.5	
BB_FS_MAG_0061	570978.71	5760966.94	TA2B045P1	27.6	1.1	19.5	
BB_FS_MAG_0062	570133.41	5761302.06	TA2B045P1	160.4	2.8	36.1	
BB_FS_MAG_0063	569799.64	5761435.50	TA2B045P1	7.4	3.6	11.7	
BB_FS_MAG_0064	570726.63	5761063.10	TA2B045P1	8.8	4.4	65.8	
BB_FS_MAG_0065	570532.66	5761144.56	TA2B045P1	7.6	2	36	
BB_FS_MAG_0066	569830.93	5761462.34	TA2B046P1	7.3	2.7	16.8	
BB_FS_MAG_0067	570862.95	5761051.22	TA2B046P1	14.9	2.6	21.7	

BB_FS_MAG_0068	571080.66	5760967.69	TA2B046P1	24.3	3	29.6	
BB_FS_MAG_0069	571019.86	5760995.54	TA2B046P1	5.7	3.3	14.3	
BB_FS_MAG_0070	570897.10	5761083.99	TA2B047P1	16.5	3.9	55.7	
BB_FS_MAG_0071	570414.14	5761276.17	TA2B047P1	21.7	3	46	
BB_FS_MAG_0072	570770.52	5761134.59	TA2B047P1	10.2	3.8	63.4	
BB_FS_MAG_0073	570645.74	5761182.44	TA2B047P1	6.1	3.5	35.3	
BB_FS_MAG_0074	571224.71	5760991.12	TA2B048P1	19.6	4.6	25.1	
BB_FS_MAG_0075	570123.34	5761429.59	TA2B048P1	5.7	2.4	17.3	
BB_FS_MAG_0076	571023.38	5761070.70	TA2B048P1	14	2.3	140.7	
BB_FS_MAG_0077	570609.68	5761236.46	TA2B048P1	101	3.2	44	
BB_FS_MAG_0078	570562.21	5761255.12	TA2B048P1	16.8	2.8	54.6	
BB_FS_MAG_0079	570237.94	5761383.53	TA2B048P1	15.2	2.8	18.3	
BB_FS_MAG_0080	571138.37	5761026.32	TA2B048P1	6	3.2	34.8	
BB_FS_MAG_0081	571102.53	5761039.04	TA2B048P1	6.1	3	17.1	
BB_FS_MAG_0082	570908.99	5761117.33	TA2B048P1	6.6	3.4	70.9	
BB_FS_MAG_0083	570784.14	5761168.85	TA2B048P1	6.6	4.2	64.4	
BB_FS_MAG_0084	570672.72	5761212.57	TA2B048P1	5.5	3.3	22.7	
BB_FS_MAG_0085	570664.10	5761260.38	TA2B049P1	18.4	3.5	27.4	
BB_FS_MAG_0086	570710.96	5761242.69	TA2B049P1	44.9	3.3	37	
BB_FS_MAG_0087	570733.56	5761233.73	TA2B049P1	70.7	3.6	25.7	
BB_FS_MAG_0088	570777.84	5761217.17	TA2B049P1	18.4	3.2	26.1	
BB_FS_MAG_0089	570852.76	5761186.84	TA2B049P1	59.9	2.6	37.4	
BB_FS_MAG_0090	570980.13	5761135.52	TA2B049P1	19.1	2.6	12.6	
BB_FS_MAG_0091	570995.45	5761129.00	TA2B049P1	7.7	2.3	8.8	
BB_FS_MAG_0092	571224.70	5761040.85	TA2B049P1	13.9	4.2	34.1	
BB_FS_MAG_0093	571063.08	5761102.96	TA2B049P1	13.6	1.1	23.4	
BB_FS_MAG_0094	570813.52	5761203.49	TA2B049P1	8.1	4	46.2	
BB_FS_MAG_0095	571222.87	5761078.35	TA2B050P1	25.9	3.8	120.8	
BB_FS_MAG_0096	571045.38	5761152.41	TA2B050P1	11	3.1	17.6	
BB_FS_MAG_0097	570926.37	5761199.05	TA2B050P1	21.7	4.2	28.8	
BB_FS_MAG_0098	570822.25	5761241.23	TA2B050P1	21.9	3.5	121.1	
BB_FS_MAG_0099	570726.39	5761277.76	TA2B050P1	34.1	3.2	23.3	
BB_FS_MAG_0100	570658.04	5761304.05	TA2B050P1	9.4	3.1	32.2	
BB_FS_MAG_0101	570312.52	5761441.83	TA2B050P1	9.8	2.8	45.5	

BB_FS_MAG_0102	569716.54	5761679.74	TA2B050P1	6.6	3.8	43.9	
BB_FS_MAG_0103	570938.08	5761240.58	TA2B051P1	16.5	2.5	51.1	
BB_FS_MAG_0104	570484.27	5761418.47	TA2B051P1	9.7	2.5	21.6	
BB_FS_MAG_0105	570615.76	5761366.73	TA2B051P1	7.4	3.4	17.7	
BB_FS_MAG_0106	570063.47	5761625.82	TA2B052P1	7.2	3.3	12.6	
BB_FS_MAG_0107	570145.95	5761594.59	TA2B052P1	7.4	2.9	20.6	
BB_FS_MAG_0108	570379.98	5761501.64	TA2B052P1	11.2	2.7	34.6	
BB_FS_MAG_0109	570868.93	5761307.65	TA2B052P1	11.3	3.1	34.3	
BB_FS_MAG_0110	571035.73	5761244.38	TA2B052P1	15.5	3.1	54.7	
BB_FS_MAG_0111	571098.87	5761217.32	TA2B052P1	45	3.3	62.3	
BB_FS_MAG_0112	570799.69	5761334.47	TA2B052P1	8.1	3.5	22.2	
BB_FS_MAG_0113	570921.75	5761285.72	TA2B052P1	6.6	3.4	29.5	
BB_FS_MAG_0114	571116.99	5761250.25	TA2B053P1	43.1	4.6	52.4	
BB_FS_MAG_0115	571057.68	5761276.30	TA2B053P1	16.2	5.9	67.3	
BB_FS_MAG_0116	570912.15	5761330.19	TA2B053P1	20.8	3.6	166.2	
BB_FS_MAG_0117	570469.28	5761511.81	TA2B053P1	7.8	3.9	16.7	
BB_FS_MAG_0118	570283.74	5761583.01	TA2B053P1	9.4	4	27.7	
BB_FS_MAG_0119	570137.26	5761642.00	TA2B053P1	9.4	3.6	27.3	
BB_FS_MAG_0120	571086.34	5761263.61	TA2B053P1	17.7	5.5	14.9	
BB_FS_MAG_0121	570316.49	5761570.20	TA2B053P1	9.2	4	17.3	
BB_FS_MAG_0122	570588.58	5761505.40	TA2B054P1	103	1.7	18.3	
BB_FS_MAG_0123	570559.69	5761517.40	TA2B054P1	10.4	2.8	18.1	
BB_FS_MAG_0124	570498.83	5761541.37	TA2B054P1	26.1	2.9	16.7	
BB_FS_MAG_0125	570303.71	5761617.88	TA2B054P1	5.1	3.3	16.4	
BB_FS_MAG_0126	570268.01	5761631.65	TA2B054P1	17.1	3	18.1	
BB_FS_MAG_0127	569966.47	5761751.29	TA2B054P1	11.8	3.2	17.7	
BB_FS_MAG_0128	569913.68	5761773.44	TA2B054P1	12.7	4.4	15.1	
BB_FS_MAG_0129	569853.37	5761797.08	TA2B054P1	8.2	3.6	23.8	
BB_FS_MAG_0130	571045.41	5761323.55	TA2B054P1	22.3	3.4	26.4	
BB_FS_MAG_0131	570949.53	5761361.88	TA2B054P1	15.7	4.7	119.9	
BB_FS_MAG_0132	570774.22	5761433.09	TA2B054P1	10.6	3.9	156.8	
BB_FS_MAG_0133	570681.15	5761470.80	TA2B054P1	50.1	3.1	16.7	
BB_FS_MAG_0134	570350.93	5761598.61	TA2B054P1	10.6	2.8	22.3	
BB_FS_MAG_0135	570066.20	5761710.81	TA2B054P1	7.8	4.4	13.2	

BB_FS_MAG_0136	570033.70	5761723.99	TA2B054P1	37.8	4.3	26.2	
BB_FS_MAG_0137	571094.90	5761304.17	TA2B054P1	5.8	5.2	37.2	
BB_FS_MAG_0138	570283.88	5761625.63	TA2B054P1	10.2	3.4	15	
BB_FS_MAG_0139	570149.72	5761677.52	TA2B054P1	5.6	4.1	21.4	
BB_FS_MAG_0140	571091.06	5761308.57	TA2B054P1_MAG_INF	7.9	4.2	17.3	
BB_FS_MAG_0141	571239.19	5761247.51	TA2B054P1_MAG_INF	8.3	4.3	25.5	
BB_FS_MAG_0142	571220.97	5761296.15	TA2B055P1	13.3	3.3	27.2	
BB_FS_MAG_0143	571173.89	5761314.89	TA2B055P1	16.7	3	86.5	
BB_FS_MAG_0144	571008.20	5761376.85	TA2B055P1	17.6	3.3	21.6	
BB_FS_MAG_0145	570981.58	5761389.42	TA2B055P1	9	3.4	17.5	
BB_FS_MAG_0146	570962.47	5761398.78	TA2B055P1	8.3	3.3	13.5	
BB_FS_MAG_0147	570661.31	5761516.64	TA2B055P1	21.8	3.4	16.4	
BB_FS_MAG_0148	570645.25	5761523.00	TA2B055P1	9.1	3.1	13.6	
BB_FS_MAG_0149	570354.62	5761638.84	TA2B055P1	8.4	3.3	36.7	
BB_FS_MAG_0150	570219.90	5761693.23	TA2B055P1	9.3	1.2	19.8	
BB_FS_MAG_0151	569874.57	5761831.08	TA2B055P1	19.8	3.3	16.7	
BB_FS_MAG_0152	569822.86	5761853.06	TA2B055P1	8.3	3.2	32	
BB_FS_MAG_0153	571051.90	5761360.90	TA2B055P1	13.2	3.6	91.7	
BB_FS_MAG_0154	570930.73	5761412.09	TA2B055P1	9.2	3.1	65.3	
BB_FS_MAG_0155	570798.38	5761465.05	TA2B055P1	26.2	3.6	29	
BB_FS_MAG_0156	570710.58	5761499.74	TA2B055P1	9.2	2.8	60.9	
BB_FS_MAG_0157	570620.98	5761533.05	TA2B055P1	778.1	2.9	28.7	
BB_FS_MAG_0158	570491.62	5761586.51	TA2B055P1	10.6	2.9	13.3	
BB_FS_MAG_0159	570386.92	5761627.10	TA2B055P1	5.7	3.1	18.5	
BB_FS_MAG_0160	570107.20	5761736.51	TA2B055P1	8.4	3.7	34.6	
BB_FS_MAG_0161	570021.01	5761776.26	TA2B055P1	10	3.1	13.9	
BB_FS_MAG_0162	569946.06	5761804.63	TA2B055P1	72.8	2.9	32.2	
BB_FS_MAG_0163	569858.37	5761837.83	TA2B055P1	16	3.4	24.7	
BB_FS_MAG_0164	570170.89	5761711.82	TA2B055P1	8.2	3.5	60.5	
BB_FS_MAG_0165	569809.44	5761902.43	TA2B056P1	37.5	2.3	17	
BB_FS_MAG_0166	570152.20	5761764.87	TA2B056P1	7.8	3.2	18.9	
BB_FS_MAG_0167	570195.05	5761749.02	TA2B056P1	8.8	3.2	11.9	
BB_FS_MAG_0168	570352.40	5761686.12	TA2B056P1	62.7	3.6	22.5	
BB_FS_MAG_0169	570508.46	5761623.90	TA2B056P1	14.8	3.1	24.7	

BB_FS_MAG_0170	570577.85	5761597.14	TA2B056P1	19.9	3.6	12.8	
BB_FS_MAG_0171	570756.63	5761524.28	TA2B056P1	35.2	3.3	14.7	
BB_FS_MAG_0172	570841.68	5761493.00	TA2B056P1	13.4	3.4	13.6	
BB_FS_MAG_0173	571007.18	5761425.28	TA2B056P1	62.2	4	21.2	
BB_FS_MAG_0174	571157.51	5761366.87	TA2B056P1	13.2	3.7	7.7	
BB_FS_MAG_0175	569781.66	5761912.30	TA2B056P1	23	3.3	23.4	
BB_FS_MAG_0176	570443.45	5761649.61	TA2B056P1	9.6	3.4	28.4	
BB_FS_MAG_0177	570603.88	5761587.62	TA2B056P1	30.1	3.5	27.8	
BB_FS_MAG_0178	571122.25	5761382.22	TA2B056P1	9.3	3.7	19.5	
BB_FS_MAG_0179	571203.79	5761348.11	TA2B056P1	18.1	4.2	29.1	
BB_FS_MAG_0180	569717.16	5761935.77	TA2B056P1	5.7	3.4	22.5	
BB_FS_MAG_0181	569946.55	5761847.33	TA2B056P1	8.3	3.2	19	
BB_FS_MAG_0182	570808.41	5761507.96	TA2B056P1	6.5	3.2	23.1	
BB_FS_MAG_0183	570895.75	5761472.89	TA2B056P1	7.3	4.3	26.3	
BB_FS_MAG_0184	570768.32	5761563.65	TA2B057P1	8.8	4.1	39.7	
BB_FS_MAG_0185	570688.22	5761596.03	TA2B057P1	53.7	3.9	29.7	
BB_FS_MAG_0186	570444.73	5761691.23	TA2B057P1	15	3.8	32.1	
BB_FS_MAG_0187	570381.05	5761718.66	TA2B057P1	9.5	3.5	19.6	
BB_FS_MAG_0188	570306.53	5761747.11	TA2B057P1	9.5	3.8	20.2	
BB_FS_MAG_0189	569925.39	5761898.64	TA2B057P1	6.1	3.3	14.4	
BB_FS_MAG_0190	571144.09	5761414.67	TA2B057P1	15.8	4.7	186.8	
BB_FS_MAG_0191	571050.10	5761453.81	TA2B057P1	33.9	4	32.2	
BB_FS_MAG_0192	571006.97	5761468.30	TA2B057P1	9.1	4.2	32	
BB_FS_MAG_0193	570878.03	5761522.61	TA2B057P1	10.3	3.5	16.7	
BB_FS_MAG_0194	570451.07	5761732.79	TA2B058P1	15.7	4.9	22.1	
BB_FS_MAG_0195	570478.92	5761721.81	TA2B058P1	5.1	4.8	17.1	
BB_FS_MAG_0196	570948.00	5761536.12	TA2B058P1	56	4.4	69.7	
BB_FS_MAG_0197	571066.02	5761489.62	TA2B058P1	15.1	6.1	34.3	
BB_FS_MAG_0198	570725.18	5761625.71	TA2B058P1	53.7	4.3	35.9	
BB_FS_MAG_0199	570770.81	5761605.42	TA2B058P1	10.5	4.4	16.2	
BB_FS_MAG_0200	571167.10	5761448.68	TA2B058P1	21.3	3.1	53.5	
BB_FS_MAG_0201	571232.79	5761423.59	TA2B058P1	11.1	3.9	32.4	
BB_FS_MAG_0202	570550.16	5761693.66	TA2B058P1	7.9	4.6	24.1	
BB_FS_MAG_0203	570816.13	5761587.70	TA2B058P1	8.9	4.5	48.4	

BB_FS_MAG_0204	571051.19	5761539.14	TA2B059P1	14.4	6.9	50.3	
BB_FS_MAG_0205	570995.35	5761560.43	TA2B059P1	78	5.3	41.4	
BB_FS_MAG_0206	570954.19	5761574.21	TA2B059P1	23.4	4.4	16.3	
BB_FS_MAG_0207	570669.28	5761689.29	TA2B059P1	20.8	4.8	21.5	
BB_FS_MAG_0208	571206.65	5761477.26	TA2B059P1	17.4	3.8	181	
BB_FS_MAG_0209	570907.77	5761595.76	TA2B059P1	18.6	4.8	17.3	
BB_FS_MAG_0210	570834.97	5761623.81	TA2B059P1	10.9	4.4	29.6	
BB_FS_MAG_0211	570128.85	5761904.31	TA2B059P1	15.8	4.5	32.7	
BB_FS_MAG_0212	569880.37	5762003.11	TA2B059P1	5.6	4.9	16.4	
BB_FS_MAG_0213	570507.06	5761753.03	TA2B059P1	5.5	5.3	34.2	
BB_FS_MAG_0214	570387.69	5761800.99	TA2B059P1	5	4.6	35.6	
BB_FS_MAG_0215	569818.82	5762027.32	TA2B059P1	6.3	5.2	22.7	
BB_FS_MAG_0216	569729.35	5762060.52	TA2B059P1	5.2	5.4	33.6	
BB_FS_MAG_0217	569775.02	5762087.68	TA2B060P1	10.6	3.8	18.8	
BB_FS_MAG_0218	569858.47	5762055.89	TA2B060P1	8.5	4	41.1	
BB_FS_MAG_0219	569913.93	5762034.48	TA2B060P1	12.3	4	43.7	
BB_FS_MAG_0220	570017.11	5761991.58	TA2B060P1	23.2	3.3	19.7	
BB_FS_MAG_0221	570056.13	5761977.28	TA2B060P1	24.6	3.2	23.9	
BB_FS_MAG_0222	570154.23	5761938.29	TA2B060P1	249.8	3.4	23.7	BB_FS_SSS_0593
BB_FS_MAG_0223	570167.81	5761932.57	TA2B060P1	7.4	3.3	10.4	
BB_FS_MAG_0224	570213.03	5761914.35	TA2B060P1	6	3.1	17.3	
BB_FS_MAG_0225	570803.97	5761679.26	TA2B060P1	24.5	4.1	202.5	
BB_FS_MAG_0226	571100.19	5761562.60	TA2B060P1	16.1	3.5	60.5	
BB_FS_MAG_0227	570390.07	5761844.75	TA2B060P1	7.9	3.8	29.5	
BB_FS_MAG_0228	570995.37	5761604.12	TA2B060P1	12.6	5.4	108.9	
BB_FS_MAG_0229	571246.00	5761505.06	TA2B060P1	18.4	3.3	101.7	
BB_FS_MAG_0230	570110.05	5761954.92	TA2B060P1	5.6	3.3	24.2	
BB_FS_MAG_0231	570349.93	5761860.25	TA2B060P1	5.2	3.6	42.5	
BB_FS_MAG_0232	570544.94	5761782.44	TA2B060P1	6.4	4	25.4	
BB_FS_MAG_0233	570930.89	5761670.44	TA2B061P1	77.8	4.2	32.1	
BB_FS_MAG_0234	570786.30	5761728.13	TA2B061P1	10	3.2	47.8	
BB_FS_MAG_0235	570328.47	5761912.45	TA2B061P1	7	4.4	12.3	
BB_FS_MAG_0236	570213.81	5761956.49	TA2B061P1	19.7	3.9	25	
BB_FS_MAG_0237	570042.59	5762025.98	TA2B061P1	19.1	3.5	19.2	

BB_FS_MAG_0238	569880.93	5762084.81	TA2B061P1	40.8	2.9	174.7	
BB_FS_MAG_0239	571228.37	5761557.75	TA2B061P1	18.9	2.9	302.2	
BB_FS_MAG_0240	570659.47	5761779.48	TA2B061P1	22	3	289.2	
BB_FS_MAG_0241	570382.53	5761889.61	TA2B061P1	107	4.3	48.2	
BB_FS_MAG_0242	570070.43	5762014.64	TA2B061P1	16.3	3.6	22.5	
BB_FS_MAG_0243	569930.38	5762111.01	TA2B062P1	7.7	4.1	17.4	
BB_FS_MAG_0244	570026.68	5762071.78	TA2B062P1	90.9	3.8	22.8	
BB_FS_MAG_0245	570085.85	5762048.75	TA2B062P1	117.3	3.5	20.1	
BB_FS_MAG_0246	570129.28	5762030.87	TA2B062P1	14	3.8	34.9	
BB_FS_MAG_0247	570320.64	5761954.97	TA2B062P1	10.4	3.9	35.3	BB_FS_SSS_0607
BB_FS_MAG_0248	570762.26	5761780.71	TA2B062P1	5.8	2.3	12.8	
BB_FS_MAG_0249	570857.54	5761742.34	TA2B062P1	53.7	2.2	13.4	
BB_FS_MAG_0250	570892.55	5761729.26	TA2B062P1	31	2.4	10	
BB_FS_MAG_0251	571078.71	5761654.77	TA2B062P1	71.6	3.1	29.7	
BB_FS_MAG_0252	571168.55	5761623.43	TA2B062P1	12.1	3	28.5	
BB_FS_MAG_0253	569988.70	5762088.18	TA2B062P1	87.4	3.7	23.4	
BB_FS_MAG_0254	570053.66	5762061.44	TA2B062P1	78.1	3.8	18.1	
BB_FS_MAG_0255	570170.32	5762014.68	TA2B062P1	41.7	3.5	30.5	
BB_FS_MAG_0256	570457.30	5761901.53	TA2B062P1	14.6	3.7	43	
BB_FS_MAG_0257	570582.99	5761852.40	TA2B062P1	9.6	4.7	40.8	
BB_FS_MAG_0258	570674.26	5761817.77	TA2B062P1	19.7	3.3	113.8	
BB_FS_MAG_0259	570751.54	5761784.79	TA2B062P1	11.6	2.4	5.6	
BB_FS_MAG_0260	570837.84	5761750.76	TA2B062P1	14	2.4	8.9	
BB_FS_MAG_0261	570934.08	5761712.34	TA2B062P1	23.9	2	36.6	
BB_FS_MAG_0262	571043.71	5761671.33	TA2B062P1	21.3	3.3	43.8	
BB_FS_MAG_0263	571210.48	5761603.33	TA2B062P1	7.9	3.7	17.7	
BB_FS_MAG_0264	569806.02	5762156.82	TA2B062P1	5.3	3.4	17.7	
BB_FS_MAG_0265	569847.69	5762143.35	TA2B062P1	6.1	4.1	32.5	
BB_FS_MAG_0266	570514.12	5761878.85	TA2B062P1	6.3	3.9	25.6	
BB_FS_MAG_0267	571182.67	5761657.01	TA2B063P1	18.7	3.6	40.3	
BB_FS_MAG_0268	571099.17	5761687.52	TA2B063P1	5.7	3.9	13.2	
BB_FS_MAG_0269	571018.73	5761719.47	TA2B063P1	11.8	4.1	17	
BB_FS_MAG_0270	570816.62	5761803.38	TA2B063P1	34.1	4.2	32.9	
BB_FS_MAG_0271	570639.17	5761873.56	TA2B063P1	13	4.1	18.8	

BB_FS_MAG_0272	570576.36	5761898.43	TA2B063P1	6.1	4	15.7	
BB_FS_MAG_0273	570514.96	5761923.89	TA2B063P1	5.2	3.9	10.2	
BB_FS_MAG_0274	570386.49	5761973.11	TA2B063P1	137.8	4.3	63.6	BB_FS_SSS_0642
BB_FS_MAG_0275	569783.81	5762213.37	TA2B063P1	16.2	4.2	21.8	
BB_FS_MAG_0276	571214.75	5761643.21	TA2B063P1	58.3	3.4	25.5	
BB_FS_MAG_0277	571074.51	5761696.23	TA2B063P1	12.8	4	16.2	
BB_FS_MAG_0278	570997.43	5761727.43	TA2B063P1	17	4.3	23.3	
BB_FS_MAG_0279	570929.39	5761759.52	TA2B063P1	8	4.3	21.2	
BB_FS_MAG_0280	570690.64	5761852.13	TA2B063P1	6.1	4.5	15.1	
BB_FS_MAG_0281	570307.28	5762004.90	TA2B063P1	25	4	15.8	
BB_FS_MAG_0282	570285.37	5762013.65	TA2B063P1	10.7	4	16.4	
BB_FS_MAG_0283	569918.36	5762160.69	TA2B063P1	20.6	4	19.1	
BB_FS_MAG_0284	570841.66	5761793.90	TA2B063P1	7.9	4.4	34.2	
BB_FS_MAG_0285	570542.25	5761912.09	TA2B063P1	5.8	3.9	30.2	
BB_FS_MAG_0286	570446.60	5761951.05	TA2B063P1	5.6	4.1	28.7	
BB_FS_MAG_0287	569991.02	5762129.32	TA2B063P1	7	3.9	90.5	
BB_FS_MAG_0288	569807.69	5762245.48	TA2B064P1	11.1	3.8	65.4	
BB_FS_MAG_0289	569888.27	5762213.43	TA2B064P1	10.1	3.8	12.5	
BB_FS_MAG_0290	570030.97	5762155.66	TA2B064P1	27.3	3.5	11.8	
BB_FS_MAG_0291	570110.34	5762125.89	TA2B064P1	9.8	3.5	25.2	
BB_FS_MAG_0292	570254.15	5762068.71	TA2B064P1	19.9	3.8	78.9	
BB_FS_MAG_0293	570642.64	5761913.23	TA2B064P1	40.4	3.6	92	
BB_FS_MAG_0294	571063.66	5761745.56	TA2B064P1	63.6	3.8	23.9	
BB_FS_MAG_0295	571093.41	5761735.25	TA2B064P1	9.3	3.9	45.2	
BB_FS_MAG_0296	571165.12	5761707.27	TA2B064P1	24.5	3.6	20.1	
BB_FS_MAG_0297	571203.03	5761692.71	TA2B064P1	64.3	3.5	26.5	
BB_FS_MAG_0298	570406.00	5762008.51	TA2B064P1	596.3	3.7	91.8	BB_FS_SSS_0678
BB_FS_MAG_0299	570531.67	5761958.97	TA2B064P1	15.5	3.8	24.6	
BB_FS_MAG_0300	570720.97	5761882.96	TA2B064P1	20.8	3.8	58.2	
BB_FS_MAG_0301	570857.05	5761830.03	TA2B064P1	38.3	3.7	68.8	
BB_FS_MAG_0302	571235.27	5761679.46	TA2B064P1	11.5	3.8	19.8	
BB_FS_MAG_0303	570998.67	5761773.36	TA2B064P1	5.8	3.4	34.7	
BB_FS_MAG_0304	571189.81	5761746.29	TA2B065P1	8.1	4	51.6	
BB_FS_MAG_0305	570888.85	5761859.21	TA2B065P1	24.1	4.8	30.7	

BB_FS_MAG_0306	570723.74	5761924.18	TA2B065P1	21	3.5	20.9	
BB_FS_MAG_0307	570146.67	5762154.05	TA2B065P1	10.1	3.9	42.7	
BB_FS_MAG_0308	570043.43	5762194.97	TA2B065P1	7.4	4.2	16.2	
BB_FS_MAG_0309	569743.91	5762314.65	TA2B065P1	32.4	4	18.4	
BB_FS_MAG_0310	571116.15	5761766.74	TA2B065P1	6.7	4.5	25.8	
BB_FS_MAG_0311	570824.82	5761884.54	TA2B065P1	25	3.6	22.9	
BB_FS_MAG_0312	570556.25	5761991.28	TA2B065P1	71.9	3.3	29.9	
BB_FS_MAG_0313	570487.05	5762019.76	TA2B065P1	14.7	3.6	70	
BB_FS_MAG_0314	569929.40	5762240.04	TA2B065P1	31.6	4.2	45.8	
BB_FS_MAG_0315	569853.10	5762270.51	TA2B065P1	5.2	4	33.5	
BB_FS_MAG_0316	570088.13	5762178.16	TA2B065P1	9.6	4	56	
BB_FS_MAG_0317	570785.14	5761901.20	TA2B065P1	5.9	3.5	62.6	
BB_FS_MAG_0318	571149.31	5761753.10	TA2B065P1	7.7	4.5	21.6	
BB_FS_MAG_0319	571251.92	5761720.50	TA2B065P1	6.8	4.8	31.3	
BB_FS_MAG_0320	569696.83	5762374.20	TA2B066P1	37.1	3.1	22	
BB_FS_MAG_0321	569795.92	5762336.02	TA2B066P1	32	2.6	19.5	
BB_FS_MAG_0322	569901.58	5762294.92	TA2B066P1	17.9	3.5	56.4	
BB_FS_MAG_0323	569984.93	5762265.74	TA2B066P1	13.5	3.3	21.2	
BB_FS_MAG_0324	570020.85	5762245.02	TA2B066P1	89.5	3.8	23.1	
BB_FS_MAG_0325	570037.55	5762238.02	TA2B066P1	8.6	3.7	20	
BB_FS_MAG_0326	570106.09	5762214.08	TA2B066P1	88.7	3.3	44	
BB_FS_MAG_0327	570158.26	5762191.54	TA2B066P1	148.1	3.9	63	
BB_FS_MAG_0328	570216.19	5762170.34	TA2B066P1	25.5	4	53.4	
BB_FS_MAG_0329	570270.89	5762148.84	TA2B066P1	6.7	4	11.6	
BB_FS_MAG_0330	570632.75	5762005.68	TA2B066P1	45.9	3.7	26	
BB_FS_MAG_0331	570819.60	5761930.79	TA2B066P1	12.4	3.7	33.2	
BB_FS_MAG_0332	570942.08	5761884.71	TA2B066P1	24.9	3.3	20.7	
BB_FS_MAG_0333	571040.22	5761843.51	TA2B066P1	24.5	3.6	82.7	
BB_FS_MAG_0334	571143.36	5761803.17	TA2B066P1	91.6	3.6	24.6	
BB_FS_MAG_0335	571163.16	5761795.06	TA2B066P1	15.9	3.7	25.9	
BB_FS_MAG_0336	569743.34	5762358.21	TA2B066P1	53.4	3.1	20.7	
BB_FS_MAG_0337	569830.02	5762323.97	TA2B066P1	14.6	3.1	38	
BB_FS_MAG_0338	570512.69	5762052.76	TA2B066P1	12.7	4	24.2	
BB_FS_MAG_0339	570603.17	5762017.31	TA2B066P1	24.3	3.8	68.5	

BB_FS_MAG_0340	570671.82	5761988.49	TA2B066P1	21.6	3.6	25.3	
BB_FS_MAG_0341	570769.96	5761950.33	TA2B066P1	13.2	3.5	34.7	
BB_FS_MAG_0342	570852.69	5761916.60	TA2B066P1	35.8	3.7	25.5	
BB_FS_MAG_0343	570886.94	5761905.22	TA2B066P1	11.8	3.6	22.2	
BB_FS_MAG_0344	570916.30	5761893.83	TA2B066P1	19.7	3.3	22.9	
BB_FS_MAG_0345	571097.36	5761820.89	TA2B066P1	156.1	3.8	31.4	
BB_FS_MAG_0346	571257.33	5761757.18	TA2B066P1	36.2	3.7	36.4	
BB_FS_MAG_0347	569718.72	5762366.40	TA2B066P1	6.2	3.3	24	
BB_FS_MAG_0348	570720.04	5761972.06	TA2B066P1	6.2	3.2	32.1	
BB_FS_MAG_0349	571250.72	5761801.04	TA2B067P1	18.3	4.4	30.3	
BB_FS_MAG_0350	571160.96	5761839.08	TA2B067P1	17.4	4.9	31.1	
BB_FS_MAG_0351	570911.96	5761936.94	TA2B067P1	31.3	4.3	17.2	
BB_FS_MAG_0352	570895.07	5761943.48	TA2B067P1	29.7	4.3	18.4	
BB_FS_MAG_0353	570775.65	5761991.09	TA2B067P1	5.6	4.7	10.7	
BB_FS_MAG_0354	570438.24	5762125.44	TA2B067P1	21.5	3.8	25.9	
BB_FS_MAG_0355	570414.78	5762132.04	TA2B067P1	103.2	3.9	39.5	
BB_FS_MAG_0356	570278.21	5762188.38	TA2B067P1	9.6	3.7	20.1	
BB_FS_MAG_0357	570255.22	5762197.69	TA2B067P1	8.3	3.9	17	
BB_FS_MAG_0358	570109.09	5762255.29	TA2B067P1	57.9	4.2	39.3	
BB_FS_MAG_0359	570073.81	5762270.02	TA2B067P1	41	4.1	25.2	
BB_FS_MAG_0360	569952.68	5762317.98	TA2B067P1	21	4.4	30.5	
BB_FS_MAG_0361	569827.28	5762368.08	TA2B067P1	9.5	4.5	93.9	
BB_FS_MAG_0362	571031.07	5761890.04	TA2B067P1	25	4.4	46.2	
BB_FS_MAG_0363	570952.36	5761920.93	TA2B067P1	36	4.1	35.6	
BB_FS_MAG_0364	570851.40	5761961.18	TA2B067P1	12	4.6	21	
BB_FS_MAG_0365	570649.24	5762040.27	TA2B067P1	19.7	4.4	22.4	
BB_FS_MAG_0366	570590.24	5762064.30	TA2B067P1	11.8	4	19	
BB_FS_MAG_0367	570553.49	5762079.59	TA2B067P1	8.4	4.1	41.5	
BB_FS_MAG_0368	570515.18	5762094.42	TA2B067P1	6	4	24.4	
BB_FS_MAG_0369	570323.01	5762170.24	TA2B067P1	8.2	3.7	29.3	
BB_FS_MAG_0370	569760.57	5762434.22	TA2B068P1	437.3	2.6	14.9	
BB_FS_MAG_0371	569809.72	5762417.25	TA2B068P1	129.4	4.2	27.1	
BB_FS_MAG_0372	569838.95	5762406.30	TA2B068P1	67.6	4.3	20.5	
BB_FS_MAG_0373	569991.74	5762345.89	TA2B068P1	210.6	3.5	23.4	

BB_FS_MAG_0374	570085.56	5762308.40	TA2B068P1	10.8	3.8	12	
BB_FS_MAG_0375	570200.75	5762260.20	TA2B068P1	17.6	2.2	12.6	
BB_FS_MAG_0376	570300.64	5762220.54	TA2B068P1	36.5	3.1	22.1	
BB_FS_MAG_0377	570330.24	5762210.42	TA2B068P1	7.2	3.4	12.3	
BB_FS_MAG_0378	570462.51	5762160.01	TA2B068P1	31.8	3.1	29.6	
BB_FS_MAG_0379	570606.68	5762101.51	TA2B068P1	9.2	3.8	16.7	
BB_FS_MAG_0380	570661.22	5762080.15	TA2B068P1	7.6	4	20	
BB_FS_MAG_0381	570731.71	5762052.11	TA2B068P1	9.8	2.7	11.6	
BB_FS_MAG_0382	570766.17	5762038.85	TA2B068P1	17.5	2.8	28.3	
BB_FS_MAG_0383	570800.90	5762024.61	TA2B068P1	121.2	2.7	17.9	
BB_FS_MAG_0384	570854.40	5762005.17	TA2B068P1	29.6	2	56	
BB_FS_MAG_0385	570939.77	5761970.89	TA2B068P1	41.5	2.5	13.1	
BB_FS_MAG_0386	570957.51	5761963.92	TA2B068P1	28.4	2.5	10.1	
BB_FS_MAG_0387	571016.20	5761939.22	TA2B068P1	35.4	3.2	18.5	
BB_FS_MAG_0388	571051.56	5761926.44	TA2B068P1	27.8	2.7	37.7	
BB_FS_MAG_0389	571103.80	5761904.23	TA2B068P1	46.4	3.1	18	
BB_FS_MAG_0390	571148.59	5761887.33	TA2B068P1	7	3.2	14.5	
BB_FS_MAG_0391	571213.49	5761861.00	TA2B068P1	27.1	3.2	17	
BB_FS_MAG_0392	569732.63	5762446.62	TA2B068P1	6.5	2	8.5	
BB_FS_MAG_0393	569906.17	5762379.70	TA2B068P1	15.2	3.2	14	
BB_FS_MAG_0394	569939.03	5762366.01	TA2B068P1	11.4	3.6	33.5	
BB_FS_MAG_0395	570067.21	5762315.48	TA2B068P1	9.4	3.3	13.9	
BB_FS_MAG_0396	570117.82	5762296.17	TA2B068P1	12.7	3.3	33.6	
BB_FS_MAG_0397	570247.49	5762246.71	TA2B068P1	25.3	2.4	15.8	
BB_FS_MAG_0398	570482.80	5762151.26	TA2B068P1	9.2	3.5	13.1	
BB_FS_MAG_0399	570524.31	5762132.60	TA2B068P1	16.1	3.8	23.5	
BB_FS_MAG_0400	570689.92	5762068.75	TA2B068P1	23.7	2.5	30.7	
BB_FS_MAG_0401	570814.92	5762019.81	TA2B068P1	34.3	2.7	15.4	
BB_FS_MAG_0402	570921.19	5761976.69	TA2B068P1	10.6	3.2	14.2	
BB_FS_MAG_0403	571192.07	5761870.26	TA2B068P1	9.6	3.1	15.3	
BB_FS_MAG_0404	571240.98	5761850.48	TA2B068P1	6.4	3.2	18.3	
BB_FS_MAG_0405	570181.39	5762271.53	TA2B068P1	5.9	3.4	18.5	
BB_FS_MAG_0406	570368.93	5762196.60	TA2B068P1	5.6	3.6	27	
BB_FS_MAG_0407	571193.28	5761910.47	TA2B069P1	6.3	5.7	18.3	

BB_FS_MAG_0408	571030.28	5761975.90	TA2B069P1	9.5	4.4	19.2	
BB_FS_MAG_0409	570990.66	5761991.47	TA2B069P1	22.7	4.3	25.4	
BB_FS_MAG_0410	570875.52	5762036.90	TA2B069P1	28.1	4.1	23.4	
BB_FS_MAG_0411	570822.41	5762058.09	TA2B069P1	17	4.3	21.3	
BB_FS_MAG_0412	570690.11	5762110.63	TA2B069P1	7.4	4.8	16.2	
BB_FS_MAG_0413	570516.42	5762179.96	TA2B069P1	13	4.3	30	
BB_FS_MAG_0414	570386.50	5762233.86	TA2B069P1	10.2	4.7	75.6	
BB_FS_MAG_0415	570207.54	5762302.92	TA2B069P1	71.6	4.4	37.8	
BB_FS_MAG_0416	570119.12	5762333.68	TA2B069P1	41.1	4.2	20.2	
BB_FS_MAG_0417	569974.90	5762397.58	TA2B069P1	446.3	4.6	41.8	
BB_FS_MAG_0418	569782.19	5762472.29	TA2B069P1	6.7	3.9	17.4	
BB_FS_MAG_0419	571105.04	5761945.61	TA2B069P1	19.7	3.9	109.1	
BB_FS_MAG_0420	570952.43	5762006.21	TA2B069P1	81.1	4	30.7	
BB_FS_MAG_0421	570618.65	5762139.07	TA2B069P1	10.4	5.1	30.1	
BB_FS_MAG_0422	570448.20	5762207.15	TA2B069P1	9.7	4.6	25	
BB_FS_MAG_0423	570263.09	5762277.71	TA2B069P1	10.6	3.6	16.5	
BB_FS_MAG_0424	570166.51	5762318.70	TA2B069P1	22.6	4.3	13.7	
BB_FS_MAG_0425	570145.86	5762325.13	TA2B069P1	179	4.2	29.6	
BB_FS_MAG_0426	570071.67	5762355.53	TA2B069P1	191.9	4	33.4	
BB_FS_MAG_0427	570026.87	5762376.46	TA2B069P1	51.7	3.7	12.5	
BB_FS_MAG_0428	570009.17	5762384.13	TA2B069P1	112.5	3.6	25	
BB_FS_MAG_0429	569930.97	5762411.99	TA2B069P1	11.1	3.6	13.9	
BB_FS_MAG_0430	569866.03	5762433.99	TA2B069P1	10.2	3.2	24.8	
BB_FS_MAG_0431	569708.24	5762500.33	TA2B069P1	27.5	1.6	31.2	
BB_FS_MAG_0432	569733.50	5762531.90	TA2B070P1	24.7	1.9	14.4	
BB_FS_MAG_0433	569788.07	5762513.46	TA2B070P1	21.5	3.8	16.4	
BB_FS_MAG_0434	569931.69	5762455.25	TA2B070P1	9	3	38	
BB_FS_MAG_0435	570091.93	5762393.02	TA2B070P1	92.5	2.1	31.4	
BB_FS_MAG_0436	570138.93	5762372.14	TA2B070P1	7.7	3.7	17.3	
BB_FS_MAG_0437	570362.21	5762284.63	TA2B070P1	10.4	4.4	21.2	
BB_FS_MAG_0438	570697.82	5762151.68	TA2B070P1	38.6	3.4	26	
BB_FS_MAG_0439	570889.46	5762077.61	TA2B070P1	416.6	3.1	37.8	
BB_FS_MAG_0440	570950.82	5762049.30	TA2B070P1	41.2	3.9	30.4	
BB_FS_MAG_0441	571187.73	5761956.00	TA2B070P1	51.1	3.5	20	

BB_FS_MAG_0442	571269.76	5761924.35	TA2B070P1	155.9	3.4	27.6	
BB_FS_MAG_0443	569706.81	5762540.99	TA2B070P1	102.7	1.9	18.4	
BB_FS_MAG_0444	569748.27	5762527.67	TA2B070P1	65.1	1.9	16.3	
BB_FS_MAG_0445	569769.23	5762520.98	TA2B070P1	10.6	3.5	14.3	
BB_FS_MAG_0446	569822.37	5762498.14	TA2B070P1	37.6	3.9	27.6	
BB_FS_MAG_0447	569861.01	5762482.18	TA2B070P1	5.8	3.7	10.3	
BB_FS_MAG_0448	570012.19	5762423.57	TA2B070P1	7	2.5	10.8	
BB_FS_MAG_0449	570037.22	5762413.72	TA2B070P1	707.1	2.3	31	
BB_FS_MAG_0450	570333.95	5762295.68	TA2B070P1	33.3	4.3	25.5	
BB_FS_MAG_0451	570620.36	5762182.04	TA2B070P1	21.4	3.3	17.6	
BB_FS_MAG_0452	570856.15	5762089.66	TA2B070P1	8.8	3.5	16.8	
BB_FS_MAG_0453	571029.82	5762020.09	TA2B070P1	54.2	3.4	21.4	
BB_FS_MAG_0454	571059.81	5762010.35	TA2B070P1	19.1	1.4	38.2	
BB_FS_MAG_0455	571209.75	5761947.97	TA2B070P1	16.3	3.5	41.2	
BB_FS_MAG_0456	571251.97	5761931.18	TA2B070P1	107.3	3.2	15.5	
BB_FS_MAG_0457	571203.68	5761994.44	TA2B071P1	15.7	4.7	24.4	
BB_FS_MAG_0458	571050.72	5762054.54	TA2B071P1	10.4	4.6	82.4	
BB_FS_MAG_0459	570876.47	5762124.12	TA2B071P1	19.8	4.8	28.5	
BB_FS_MAG_0460	570811.67	5762149.50	TA2B071P1	16.9	4.2	22.5	
BB_FS_MAG_0461	570780.59	5762161.72	TA2B071P1	31.5	4.5	22.3	
BB_FS_MAG_0462	570568.29	5762246.20	TA2B071P1	11.1	4.7	27.6	
BB_FS_MAG_0463	570523.91	5762264.38	TA2B071P1	82.8	4.3	37.3	
BB_FS_MAG_0464	570208.94	5762389.28	TA2B071P1	72.6	4	35.8	
BB_FS_MAG_0465	570082.90	5762438.36	TA2B071P1	31.2	4.5	29.9	
BB_FS_MAG_0466	569994.34	5762473.52	TA2B071P1	7.9	4.5	19.7	
BB_FS_MAG_0467	571159.62	5762011.41	TA2B071P1	16.7	4.8	56.1	
BB_FS_MAG_0468	571112.53	5762030.65	TA2B071P1	45.6	4.4	53.6	
BB_FS_MAG_0469	570925.00	5762104.43	TA2B071P1	19.8	4.6	28.1	
BB_FS_MAG_0470	570751.11	5762173.45	TA2B071P1	33.5	4.6	52.3	
BB_FS_MAG_0471	570727.83	5762182.70	TA2B071P1	12.5	4.6	14.2	
BB_FS_MAG_0472	570388.28	5762316.57	TA2B071P1	22.2	4.3	24.9	
BB_FS_MAG_0473	570348.57	5762331.59	TA2B071P1	84.1	4.2	38.6	
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BB_FS_MAG_0475	570163.60	5762407.93	TA2B071P1	29.3	4	34.3	

BB_FS_MAG_0476	569975.52	5762480.67	TA2B071P1	10.4	4.4	20.7	
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BB_FS_MAG_0478	570650.57	5762213.91	TA2B071P1	8.9	4.8	68.1	
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BB_FS_MAG_0480	570490.15	5762278.32	TA2B071P1	8.5	4	50.6	
BB_FS_MAG_0481	569906.23	5762553.42	TA2B072P1	31.5	4.6	32.5	
BB_FS_MAG_0482	570061.08	5762490.76	TA2B072P1	5.9	4.1	13.7	
BB_FS_MAG_0483	570463.13	5762331.64	TA2B072P1	13.2	3.8	20.2	
BB_FS_MAG_0484	570650.85	5762256.67	TA2B072P1	154.6	4.3	29.2	
BB_FS_MAG_0485	570755.93	5762213.78	TA2B072P1	15.9	4.8	29.1	
BB_FS_MAG_0486	570957.30	5762132.35	TA2B072P1	13.4	2.7	11	
BB_FS_MAG_0487	570993.61	5762115.84	TA2B072P1	76.5	2.8	17.8	
BB_FS_MAG_0488	571108.15	5762073.09	TA2B072P1	11.6	2.9	26.7	
BB_FS_MAG_0489	571187.67	5762041.84	TA2B072P1	16.1	2.8	14.7	
BB_FS_MAG_0490	571216.92	5762030.01	TA2B072P1	43.4	2.9	11.7	
BB_FS_MAG_0491	571229.62	5762025.37	TA2B072P1	18.6	2.8	13.9	
BB_FS_MAG_0492	571259.33	5762014.96	TA2B072P1	16.1	2.9	17	
BB_FS_MAG_0493	569756.92	5762611.53	TA2B072P1	2228.3	2	51.8	
BB_FS_MAG_0494	569872.43	5762566.52	TA2B072P1	24.9	4.7	27.1	
BB_FS_MAG_0495	569956.54	5762532.52	TA2B072P1	29.1	4.5	24.6	
BB_FS_MAG_0496	570288.36	5762401.68	TA2B072P1	7.4	4.7	30.8	
BB_FS_MAG_0497	570322.62	5762387.75	TA2B072P1	35.8	4.9	24.4	
BB_FS_MAG_0498	570395.22	5762359.28	TA2B072P1	18.1	3.7	16.5	
BB_FS_MAG_0499	570517.56	5762308.47	TA2B072P1	18.9	3.8	12.7	
BB_FS_MAG_0500	570539.86	5762299.41	TA2B072P1	14.6	4	17	
BB_FS_MAG_0501	570710.18	5762233.61	TA2B072P1	13.1	4.5	28.3	
BB_FS_MAG_0502	570966.75	5762127.49	TA2B072P1	41.5	2.6	9.9	
BB_FS_MAG_0503	570977.58	5762122.13	TA2B072P1	132.4	2.7	12.3	
BB_FS_MAG_0504	571012.53	5762110.03	TA2B072P1	18.7	2.9	15.8	
BB_FS_MAG_0505	571064.72	5762090.89	TA2B072P1	49.8	2.9	75.6	
BB_FS_MAG_0506	571152.40	5762057.41	TA2B072P1	30	2.8	33.3	
BB_FS_MAG_0507	569793.44	5762597.55	TA2B072P1	7	4.7	35	
BB_FS_MAG_0508	570085.74	5762481.97	TA2B072P1	6.2	4.2	22.8	
BB_FS_MAG_0509	571265.09	5762055.26	TA2B073P1	9.7	4.9	22.9	

BB_FS_MAG_0510	571196.47	5762083.03	TA2B073P1	12.8	4.5	22.5	
BB_FS_MAG_0511	571174.15	5762091.78	TA2B073P1	9.7	4.5	17.1	
BB_FS_MAG_0512	570625.77	5762309.24	TA2B073P1	26.2	4.8	35.5	
BB_FS_MAG_0513	570573.03	5762329.55	TA2B073P1	13.6	4.9	54.2	
BB_FS_MAG_0514	570547.09	5762339.19	TA2B073P1	15.9	3.9	14.7	
BB_FS_MAG_0515	570527.38	5762346.73	TA2B073P1	79.1	4	21.9	
BB_FS_MAG_0516	570498.69	5762358.15	TA2B073P1	11.9	4	13.3	
BB_FS_MAG_0517	570421.56	5762390.80	TA2B073P1	11.5	4.1	31.1	
BB_FS_MAG_0518	570232.36	5762465.14	TA2B073P1	7.4	4	22.5	
BB_FS_MAG_0519	570088.01	5762523.47	TA2B073P1	15.1	4	28.7	
BB_FS_MAG_0520	569928.62	5762586.50	TA2B073P1	9.3	4	26	
BB_FS_MAG_0521	569766.62	5762650.75	TA2B073P1	8.9	3.3	14	
BB_FS_MAG_0522	571115.10	5762115.07	TA2B073P1	38.3	4.6	33.8	
BB_FS_MAG_0523	571031.37	5762148.13	TA2B073P1	8.7	4.7	19.2	
BB_FS_MAG_0524	570955.00	5762178.24	TA2B073P1	21.3	4.7	98	
BB_FS_MAG_0525	570762.60	5762254.62	TA2B073P1	16.5	4.9	47.5	
BB_FS_MAG_0526	570263.88	5762452.95	TA2B073P1	13.7	4.1	22.7	
BB_FS_MAG_0527	570124.02	5762508.84	TA2B073P1	28.5	4.1	32.4	
BB_FS_MAG_0528	569989.43	5762562.13	TA2B073P1	20.1	4.2	35.3	
BB_FS_MAG_0529	569888.07	5762605.52	TA2B073P1	14.2	3.7	38.1	
BB_FS_MAG_0530	569819.11	5762636.75	TA2B073P1	14.3	2.6	16.2	
BB_FS_MAG_0531	571227.59	5762070.69	TA2B073P1	7.5	4.4	43.2	
BB_FS_MAG_0532	571142.69	5762104.18	TA2B073P1	7	4.6	33.3	
BB_FS_MAG_0533	571057.62	5762138.08	TA2B073P1	7.3	4.6	17.9	
BB_FS_MAG_0534	570836.13	5762225.85	TA2B073P1	6.1	4.9	53.1	
BB_FS_MAG_0535	569947.22	5762622.55	TA2B074P1	27.4	3.6	28.6	
BB_FS_MAG_0536	570045.22	5762582.19	TA2B074P1	12.5	4	19.5	
BB_FS_MAG_0537	570243.26	5762503.17	TA2B074P1	8.4	4.7	17.5	
BB_FS_MAG_0538	570281.15	5762489.94	TA2B074P1	61.3	4.8	31.7	
BB_FS_MAG_0539	570303.45	5762480.38	TA2B074P1	13.8	4.7	18.4	
BB_FS_MAG_0540	570416.86	5762436.78	TA2B074P1	81.8	4.3	44.2	
BB_FS_MAG_0541	570747.39	5762305.20	TA2B074P1	22	4	15.6	
BB_FS_MAG_0542	571049.83	5762184.73	TA2B074P1	40.5	4.2	17.7	
BB_FS_MAG_0543	571067.01	5762177.98	TA2B074P1	29.6	4.2	17.4	

BB_FS_MAG_0544	571200.69	5762123.02	TA2B074P1	6.5	4.1	8.3	
BB_FS_MAG_0545	571221.19	5762115.64	TA2B074P1	48.2	3.7	24.3	
BB_FS_MAG_0546	569843.70	5762662.16	TA2B074P1	14.1	4.1	26.4	
BB_FS_MAG_0547	569970.96	5762611.54	TA2B074P1	13.1	3.8	14.9	
BB_FS_MAG_0548	570212.02	5762516.12	TA2B074P1	7.6	4.7	15.6	
BB_FS_MAG_0549	570677.57	5762332.33	TA2B074P1	16.6	3.9	15.2	
BB_FS_MAG_0550	570834.39	5762270.42	TA2B074P1	25.2	4.4	29.2	
BB_FS_MAG_0551	570936.13	5762229.09	TA2B074P1	16.5	4.4	24.9	
BB_FS_MAG_0552	570980.07	5762211.71	TA2B074P1	27.8	4.3	26	
BB_FS_MAG_0553	571019.85	5762196.36	TA2B074P1	33.2	4.2	41.4	
BB_FS_MAG_0554	571081.00	5762172.64	TA2B074P1	12.1	4.2	15.4	
BB_FS_MAG_0555	571253.09	5762103.93	TA2B074P1	35	3.5	23.4	
BB_FS_MAG_0556	569743.12	5762702.16	TA2B074P1	5.3	4.2	84.4	
BB_FS_MAG_0557	570560.78	5762378.01	TA2B074P1	7.1	4.6	63.7	
BB_FS_MAG_0558	570650.87	5762342.65	TA2B074P1	9.3	4.1	32.8	
BB_FS_MAG_0559	570799.09	5762285.09	TA2B074P1	5.5	4.2	19.3	
BB_FS_MAG_0560	571107.93	5762162.31	TA2B074P1	5.8	4.1	16	
BB_FS_MAG_0561	571157.73	5762181.33	TA2B075P1	15.3	3.8	21.2	
BB_FS_MAG_0562	571055.96	5762221.20	TA2B075P1	16	3.9	14.7	
BB_FS_MAG_0563	571031.80	5762231.09	TA2B075P1	286.6	3.9	26.6	
BB_FS_MAG_0564	570986.94	5762248.60	TA2B075P1	20.1	4	16	
BB_FS_MAG_0565	570829.42	5762312.26	TA2B075P1	33.4	4.1	21.3	
BB_FS_MAG_0566	570809.54	5762320.03	TA2B075P1	8.1	4.1	22.3	
BB_FS_MAG_0567	570479.63	5762450.36	TA2B075P1	66.4	4.3	27.9	BB_FS_SSS_0884
BB_FS_MAG_0568	570437.20	5762467.40	TA2B075P1	5.7	4	18.2	
BB_FS_MAG_0569	570120.91	5762592.96	TA2B075P1	281.8	3.9	32.2	
BB_FS_MAG_0570	569870.23	5762692.29	TA2B075P1	13.5	4.6	15.7	
BB_FS_MAG_0571	569799.68	5762721.06	TA2B075P1	7.2	4.6	18	
BB_FS_MAG_0572	569696.16	5762761.24	TA2B075P1	11.3	4.9	15.1	
BB_FS_MAG_0573	571277.78	5762134.05	TA2B075P1	9.5	3.6	19.7	
BB_FS_MAG_0574	571248.34	5762145.94	TA2B075P1	13.3	3.7	21.2	
BB_FS_MAG_0575	571180.83	5762172.36	TA2B075P1	180.8	3.8	44.2	
BB_FS_MAG_0576	570880.53	5762290.95	TA2B075P1	8.8	4.1	29.7	
BB_FS_MAG_0577	570750.11	5762342.82	TA2B075P1	7.6	4.2	19.5	

BB_FS_MAG_0578	570534.88	5762428.60	TA2B075P1	18.4	4.1	25	
BB_FS_MAG_0579	570089.73	5762605.77	TA2B075P1	8.3	4.1	19.1	
BB_FS_MAG_0580	570027.12	5762630.95	TA2B075P1	28.5	4.3	32.3	
BB_FS_MAG_0581	570922.29	5762273.68	TA2B075P1	5.9	3.9	63.9	
BB_FS_MAG_0582	570363.61	5762499.67	TA2B075P1	5	3.4	27.2	
BB_FS_MAG_0583	570269.17	5762534.15	TA2B075P1	5.1	3.6	25	
BB_FS_MAG_0584	569722.58	5762751.26	TA2B075P1	7.9	5	43.7	
BB_FS_MAG_0585	569740.05	5762791.60	TA2B076P1	8.9	3.9	15.4	
BB_FS_MAG_0586	570094.69	5762646.90	TA2B076P1	12.6	3.7	21.1	
BB_FS_MAG_0587	570322.23	5762562.86	TA2B076P1	14.2	3.4	19.9	
BB_FS_MAG_0588	570766.04	5762383.35	TA2B076P1	15.6	4.5	20.3	
BB_FS_MAG_0589	570870.59	5762339.15	TA2B076P1	10.3	4.5	21.2	
BB_FS_MAG_0590	570911.51	5762321.76	TA2B076P1	25	4	15.1	
BB_FS_MAG_0591	570953.17	5762307.94	TA2B076P1	11	4	49.8	
BB_FS_MAG_0592	571073.04	5762259.58	TA2B076P1	13.3	4	148.9	
BB_FS_MAG_0593	571265.95	5762183.11	TA2B076P1	13.3	3.6	17.3	
BB_FS_MAG_0594	569818.14	5762757.54	TA2B076P1	21.5	3.6	48.7	
BB_FS_MAG_0595	569995.43	5762686.40	TA2B076P1	53.6	3.6	27.8	
BB_FS_MAG_0596	570202.71	5762604.44	TA2B076P1	82.1	3.9	28.4	
BB_FS_MAG_0597	570396.94	5762528.21	TA2B076P1	52.1	3.4	33.7	
BB_FS_MAG_0598	570715.90	5762403.38	TA2B076P1	21.8	4.5	35.2	
BB_FS_MAG_0599	570783.80	5762376.40	TA2B076P1	6.8	4.6	16.8	
BB_FS_MAG_0600	570893.57	5762328.50	TA2B076P1	7.5	4	8	
BB_FS_MAG_0601	571146.20	5762231.68	TA2B076P1	129.8	3.8	18.4	
BB_FS_MAG_0602	571249.01	5762189.02	TA2B076P1	8.2	3.7	13.8	
BB_FS_MAG_0603	569710.01	5762803.57	TA2B076P1	6.9	4	25.9	
BB_FS_MAG_0604	569766.08	5762780.33	TA2B076P1	5.3	3.8	17.5	
BB_FS_MAG_0605	570131.22	5762631.97	TA2B076P1	5.8	3.8	44.1	BB_FS_SSS_0916
BB_FS_MAG_0606	570233.53	5762596.72	TA2B076P1	6.1	3.8	26.1	
BB_FS_MAG_0607	570279.61	5762580.41	TA2B076P1	9.1	3.6	57.1	
BB_FS_MAG_0608	570590.18	5762450.17	TA2B076P1	7.3	4.2	28.8	
BB_FS_MAG_0609	570640.27	5762432.22	TA2B076P1	5.6	4.6	27.3	
BB_FS_MAG_0610	570683.33	5762416.75	TA2B076P1	7.4	4.5	29.7	
BB_FS_MAG_0611	571201.95	5762207.12	TA2B076P1	9.2	3.7	17.1	

BB_FS_MAG_0612	571171.94	5762220.35	TA2B076P1	7.3	3.6	23.3	
BB_FS_MAG_0613	571138.71	5762277.20	TA2B077P1	9.9	3.8	8.8	
BB_FS_MAG_0614	571126.67	5762281.07	TA2B077P1	80.9	3.9	29.9	
BB_FS_MAG_0615	571049.13	5762311.01	TA2B077P1	55.6	3.7	25.2	
BB_FS_MAG_0616	570829.53	5762402.17	TA2B077P1	29.4	4.6	16.5	
BB_FS_MAG_0617	570747.29	5762442.11	TA2B077P1	23.9	4.5	78.6	
BB_FS_MAG_0618	570685.13	5762465.96	TA2B077P1	72.2	4.5	47.2	
BB_FS_MAG_0619	570655.20	5762476.09	TA2B077P1	42.2	4.5	13.9	
BB_FS_MAG_0620	570379.91	5762577.87	TA2B077P1	6.6	4.9	23.9	
BB_FS_MAG_0621	570061.58	5762705.22	TA2B077P1	10.6	3.9	22.1	
BB_FS_MAG_0622	570037.29	5762713.51	TA2B077P1	16.2	3.9	17	
BB_FS_MAG_0623	570015.93	5762720.66	TA2B077P1	12.9	4	34.3	
BB_FS_MAG_0624	569910.16	5762765.34	TA2B077P1	32.4	4.5	27.7	
BB_FS_MAG_0625	569884.29	5762776.43	TA2B077P1	13	4.4	31.1	
BB_FS_MAG_0626	569697.43	5762844.35	TA2B077P1	8.1	4.3	17.9	
BB_FS_MAG_0627	571214.44	5762251.62	TA2B077P1	52	3.8	34.2	
BB_FS_MAG_0628	571167.35	5762267.46	TA2B077P1	8.3	3.9	16.8	
BB_FS_MAG_0629	571023.86	5762320.83	TA2B077P1	7.5	3.8	16	
BB_FS_MAG_0630	570972.88	5762340.65	TA2B077P1	9.8	4.1	15.5	
BB_FS_MAG_0631	570632.51	5762483.59	TA2B077P1	33.7	4.4	30	
BB_FS_MAG_0632	570569.25	5762503.57	TA2B077P1	14.6	4.8	26.8	
BB_FS_MAG_0633	570319.24	5762601.96	TA2B077P1	82.1	4.4	38.6	
BB_FS_MAG_0634	570223.05	5762640.80	TA2B077P1	7.5	4.5	24.4	
BB_FS_MAG_0635	570078.57	5762699.19	TA2B077P1	15.6	3.9	14.5	
BB_FS_MAG_0636	569795.82	5762810.60	TA2B077P1	92.3	4	40.3	
BB_FS_MAG_0637	570886.86	5762374.99	TA2B077P1	7.8	4.2	67.9	
BB_FS_MAG_0638	569764.54	5762864.09	TA2B078P1	49.7	3.2	21.6	
BB_FS_MAG_0639	569884.14	5762818.52	TA2B078P1	36.5	2.9	20	
BB_FS_MAG_0640	569941.75	5762795.91	TA2B078P1	48	2.5	16.6	
BB_FS_MAG_0641	569994.83	5762775.16	TA2B078P1	116.6	2.7	12.1	
BB_FS_MAG_0642	570139.79	5762717.84	TA2B078P1	379.1	3.2	25.3	
BB_FS_MAG_0643	570166.32	5762707.54	TA2B078P1	18.1	3.2	13.5	
BB_FS_MAG_0644	570302.45	5762654.24	TA2B078P1	8.5	3.4	16.6	
BB_FS_MAG_0645	570466.70	5762591.78	TA2B078P1	67.6	2.6	30.3	

BB_FS_MAG_0646	570484.49	5762584.96	TA2B078P1	9.6	2.3	8.6	
BB_FS_MAG_0647	570543.66	5762559.27	TA2B078P1	19.5	3.4	60.4	
BB_FS_MAG_0648	570710.03	5762491.97	TA2B078P1	40.6	3.5	12.3	
BB_FS_MAG_0649	570740.06	5762481.06	TA2B078P1	36	3.5	12.1	
BB_FS_MAG_0650	570748.95	5762477.47	TA2B078P1	9.8	3.6	9.1	
BB_FS_MAG_0651	570799.41	5762456.52	TA2B078P1	10	3.5	28.4	
BB_FS_MAG_0652	570930.78	5762404.84	TA2B078P1	28.7	3.6	38.1	
BB_FS_MAG_0653	570988.25	5762381.84	TA2B078P1	15.3	3.5	15.7	
BB_FS_MAG_0654	571009.02	5762372.14	TA2B078P1	23	3.5	12.4	
BB_FS_MAG_0655	571039.40	5762359.91	TA2B078P1	21.3	3.4	45.3	
BB_FS_MAG_0656	571071.17	5762348.18	TA2B078P1	10.6	3.4	8.8	
BB_FS_MAG_0657	571276.89	5762266.60	TA2B078P1	86.3	3	16.7	
BB_FS_MAG_0658	569802.73	5762851.16	TA2B078P1	40	3.2	20.2	
BB_FS_MAG_0659	569822.17	5762844.71	TA2B078P1	8.7	3.3	15.8	
BB_FS_MAG_0660	569962.85	5762787.98	TA2B078P1	7.2	2.6	8.4	
BB_FS_MAG_0661	570014.78	5762767.85	TA2B078P1	58.3	3	22.4	
BB_FS_MAG_0662	570077.66	5762742.91	TA2B078P1	12	3.3	13.9	
BB_FS_MAG_0663	570230.76	5762681.39	TA2B078P1	518.9	3.2	19.5	
BB_FS_MAG_0664	570257.23	5762671.25	TA2B078P1	16.1	3.2	14.2	
BB_FS_MAG_0665	570380.06	5762622.00	TA2B078P1	41.3	3.6	35.1	
BB_FS_MAG_0666	570619.83	5762530.30	TA2B078P1	9.5	3.4	16.5	
BB_FS_MAG_0667	570654.38	5762515.84	TA2B078P1	18.1	3.4	25.1	
BB_FS_MAG_0668	570685.37	5762501.50	TA2B078P1	11.2	3.5	31.6	
BB_FS_MAG_0669	570883.45	5762422.59	TA2B078P1	29.9	3.6	21.3	
BB_FS_MAG_0670	570974.10	5762387.97	TA2B078P1	37.8	3.6	18.6	
BB_FS_MAG_0671	571100.33	5762336.71	TA2B078P1	30.6	3.4	25.6	
BB_FS_MAG_0672	571138.02	5762321.92	TA2B078P1	91.3	3.3	26.6	
BB_FS_MAG_0673	571167.57	5762310.43	TA2B078P1	63.2	3.2	37.6	
BB_FS_MAG_0674	571215.49	5762290.99	TA2B078P1	7.3	3.1	20.1	
BB_FS_MAG_0675	571238.13	5762281.96	TA2B078P1	250.6	3.1	33.9	
BB_FS_MAG_0676	570048.40	5762754.39	TA2B078P1	8.5	3.1	23.1	
BB_FS_MAG_0677	571253.73	5762320.17	TA2B079P1	26.4	3.8	30	
BB_FS_MAG_0678	571123.92	5762369.12	TA2B079P1	10.1	3.7	22.3	
BB_FS_MAG_0679	571033.81	5762406.75	TA2B079P1	16.8	3.9	30.7	

BB_FS_MAG_0680	570995.08	5762423.03	TA2B079P1	165.2	4	39.4	
BB_FS_MAG_0681	570855.70	5762477.61	TA2B079P1	8.1	4	15.3	
BB_FS_MAG_0682	570812.99	5762494.15	TA2B079P1	8.2	4	17.7	
BB_FS_MAG_0683	570711.32	5762534.94	TA2B079P1	113.1	4	26.5	
BB_FS_MAG_0684	570627.14	5762566.96	TA2B079P1	13.2	4.2	18.3	
BB_FS_MAG_0685	570574.93	5762587.54	TA2B079P1	35.3	4	50	
BB_FS_MAG_0686	570527.06	5762606.13	TA2B079P1	11.1	3.9	57.3	
BB_FS_MAG_0687	570458.77	5762630.63	TA2B079P1	25.5	3.2	22.9	
BB_FS_MAG_0688	570339.44	5762680.79	TA2B079P1	29.3	3.6	16.6	
BB_FS_MAG_0689	570277.92	5762701.28	TA2B079P1	26.6	3.8	8.6	
BB_FS_MAG_0690	570257.60	5762710.40	TA2B079P1	36.3	3.8	18.9	
BB_FS_MAG_0691	570182.08	5762744.10	TA2B079P1	65.3	4.1	20.4	BB_FS_SSS_0929
BB_FS_MAG_0692	570069.28	5762790.18	TA2B079P1	9.6	4.4	14	
BB_FS_MAG_0693	569738.53	5762919.35	TA2B079P1	10.4	4.8	39.7	
BB_FS_MAG_0694	571207.63	5762339.02	TA2B079P1	12.3	3.8	38.9	
BB_FS_MAG_0695	571152.83	5762359.89	TA2B079P1	11.9	3.6	30.5	
BB_FS_MAG_0696	571099.66	5762378.09	TA2B079P1	83	3.8	33.6	
BB_FS_MAG_0697	570834.37	5762486.04	TA2B079P1	9.8	4	17.3	
BB_FS_MAG_0698	570684.83	5762545.46	TA2B079P1	29.4	4	14.8	
BB_FS_MAG_0699	570666.68	5762552.26	TA2B079P1	19.3	4.1	11.3	
BB_FS_MAG_0700	570398.81	5762658.24	TA2B079P1	12.3	3.5	11.2	
BB_FS_MAG_0701	570352.73	5762676.00	TA2B079P1	17.2	3.6	20.3	
BB_FS_MAG_0702	570120.33	5762770.84	TA2B079P1	27	4.2	16.2	
BB_FS_MAG_0703	570095.15	5762780.56	TA2B079P1	17.3	4.3	20.1	
BB_FS_MAG_0704	569919.28	5762846.31	TA2B079P1	6.5	4.4	28.7	
BB_FS_MAG_0705	569815.41	5762888.87	TA2B079P1	34.7	4.8	61.2	
BB_FS_MAG_0706	571279.50	5762308.38	TA2B079P1	7	3.7	47.4	
BB_FS_MAG_0707	569696.67	5762980.78	TA2B080P1	13.2	2.8	14.1	
BB_FS_MAG_0708	569756.37	5762955.61	TA2B080P1	12.1	3	45.6	
BB_FS_MAG_0709	569841.79	5762923.34	TA2B080P1	6	3	7.7	BB_FS_SSS_0946
BB_FS_MAG_0710	570080.80	5762828.30	TA2B080P1	7.2	2.5	10.4	
BB_FS_MAG_0711	570145.13	5762803.43	TA2B080P1	256.5	2.5	20.1	
BB_FS_MAG_0712	570204.91	5762778.05	TA2B080P1	53.7	2.1	6.8	
BB_FS_MAG_0713	570263.86	5762756.49	TA2B080P1	10.1	2.4	11.4	

BB_FS_MAG_0714	570292.61	5762745.57	TA2B080P1	12.5	2	10.4	
BB_FS_MAG_0715	570345.47	5762722.67	TA2B080P1	14	3.9	31.6	
BB_FS_MAG_0716	570390.93	5762704.95	TA2B080P1	13.6	3.8	49	
BB_FS_MAG_0717	570499.93	5762662.64	TA2B080P1	14.6	4.1	26.9	
BB_FS_MAG_0718	570541.72	5762644.84	TA2B080P1	117	3.7	34.8	
BB_FS_MAG_0719	570808.93	5762540.57	TA2B080P1	37.3	3.9	19.5	
BB_FS_MAG_0720	570841.39	5762526.18	TA2B080P1	55.2	4.1	22.5	
BB_FS_MAG_0721	570887.94	5762508.58	TA2B080P1	8.3	4.4	15.6	
BB_FS_MAG_0722	571021.12	5762455.42	TA2B080P1	7.1	4.7	16.8	
BB_FS_MAG_0723	569856.12	5762917.29	TA2B080P1	8.5	2.9	13.7	
BB_FS_MAG_0724	570108.39	5762817.08	TA2B080P1	450.2	2.7	26.3	
BB_FS_MAG_0725	570170.03	5762793.24	TA2B080P1	14.3	2.2	10.5	
BB_FS_MAG_0726	570185.79	5762786.61	TA2B080P1	16.5	2.2	8.5	
BB_FS_MAG_0727	570194.58	5762782.89	TA2B080P1	911.1	2	12.6	
BB_FS_MAG_0728	570688.96	5762587.87	TA2B080P1	102.2	3.9	15.8	
BB_FS_MAG_0729	570721.18	5762575.07	TA2B080P1	217.9	4.1	31.5	
BB_FS_MAG_0730	570914.77	5762496.95	TA2B080P1	18.5	4.5	20.7	
BB_FS_MAG_0731	570933.58	5762490.50	TA2B080P1	33.2	4.6	12.4	
BB_FS_MAG_0732	570962.35	5762479.64	TA2B080P1	11.5	4.4	13.8	
BB_FS_MAG_0733	571007.34	5762460.95	TA2B080P1	11.5	4.6	21.9	
BB_FS_MAG_0734	571091.36	5762428.43	TA2B080P1	28.7	4.7	23.7	
BB_FS_MAG_0735	571125.44	5762414.74	TA2B080P1	32.4	4.7	45.8	
BB_FS_MAG_0736	571174.84	5762394.76	TA2B080P1	7.6	4.6	39.5	
BB_FS_MAG_0737	569894.51	5762900.99	TA2B080P1	6.8	3	41.6	
BB_FS_MAG_0738	569983.78	5762866.58	TA2B080P1	8.8	2.4	24.2	
BB_FS_MAG_0739	570456.63	5762678.79	TA2B080P1	5.8	3.6	22	
BB_FS_MAG_0740	570966.84	5762518.81	TA2B081P1	12.4	4.1	10.7	
BB_FS_MAG_0741	570912.53	5762540.61	TA2B081P1	12.1	4.1	15.6	
BB_FS_MAG_0742	570726.84	5762624.88	TA2B081P1	24.5	3.2	29.5	
BB_FS_MAG_0743	570651.67	5762656.70	TA2B081P1	10.8	3	10.2	
BB_FS_MAG_0744	570468.62	5762719.91	TA2B081P1	12.5	3.2	13	
BB_FS_MAG_0745	570354.27	5762762.79	TA2B081P1	8.2	4.3	13.8	
BB_FS_MAG_0746	570258.72	5762802.72	TA2B081P1	67.1	3.8	18.8	
BB_FS_MAG_0747	570073.01	5762877.36	TA2B081P1	108.1	4.3	28	

BB_FS_MAG_0748	571232.40	5762414.08	TA2B081P1	6.8	4.9	20.4	
BB_FS_MAG_0749	571119.24	5762457.55	TA2B081P1	31.5	4.9	48.3	
BB_FS_MAG_0750	571010.42	5762500.90	TA2B081P1	23.8	4	49.6	
BB_FS_MAG_0751	570855.13	5762563.87	TA2B081P1	19.7	4.3	17.5	
BB_FS_MAG_0752	570749.33	5762607.12	TA2B081P1	59.1	3.8	21.6	
BB_FS_MAG_0753	570704.99	5762637.75	TA2B081P1	21.3	3.5	7.8	
BB_FS_MAG_0754	570667.99	5762652.17	TA2B081P1	80.3	3.1	19.9	
BB_FS_MAG_0755	570601.07	5762670.53	TA2B081P1	20.9	3	35.8	
BB_FS_MAG_0756	570503.87	5762708.48	TA2B081P1	47.9	3.5	20.7	
BB_FS_MAG_0757	570445.49	5762725.53	TA2B081P1	19.9	3.3	15.1	
BB_FS_MAG_0758	570389.18	5762743.87	TA2B081P1	18.2	4.2	23.2	
BB_FS_MAG_0759	570232.03	5762810.89	TA2B081P1	7.8	3.6	12.2	
BB_FS_MAG_0760	570198.63	5762820.48	TA2B081P1	9	4.1	11.1	
BB_FS_MAG_0761	570116.59	5762860.00	TA2B081P1	36.7	4.3	14.4	
BB_FS_MAG_0762	569995.14	5762902.66	TA2B081P1	34.3	4.4	22.7	
BB_FS_MAG_0763	569914.96	5762929.62	TA2B081P1	52.5	5.2	31.4	
BB_FS_MAG_0764	569843.68	5762961.73	TA2B081P1	15.8	4.3	50.3	
BB_FS_MAG_0765	571061.56	5762480.41	TA2B081P1	6.2	5	16.7	
BB_FS_MAG_0766	570310.49	5762784.93	TA2B081P1	6	3.9	41.2	
BB_FS_MAG_0767	569799.07	5762983.17	TA2B081P1	7.8	4.2	16.7	
BB_FS_MAG_0768	569714.86	5763060.30	TA2B082P1	8.9	4.8	21.2	
BB_FS_MAG_0769	569906.39	5762975.95	TA2B082P1	38.6	4.2	20	
BB_FS_MAG_0770	569935.20	5762966.35	TA2B082P1	50.8	4.3	24.6	
BB_FS_MAG_0771	570115.40	5762902.57	TA2B082P1	11.4	3.9	17.8	
BB_FS_MAG_0772	570198.29	5762868.67	TA2B082P1	26.8	4	35.4	
BB_FS_MAG_0773	570401.47	5762789.08	TA2B082P1	53.5	1.5	41.6	
BB_FS_MAG_0774	570459.66	5762763.95	TA2B082P1	59.8	3	20.8	
BB_FS_MAG_0775	570758.54	5762642.40	TA2B082P1	40.7	4.1	22.6	
BB_FS_MAG_0776	570924.08	5762582.94	TA2B082P1	27.8	4.6	16.9	
BB_FS_MAG_0777	571007.12	5762539.27	TA2B082P1	20.3	4.6	19.3	
BB_FS_MAG_0778	571264.85	5762446.97	TA2B082P1	8.9	4.6	15.1	
BB_FS_MAG_0779	569850.97	5763001.25	TA2B082P1	5	4	12.5	
BB_FS_MAG_0780	569982.25	5762951.38	TA2B082P1	132.4	4.2	58.4	
BB_FS_MAG_0781	570026.92	5762936.84	TA2B082P1	9.3	4.2	17.7	

BB_FS_MAG_0782	570095.79	5762910.60	TA2B082P1	15.3	4	16.3	
BB_FS_MAG_0783	570154.49	5762886.78	TA2B082P1	42.1	3.8	24.5	
BB_FS_MAG_0784	570356.53	5762807.56	TA2B082P1	12.5	3.9	12.7	
BB_FS_MAG_0785	570684.06	5762674.78	TA2B082P1	11.8	3.6	12.3	
BB_FS_MAG_0786	570703.54	5762666.08	TA2B082P1	7.7	3.7	8.9	
BB_FS_MAG_0787	570880.27	5762602.21	TA2B082P1	41.4	4.5	13.4	
BB_FS_MAG_0788	571284.03	5762436.83	TA2B082P1	27.1	4.7	25.5	
BB_FS_MAG_0789	571210.20	5762474.77	TA2B082P1	7	4.7	21.6	

Appendix H

Contacts Listing – Subsea Contacts

Unique_ID	Line_Name	Trace_No	Easting	Northing	Depth_BSB	Interp	Conf	MAG_Corr
BA_FS_SBP_0001	ARAMIS_SK_SBP_TA2A001P1_1_LAT_20220713	3347	570249.87	5759967.81	4.2	Sub-bottom Contact	Low	
BA_FS_SBP_0002	ARAMIS_SK_SBP_TA2A001P1_1_LAT_20220713	3220	570240.10	5759970.27	3.7	Sub-bottom Contact	Low	
BA_FS_SBP_0003	ARAMIS_SK_SBP_TA2A004P1_1_LAT_20220713	6243	570335.60	5760017.43	6	Sub-bottom Contact	Low	
BA_FS_SBP_0004	ARAMIS_SK_SBP_TA2A004P1_1_LAT_20220713	5396	570277.88	5760018.50	4.3	Sub-bottom Contact	Low	
BA_FS_SBP_0005	ARAMIS_SK_SBP_TA2A004P1_1_LAT_20220713	5874	570310.03	5760018.54	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0006	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	8465	570377.04	5760034.48	4.9	Sub-bottom Contact	Low	
BA_FS_SBP_0007	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	8521	570380.73	5760034.79	4.9	Sub-bottom Contact	Low	
BA_FS_SBP_0008	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	8301	570365.93	5760035.02	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0009	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	8236	570361.55	5760035.05	4.8	Sub-bottom Contact	Low	BA_FS_MAG_0020
BA_FS_SBP_0010	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	7909	570339.75	5760036.47	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0011	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	7378	570305.30	5760037.96	4.1	Sub-bottom Contact	Low	
BA_FS_SBP_0012	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	7289	570299.59	5760038.06	3.7	Sub-bottom Contact	Low	
BA_FS_SBP_0013	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	6730	570264.26	5760038.73	4	Sub-bottom Contact	Low	
BA_FS_SBP_0014	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	6326	570240.19	5760040.42	3.8	Sub-bottom Contact	Low	
BA_FS_SBP_0015	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	8902	570403.16	5760043.89	3.3	Sub-bottom Contact	Low	
BA_FS_SBP_0016	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	4303	570117.50	5760046.82	3.7	Sub-bottom Contact	Low	
BA_FS_SBP_0017	ARAMIS_SK_SBP_TA2A005P1_1_LAT_20220713	9084	570412.77	5760050.02	3.3	Sub-bottom Contact	Low	
BA_FS_SBP_0018	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8793	570409.87	5760053.02	4	Sub-bottom Contact	Low	BA_FS_MAG_0023
BA_FS_SBP_0019	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8712	570404.06	5760053.81	5	Sub-bottom Contact	Low	
BA_FS_SBP_0020	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8139	570363.07	5760054.01	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0021	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8054	570357.15	5760054.11	4.9	Sub-bottom Contact	Low	
BA_FS_SBP_0022	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8302	570374.60	5760054.14	3.7	Sub-bottom Contact	Low	
BA_FS_SBP_0023	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8392	570380.96	5760054.22	3.6	Sub-bottom Contact	Low	
BA_FS_SBP_0024	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	8400	570381.51	5760054.22	4.3	Sub-bottom Contact	Low	
BA_FS_SBP_0025	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7903	570346.64	5760054.60	4.7	Sub-bottom Contact	Low	
BA_FS_SBP_0026	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7837	570341.94	5760054.93	3.8	Sub-bottom Contact	Low	
BA_FS_SBP_0027	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7659	570329.50	5760055.52	5.9	Sub-bottom Contact	Low	
BA_FS_SBP_0028	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7332	570306.53	5760056.92	4.2	Sub-bottom Contact	Low	
BA_FS_SBP_0029	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7102	570290.05	5760057.23	4.7	Sub-bottom Contact	Low	
BA_FS_SBP_0030	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	7068	570287.67	5760057.33	4.3	Sub-bottom Contact	Low	
BA_FS_SBP_0031	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	6820	570270.41	5760058.58	4.4	Sub-bottom Contact	High	
BA_FS_SBP_0032	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	6298	570233.40	5760061.17	6.5	Sub-bottom Contact	Low	
BA_FS_SBP_0033	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	3702	570060.15	5760068.00	4	Sub-bottom Contact	Low	
BA_FS_SBP_0034	ARAMIS_SK_SBP_TA2A006P1_1_LAT_20220713	3646	570056.56	5760068.09	3.1	Sub-bottom Contact	Low	
BA_FS_SBP_0035	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	12462	570439.80	5760071.07	5.7	Sub-bottom Contact	Low	
BA_FS_SBP_0036	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	12373	570433.70	5760071.28	4.7	Sub-bottom Contact	Low	
BA_FS_SBP_0037	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	12057	570411.64	5760072.44	5.2	Sub-bottom Contact	Low	
BA_FS_SBP_0038	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	11882	570399.53	5760072.91	8	Sub-bottom Contact	Low	
BA_FS_SBP_0039	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	11667	570384.73	5760073.55	4.2	Sub-bottom Contact	Low	
BA_FS_SBP_0040	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	11627	570382.02	5760073.81	4	Sub-bottom Contact	Low	
BA_FS_SBP_0041	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	11321	570360.79	5760074.30	3.9	Sub-bottom Contact	Low	
BA_FS_SBP_0042	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	10815	570326.62	5760075.41	5	Sub-bottom Contact	Low	

BA_FS_SBP_0043	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	10916	570333.39	5760075.48	4.4	Sub-bottom Contact	Low	
BA_FS_SBP_0044	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	10751	570322.25	5760075.68	4.5	Sub-bottom Contact	Low	
BA_FS_SBP_0045	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	10603	570311.91	5760076.72	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0046	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	10285	570289.82	5760077.46	6.5	Sub-bottom Contact	Low	
BA_FS_SBP_0047	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	9225	570218.42	5760080.43	5.7	Sub-bottom Contact	Low	
BA_FS_SBP_0048	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	9210	570217.53	5760080.45	3.1	Sub-bottom Contact	Low	
BA_FS_SBP_0049	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	9486	570235.39	5760080.81	4.7	Sub-bottom Contact	Low	
BA_FS_SBP_0050	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	10285	570469.95	5760089.65	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0051	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	10407	570478.30	5760089.66	3.2	Sub-bottom Contact	Low	
BA_FS_SBP_0052	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	10163	570461.47	5760090.29	7	Sub-bottom Contact	Low	
BA_FS_SBP_0053	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9907	570443.76	5760091.84	6.2	Sub-bottom Contact	Low	
BA_FS_SBP_0054	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9784	570434.96	5760092.00	8.9	Sub-bottom Contact	Low	
BA_FS_SBP_0055	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9157	570390.64	5760092.90	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0056	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9130	570388.70	5760093.02	3.5	Sub-bottom Contact	Low	
BA_FS_SBP_0057	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9049	570382.75	5760093.25	3.5	Sub-bottom Contact	Low	
BA_FS_SBP_0058	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9070	570384.22	5760093.26	3.1	Sub-bottom Contact	Low	
BA_FS_SBP_0059	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	9072	570384.36	5760093.27	5.4	Sub-bottom Contact	Low	
BA_FS_SBP_0060	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8910	570372.55	5760093.52	6.2	Sub-bottom Contact	Low	
BA_FS_SBP_0061	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8860	570368.95	5760093.62	4.2	Sub-bottom Contact	Low	
BA_FS_SBP_0062	ARAMIS_SK_SBP_TA2A007P1_1_LAT_20220713	5389	569976.82	5760094.80	5.7	Sub-bottom Contact	Low	
BA_FS_SBP_0063	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8549	570346.40	5760095.43	3.3	Sub-bottom Contact	Low	
BA_FS_SBP_0064	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8354	570332.24	5760096.52	3.2	Sub-bottom Contact	Low	
BA_FS_SBP_0065	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8309	570328.98	5760096.71	4.6	Sub-bottom Contact	Low	
BA_FS_SBP_0066	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8229	570323.36	5760096.74	5	Sub-bottom Contact	Low	
BA_FS_SBP_0067	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8164	570318.70	5760096.81	3.5	Sub-bottom Contact	Low	
BA_FS_SBP_0068	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	8075	570312.34	5760097.01	5	Sub-bottom Contact	Low	BA_FS_MAG_0031
BA_FS_SBP_0069	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	7024	570240.05	5760102.38	5.6	Sub-bottom Contact	Low	
BA_FS_SBP_0070	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	4919	570095.19	5760108.05	5.6	Sub-bottom Contact	Low	
BA_FS_SBP_0071	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	9263	570479.73	5760108.93	5.1	Sub-bottom Contact	Low	
BA_FS_SBP_0072	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	9805	570525.26	5760109.08	3	Sub-bottom Contact	Low	
BA_FS_SBP_0073	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	9627	570510.22	5760109.12	5.6	Sub-bottom Contact	Low	
BA_FS_SBP_0074	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	9739	570519.67	5760109.13	3.6	Sub-bottom Contact	Low	
BA_FS_SBP_0075	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	9446	570495.31	5760109.20	3.7	Sub-bottom Contact	Low	
BA_FS_SBP_0076	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	4117	570043.15	5760110.65	3.5	Sub-bottom Contact	Low	
BA_FS_SBP_0077	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	3356	569994.64	5760111.01	4.3	Sub-bottom Contact	Low	
BA_FS_SBP_0078	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	8736	570434.49	5760111.02	3.9	Sub-bottom Contact	Low	
BA_FS_SBP_0079	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	8641	570426.29	5760111.18	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0080	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	8473	570411.48	5760111.41	5.8	Sub-bottom Contact	Low	
BA_FS_SBP_0081	ARAMIS_SK_SBP_TA2A008P1_1_LAT_20220713	3288	569990.09	5760111.48	3.2	Sub-bottom Contact	Low	
BA_FS_SBP_0082	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	8142	570382.02	5760113.15	3.4	Sub-bottom Contact	Low	
BA_FS_SBP_0083	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	7921	570362.37	5760114.23	4.5	Sub-bottom Contact	Low	
BA_FS_SBP_0084	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	7821	570353.45	5760114.81	5.8	Sub-bottom Contact	Low	
BA_FS_SBP_0085	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	7567	570331.34	5760116.11	3.7	Sub-bottom Contact	Low	

BA_FS_SBP_0086	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	6973	570280.51	5760119.01	6	Sub-bottom Contact	Low	
BA_FS_SBP_0087	ARAMIS_SK_SBP_TA2A009P1_1_LAT_20220713	6377	570229.63	5760122.34	5.3	Sub-bottom Contact	Low	
BA_FS_SBP_0088	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	9612	570570.48	5760127.59	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0089	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	9339	570543.68	5760128.26	10	Sub-bottom Contact	Low	
BA_FS_SBP_0090	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	9229	570532.97	5760128.81	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0091	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	9099	570520.65	5760129.24	10.5	Sub-bottom Contact	Low	
BA_FS_SBP_0092	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	8243	570436.95	5760131.07	9.7	Sub-bottom Contact	Low	
BA_FS_SBP_0093	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	8273	570439.82	5760131.11	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0094	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	8076	570420.70	5760131.35	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0095	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7961	570409.82	5760131.44	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0096	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7761	570390.32	5760132.23	7.1	Sub-bottom Contact	Low	
BA_FS_SBP_0097	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7725	570386.73	5760132.51	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0098	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7604	570374.43	5760134.13	8.2	Sub-bottom Contact	Low	
BA_FS_SBP_0099	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7562	570370.32	5760134.51	7.3	Sub-bottom Contact	Low	
BA_FS_SBP_0100	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7551	570369.21	5760134.62	8.4	Sub-bottom Contact	Low	
BA_FS_SBP_0101	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7433	570357.34	5760135.63	7.1	Sub-bottom Contact	Low	
BA_FS_SBP_0102	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7213	570335.60	5760136.43	7	Sub-bottom Contact	Low	
BA_FS_SBP_0103	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	7160	570330.26	5760136.58	7	Sub-bottom Contact	Low	
BA_FS_SBP_0104	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	6721	570286.48	5760137.61	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0105	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	6478	570262.36	5760138.53	7.7	Sub-bottom Contact	Low	
BA_FS_SBP_0106	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	6477	570262.27	5760138.53	8.3	Sub-bottom Contact	Low	
BA_FS_SBP_0107	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	6293	570244.17	5760139.76	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0108	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	5027	570113.44	5760145.01	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0109	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	4838	570093.64	5760146.21	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0110	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	9455	570561.87	5760146.24	11.6	Sub-bottom Contact	Low	
BA_FS_SBP_0111	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	9802	570599.29	5760146.26	6.5	Sub-bottom Contact	Low	
BA_FS_SBP_0112	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	9976	570614.35	5760146.71	10.7	Sub-bottom Contact	Low	
BA_FS_SBP_0113	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	9376	570552.86	5760146.73	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0114	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	9028	570513.59	5760148.06	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0115	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8953	570505.13	5760148.33	8.9	Sub-bottom Contact	Low	
BA_FS_SBP_0116	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8696	570476.29	5760149.03	8.5	Sub-bottom Contact	Low	
BA_FS_SBP_0117	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8699	570476.60	5760149.03	6.3	Sub-bottom Contact	Low	
BA_FS_SBP_0118	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	4378	570045.63	5760149.17	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0119	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8518	570456.98	5760149.55	7	Sub-bottom Contact	Low	
BA_FS_SBP_0120	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8451	570449.80	5760149.81	6.9	Sub-bottom Contact	Low	
BA_FS_SBP_0121	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	3979	570003.65	5760152.23	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0122	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	8046	570405.62	5760152.26	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0123	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	7803	570379.39	5760153.55	6.1	Sub-bottom Contact	Low	
BA_FS_SBP_0124	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	7612	570358.42	5760154.53	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0125	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	7409	570336.55	5760155.66	8.8	Sub-bottom Contact	Low	
BA_FS_SBP_0126	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	2760	569875.04	5760156.00	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0127	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	2758	569874.82	5760156.01	7.3	Sub-bottom Contact	Low	
BA_FS_SBP_0128	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	2459	569842.42	5760157.43	7.1	Sub-bottom Contact	Low	

BA_FS_SBP_0129	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	7054	570298.92	5760157.43	7.3	Sub-bottom Contact	Low	
BA_FS_SBP_0130	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9393	570617.25	5760158.20	6.4	Sub-bottom Contact	Low	
BA_FS_SBP_0131	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9416	570619.65	5760158.27	11.5	Sub-bottom Contact	Low	
BA_FS_SBP_0132	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9486	570627.07	5760158.61	6.3	Sub-bottom Contact	Low	
BA_FS_SBP_0133	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9494	570627.90	5760158.64	10.4	Sub-bottom Contact	Low	
BA_FS_SBP_0134	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9522	570630.64	5760158.72	10.5	Sub-bottom Contact	Low	
BA_FS_SBP_0135	ARAMIS_SK_SBP_TA2A010P1_1_LAT_20220713	2155	569809.81	5760158.85	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0136	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9155	570591.40	5760158.96	6.3	Sub-bottom Contact	Low	
BA_FS_SBP_0137	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9850	570665.54	5760159.67	7	Sub-bottom Contact	Low	
BA_FS_SBP_0138	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	9050	570579.52	5760160.08	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0139	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8996	570573.24	5760160.46	8.1	Sub-bottom Contact	Low	
BA_FS_SBP_0140	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8983	570571.81	5760160.53	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0141	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8948	570567.56	5760160.81	7	Sub-bottom Contact	Low	
BA_FS_SBP_0142	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8769	570546.76	5760161.82	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0143	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8731	570542.53	5760162.12	10	Sub-bottom Contact	Low	
BA_FS_SBP_0144	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8521	570518.07	5760164.68	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0145	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	5315	570112.52	5760166.21	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0146	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8345	570497.25	5760167.05	6.9	Sub-bottom Contact	Low	
BA_FS_SBP_0147	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	8262	570487.50	5760167.99	6.4	Sub-bottom Contact	Low	
BA_FS_SBP_0148	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7918	570446.51	5760170.34	6.9	Sub-bottom Contact	Low	
BA_FS_SBP_0149	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7884	570442.32	5760170.54	7	Sub-bottom Contact	Low	
BA_FS_SBP_0150	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7677	570417.76	5760170.77	7	Sub-bottom Contact	Low	
BA_FS_SBP_0151	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7779	570429.82	5760170.79	7	Sub-bottom Contact	Low	
BA_FS_SBP_0152	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7726	570423.67	5760170.85	11.7	Sub-bottom Contact	Low	
BA_FS_SBP_0153	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	7162	570360.55	5760172.73	8.1	Sub-bottom Contact	Low	
BA_FS_SBP_0154	ARAMIS_SK_SBP_TA2A011P1_1_LAT_20220713	3696	569939.65	5760174.15	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0155	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	25404	571132.82	5760177.95	8.1	Sub-bottom Contact	Low	
BA_FS_SBP_0156	ARAMIS_SK_SBP_TA2A014P1_2_LAT_20220713	74	571155.82	5760178.85	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0157	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	5396	570779.75	5760179.28	5.8	Sub-bottom Contact	Low	
BA_FS_SBP_0158	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	5405	570778.92	5760179.34	8.9	Sub-bottom Contact	Low	
BA_FS_SBP_0159	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	6358	570269.55	5760179.59	8.1	Sub-bottom Contact	Low	
BA_FS_SBP_0160	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	6127	570242.51	5760180.16	7.1	Sub-bottom Contact	Low	
BA_FS_SBP_0161	ARAMIS_SK_SBP_TA2A014P1_2_LAT_20220713	447	571175.04	5760180.17	6.4	Sub-bottom Contact	Low	
BA_FS_SBP_0162	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	5541	570766.60	5760180.34	9.9	Sub-bottom Contact	Low	
BA_FS_SBP_0163	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	6032	570722.89	5760182.68	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0164	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	24221	571069.67	5760183.65	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0165	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	23673	571038.21	5760186.13	5.9	Sub-bottom Contact	Low	
BA_FS_SBP_0166	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	6761	570655.41	5760187.23	7.7	Sub-bottom Contact	Low	
BA_FS_SBP_0167	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	6837	570648.57	5760187.43	8.7	Sub-bottom Contact	Low	
BA_FS_SBP_0168	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	7231	570612.92	5760187.64	5.6	Sub-bottom Contact	Low	
BA_FS_SBP_0169	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	7036	570630.48	5760187.65	8.8	Sub-bottom Contact	Low	
BA_FS_SBP_0170	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	23268	571015.29	5760188.08	6.5	Sub-bottom Contact	Low	
BA_FS_SBP_0171	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	7850	570559.26	5760189.62	5.8	Sub-bottom Contact	Low	

BA_FS_SBP_0172	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	22414	570967.13	5760189.79	6	Sub-bottom Contact	Low	
BA_FS_SBP_0173	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	22365	570964.25	5760189.92	6.3	Sub-bottom Contact	Low	
BA_FS_SBP_0174	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	21538	570918.30	5760191.03	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0175	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	21154	570896.81	5760191.40	7.8	Sub-bottom Contact	Low	
BA_FS_SBP_0176	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	20279	570843.11	5760191.83	7.8	Sub-bottom Contact	Low	BA_FS_MAG_0052
BA_FS_SBP_0177	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	8245	570525.12	5760191.92	5.2	Sub-bottom Contact	Low	
BA_FS_SBP_0178	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	20055	570829.82	5760192.79	8.1	Sub-bottom Contact	Low	
BA_FS_SBP_0179	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	19541	570797.32	5760193.15	7.8	Sub-bottom Contact	Low	
BA_FS_SBP_0180	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	19043	570765.26	5760194.32	9.6	Sub-bottom Contact	Low	
BA_FS_SBP_0181	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	18398	570722.87	5760194.73	8.3	Sub-bottom Contact	Low	
BA_FS_SBP_0182	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	18624	570737.45	5760194.79	8.6	Sub-bottom Contact	Low	
BA_FS_SBP_0183	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	9289	570443.12	5760195.25	14.3	Sub-bottom Contact	Low	
BA_FS_SBP_0184	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	3197	569907.88	5760196.19	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0185	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	3035	569889.92	5760196.50	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0186	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	2542	569834.18	5760197.93	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0187	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	18076	570701.68	5760198.06	9	Sub-bottom Contact	Low	
BA_FS_SBP_0188	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	17858	570686.60	5760198.78	9	Sub-bottom Contact	Low	
BA_FS_SBP_0189	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	17832	570684.81	5760198.88	8.5	Sub-bottom Contact	Low	
BA_FS_SBP_0190	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	17742	570678.72	5760199.05	5.5	Sub-bottom Contact	Low	
BA_FS_SBP_0191	ARAMIS_SK_SBP_TA2A012P1_1_LAT_20220713	2194	569795.05	5760199.25	7.1	Sub-bottom Contact	Low	
BA_FS_SBP_0192	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	17480	570660.66	5760200.95	8.2	Sub-bottom Contact	Low	
BA_FS_SBP_0193	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	1745	571163.90	5760201.80	9.1	Sub-bottom Contact	Low	
BA_FS_SBP_0194	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	10883	570311.80	5760202.51	6.1	Sub-bottom Contact	Low	
BA_FS_SBP_0195	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	11004	570302.07	5760202.77	7	Sub-bottom Contact	Low	
BA_FS_SBP_0196	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	17107	570633.11	5760203.76	8.4	Sub-bottom Contact	Low	
BA_FS_SBP_0197	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	2102	571127.85	5760204.20	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0198	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	11465	570263.82	5760204.24	6.5	Sub-bottom Contact	Low	
BA_FS_SBP_0199	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	16100	570562.24	5760204.55	5.3	Sub-bottom Contact	Low	
BA_FS_SBP_0200	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	11595	570253.57	5760204.70	6.1	Sub-bottom Contact	Low	
BA_FS_SBP_0201	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	15944	570551.21	5760205.83	5.7	Sub-bottom Contact	Low	
BA_FS_SBP_0202	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	15460	570517.80	5760207.37	5.4	Sub-bottom Contact	Low	
BA_FS_SBP_0203	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	13824	570406.37	5760212.81	6.2	Sub-bottom Contact	Low	
BA_FS_SBP_0204	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	4552	570862.51	5760214.99	9	Sub-bottom Contact	Low	
BA_FS_SBP_0205	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	13184	570359.12	5760215.13	5.5	Sub-bottom Contact	Low	
BA_FS_SBP_0206	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	13153	570356.82	5760215.20	5.8	Sub-bottom Contact	Low	
BA_FS_SBP_0207	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	12521	570311.04	5760217.00	7.6	Sub-bottom Contact	Low	
BA_FS_SBP_0208	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	4981	570816.77	5760217.65	8	Sub-bottom Contact	Low	
BA_FS_SBP_0209	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	12025	570275.07	5760218.39	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0210	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	11651	570248.34	5760219.62	6.3	Sub-bottom Contact	Low	
BA_FS_SBP_0211	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	11550	570241.05	5760220.13	6.7	Sub-bottom Contact	Low	
BA_FS_SBP_0212	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	5360	570776.89	5760220.81	8.3	Sub-bottom Contact	Low	
BA_FS_SBP_0213	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	5361	570776.79	5760220.82	7.8	Sub-bottom Contact	Low	
BA_FS_SBP_0214	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	5651	570749.62	5760222.18	7.7	Sub-bottom Contact	Low	

BA_FS_SBP_0215	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	22412	571035.24	5760223.00	9.3	Sub-bottom Contact	Low	
BA_FS_SBP_0216	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	6280	570690.42	5760224.51	6.8	Sub-bottom Contact	Low	
BA_FS_SBP_0217	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	6336	570685.12	5760224.73	7.4	Sub-bottom Contact	Low	
BA_FS_SBP_0218	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	16230	569867.04	5760225.19	5.2	Sub-bottom Contact	Low	
BA_FS_SBP_0219	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	16367	569856.32	5760225.68	5.9	Sub-bottom Contact	Low	
BA_FS_SBP_0220	ARAMIS_SK_SBP_TA2A013P1_1_LAT_20220713	16549	569842.87	5760226.54	6	Sub-bottom Contact	Low	
BA_FS_SBP_0221	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	21414	570968.53	5760226.75	9.7	Sub-bottom Contact	Low	
BA_FS_SBP_0222	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	21100	570948.21	5760228.82	12.6	Sub-bottom Contact	Low	
BA_FS_SBP_0223	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	20106	570882.32	5760228.97	9.6	Sub-bottom Contact	Low	
BA_FS_SBP_0224	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	7616	570566.43	5760229.41	10.7	Sub-bottom Contact	Low	
BA_FS_SBP_0225	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	20913	570935.69	5760229.66	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0226	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	20698	570921.54	5760229.90	10.2	Sub-bottom Contact	Low	
BA_FS_SBP_0227	ARAMIS_SK_SBP_TA2A014P1_1_LAT_20220713	8573	570024.81	5760230.63	6.6	Sub-bottom Contact	Low	
BA_FS_SBP_0228	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	19841	570865.01	5760231.51	9.3	Sub-bottom Contact	Low	
BA_FS_SBP_0229	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	19754	570858.99	5760232.49	9.3	Sub-bottom Contact	Low	
BA_FS_SBP_0230	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	19753	570858.92	5760232.50	11.3	Sub-bottom Contact	Low	
BA_FS_SBP_0231	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	19382	570832.73	5760233.63	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0232	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	18934	570800.91	5760234.37	9.4	Sub-bottom Contact	Low	
BA_FS_SBP_0233	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	18898	570798.48	5760234.48	9	Sub-bottom Contact	Low	
BA_FS_SBP_0234	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9323	570403.20	5760236.25	5.9	Sub-bottom Contact	Low	
BA_FS_SBP_0235	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9370	570398.89	5760236.87	7	Sub-bottom Contact	Low	
BA_FS_SBP_0236	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	17525	570707.51	5760237.13	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0237	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9529	570383.93	5760238.74	7.5	Sub-bottom Contact	Low	
BA_FS_SBP_0238	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	17037	570674.53	5760239.86	10.4	Sub-bottom Contact	Low	
BA_FS_SBP_0239	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9700	570367.45	5760240.88	5.9	Sub-bottom Contact	Low	
BA_FS_SBP_0240	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	16591	570642.52	5760241.70	9.4	Sub-bottom Contact	Low	
BA_FS_SBP_0241	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9784	570359.09	5760241.77	7.7	Sub-bottom Contact	Low	
BA_FS_SBP_0242	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9901	570347.72	5760242.62	7.8	Sub-bottom Contact	Low	
BA_FS_SBP_0243	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	9954	570342.78	5760242.96	9.2	Sub-bottom Contact	Low	
BA_FS_SBP_0244	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	16066	570603.54	5760243.46	11.1	Sub-bottom Contact	Low	
BA_FS_SBP_0245	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	15965	570596.22	5760243.50	7.7	Sub-bottom Contact	Low	
BA_FS_SBP_0246	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	10089	570330.15	5760244.00	7	Sub-bottom Contact	Low	
BA_FS_SBP_0247	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	10109	570328.23	5760244.14	5.4	Sub-bottom Contact	Low	
BA_FS_SBP_0248	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	10189	570320.70	5760244.70	8	Sub-bottom Contact	Low	
BA_FS_SBP_0249	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	10291	570311.43	5760245.33	7.2	Sub-bottom Contact	Low	
BA_FS_SBP_0250	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	10321	570308.90	5760245.42	7.3	Sub-bottom Contact	Low	
BA_FS_SBP_0251	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	2884	570986.47	5760249.02	10.3	Sub-bottom Contact	Low	
BA_FS_SBP_0252	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	3085	570961.24	5760250.74	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0253	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	13381	570410.20	5760252.80	9.6	Sub-bottom Contact	Low	
BA_FS_SBP_0254	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	13374	570409.68	5760252.84	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0255	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	13048	570386.30	5760253.92	9.2	Sub-bottom Contact	Low	
BA_FS_SBP_0256	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	3624	570894.01	5760255.38	9	Sub-bottom Contact	Low	
BA_FS_SBP_0257	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	12024	570312.77	5760256.05	10.1	Sub-bottom Contact	Low	

BA_FS_SBP_0258	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	3887	570860.87	5760256.13	8.8	Sub-bottom Contact	Low	
BA_FS_SBP_0259	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	11968	570308.57	5760256.23	8.2	Sub-bottom Contact	Low	
BA_FS_SBP_0260	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	11943	570306.71	5760256.24	11	Sub-bottom Contact	Low	
BA_FS_SBP_0261	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	12460	570344.37	5760256.31	10.7	Sub-bottom Contact	Low	
BA_FS_SBP_0262	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	12149	570321.78	5760256.32	11.3	Sub-bottom Contact	Low	
BA_FS_SBP_0263	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	12189	570324.81	5760256.44	10.3	Sub-bottom Contact	Low	
BA_FS_SBP_0264	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	4061	570838.76	5760257.43	8.9	Sub-bottom Contact	Low	
BA_FS_SBP_0265	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	4286	570810.97	5760259.02	12	Sub-bottom Contact	Low	
BA_FS_SBP_0266	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	11476	570272.90	5760259.69	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0267	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	4529	570781.62	5760260.52	9.7	Sub-bottom Contact	Low	
BA_FS_SBP_0268	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	4589	570774.13	5760260.95	10.3	Sub-bottom Contact	Low	
BA_FS_SBP_0269	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	4810	570747.00	5760262.02	11.4	Sub-bottom Contact	Low	
BA_FS_SBP_0270	ARAMIS_SK_SBP_TA2A015P1_1_LAT_20220713	16701	569739.25	5760268.77	12.2	Sub-bottom Contact	Low	
BA_FS_SBP_0271	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	15892	570861.41	5760270.08	12.9	Sub-bottom Contact	Low	
BA_FS_SBP_0272	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	15305	570805.20	5760272.65	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0273	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	14804	570756.52	5760274.51	11.2	Sub-bottom Contact	Low	
BA_FS_SBP_0274	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	7033	570485.73	5760274.52	8.6	Sub-bottom Contact	Low	
BA_FS_SBP_0275	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	14732	570749.26	5760275.24	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0276	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	14631	570739.27	5760276.25	11	Sub-bottom Contact	Low	
BA_FS_SBP_0277	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	7797	570397.06	5760277.98	8.5	Sub-bottom Contact	Low	
BA_FS_SBP_0278	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	7917	570384.32	5760278.89	7.9	Sub-bottom Contact	Low	
BA_FS_SBP_0279	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	7962	570379.31	5760279.21	9.9	Sub-bottom Contact	Low	
BA_FS_SBP_0280	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	8208	570351.79	5760280.67	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0281	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	8325	570338.42	5760281.36	10.1	Sub-bottom Contact	Low	
BA_FS_SBP_0282	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	8403	570329.51	5760281.94	11	Sub-bottom Contact	Low	
BA_FS_SBP_0283	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	8426	570326.85	5760282.12	12.8	Sub-bottom Contact	Low	
BA_FS_SBP_0284	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	8438	570325.46	5760282.22	11.2	Sub-bottom Contact	Low	
BA_FS_SBP_0285	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	13246	570601.98	5760282.57	10.6	Sub-bottom Contact	Low	
BA_FS_SBP_0286	ARAMIS_SK_SBP_TA2A016P1_1_LAT_20220713	4070	569716.80	5760284.61	9.9	Sub-bottom Contact	Low	
BA_FS_SBP_0287	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	12086	570490.64	5760290.25	8.7	Sub-bottom Contact	Low	
BA_FS_SBP_0288	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	11585	570445.76	5760290.31	8.8	Sub-bottom Contact	Low	
BA_FS_SBP_0289	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	11075	570399.84	5760293.36	8	Sub-bottom Contact	Low	
BA_FS_SBP_0290	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	11038	570396.32	5760293.88	9.4	Sub-bottom Contact	Low	
BA_FS_SBP_0291	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	11022	570394.92	5760294.05	9.6	Sub-bottom Contact	Low	
BA_FS_SBP_0292	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	10924	570385.74	5760294.90	10	Sub-bottom Contact	Low	
BA_FS_SBP_0293	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	9801	570276.71	5760296.60	9.5	Sub-bottom Contact	Low	
BA_FS_SBP_0294	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	10546	570349.51	5760297.11	11	Sub-bottom Contact	Low	
BA_FS_SBP_0295	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	10502	570345.48	5760297.29	9.8	Sub-bottom Contact	Low	
BA_FS_SBP_0296	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	10487	570344.06	5760297.35	9.4	Sub-bottom Contact	Low	
BA_FS_SBP_0297	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	10486	570343.96	5760297.36	9.4	Sub-bottom Contact	Low	
BA_FS_SBP_0298	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	9268	570223.46	5760300.02	8.8	Sub-bottom Contact	Low	
BA_FS_SBP_0299	ARAMIS_SK_SBP_TA2A018P1_1_LAT_20220713	8767	570175.59	5760304.87	8.4	Sub-bottom Contact	Low	
BA_FS_SBP_0300	ARAMIS_SK_SBP_TA2A017P1_1_LAT_20220713	14106	569715.05	5760311.45	9.7	Sub-bottom Contact	Low	

Unique_ID	Line_Name	Trace_No	Easting	Northing	Depth_BSB	Interp	Conf	MAG_Corr
BB_FS_SBP_0001	ARAMIS_SK_SBP_TA2B085P1_2_LAT_20220714	2392	570282.36	5760041.03	7.9	Sub-bottom Contact	Low	
BB_FS_SBP_0002	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	1320	570220.09	5760041.91	6.3	Sub-bottom Contact	Low	
BB_FS_SBP_0003	ARAMIS_SK_SBP_TA2B085P1_2_LAT_20220714	1985	570272.72	5760077.76	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0004	ARAMIS_SK_SBP_TA2B083P1_2_LAT_20220714	1569	570165.14	5760078.54	8	Sub-bottom Contact	Low	
BB_FS_SBP_0005	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	859	570887.07	5760193.89	7.9	Sub-bottom Contact	Low	
BB_FS_SBP_0006	ARAMIS_SK_SBP_TA2B019P1_1_LAT_20220717	214	570091.78	5760197.61	7.3	Sub-bottom Contact	Low	
BB_FS_SBP_0007	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	430	571158.50	5760214.79	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_0008	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	14403	570360.15	5760218.10	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0009	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	14387	570359.23	5760218.51	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0010	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	14354	570357.23	5760219.09	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0011	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	718	570975.12	5760225.78	2.8	Sub-bottom Contact	Low	
BB_FS_SBP_0012	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	13741	570797.16	5760225.90	8	Sub-bottom Contact	Low	
BB_FS_SBP_0013	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	13641	570786.82	5760226.21	7.6	Sub-bottom Contact	Low	
BB_FS_SBP_0014	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	13570	570779.24	5760226.83	7.8	Sub-bottom Contact	Low	
BB_FS_SBP_0015	ARAMIS_SK_SBP_TA2B019P1_1_LAT_20220717	827	570024.95	5760227.83	7.4	Sub-bottom Contact	Low	
BB_FS_SBP_0016	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	13937	570332.54	5760228.53	11	Sub-bottom Contact	Low	
BB_FS_SBP_0017	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	13867	570328.57	5760229.77	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0018	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	13864	570328.39	5760229.83	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0019	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	752	570907.98	5760235.73	9.5	Sub-bottom Contact	Low	
BB_FS_SBP_0020	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	754	570907.74	5760235.75	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0021	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	858	570895.07	5760236.68	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0022	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	925	570886.79	5760237.39	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0023	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	13474	570304.97	5760238.53	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0024	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	1154	570859.20	5760240.44	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0025	ARAMIS_SK_SBP_TA2B019P1_1_LAT_20220717	1083	569996.66	5760240.53	6.5	Sub-bottom Contact	Low	
BB_FS_SBP_0026	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	1177	571071.93	5760241.42	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_0027	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	1219	570851.95	5760241.72	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0028	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	13298	570294.67	5760242.95	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0029	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	1265	570846.78	5760243.27	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0030	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	14874	570947.32	5760244.52	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0031	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	1312	571056.49	5760246.89	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_0032	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	20031	571144.90	5760252.55	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0033	ARAMIS_SK_SBP_TA2B022P1_1_LAT_20220717	12865	570270.48	5760254.04	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0034	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	650	570385.00	5760254.28	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0035	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	12811	570481.30	5760256.68	5.2	Sub-bottom Contact	Low	
BB_FS_SBP_0036	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	1796	570876.01	5760258.06	6.4	Sub-bottom Contact	Low	
BB_FS_SBP_0037	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	19891	571133.17	5760258.09	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0038	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	12710	570693.68	5760258.41	7.6	Sub-bottom Contact	Low	
BB_FS_SBP_0039	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	761	570371.78	5760260.23	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0040	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	1655	570805.26	5760260.50	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0041	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	1710	570799.56	5760263.29	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0042	ARAMIS_SK_SBP_TA2B019P1_2_LAT_20220717	40	569936.19	5760263.35	15.3	Sub-bottom Contact	Low	

BB_FS_SBP_0043	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	19703	571117.04	5760264.57	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0044	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	920	570352.13	5760269.18	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_0045	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	949	570348.39	5760270.64	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0046	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	765	570129.57	5760274.40	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_0047	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	767	570129.46	5760274.45	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0048	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	12227	570433.73	5760274.99	5.3	Sub-bottom Contact	Low	
BB_FS_SBP_0049	ARAMIS_SK_SBP_TA2B020P1_1_LAT_20220717	5757	569995.11	5760276.65	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0050	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1093	570330.37	5760278.05	11.2	Sub-bottom Contact	Low	
BB_FS_SBP_0051	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1124	570326.54	5760279.77	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_0052	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1192	570317.81	5760283.27	13	Sub-bottom Contact	Low	
BB_FS_SBP_0053	ARAMIS_SK_SBP_TA2B087P1_2_LAT_20220714	2045	570924.53	5760283.96	7.9	Sub-bottom Contact	Low	
BB_FS_SBP_0054	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	2190	570747.69	5760287.05	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_0055	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	1641	571164.03	5760289.28	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0056	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	2247	570741.31	5760289.81	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0057	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	25382	570224.53	5760290.12	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0058	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	2312	570876.51	5760294.03	6.2	Sub-bottom Contact	Low	
BB_FS_SBP_0059	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	2315	570876.49	5760294.26	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0060	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	11628	570385.73	5760295.25	6.6	Sub-bottom Contact	Low	
BB_FS_SBP_0061	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	11609	570384.38	5760295.83	7.5	Sub-bottom Contact	Low	
BB_FS_SBP_0062	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1445	570285.85	5760296.99	10	Sub-bottom Contact	Low	
BB_FS_SBP_0063	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	1805	571144.37	5760297.71	6.4	Sub-bottom Contact	Low	
BB_FS_SBP_0064	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	18523	571013.86	5760305.58	12	Sub-bottom Contact	Low	
BB_FS_SBP_0065	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	1981	571123.21	5760305.87	6.4	Sub-bottom Contact	Low	
BB_FS_SBP_0066	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	2606	570701.27	5760305.97	17.5	Sub-bottom Contact	Low	
BB_FS_SBP_0067	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	2656	570905.81	5760306.65	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0068	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1624	570263.38	5760306.80	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_0069	ARAMIS_SK_SBP_TA2B087P1_2_LAT_20220714	1762	570925.67	5760306.95	6.9	Sub-bottom Contact	Low	
BB_FS_SBP_0070	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	11218	570354.02	5760307.96	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_0071	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	1680	570980.26	5760308.35	3	Sub-bottom Contact	Low	
BB_FS_SBP_0072	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	2658	570695.50	5760308.71	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0073	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	1685	570980.27	5760308.81	2.1	Sub-bottom Contact	Low	
BB_FS_SBP_0074	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	1713	570252.11	5760311.62	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0075	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	2235	571092.24	5760317.55	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0076	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	2609	570872.63	5760317.57	6.7	Sub-bottom Contact	Low	
BB_FS_SBP_0077	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	18144	570981.74	5760319.23	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_0078	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	10761	570317.76	5760320.57	8	Sub-bottom Contact	Low	
BB_FS_SBP_0079	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	2960	570662.00	5760322.73	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0080	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	10680	570311.25	5760323.28	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0081	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	2598	570431.96	5760323.56	9	Sub-bottom Contact	Low	
BB_FS_SBP_0082	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	17991	570968.57	5760323.96	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0083	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	10638	570308.18	5760324.45	7.5	Sub-bottom Contact	Low	
BB_FS_SBP_0084	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	10610	570305.87	5760325.21	7.3	Sub-bottom Contact	Low	
BB_FS_SBP_0085	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	3127	570643.30	5760329.75	17.8	Sub-bottom Contact	Low	

BB_FS_SBP_0086	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	10777	570508.97	5760329.86	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0087	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	3141	570641.71	5760330.46	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0088	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	3289	570831.94	5760334.15	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0089	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	2036	569978.06	5760334.57	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0090	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	3272	570626.90	5760336.37	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0091	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	3348	570825.35	5760337.21	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0092	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	2631	571039.64	5760338.62	13	Sub-bottom Contact	Low	
BB_FS_SBP_0093	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	3394	570820.13	5760339.40	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0094	ARAMIS_SK_SBP_TA2B019P1_2_LAT_20220717	1683	569746.82	5760339.81	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0095	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	2877	570401.02	5760339.81	5.8	Sub-bottom Contact	Low	
BB_FS_SBP_0096	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	10470	570480.25	5760341.44	6.9	Sub-bottom Contact	Low	
BB_FS_SBP_0097	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	2872	570870.12	5760341.78	5.3	Sub-bottom Contact	Low	
BB_FS_SBP_0098	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	2975	570389.74	5760345.15	5.5	Sub-bottom Contact	Low	
BB_FS_SBP_0099	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	2980	570389.16	5760345.41	5	Sub-bottom Contact	Low	
BB_FS_SBP_0100	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	12277	570694.02	5760346.04	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_0101	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	18527	571119.52	5760347.31	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0102	ARAMIS_SK_SBP_TA2B087P1_2_LAT_20220714	1211	570928.77	5760349.03	6.9	Sub-bottom Contact	Low	
BB_FS_SBP_0103	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	3064	570379.45	5760349.40	6.8	Sub-bottom Contact	Low	
BB_FS_SBP_0104	ARAMIS_SK_SBP_TA2B019P1_2_LAT_20220717	1879	569723.49	5760350.30	7.8	Sub-bottom Contact	Low	
BB_FS_SBP_0105	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	10203	570455.30	5760351.30	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0106	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	2464	570153.41	5760353.15	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0107	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	3158	570368.38	5760353.83	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0108	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	12007	570668.72	5760355.46	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_0109	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	2508	570147.84	5760355.67	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0110	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	3219	570361.41	5760356.79	7.3	Sub-bottom Contact	Low	
BB_FS_SBP_0111	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	3243	570358.55	5760357.88	7	Sub-bottom Contact	Low	
BB_FS_SBP_0112	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	3298	570352.11	5760360.74	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0113	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	3912	570554.96	5760365.32	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0114	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	3130	570973.49	5760365.78	8	Sub-bottom Contact	Low	
BB_FS_SBP_0115	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	16567	570847.77	5760368.09	8.5	Sub-bottom Contact	Low	
BB_FS_SBP_0116	ARAMIS_SK_SBP_TA2B020P1_1_LAT_20220717	2817	569761.63	5760370.72	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0117	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	9671	570406.22	5760371.73	6.5	Sub-bottom Contact	Low	
BB_FS_SBP_0118	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	2806	569885.16	5760372.61	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0119	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	4108	570741.32	5760373.55	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0120	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	2837	569881.41	5760374.52	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0121	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	1197	571155.99	5760376.16	27.5	Sub-bottom Contact	Low	
BB_FS_SBP_0122	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	4205	570730.75	5760378.04	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_0123	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	16257	570821.69	5760378.28	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0124	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	16220	570818.35	5760379.49	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0125	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	3033	569857.12	5760383.99	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0126	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	9308	570372.67	5760385.25	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0127	ARAMIS_SK_SBP_TA2B020P1_1_LAT_20220717	2325	569723.75	5760385.64	10.2	Sub-bottom Contact	Low	
BB_FS_SBP_0128	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	4466	570491.63	5760389.49	8.3	Sub-bottom Contact	Low	

BB_FS_SBP_0129	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	3188	569838.11	5760391.25	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0130	ARAMIS_SK_SBP_TA2B087P1_2_LAT_20220714	576	570927.20	5760394.91	7.4	Sub-bottom Contact	Low	
BB_FS_SBP_0131	ARAMIS_SK_SBP_TA2B087P1_2_LAT_20220714	501	570927.54	5760400.74	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0132	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	10857	570564.21	5760406.92	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_0133	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	5022	570427.66	5760413.60	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0134	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	4069	570845.67	5760418.58	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0135	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	5142	570627.36	5760421.49	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0136	ARAMIS_SK_SBP_TA2B026P1_1_LAT_20220717	8309	570281.61	5760421.99	7.1	Sub-bottom Contact	Low	
BB_FS_SBP_0137	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	5197	570621.35	5760424.09	11.2	Sub-bottom Contact	Low	
BB_FS_SBP_0138	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	16299	570929.76	5760424.10	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0139	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	3963	569742.49	5760428.85	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0140	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	5431	570381.47	5760432.52	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0141	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	16047	570907.80	5760433.79	21.4	Sub-bottom Contact	Low	
BB_FS_SBP_0142	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	4153	569719.11	5760438.14	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0143	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	4157	569718.48	5760438.41	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0144	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	4117	569931.56	5760440.32	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_0145	ARAMIS_SK_SBP_TA2B021P1_1_LAT_20220717	4196	569713.44	5760440.41	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0146	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	4152	569926.79	5760442.34	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0147	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	5681	570353.39	5760444.06	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0148	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	14209	570652.11	5760448.09	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_0149	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	25571	570924.75	5760451.85	11	Sub-bottom Contact	Low	
BB_FS_SBP_0150	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	6000	570317.97	5760458.00	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0151	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	9236	570412.10	5760458.23	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0152	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	6025	570529.05	5760459.68	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0153	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	9095	570398.97	5760463.62	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0154	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	5038	570710.71	5760469.13	7.9	Sub-bottom Contact	Low	
BB_FS_SBP_0155	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	6529	570473.55	5760481.43	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0156	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	14400	570766.53	5760489.95	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_0157	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	6757	570448.80	5760491.38	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_0158	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	4373	570879.20	5760493.44	5.2	Sub-bottom Contact	Low	
BB_FS_SBP_0159	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	1554	571096.92	5760495.31	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0160	ARAMIS_SK_SBP_TA2B023P1_1_LAT_20220717	5269	569775.78	5760500.25	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_0161	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	12462	570511.82	5760501.02	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0162	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	3144	570859.49	5760501.53	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0163	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	16104	571157.96	5760504.82	34.2	Sub-bottom Contact	Low	
BB_FS_SBP_0164	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	7914	570287.40	5760505.20	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0165	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	7152	570140.02	5760509.09	6.7	Sub-bottom Contact	Low	
BB_FS_SBP_0166	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	12173	570488.07	5760509.42	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0167	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	12170	570487.90	5760509.48	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_0168	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	11733	570453.21	5760523.33	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0169	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	11730	570453.01	5760523.41	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_0170	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	6819	569927.91	5760526.51	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0171	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	7256	570226.69	5760529.17	8.7	Sub-bottom Contact	Low	

BB_FS_SBP_0172	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	11356	570424.77	5760533.67	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_0173	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	7094	570212.29	5760535.84	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0174	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	3453	569770.91	5760539.30	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0175	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	12826	570639.85	5760539.46	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0176	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	2291	570979.80	5760542.35	6.9	Sub-bottom Contact	Low	
BB_FS_SBP_0177	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	8215	570287.66	5760553.97	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0178	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10755	570379.72	5760554.69	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0179	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10666	570373.17	5760557.33	9	Sub-bottom Contact	Low	
BB_FS_SBP_0180	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10664	570373.01	5760557.40	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0181	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	2798	569723.82	5760557.96	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0182	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	2769	569721.86	5760558.80	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_0183	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	2765	569721.60	5760558.93	10.2	Sub-bottom Contact	Low	
BB_FS_SBP_0184	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	2647	569713.32	5760562.70	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0185	ARAMIS_SK_SBP_TA2B024P1_1_LAT_20220717	2599	569709.89	5760564.17	6	Sub-bottom Contact	Low	
BB_FS_SBP_0186	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10438	570355.53	5760565.23	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_0187	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10275	570342.76	5760569.86	8.5	Sub-bottom Contact	Low	
BB_FS_SBP_0188	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	8576	570248.91	5760570.50	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0189	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10226	570338.82	5760571.34	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0190	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10168	570333.98	5760573.16	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0191	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	8658	570240.03	5760574.33	10	Sub-bottom Contact	Low	
BB_FS_SBP_0192	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	10071	570326.37	5760576.05	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_0193	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	6915	570446.03	5760577.42	7.4	Sub-bottom Contact	Low	
BB_FS_SBP_0194	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	8740	570230.91	5760577.96	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0195	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9956	570317.25	5760579.40	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_0196	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9952	570316.91	5760579.51	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0197	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	7985	569783.82	5760581.66	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0198	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9843	570308.02	5760582.49	8.6	Sub-bottom Contact	Low	
BB_FS_SBP_0199	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	8714	570001.16	5760582.76	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0200	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	8058	569774.77	5760585.18	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0201	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9721	570298.22	5760585.97	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0202	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	8103	569769.43	5760587.50	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0203	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	11329	570514.41	5760588.97	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0204	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9535	570283.32	5760592.04	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_0205	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9530	570282.92	5760592.21	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0206	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	21914	570177.71	5760592.91	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0207	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	7200	570404.49	5760592.94	5.9	Sub-bottom Contact	Low	
BB_FS_SBP_0208	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	8219	569754.95	5760593.12	7.5	Sub-bottom Contact	Low	
BB_FS_SBP_0209	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	9460	570277.28	5760594.23	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0210	ARAMIS_SK_SBP_TA2B037P1_1_LAT_20220718	2268	571063.74	5760594.84	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_0211	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	8120	570123.25	5760596.06	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0212	ARAMIS_SK_SBP_TA2B025P1_1_LAT_20220717	8401	569732.46	5760601.90	12	Sub-bottom Contact	Low	
BB_FS_SBP_0213	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	10815	570470.42	5760607.37	12	Sub-bottom Contact	Low	
BB_FS_SBP_0214	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	9436	570153.03	5760609.14	12.5	Sub-bottom Contact	Low	

BB_FS_SBP_0215	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	9474	570148.89	5760610.92	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_0216	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	8305	570120.29	5760611.81	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0217	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	10611	570452.66	5760613.68	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0218	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	8803	570225.14	5760614.38	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0219	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	9411	569918.77	5760616.24	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0220	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	9596	570134.91	5760616.43	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0221	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	8682	570215.34	5760618.64	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0222	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	8680	570215.18	5760618.70	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0223	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	9746	570117.82	5760623.20	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0224	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	8507	570115.53	5760628.08	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0225	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	8344	570189.04	5760629.53	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_0226	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	9887	570101.99	5760629.83	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_0227	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	8544	570114.62	5760630.72	9	Sub-bottom Contact	Low	
BB_FS_SBP_0228	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	5372	570530.20	5760632.81	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0229	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	21849	570065.94	5760634.31	13	Sub-bottom Contact	Low	
BB_FS_SBP_0230	ARAMIS_SK_SBP_TA2B037P1_1_LAT_20220718	2954	570960.31	5760635.39	20.9	Sub-bottom Contact	Low	
BB_FS_SBP_0231	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	5540	570505.68	5760642.41	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0232	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	5554	570503.68	5760643.15	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0233	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	10020	569847.18	5760645.29	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_0234	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	7848	570149.69	5760645.45	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_0235	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	5601	570496.70	5760645.62	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_0236	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	3892	570720.56	5760647.35	7.8	Sub-bottom Contact	Low	
BB_FS_SBP_0237	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	10278	570057.96	5760647.84	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0238	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	10368	570047.84	5760652.04	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_0239	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	5741	570475.98	5760653.02	12	Sub-bottom Contact	Low	
BB_FS_SBP_0240	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	7565	570127.35	5760654.71	10.2	Sub-bottom Contact	Low	
BB_FS_SBP_0241	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	3795	569907.20	5760655.98	9.5	Sub-bottom Contact	Low	
BB_FS_SBP_0242	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	3513	569881.54	5760665.79	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_0243	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	9029	570110.10	5760667.63	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0244	ARAMIS_SK_SBP_TA2B039P1_1_LAT_20220718	1914	571078.24	5760674.41	32.4	Sub-bottom Contact	Low	
BB_FS_SBP_0245	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	8709	570192.27	5760678.20	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0246	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	11003	569975.92	5760680.03	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_0247	ARAMIS_SK_SBP_TA2B037P1_1_LAT_20220718	3727	570841.45	5760681.44	31	Sub-bottom Contact	Low	
BB_FS_SBP_0248	ARAMIS_SK_SBP_TA2B027P1_1_LAT_20220717	10827	569750.63	5760682.17	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0249	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	5790	570876.40	5760685.63	4.9	Sub-bottom Contact	Low	
BB_FS_SBP_0250	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	8845	570174.25	5760686.15	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_0251	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	9020	570151.01	5760695.87	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0252	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	6541	570355.65	5760702.83	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0253	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	20592	570154.39	5760703.89	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_0254	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	9190	570128.07	5760705.21	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0255	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	11634	569904.20	5760707.58	12	Sub-bottom Contact	Low	
BB_FS_SBP_0256	ARAMIS_SK_SBP_TA2B039P1_1_LAT_20220718	2480	570980.71	5760707.72	32.7	Sub-bottom Contact	Low	
BB_FS_SBP_0257	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	9600	570102.72	5760713.84	9.5	Sub-bottom Contact	Low	

BB_FS_SBP_0258	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	5080	570523.00	5760715.81	7.8	Sub-bottom Contact	Low	
BB_FS_SBP_0259	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	5501	569963.09	5760719.61	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0260	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	5350	569951.43	5760725.18	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0261	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	12069	569854.14	5760726.80	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0262	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	9629	570067.90	5760729.40	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0263	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	5115	569933.13	5760732.60	11	Sub-bottom Contact	Low	
BB_FS_SBP_0264	ARAMIS_SK_SBP_TA2B028P1_1_LAT_20220717	1519	569706.32	5760737.14	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0265	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	20878	570049.77	5760737.16	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0266	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	12544	569801.35	5760747.57	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_0267	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	10372	570547.81	5760747.63	27.3	Sub-bottom Contact	Low	
BB_FS_SBP_0268	ARAMIS_SK_SBP_TA2B029P1_1_LAT_20220717	12586	569796.59	5760749.45	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0269	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	10076	570005.51	5760751.53	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0270	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	6011	570071.37	5760764.63	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0271	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	6005	570070.86	5760764.75	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_0272	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	5842	570395.60	5760765.05	7	Sub-bottom Contact	Low	
BB_FS_SBP_0273	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	10629	569928.16	5760778.00	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_0274	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	2796	570998.65	5760785.63	18.5	Sub-bottom Contact	Low	
BB_FS_SBP_0275	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	10821	569901.57	5760788.27	6.4	Sub-bottom Contact	Low	
BB_FS_SBP_0276	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	3345	569790.43	5760788.40	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0277	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	10347	570093.69	5760794.28	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0278	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	8071	570122.92	5760794.61	14	Sub-bottom Contact	Low	
BB_FS_SBP_0279	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	5088	569996.13	5760794.77	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0280	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	5023	569990.44	5760797.14	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0281	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	10402	570092.74	5760800.66	10.2	Sub-bottom Contact	Low	
BB_FS_SBP_0282	ARAMIS_SK_SBP_TA2B040P1_1_LAT_20220718	11290	570812.17	5760814.50	20	Sub-bottom Contact	Low	
BB_FS_SBP_0283	ARAMIS_SK_SBP_TA2B030P1_1_LAT_20220717	2343	569709.00	5760821.43	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0284	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	20071	570034.77	5760826.27	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0285	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	3584	570894.51	5760832.30	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0286	ARAMIS_SK_SBP_TA2B031P1_1_LAT_20220717	11805	569768.60	5760846.01	10	Sub-bottom Contact	Low	
BB_FS_SBP_0287	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	7804	570291.60	5760847.08	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_0288	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	6250	570976.53	5760850.32	1.4	Sub-bottom Contact	Low	
BB_FS_SBP_0289	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	11640	570500.55	5760850.51	20.2	Sub-bottom Contact	Low	
BB_FS_SBP_0290	ARAMIS_SK_SBP_TA2B045P1_1_LAT_20220718	949	571207.81	5760876.73	21.3	Sub-bottom Contact	Low	
BB_FS_SBP_0291	ARAMIS_SK_SBP_TA2B037P1_1_LAT_20220718	6823	570348.38	5760880.57	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0292	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	9748	569889.39	5760885.78	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0293	ARAMIS_SK_SBP_TA2B045P1_1_LAT_20220718	1079	571188.07	5760886.35	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0294	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	9886	569871.72	5760894.02	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0295	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	10292	570389.65	5760896.21	33.6	Sub-bottom Contact	Low	
BB_FS_SBP_0296	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	1963	569718.50	5760903.64	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0297	ARAMIS_SK_SBP_TA2B032P1_1_LAT_20220717	1854	569708.89	5760907.45	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0298	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	6249	570138.60	5760908.48	20.8	Sub-bottom Contact	Low	
BB_FS_SBP_0299	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	5008	570702.90	5760909.09	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0300	ARAMIS_SK_SBP_TA2B033P1_1_LAT_20220717	10141	569838.12	5760910.44	14.6	Sub-bottom Contact	Low	

BB_FS_SBP_0301	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	9640	570334.77	5760915.92	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0302	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	9619	570333.07	5760916.71	19	Sub-bottom Contact	Low	
BB_FS_SBP_0303	ARAMIS_SK_SBP_TA2B042P1_1_LAT_20220718	12404	570762.24	5760923.31	18.9	Sub-bottom Contact	Low	
BB_FS_SBP_0304	ARAMIS_SK_SBP_TA2B035P1_1_LAT_20220717	8384	569990.05	5760935.23	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0305	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	5764	570601.38	5760949.48	20.8	Sub-bottom Contact	Low	
BB_FS_SBP_0306	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	8477	570239.26	5760953.45	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0307	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	4912	570008.29	5760959.44	36.4	Sub-bottom Contact	Low	
BB_FS_SBP_0308	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	943	571219.23	5760964.46	24.3	Sub-bottom Contact	Low	
BB_FS_SBP_0309	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	7915	570193.76	5760971.42	21.7	Sub-bottom Contact	Low	
BB_FS_SBP_0310	ARAMIS_SK_SBP_TA2B036P1_1_LAT_20220718	4590	569976.95	5760972.33	21.5	Sub-bottom Contact	Low	
BB_FS_SBP_0311	ARAMIS_SK_SBP_TA2B044P1_1_LAT_20220718	11645	570849.25	5760975.17	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0312	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	1119	571191.74	5760976.35	21	Sub-bottom Contact	Low	
BB_FS_SBP_0313	ARAMIS_SK_SBP_TA2B039P1_1_LAT_20220718	6381	570311.52	5760976.66	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0314	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	1147	571187.35	5760978.25	20.8	Sub-bottom Contact	Low	
BB_FS_SBP_0315	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	18530	570012.47	5761001.19	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0316	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	993	571205.03	5761003.29	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0317	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	994	571204.87	5761003.36	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0318	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	6544	570084.86	5761014.48	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0319	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	7124	570418.16	5761022.10	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0320	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	1348	571150.80	5761027.67	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0321	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	7259	570399.93	5761029.81	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_0322	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	1442	571136.22	5761033.68	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0323	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	19920	571221.00	5761040.39	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0324	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	7577	570356.42	5761048.00	27.6	Sub-bottom Contact	Low	
BB_FS_SBP_0325	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	1794	571081.84	5761053.15	25.8	Sub-bottom Contact	Low	
BB_FS_SBP_0326	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	2553	570969.31	5761060.45	22.3	Sub-bottom Contact	Low	
BB_FS_SBP_0327	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	1939	571059.70	5761061.99	26.5	Sub-bottom Contact	Low	
BB_FS_SBP_0328	ARAMIS_SK_SBP_TA2B037P1_1_LAT_20220718	9815	569860.99	5761073.71	20.8	Sub-bottom Contact	Low	
BB_FS_SBP_0329	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	8072	570287.77	5761074.45	29	Sub-bottom Contact	Low	
BB_FS_SBP_0330	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	16887	570923.32	5761077.30	11	Sub-bottom Contact	Low	
BB_FS_SBP_0331	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	2899	570916.74	5761082.90	22.3	Sub-bottom Contact	Low	
BB_FS_SBP_0332	ARAMIS_SK_SBP_TA2B046P1_1_LAT_20220718	13597	570777.63	5761086.26	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_0333	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	53	571211.34	5761089.28	20.2	Sub-bottom Contact	Low	
BB_FS_SBP_0334	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	8369	570246.36	5761090.09	18.4	Sub-bottom Contact	Low	
BB_FS_SBP_0335	ARAMIS_SK_SBP_TA2B044P1_1_LAT_20220718	8879	570549.99	5761092.04	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_0336	ARAMIS_SK_SBP_TA2B050P1_INF_LAT_20220730	2785	571193.11	5761092.52	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0337	ARAMIS_SK_SBP_TA2B040P1_1_LAT_20220718	4778	570096.80	5761098.60	20.5	Sub-bottom Contact	Low	
BB_FS_SBP_0338	ARAMIS_SK_SBP_TA2B050P1_INF_LAT_20220730	2544	571168.62	5761101.25	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0339	ARAMIS_SK_SBP_TA2B046P1_1_LAT_20220718	13103	570734.27	5761103.68	22.6	Sub-bottom Contact	Low	
BB_FS_SBP_0340	ARAMIS_SK_SBP_TA2B050P1_INF_LAT_20220730	2297	571144.26	5761110.96	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0341	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	3591	569842.23	5761112.82	21.5	Sub-bottom Contact	Low	
BB_FS_SBP_0342	ARAMIS_SK_SBP_TA2B050P1_INF_LAT_20220730	1932	571110.07	5761125.83	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0343	ARAMIS_SK_SBP_TA2B050P1_INF_LAT_20220730	1450	571066.07	5761143.74	17.4	Sub-bottom Contact	Low	

BB_FS_SBP_0344	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	852	571083.82	5761144.06	19.7	Sub-bottom Contact	Low	
BB_FS_SBP_0345	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	9426	570098.00	5761146.58	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0346	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	1035	571054.78	5761154.81	24.2	Sub-bottom Contact	Low	
BB_FS_SBP_0347	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	1037	571054.31	5761154.98	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_0348	ARAMIS_SK_SBP_TA2B042P1_1_LAT_20220718	6536	570173.74	5761155.33	21.6	Sub-bottom Contact	Low	
BB_FS_SBP_0349	ARAMIS_SK_SBP_TA2B038P1_1_LAT_20220718	2289	569732.35	5761157.27	20.6	Sub-bottom Contact	Low	
BB_FS_SBP_0350	ARAMIS_SK_SBP_TA2B039P1_1_LAT_20220718	8974	569856.96	5761160.58	20.7	Sub-bottom Contact	Low	
BB_FS_SBP_0351	ARAMIS_SK_SBP_TA2B040P1_1_LAT_20220718	3202	569931.35	5761165.07	26.4	Sub-bottom Contact	Low	
BB_FS_SBP_0352	ARAMIS_SK_SBP_TA2B040P1_1_LAT_20220718	3125	569923.34	5761168.36	23.2	Sub-bottom Contact	Low	
BB_FS_SBP_0353	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	15118	570867.17	5761179.85	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0354	ARAMIS_SK_SBP_TA2B041P1_1_LAT_20220718	10211	569987.89	5761193.16	29.3	Sub-bottom Contact	Low	
BB_FS_SBP_0355	ARAMIS_SK_SBP_TA2B042P1_1_LAT_20220718	5451	570071.54	5761196.90	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0356	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	4930	570594.62	5761210.05	19.4	Sub-bottom Contact	Low	
BB_FS_SBP_0357	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	14165	570790.26	5761211.57	17	Sub-bottom Contact	Low	
BB_FS_SBP_0358	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	1974	570909.38	5761211.73	18.8	Sub-bottom Contact	Low	
BB_FS_SBP_0359	ARAMIS_SK_SBP_TA2B053P1_INF_LAT_20220730	3359	571206.25	5761217.47	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0360	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	14721	570926.99	5761240.17	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0361	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	2463	570830.65	5761243.79	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_0362	ARAMIS_SK_SBP_TA2B040P1_1_LAT_20220718	1144	569718.57	5761248.01	35.6	Sub-bottom Contact	Low	
BB_FS_SBP_0363	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	9163	570975.07	5761253.26	3.6	Sub-bottom Contact	Low	
BB_FS_SBP_0364	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	16006	570896.20	5761254.28	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0365	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	14244	570053.57	5761254.61	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0366	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	12632	570667.00	5761259.28	17.5	Sub-bottom Contact	Low	
BB_FS_SBP_0367	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	2288	571104.85	5761261.96	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0368	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	2470	571077.98	5761274.46	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0369	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	2240	571151.90	5761281.36	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0370	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	15148	570823.42	5761284.10	18.5	Sub-bottom Contact	Low	
BB_FS_SBP_0371	ARAMIS_SK_SBP_TA2B053P1_INF_LAT_20220730	1729	571030.30	5761287.59	18	Sub-bottom Contact	Low	
BB_FS_SBP_0372	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	1430	571125.82	5761295.14	18.7	Sub-bottom Contact	Low	
BB_FS_SBP_0373	ARAMIS_SK_SBP_TA2B053P1_INF_LAT_20220730	1493	571006.31	5761297.88	18.3	Sub-bottom Contact	Low	
BB_FS_SBP_0374	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	1878	571114.92	5761298.01	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0375	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	1524	571111.43	5761301.07	21.2	Sub-bottom Contact	Low	
BB_FS_SBP_0376	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	1717	571217.00	5761302.08	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_0377	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	16685	570880.85	5761303.76	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0378	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	11013	570537.50	5761310.36	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_0379	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	3139	570983.41	5761310.93	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_0380	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	14239	570747.36	5761313.54	21.4	Sub-bottom Contact	Low	
BB_FS_SBP_0381	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	6133	570428.73	5761314.99	20	Sub-bottom Contact	Low	
BB_FS_SBP_0382	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	1238	571051.45	5761321.42	17.5	Sub-bottom Contact	Low	
BB_FS_SBP_0383	ARAMIS_SK_SBP_TA2B050P1_1_LAT_20220719	3744	570620.65	5761325.45	20.2	Sub-bottom Contact	Low	
BB_FS_SBP_0384	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	13850	570714.32	5761326.79	18.9	Sub-bottom Contact	Low	
BB_FS_SBP_0385	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	1058	571034.44	5761327.76	18.3	Sub-bottom Contact	Low	
BB_FS_SBP_0386	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	10404	570882.57	5761328.71	5.4	Sub-bottom Contact	Low	

BB_FS_SBP_0387	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	2258	571154.64	5761328.91	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0388	ARAMIS_SK_SBP_TA2B053P1_INF_LAT_20220730	603	570913.04	5761332.57	22.7	Sub-bottom Contact	Low	BB_FS_MAG_0116
BB_FS_SBP_0389	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	3568	570923.84	5761333.64	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0390	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	2419	571136.07	5761336.80	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0391	ARAMIS_SK_SBP_TA2B042P1_1_LAT_20220718	1545	569713.80	5761337.44	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0392	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	3660	570911.07	5761338.90	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0393	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	3663	570910.66	5761339.07	16	Sub-bottom Contact	Low	
BB_FS_SBP_0394	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	2187	571020.44	5761339.94	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0395	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	2190	571020.02	5761340.11	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0396	ARAMIS_SK_SBP_TA2B046P1_1_LAT_20220718	6176	570139.15	5761340.40	26.6	Sub-bottom Contact	Low	
BB_FS_SBP_0397	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	13396	570676.26	5761342.50	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_0398	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	15633	570776.19	5761343.81	18	Sub-bottom Contact	Low	
BB_FS_SBP_0399	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	6626	570355.22	5761344.81	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0400	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	22359	571207.26	5761345.36	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0401	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	22354	571206.76	5761345.53	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0402	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	22352	571206.55	5761345.60	13	Sub-bottom Contact	Low	
BB_FS_SBP_0403	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	22351	571206.45	5761345.64	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0404	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	15594	570772.12	5761345.67	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0405	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	22256	571196.76	5761349.28	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0406	ARAMIS_SK_SBP_TA2B046P1_1_LAT_20220718	5936	570118.09	5761349.94	23.5	Sub-bottom Contact	Low	
BB_FS_SBP_0407	ARAMIS_SK_SBP_TA2B053P1_INF_LAT_20220730	204	570870.39	5761351.07	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0408	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	3890	570879.50	5761351.95	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0409	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	2444	570985.39	5761353.71	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0410	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	12977	570641.84	5761355.26	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0411	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	370	570965.28	5761357.71	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0412	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	348	570963.12	5761358.64	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0413	ARAMIS_SK_SBP_TA2B054P1_INF_LAT_20220730	115	570939.56	5761368.04	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0414	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	3174	571044.82	5761368.44	18.2	Sub-bottom Contact	Low	
BB_FS_SBP_0415	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	21646	571138.89	5761374.09	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0416	ARAMIS_SK_SBP_TA2B044P1_1_LAT_20220718	2460	569828.21	5761377.96	19.4	Sub-bottom Contact	Low	
BB_FS_SBP_0417	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	7223	570266.96	5761378.23	19.5	Sub-bottom Contact	Low	
BB_FS_SBP_0418	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	7298	570255.88	5761382.61	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0419	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	4379	570810.63	5761383.81	20.7	Sub-bottom Contact	Low	
BB_FS_SBP_0420	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	3553	571000.03	5761387.30	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_0421	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	8653	570343.02	5761387.65	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0422	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	7388	570242.64	5761388.01	20.6	Sub-bottom Contact	Low	
BB_FS_SBP_0423	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	3116	570890.74	5761388.92	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0424	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	21191	571096.89	5761390.60	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0425	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	12869	570926.02	5761391.63	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_0426	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	3730	570979.45	5761397.50	19.5	Sub-bottom Contact	Low	
BB_FS_SBP_0427	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	8108	570298.87	5761405.89	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_0428	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	8093	570297.57	5761406.29	19.5	Sub-bottom Contact	Low	
BB_FS_SBP_0429	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	3897	570960.34	5761406.69	13.2	Sub-bottom Contact	Low	

BB_FS_SBP_0430	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	7718	570193.63	5761407.86	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0431	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	11334	570505.35	5761409.96	19	Sub-bottom Contact	Low	
BB_FS_SBP_0432	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	7825	570274.02	5761413.92	19.5	Sub-bottom Contact	Low	
BB_FS_SBP_0433	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	7814	570273.07	5761414.23	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_0434	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	18105	571245.03	5761415.64	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0435	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	13751	570595.41	5761415.72	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0436	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	11148	570490.40	5761415.97	18.8	Sub-bottom Contact	Low	
BB_FS_SBP_0437	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	4261	570916.88	5761424.63	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0438	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	4303	570911.71	5761426.53	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0439	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	5160	570688.12	5761428.25	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0440	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	12369	570928.21	5761435.97	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_0441	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	7189	570220.53	5761438.17	19	Sub-bottom Contact	Low	
BB_FS_SBP_0442	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	19870	570975.35	5761439.38	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0443	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	13097	570535.41	5761440.56	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0444	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	7058	570208.10	5761441.63	19.1	Sub-bottom Contact	Low	
BB_FS_SBP_0445	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	7044	570206.78	5761442.07	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_0446	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	19626	570952.34	5761447.51	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0447	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	12752	570104.86	5761448.75	11	Sub-bottom Contact	Low	
BB_FS_SBP_0448	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	4838	570845.64	5761450.59	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0449	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	12582	570490.13	5761457.83	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0450	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	6505	570158.67	5761461.25	18.5	Sub-bottom Contact	Low	
BB_FS_SBP_0451	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	6303	570141.18	5761468.78	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0452	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	8762	570040.03	5761468.81	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0453	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	6302	570141.09	5761468.81	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0454	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	5247	570796.49	5761470.84	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0455	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	6218	570133.81	5761471.84	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0456	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	8866	570024.56	5761474.89	19.3	Sub-bottom Contact	Low	
BB_FS_SBP_0457	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	18854	570886.94	5761475.56	26	Sub-bottom Contact	Low	
BB_FS_SBP_0458	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	9146	570313.19	5761486.05	23.5	Sub-bottom Contact	Low	
BB_FS_SBP_0459	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	5584	570754.86	5761487.45	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0460	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	16317	571059.56	5761488.77	21	Sub-bottom Contact	Low	
BB_FS_SBP_0461	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	12327	570104.89	5761489.87	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0462	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	18319	570843.36	5761490.71	11.3	Sub-bottom Contact	Low	BB_FS_MAG_0172
BB_FS_SBP_0463	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	1506	571172.99	5761491.52	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0464	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	16197	571046.96	5761493.84	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0465	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	16050	571031.77	5761499.66	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0466	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	9294	569961.95	5761500.36	19.1	Sub-bottom Contact	Low	
BB_FS_SBP_0467	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	5014	570618.49	5761500.65	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0468	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	5868	570719.96	5761500.92	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0469	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	16976	571216.29	5761512.67	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0470	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	5253	570583.82	5761515.26	31.7	Sub-bottom Contact	Low	
BB_FS_SBP_0471	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	17525	570778.62	5761516.04	13	Sub-bottom Contact	Low	
BB_FS_SBP_0472	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	17503	570776.95	5761516.48	11.9	Sub-bottom Contact	Low	

BB_FS_SBP_0473	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	9605	569916.31	5761518.10	20.2	Sub-bottom Contact	Low	
BB_FS_SBP_0474	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	16676	571185.32	5761524.43	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0475	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	5437	570557.32	5761526.07	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0476	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	5484	570550.54	5761528.80	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0477	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	16879	570724.16	5761536.05	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0478	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	12056	570877.88	5761537.02	5.9	Sub-bottom Contact	Low	
BB_FS_SBP_0479	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	12076	570877.77	5761539.44	7.1	Sub-bottom Contact	Low	
BB_FS_SBP_0480	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	10045	569851.64	5761543.18	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0481	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	7020	570396.18	5761547.55	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0482	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	496	571248.57	5761551.49	22.7	Sub-bottom Contact	Low	
BB_FS_SBP_0483	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	3909	569924.74	5761554.02	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0484	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	608	571235.82	5761556.11	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0485	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	15840	571098.56	5761560.03	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0486	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	14551	570879.06	5761561.09	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0487	ARAMIS_SK_SBP_TA2B049P1_1_LAT_20220719	3709	569906.55	5761561.33	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0488	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	16085	570659.53	5761562.50	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0489	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	794	571214.94	5761563.44	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0490	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	7174	570563.51	5761563.53	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0491	ARAMIS_SK_SBP_TA2B047P1_1_LAT_20220718	10643	569706.38	5761563.73	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0492	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	3959	570773.32	5761563.95	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0493	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	7294	570353.82	5761564.35	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0494	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	3189	570982.31	5761566.80	14	Sub-bottom Contact	Low	
BB_FS_SBP_0495	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	14368	570860.82	5761568.30	15	Sub-bottom Contact	Low	
BB_FS_SBP_0496	ARAMIS_SK_SBP_TA2B048P1_1_LAT_20220719	10501	569785.35	5761569.81	19.7	Sub-bottom Contact	Low	
BB_FS_SBP_0497	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	7404	570534.07	5761574.82	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0498	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	15469	570610.34	5761583.30	12.5	Sub-bottom Contact	Low	
BB_FS_SBP_0499	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	13927	570816.96	5761584.48	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0500	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	3649	570930.93	5761585.93	13	Sub-bottom Contact	Low	
BB_FS_SBP_0501	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	21129	571238.26	5761589.78	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0502	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	15199	570588.67	5761591.44	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0503	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	12511	570877.17	5761592.94	6.7	Sub-bottom Contact	Low	
BB_FS_SBP_0504	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	7825	570272.46	5761595.85	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0505	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	3986	570892.36	5761604.70	21.3	Sub-bottom Contact	Low	
BB_FS_SBP_0506	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	6731	570353.85	5761604.98	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0507	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	1750	571106.18	5761606.08	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0508	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	14610	570974.44	5761608.34	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_0509	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	13323	570756.54	5761609.41	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0510	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	2759	570654.98	5761609.78	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0511	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	1877	571091.37	5761612.31	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0512	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	8086	570233.03	5761612.37	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_0513	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	13161	570740.07	5761615.65	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_0514	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	10451	570924.82	5761616.47	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_0515	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	6922	570323.73	5761617.73	18.5	Sub-bottom Contact	Low	

BB_FS_SBP_0516	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	14315	570519.07	5761618.17	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0517	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	10395	570924.92	5761622.06	10	Sub-bottom Contact	Low	
BB_FS_SBP_0518	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	8424	570411.70	5761623.73	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0519	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	4446	570838.31	5761624.45	16	Sub-bottom Contact	Low	
BB_FS_SBP_0520	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	2331	570610.71	5761624.81	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0521	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	1181	571254.20	5761628.22	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0522	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	14108	570926.05	5761628.57	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0523	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	2240	571048.62	5761630.05	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0524	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	2243	571048.27	5761630.19	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0525	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	7141	570288.44	5761631.55	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0526	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	14015	570916.92	5761632.08	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0527	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	4794	569941.20	5761632.81	18.5	Sub-bottom Contact	Low	
BB_FS_SBP_0528	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	1321	571239.61	5761633.87	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0529	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	10880	570109.11	5761634.06	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0530	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	12694	570693.24	5761635.27	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0531	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	2122	570590.45	5761635.31	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_0532	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	12509	570977.11	5761637.68	3.9	Sub-bottom Contact	Low	
BB_FS_SBP_0533	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	7478	570034.32	5761638.88	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0534	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	1449	571226.24	5761639.12	15	Sub-bottom Contact	Low	
BB_FS_SBP_0535	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	1450	571226.14	5761639.15	16.5	Sub-bottom Contact	Low	
BB_FS_SBP_0536	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	12967	570874.27	5761644.22	10	Sub-bottom Contact	Low	
BB_FS_SBP_0537	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	4938	570780.01	5761646.37	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0538	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	1724	571197.87	5761650.46	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0539	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	1572	570539.84	5761651.99	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0540	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	13463	570861.89	5761653.66	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0541	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	4199	569890.36	5761654.28	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_0542	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	2940	570967.38	5761658.45	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0543	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	5177	570751.21	5761658.55	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0544	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	12049	570628.95	5761659.44	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0545	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	9187	570318.95	5761659.68	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0546	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	3056	570954.43	5761663.22	16.5	Sub-bottom Contact	Low	
BB_FS_SBP_0547	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12872	570408.07	5761663.47	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0548	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	1296	570513.09	5761664.08	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0549	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12817	570403.84	5761664.97	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0550	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12812	570403.45	5761665.11	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0551	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	5367	570727.53	5761668.07	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0552	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	2113	571157.57	5761668.12	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0553	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	12782	570015.44	5761669.72	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_0554	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	13223	570872.80	5761670.32	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_0555	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	5412	570721.93	5761670.49	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0556	ARAMIS_SK_SBP_TA2B051P1_1_LAT_20220719	3651	569843.94	5761673.50	20	Sub-bottom Contact	Low	
BB_FS_SBP_0557	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	3327	570922.80	5761675.70	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0558	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	3382	570916.32	5761677.83	17.1	Sub-bottom Contact	Low	

BB_FS_SBP_0559	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	7885	570167.03	5761679.14	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0560	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12276	570361.01	5761681.01	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0561	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	9639	570261.57	5761683.52	20.1	Sub-bottom Contact	Low	
BB_FS_SBP_0562	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	18337	570995.02	5761684.31	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0563	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12140	570350.30	5761685.87	13.7	Sub-bottom Contact	Low	BB_FS_MAG_0168
BB_FS_SBP_0564	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	12125	570349.21	5761686.28	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0565	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	570	570436.49	5761688.08	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0566	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	16748	571201.53	5761688.68	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0567	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	9808	570240.38	5761691.43	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0568	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	16653	571193.00	5761691.93	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0569	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	2826	571079.74	5761695.30	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0570	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9643	570925.30	5761695.81	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0571	ARAMIS_SK_SBP_TA2B057P1_INF_LAT_20220804	234	570400.61	5761698.23	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0572	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	17894	570955.70	5761699.87	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_0573	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	2948	571066.51	5761699.96	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0574	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	12259	570743.53	5761700.75	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0575	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9549	570925.20	5761704.56	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0576	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	8324	570094.69	5761705.22	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0577	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	12104	570728.27	5761706.39	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0578	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	9760	569981.46	5761710.62	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0579	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	5263	569843.53	5761710.66	16.8	Sub-bottom Contact	Low	
BB_FS_SBP_0580	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	6270	570616.79	5761711.84	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_0581	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9472	570924.92	5761711.94	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_0582	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	8425	570077.72	5761712.37	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0583	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	3218	571036.96	5761712.78	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0584	ARAMIS_SK_SBP_TA2B052P1_1_LAT_20220730	5169	569835.40	5761713.81	18.4	Sub-bottom Contact	Low	
BB_FS_SBP_0585	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	6372	570604.35	5761716.60	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_0586	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	13702	570876.78	5761717.59	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_0587	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	6395	570601.68	5761717.93	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0588	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9395	570924.70	5761719.31	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0589	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	15903	571120.21	5761721.37	16.5	Sub-bottom Contact	Low	
BB_FS_SBP_0590	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	10418	570472.40	5761721.50	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0591	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	2045	571250.73	5761721.51	14.8	Sub-bottom Contact	Low	BB_FS_MAG_0319
BB_FS_SBP_0592	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	2069	571248.34	5761722.46	21.3	Sub-bottom Contact	Low	
BB_FS_SBP_0593	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	3433	571013.28	5761722.76	17.5	Sub-bottom Contact	Low	
BB_FS_SBP_0594	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9356	570924.64	5761723.15	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0595	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	9968	569950.87	5761724.07	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0596	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	3512	571004.29	5761726.05	19.7	Sub-bottom Contact	Low	
BB_FS_SBP_0597	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9322	570924.68	5761726.41	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0598	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	3535	571001.82	5761727.16	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_0599	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	4438	570793.74	5761727.81	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0600	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	6659	570569.36	5761730.98	14	Sub-bottom Contact	Low	
BB_FS_SBP_0601	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	13853	570877.43	5761732.19	7.7	Sub-bottom Contact	Low	

BB_FS_SBP_0602	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	13569	570976.40	5761732.33	5.2	Sub-bottom Contact	Low	
BB_FS_SBP_0603	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	2431	571210.66	5761738.29	18.2	Sub-bottom Contact	Low	
BB_FS_SBP_0604	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	2435	571210.24	5761738.47	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0605	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	6864	570544.23	5761740.50	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_0606	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	11202	570638.75	5761741.86	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0607	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	10188	570199.50	5761745.68	26.1	Sub-bottom Contact	Low	
BB_FS_SBP_0608	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9122	570924.64	5761746.02	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0609	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	15201	571050.53	5761746.14	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0610	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	10366	569890.99	5761748.17	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0611	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	2788	571172.04	5761750.44	16.7	Sub-bottom Contact	Low	
BB_FS_SBP_0612	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	9064	570924.96	5761751.44	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0613	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	13795	570977.10	5761753.61	5.1	Sub-bottom Contact	Low	
BB_FS_SBP_0614	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	9882	570176.31	5761753.83	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0615	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	13805	570977.07	5761754.55	2.1	Sub-bottom Contact	Low	
BB_FS_SBP_0616	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	9817	570171.43	5761755.67	14	Sub-bottom Contact	Low	
BB_FS_SBP_0617	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	9815	570171.26	5761755.75	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0618	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	3097	571139.29	5761756.73	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0619	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	14942	571025.70	5761757.57	14	Sub-bottom Contact	Low	
BB_FS_SBP_0620	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	20164	571242.69	5761758.81	21.6	Sub-bottom Contact	Low	
BB_FS_SBP_0621	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	13853	570977.02	5761758.88	5.4	Sub-bottom Contact	Low	
BB_FS_SBP_0622	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8987	570924.80	5761759.33	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0623	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	9694	570162.32	5761759.43	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_0624	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	20124	571238.89	5761759.93	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0625	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	9415	570374.68	5761760.04	14.9	Sub-bottom Contact	Low	
BB_FS_SBP_0626	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	20120	571238.41	5761760.07	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0627	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	20116	571238.04	5761760.19	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0628	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	20047	571232.53	5761762.74	21.4	Sub-bottom Contact	Low	
BB_FS_SBP_0629	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	14762	571009.03	5761764.49	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0630	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	10600	570579.07	5761765.85	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0631	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	7384	570480.21	5761766.12	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0632	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	19938	571222.67	5761766.33	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0633	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	14235	570875.98	5761770.07	5	Sub-bottom Contact	Low	
BB_FS_SBP_0634	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	18407	570071.57	5761770.68	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0635	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	18408	570071.60	5761770.79	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0636	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	5417	570685.73	5761771.91	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0637	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	11723	570018.76	5761772.27	11	Sub-bottom Contact	Low	
BB_FS_SBP_0638	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8855	570925.05	5761772.27	11	Sub-bottom Contact	Low	
BB_FS_SBP_0639	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	14263	570875.81	5761773.08	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_0640	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	10416	570561.06	5761773.21	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0641	ARAMIS_SK_SBP_TA2B056P1_1_LAT_20220730	9096	570117.74	5761777.02	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0642	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	19580	571190.69	5761778.24	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0643	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	11501	570028.25	5761779.09	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0644	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	9388	569919.14	5761779.31	14.3	Sub-bottom Contact	Low	

BB_FS_SBP_0645	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	14328	570875.64	5761779.61	6.8	Sub-bottom Contact	Low	
BB_FS_SBP_0646	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	5625	570662.37	5761780.54	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0647	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	10934	569804.10	5761782.15	16.7	Sub-bottom Contact	Low	
BB_FS_SBP_0648	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8747	570925.24	5761782.85	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0649	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	5712	570652.40	5761784.05	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0650	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	7761	570433.93	5761785.21	15	Sub-bottom Contact	Low	
BB_FS_SBP_0651	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	3680	571078.11	5761785.56	24.6	Sub-bottom Contact	Low	
BB_FS_SBP_0652	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	7792	570430.21	5761786.94	24.3	Sub-bottom Contact	Low	
BB_FS_SBP_0653	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	14405	570875.60	5761787.26	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_0654	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	7847	570423.29	5761789.75	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0655	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	5875	570634.27	5761790.85	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0656	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	5884	570633.32	5761791.36	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0657	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	14199	570976.51	5761791.39	4.2	Sub-bottom Contact	Low	
BB_FS_SBP_0658	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	3820	571063.28	5761791.91	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0659	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	11749	569997.59	5761792.77	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0660	ARAMIS_SK_SBP_TA2B053P1_1_LAT_20220730	11111	569777.50	5761792.95	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0661	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	4931	570845.97	5761792.99	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_0662	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	14476	570875.84	5761794.26	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_0663	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	9825	570503.37	5761795.92	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0664	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	6007	570619.42	5761796.86	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0665	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	6023	570617.60	5761797.65	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0666	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8591	570925.48	5761798.23	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0667	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	4033	571040.75	5761801.14	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0668	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	9757	569858.09	5761802.01	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_0669	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	8145	570387.97	5761803.17	15	Sub-bottom Contact	Low	BB_FS_MAG_0214
BB_FS_SBP_0670	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	9778	569854.68	5761803.34	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0671	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	8212	570379.79	5761806.53	23.8	Sub-bottom Contact	Low	
BB_FS_SBP_0672	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	6305	570585.13	5761810.35	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0673	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8447	570925.62	5761811.83	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_0674	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	5389	570794.64	5761812.71	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0675	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	14717	570675.65	5761812.75	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0676	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	9369	570458.82	5761813.26	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0677	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	7952	570236.69	5761815.44	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0678	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	13366	570874.12	5761818.14	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0679	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	14504	570975.51	5761819.10	5.2	Sub-bottom Contact	Low	
BB_FS_SBP_0680	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	18376	571087.20	5761820.37	21.4	Sub-bottom Contact	Low	
BB_FS_SBP_0681	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	3357	571201.18	5761821.29	18.4	Sub-bottom Contact	Low	
BB_FS_SBP_0682	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	13280	570865.65	5761821.34	16	Sub-bottom Contact	Low	
BB_FS_SBP_0683	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	3360	571200.90	5761821.39	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_0684	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	12484	569906.30	5761824.45	14.9	Sub-bottom Contact	Low	
BB_FS_SBP_0685	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	4617	570978.27	5761825.09	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0686	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	12516	569902.24	5761825.95	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0687	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8291	570924.99	5761826.76	12.2	Sub-bottom Contact	Low	

BB_FS_SBP_0688	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	14268	570629.79	5761827.23	22.8	Sub-bottom Contact	Low	
BB_FS_SBP_0689	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	14621	570974.91	5761829.35	3.1	Sub-bottom Contact	Low	
BB_FS_SBP_0690	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	3609	571176.87	5761831.10	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0691	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	3609	571176.77	5761831.15	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0692	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	4774	570961.46	5761831.43	18.2	Sub-bottom Contact	Low	
BB_FS_SBP_0693	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12941	570832.40	5761834.22	14	Sub-bottom Contact	Low	
BB_FS_SBP_0694	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	4847	570953.54	5761834.33	13	Sub-bottom Contact	Low	
BB_FS_SBP_0695	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	4865	570951.71	5761835.00	18	Sub-bottom Contact	Low	
BB_FS_SBP_0696	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	12710	569877.51	5761835.54	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0697	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	13919	570595.66	5761842.90	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0698	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12648	570803.64	5761844.99	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0699	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8104	570924.32	5761844.99	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_0700	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12645	570803.34	5761845.11	24.2	Sub-bottom Contact	Low	
BB_FS_SBP_0701	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	13855	570589.86	5761845.32	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0702	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12639	570802.74	5761845.37	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0703	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8093	570924.30	5761845.98	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0704	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12576	570796.12	5761848.22	16.5	Sub-bottom Contact	Low	
BB_FS_SBP_0705	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	4015	571137.21	5761848.36	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0706	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	8065	570924.38	5761848.48	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0707	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	5187	570917.55	5761849.00	19.7	Sub-bottom Contact	Low	
BB_FS_SBP_0708	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	19162	571221.57	5761852.56	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0709	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	19142	571219.73	5761853.25	19.9	Sub-bottom Contact	Low	
BB_FS_SBP_0710	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	4167	571121.42	5761853.29	22	Sub-bottom Contact	Low	
BB_FS_SBP_0711	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	12443	570782.95	5761853.37	16.7	Sub-bottom Contact	Low	
BB_FS_SBP_0712	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	19129	571218.54	5761853.74	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0713	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	13603	570566.77	5761854.14	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0714	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	7305	570469.85	5761856.77	13	Sub-bottom Contact	Low	
BB_FS_SBP_0715	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	7309	570469.40	5761856.98	18.4	Sub-bottom Contact	Low	
BB_FS_SBP_0716	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18983	571204.71	5761859.07	19.2	Sub-bottom Contact	Low	
BB_FS_SBP_0717	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	14974	570976.97	5761860.24	3.2	Sub-bottom Contact	Low	
BB_FS_SBP_0718	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	4369	571100.52	5761860.58	18	Sub-bottom Contact	Low	
BB_FS_SBP_0719	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18926	571199.52	5761861.33	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0720	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18925	571199.43	5761861.36	14.9	Sub-bottom Contact	Low	
BB_FS_SBP_0721	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18924	571199.34	5761861.39	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0722	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	6505	570668.36	5761862.04	18.7	Sub-bottom Contact	Low	
BB_FS_SBP_0723	ARAMIS_SK_SBP_TA2B054P1_1_LAT_20220730	10698	569703.57	5761862.55	15	Sub-bottom Contact	Low	
BB_FS_SBP_0724	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18868	571193.92	5761863.33	19.1	Sub-bottom Contact	Low	
BB_FS_SBP_0725	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18836	571191.04	5761864.49	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_0726	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18827	571190.25	5761864.83	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0727	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	10726	570027.32	5761867.08	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_0728	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	7839	570923.75	5761870.10	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0729	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	13347	569797.59	5761870.18	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0730	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	6477	570095.69	5761871.16	12.9	Sub-bottom Contact	Low	

BB_FS_SBP_0731	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	6415	570089.38	5761873.81	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0732	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	13442	569785.54	5761875.41	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0733	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	19293	570080.76	5761876.23	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0734	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	19328	570081.92	5761880.10	9	Sub-bottom Contact	Low	
BB_FS_SBP_0735	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	10566	570031.80	5761882.62	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_0736	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	4867	571049.55	5761883.15	16	Sub-bottom Contact	Low	
BB_FS_SBP_0737	ARAMIS_SK_SBP_TA2B055P1_1_LAT_20220730	13634	569760.62	5761885.00	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0738	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	10540	570032.57	5761885.07	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0739	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	7491	570274.25	5761886.02	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0740	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	15278	570977.94	5761887.65	3.1	Sub-bottom Contact	Low	
BB_FS_SBP_0741	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	7078	570603.07	5761888.50	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0742	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	18149	571127.67	5761889.97	17.3	Sub-bottom Contact	Low	
BB_FS_SBP_0743	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	5039	571031.55	5761890.62	16.9	Sub-bottom Contact	Low	BB_FS_MAG_0362
BB_FS_SBP_0744	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	7334	570259.07	5761892.88	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0745	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	9966	570162.59	5761893.44	23.1	Sub-bottom Contact	Low	
BB_FS_SBP_0746	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	5864	570037.20	5761893.50	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0747	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	5113	571023.71	5761893.52	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0748	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	15530	570875.24	5761897.10	7.8	Sub-bottom Contact	Low	
BB_FS_SBP_0749	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	7343	570573.50	5761900.04	23.2	Sub-bottom Contact	Low	
BB_FS_SBP_0750	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	5346	570999.59	5761902.64	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0751	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	7430	570564.06	5761903.96	19.5	Sub-bottom Contact	Low	
BB_FS_SBP_0752	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	7465	570560.09	5761905.54	23.4	Sub-bottom Contact	Low	
BB_FS_SBP_0753	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	7547	570551.05	5761909.12	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0754	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	1628	571178.65	5761915.82	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_0755	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	8548	570322.66	5761915.90	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0756	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	5283	569984.44	5761917.06	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0757	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	10672	570611.05	5761922.46	28.8	Sub-bottom Contact	Low	
BB_FS_SBP_0758	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	15694	570975.78	5761927.03	4.3	Sub-bottom Contact	Low	
BB_FS_SBP_0759	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	15738	570975.43	5761931.11	5.9	Sub-bottom Contact	Low	
BB_FS_SBP_0760	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	17020	571024.26	5761931.14	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_0761	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	10350	570579.77	5761934.12	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0762	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	16718	570996.17	5761941.26	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0763	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	18855	571212.13	5761941.30	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0764	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	14654	570773.32	5761944.25	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0765	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	9209	570243.31	5761945.91	22.8	Sub-bottom Contact	Low	
BB_FS_SBP_0766	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	18701	571198.41	5761946.56	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0767	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	14568	570766.16	5761946.92	23.1	Sub-bottom Contact	Low	
BB_FS_SBP_0768	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	8405	570456.99	5761947.46	14	Sub-bottom Contact	Low	
BB_FS_SBP_0769	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	15926	570975.07	5761947.82	6.3	Sub-bottom Contact	Low	
BB_FS_SBP_0770	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	4413	569902.86	5761948.54	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_0771	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	16018	570975.04	5761955.82	3.9	Sub-bottom Contact	Low	
BB_FS_SBP_0772	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	7675	570647.04	5761956.46	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_0773	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	4151	569878.20	5761957.45	16.9	Sub-bottom Contact	Low	

BB_FS_SBP_0774	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	14178	570733.92	5761960.87	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_0775	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	7792	570634.70	5761961.54	22.3	Sub-bottom Contact	Low	
BB_FS_SBP_0776	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	10342	570288.65	5761962.58	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0777	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	11541	569970.88	5761967.11	23	Sub-bottom Contact	Low	
BB_FS_SBP_0778	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	11593	569964.39	5761970.10	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0779	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9670	570051.34	5761972.03	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0780	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	15825	570916.01	5761973.17	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_0781	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20148	570102.67	5761974.14	7.1	Sub-bottom Contact	Low	
BB_FS_SBP_0782	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	2677	571251.96	5761974.65	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_0783	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	3657	569831.17	5761975.66	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0784	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	13587	570684.93	5761978.81	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_0785	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	11779	569941.11	5761980.14	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0786	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20206	570103.91	5761980.96	7.6	Sub-bottom Contact	Low	
BB_FS_SBP_0787	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20231	570104.30	5761983.47	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0788	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	8454	570565.06	5761988.75	23.5	Sub-bottom Contact	Low	
BB_FS_SBP_0789	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	2960	571216.23	5761989.15	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0790	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	15316	570870.38	5761992.13	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0791	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	9446	570213.21	5761994.10	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0792	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	8773	570427.66	5761994.47	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0793	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	4646	569999.38	5761994.63	15.8	Sub-bottom Contact	Low	
BB_FS_SBP_0794	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	6516	570924.85	5761995.02	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0795	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	7285	570159.57	5761997.64	9	Sub-bottom Contact	Low	
BB_FS_SBP_0796	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	16517	570975.12	5761999.85	4.5	Sub-bottom Contact	Low	
BB_FS_SBP_0797	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	16581	570873.48	5762000.44	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0798	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9346	570059.02	5762002.13	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_0799	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9345	570059.04	5762002.23	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0800	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9345	570059.06	5762002.33	14.9	Sub-bottom Contact	Low	
BB_FS_SBP_0801	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	15053	570848.11	5762002.34	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0802	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	15048	570847.71	5762002.48	16	Sub-bottom Contact	Low	
BB_FS_SBP_0803	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	8804	570529.51	5762003.36	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0804	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	4402	569975.61	5762005.00	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0805	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20425	570108.55	5762005.57	7.2	Sub-bottom Contact	Low	
BB_FS_SBP_0806	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	16720	571048.73	5762007.60	17	Sub-bottom Contact	Low	
BB_FS_SBP_0807	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20459	570109.38	5762009.33	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_0808	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	16647	571042.43	5762009.44	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0809	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20465	570109.51	5762010.01	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_0810	ARAMIS_SK_SBP_TA2B058P1_1_LAT_20220723	2699	569740.63	5762010.40	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0811	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	3392	571161.81	5762010.99	12.1	Sub-bottom Contact	Low	BB_FS_MAG_0467
BB_FS_SBP_0812	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	3464	571152.47	5762014.58	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_0813	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	8275	570379.63	5762014.66	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0814	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	16739	570873.14	5762015.77	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_0815	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	16430	571024.31	5762016.15	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0816	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	8210	570373.21	5762017.40	23.3	Sub-bottom Contact	Low	

BB_FS_SBP_0817	ARAMIS_SK_SBP_TA2B060P1_1_LAT_20220723	4042	569939.73	5762020.16	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0818	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9109	570063.01	5762024.06	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0819	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	8008	570352.42	5762024.59	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0820	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	16175	571002.76	5762024.64	21.6	Sub-bottom Contact	Low	
BB_FS_SBP_0821	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	8330	570687.42	5762025.61	15	Sub-bottom Contact	Low	
BB_FS_SBP_0822	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	10936	570044.20	5762026.12	12.5	Sub-bottom Contact	Low	BB_FS_MAG_0237
BB_FS_SBP_0823	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	14360	570784.35	5762026.35	18.4	Sub-bottom Contact	Low	
BB_FS_SBP_0824	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	20638	570114.47	5762029.47	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_0825	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	15983	570986.81	5762030.11	22.4	Sub-bottom Contact	Low	
BB_FS_SBP_0826	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6987	570166.67	5762030.29	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_0827	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	7822	570333.72	5762031.30	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_0828	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	9015	570064.18	5762033.25	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0829	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	10342	570235.04	5762035.05	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0830	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	11152	570019.76	5762035.29	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_0831	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	18157	571200.07	5762035.37	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0832	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	14089	570759.53	5762036.04	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0833	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	9610	570445.25	5762036.47	23.4	Sub-bottom Contact	Low	
BB_FS_SBP_0834	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	12948	569797.62	5762037.09	22.6	Sub-bottom Contact	Low	
BB_FS_SBP_0835	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	12985	569792.99	5762039.05	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0836	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	11241	570009.48	5762039.07	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0837	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6905	570168.76	5762039.28	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_0838	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	14004	570751.89	5762039.29	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0839	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	15637	570957.31	5762041.31	22.4	Sub-bottom Contact	Low	
BB_FS_SBP_0840	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	9745	570430.82	5762042.00	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_0841	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	11671	570519.48	5762045.11	24.5	Sub-bottom Contact	Low	
BB_FS_SBP_0842	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	10598	570204.42	5762046.14	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0843	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	17070	570974.39	5762046.69	7.7	Sub-bottom Contact	Low	
BB_FS_SBP_0844	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	7879	570078.55	5762046.88	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0845	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	17857	571172.51	5762047.85	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_0846	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	17097	570873.36	5762049.37	9.5	Sub-bottom Contact	Low	
BB_FS_SBP_0847	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	17786	571166.10	5762050.73	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0848	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	8819	570067.06	5762052.17	18.7	Sub-bottom Contact	Low	
BB_FS_SBP_0849	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	8959	570618.86	5762052.90	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0850	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	9062	570607.40	5762057.32	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_0851	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	13469	570703.03	5762058.47	18.6	Sub-bottom Contact	Low	
BB_FS_SBP_0852	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	7137	570266.03	5762058.84	14	Sub-bottom Contact	Low	
BB_FS_SBP_0853	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6715	570173.24	5762060.47	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0854	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	4865	571263.17	5762061.66	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0855	ARAMIS_SK_SBP_TA2B059P1_1_LAT_20220723	13477	569732.03	5762061.68	13	Sub-bottom Contact	Low	BB_FS_MAG_0216
BB_FS_SBP_0856	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6692	570173.91	5762062.90	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_0857	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	11814	569944.84	5762063.19	16.5	Sub-bottom Contact	Low	
BB_FS_SBP_0858	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	4794	570804.29	5762065.14	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0859	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	5738	570925.18	5762068.18	11.5	Sub-bottom Contact	Low	

BB_FS_SBP_0860	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6618	570175.75	5762070.98	12	Sub-bottom Contact	Low	
BB_FS_SBP_0861	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	5057	571239.51	5762071.51	15	Sub-bottom Contact	Low	
BB_FS_SBP_0862	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	11182	570137.26	5762072.32	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0863	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	17030	571094.97	5762076.76	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_0864	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	5646	570925.46	5762077.06	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_0865	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	5633	570925.54	5762078.23	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0866	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	5196	571222.03	5762078.56	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0867	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	9623	570548.19	5762082.07	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0868	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	11396	570113.69	5762082.97	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0869	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6483	570178.91	5762085.48	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0870	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6438	570179.88	5762090.33	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0871	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	21177	570130.19	5762090.45	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_0872	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	10344	570401.36	5762091.88	16.8	Sub-bottom Contact	Low	
BB_FS_SBP_0873	ARAMIS_SK_SBP_TA2B061P1_1_LAT_20220723	12556	569863.01	5762096.08	23.3	Sub-bottom Contact	Low	
BB_FS_SBP_0874	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	10229	570390.86	5762096.33	23.3	Sub-bottom Contact	Low	
BB_FS_SBP_0875	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6323	570182.32	5762102.60	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_0876	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	10055	570375.18	5762102.79	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0877	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	12214	570589.36	5762103.14	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0878	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	20184	571252.51	5762103.43	10.2	Sub-bottom Contact	Low	BB_FS_MAG_0555
BB_FS_SBP_0879	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	8270	570077.36	5762103.95	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_0880	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	5611	570706.71	5762104.03	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0881	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	5258	570922.37	5762105.15	11.8	Sub-bottom Contact	Low	BB_FS_MAG_0469
BB_FS_SBP_0882	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	10183	570488.42	5762105.24	23.1	Sub-bottom Contact	Low	
BB_FS_SBP_0883	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	5353	570926.45	5762105.29	12.9	Sub-bottom Contact	Low	BB_FS_MAG_0469
BB_FS_SBP_0884	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	12144	570582.76	5762106.04	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0885	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	11930	570053.00	5762106.93	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0886	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	5343	570911.66	5762109.61	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0887	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	12028	570572.28	5762110.52	23.8	Sub-bottom Contact	Low	
BB_FS_SBP_0888	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	11407	570252.93	5762112.30	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0889	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	17911	570975.20	5762112.92	4.9	Sub-bottom Contact	Low	
BB_FS_SBP_0890	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	11454	570247.97	5762114.38	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0891	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6183	570185.57	5762117.63	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_0892	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	11534	570239.09	5762117.91	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_0893	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	5977	570662.13	5762121.10	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0894	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	12983	570740.38	5762127.61	15.8	Sub-bottom Contact	Low	
BB_FS_SBP_0895	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	5112	570927.55	5762128.59	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0896	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	12450	569993.82	5762128.92	20.4	Sub-bottom Contact	Low	BB_FS_MAG_0287
BB_FS_SBP_0897	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	9233	570300.40	5762130.69	25.7	Sub-bottom Contact	Low	
BB_FS_SBP_0898	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	6058	570188.55	5762131.09	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0899	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	15529	570955.79	5762131.50	13.2	Sub-bottom Contact	Low	BB_FS_MAG_0486
BB_FS_SBP_0900	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	7966	570084.07	5762132.39	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_0901	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	9077	570286.64	5762136.70	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_0902	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	18039	570876.27	5762139.15	5.2	Sub-bottom Contact	Low	

BB_FS_SBP_0903	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5971	570190.75	5762140.29	12.5	Sub-bottom Contact	Low	
BB_FS_SBP_0904	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5966	570190.87	5762140.79	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_0905	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5964	570190.92	5762140.99	11.2	Sub-bottom Contact	Low	
BB_FS_SBP_0906	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5956	570191.13	5762141.79	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0907	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	11143	570387.32	5762142.15	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0908	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	18911	571152.99	5762144.01	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0909	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	2615	571263.14	5762146.04	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_0910	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	21673	570140.41	5762147.94	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_0911	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	8772	570259.67	5762149.54	23.6	Sub-bottom Contact	Low	
BB_FS_SBP_0912	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	4804	569805.51	5762152.74	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0913	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	14963	570902.65	5762152.77	13	Sub-bottom Contact	Low	
BB_FS_SBP_0914	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	2770	571244.76	5762153.35	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_0915	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5827	570193.68	5762155.45	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0916	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	18504	570976.59	5762158.06	2	Sub-bottom Contact	Low	
BB_FS_SBP_0917	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	2901	571229.12	5762159.46	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0918	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	6336	570782.71	5762160.35	9.9	Sub-bottom Contact	Low	BB_FS_MAG_0461
BB_FS_SBP_0919	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	13132	569919.05	5762160.88	15.6	Sub-bottom Contact	Low	BB_FS_MAG_0283
BB_FS_SBP_0920	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	2935	571225.19	5762160.95	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0921	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	18300	570876.57	5762162.96	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_0922	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	18297	571104.00	5762163.20	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0923	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	10398	570429.52	5762166.21	23.8	Sub-bottom Contact	Low	
BB_FS_SBP_0924	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5710	570195.79	5762168.10	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_0925	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	14567	570864.50	5762168.43	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0926	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	14550	570862.79	5762169.04	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0927	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	18691	570976.91	5762171.99	2.4	Sub-bottom Contact	Low	
BB_FS_SBP_0928	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	18402	570877.26	5762172.32	10	Sub-bottom Contact	Low	
BB_FS_SBP_0929	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	3184	571195.32	5762172.67	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_0930	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	3194	571194.13	5762173.13	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_0931	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	13446	569883.57	5762173.62	16	Sub-bottom Contact	Low	
BB_FS_SBP_0932	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	8051	570193.13	5762174.81	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0933	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	4165	569973.31	5762175.44	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0934	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	13518	569875.64	5762176.53	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_0935	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	18767	570977.32	5762177.69	2.2	Sub-bottom Contact	Low	
BB_FS_SBP_0936	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	7451	570094.53	5762178.17	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0937	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	7405	570095.82	5762181.91	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_0938	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	3429	571166.03	5762184.06	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_0939	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	16999	571260.07	5762184.19	13	Sub-bottom Contact	Low	
BB_FS_SBP_0940	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	9891	570384.89	5762184.47	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0941	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	11241	570598.99	5762184.61	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_0942	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	14135	570823.00	5762185.33	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0943	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	7355	570097.24	5762186.35	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_0944	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	7663	570157.55	5762187.29	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0945	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	13269	570053.96	5762191.72	16.2	Sub-bottom Contact	Low	

BB_FS_SBP_0946	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	13888	569835.05	5762192.45	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_0947	ARAMIS_SK_SBP_TA2B062P1_1_LAT_20220723	3605	569708.23	5762192.74	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0948	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	18668	570878.69	5762196.72	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_0949	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	13992	569823.97	5762197.64	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0950	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	13489	570029.64	5762200.72	14	Sub-bottom Contact	Low	
BB_FS_SBP_0951	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	10765	570559.94	5762200.85	16.7	Sub-bottom Contact	Low	
BB_FS_SBP_0952	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	14061	569816.57	5762201.21	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_0953	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	22170	570153.89	5762202.73	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_0954	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	7157	570101.89	5762203.29	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0955	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	13555	570022.38	5762203.80	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_0956	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	7769	570899.66	5762206.32	16.4	Sub-bottom Contact	Low	
BB_FS_SBP_0957	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	16434	571200.40	5762207.14	10.4	Sub-bottom Contact	Low	BB_FS_MAG_0611
BB_FS_SBP_0958	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5339	570203.26	5762207.79	14.9	Sub-bottom Contact	Low	
BB_FS_SBP_0959	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	3956	571103.14	5762207.98	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_0960	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	10488	570536.26	5762210.20	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_0961	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4015	571096.32	5762210.67	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_0962	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5309	570204.11	5762210.92	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_0963	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4033	571094.18	5762211.49	15.8	Sub-bottom Contact	Low	
BB_FS_SBP_0964	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4063	571090.54	5762212.98	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0965	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	16710	570975.24	5762213.03	13	Sub-bottom Contact	Low	
BB_FS_SBP_0966	ARAMIS_SK_SBP_TA2B064P1_1_LAT_20220723	3191	569876.26	5762213.46	14.1	Sub-bottom Contact	Low	
BB_FS_SBP_0967	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	12843	570213.66	5762214.22	25	Sub-bottom Contact	Low	
BB_FS_SBP_0968	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	19270	570980.60	5762215.40	2.6	Sub-bottom Contact	Low	
BB_FS_SBP_0969	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4116	571084.39	5762215.50	14.8	Sub-bottom Contact	Low	
BB_FS_SBP_0970	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4121	571083.92	5762215.68	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0971	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	10227	570512.69	5762218.47	17.1	Sub-bottom Contact	Low	
BB_FS_SBP_0972	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	8013	570868.88	5762218.69	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0973	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4232	571070.80	5762221.19	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_0974	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	8728	570285.95	5762223.38	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0975	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	6922	570107.63	5762223.68	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_0976	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	8682	570283.13	5762225.18	16.8	Sub-bottom Contact	Low	
BB_FS_SBP_0977	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	6896	570108.23	5762225.89	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_0978	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	8174	570848.55	5762226.70	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_0979	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	6883	570108.49	5762227.12	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_0980	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	6457	570048.61	5762228.90	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_0981	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	16211	570934.41	5762229.04	14.3	Sub-bottom Contact	Low	BB_FS_MAG_0551
BB_FS_SBP_0982	ARAMIS_SK_SBP_TA2B063P1_1_LAT_20220723	14775	569737.22	5762231.40	21.8	Sub-bottom Contact	Low	
BB_FS_SBP_0983	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	6827	570109.61	5762232.22	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_0984	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	1778	571274.55	5762232.87	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0985	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	8490	570271.88	5762232.94	16.1	Sub-bottom Contact	Low	
BB_FS_SBP_0986	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	6268	570031.11	5762235.43	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0987	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	9705	570469.32	5762235.77	15.8	Sub-bottom Contact	Low	
BB_FS_SBP_0988	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	13360	570160.20	5762236.30	17.5	Sub-bottom Contact	Low	

BB_FS_SBP_0989	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	5060	570209.40	5762236.99	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_0990	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	9633	570463.50	5762238.28	18.9	Sub-bottom Contact	Low	
BB_FS_SBP_0991	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	7794	570588.34	5762238.35	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_0992	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	13427	570153.25	5762238.96	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_0993	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	15901	570908.93	5762239.02	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_0994	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	6179	570022.94	5762239.14	22.9	Sub-bottom Contact	Low	
BB_FS_SBP_0995	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	14370	569932.82	5762239.24	15.5	Sub-bottom Contact	Low	
BB_FS_SBP_0996	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4644	571022.37	5762241.08	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_0997	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	15674	571121.36	5762241.40	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_0998	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	22524	570160.65	5762242.27	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_0999	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	14479	569920.95	5762243.96	18.3	Sub-bottom Contact	Low	
BB_FS_SBP_1000	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	9372	570441.06	5762248.36	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1001	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	8652	570788.21	5762249.97	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_1002	ARAMIS_SK_SBP_TA2B088P1_1_LAT_20220714	19726	570982.82	5762250.49	2.4	Sub-bottom Contact	Low	
BB_FS_SBP_1003	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	4852	570997.65	5762250.51	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_1004	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	15417	571094.07	5762251.46	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_1005	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	5876	569997.07	5762252.63	22.5	Sub-bottom Contact	Low	
BB_FS_SBP_1006	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	15358	571087.65	5762253.48	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1007	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	15419	570870.41	5762255.35	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1008	ARAMIS_SK_SBP_TA2B065P1_1_LAT_20220723	14762	569890.21	5762256.17	15	Sub-bottom Contact	Low	
BB_FS_SBP_1009	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	4879	570213.80	5762256.95	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_1010	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	7502	570195.86	5762257.31	23.5	Sub-bottom Contact	Low	
BB_FS_SBP_1011	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	3729	570929.31	5762258.17	19	Sub-bottom Contact	Low	
BB_FS_SBP_1012	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	13924	570100.10	5762258.92	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_1013	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	7452	570192.32	5762258.93	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_1014	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5054	570973.82	5762259.87	14	Sub-bottom Contact	Low	
BB_FS_SBP_1015	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	13952	570097.06	5762260.13	17.9	Sub-bottom Contact	Low	
BB_FS_SBP_1016	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	8964	570404.84	5762260.51	17.5	Sub-bottom Contact	Low	
BB_FS_SBP_1017	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	8884	570300.62	5762262.64	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_1018	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	15106	571060.70	5762263.25	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1019	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	14028	570088.98	5762263.36	17.4	Sub-bottom Contact	Low	
BB_FS_SBP_1020	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	4813	570215.95	5762263.56	10	Sub-bottom Contact	Low	
BB_FS_SBP_1021	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	8930	570294.77	5762264.69	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_1022	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	14079	570083.46	5762265.62	19.4	Sub-bottom Contact	Low	
BB_FS_SBP_1023	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	14195	570071.41	5762270.87	18.6	Sub-bottom Contact	Low	BB_FS_MAG_0359
BB_FS_SBP_1024	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	4745	570217.67	5762271.17	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_1025	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	2621	571160.82	5762274.27	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_1026	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	9184	570721.12	5762276.47	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_1027	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	4682	570219.38	5762277.79	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_1028	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	19295	571237.74	5762280.96	13.8	Sub-bottom Contact	Low	BB_FS_MAG_0675
BB_FS_SBP_1029	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	3494	570932.37	5762281.87	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_1030	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	14656	571013.24	5762282.41	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_1031	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5602	570909.68	5762285.12	17	Sub-bottom Contact	Low	

BB_FS_SBP_1032	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	19178	571227.45	5762285.14	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_1033	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5625	570906.94	5762286.28	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1034	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	4839	569907.15	5762287.18	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_1035	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	6485	570123.10	5762288.36	24.3	Sub-bottom Contact	Low	
BB_FS_SBP_1036	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5676	570901.02	5762288.73	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1037	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5720	570895.95	5762290.87	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_1038	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5737	570894.07	5762291.65	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_1039	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5748	570892.67	5762292.24	15	Sub-bottom Contact	Low	
BB_FS_SBP_1040	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5793	570887.48	5762294.45	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_1041	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5866	570879.03	5762298.05	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_1042	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	5881	570877.27	5762298.80	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1043	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	23064	570177.93	5762302.72	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_1044	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	14138	570959.24	5762304.78	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_1045	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	7692	570290.75	5762306.85	22.4	Sub-bottom Contact	Low	
BB_FS_SBP_1046	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	5854	570072.39	5762308.41	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_1047	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	18385	571157.39	5762313.28	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_1048	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	9915	570628.82	5762313.75	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1049	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	13796	570922.71	5762316.99	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_1050	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	13774	570920.43	5762317.69	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_1051	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	15308	569951.57	5762318.10	22	Sub-bottom Contact	Low	BB_FS_MAG_0360
BB_FS_SBP_1052	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	13414	570713.43	5762318.33	15.2	Sub-bottom Contact	Low	
BB_FS_SBP_1053	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	13743	570917.09	5762318.72	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1054	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	10025	570614.90	5762319.16	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1055	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	6307	570827.73	5762319.31	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1056	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	18154	571136.89	5762321.31	10.1	Sub-bottom Contact	Low	BB_FS_MAG_0672
BB_FS_SBP_1057	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	5753	570126.57	5762322.53	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_1058	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	1567	571253.46	5762325.70	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1059	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	17982	571121.53	5762327.23	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1060	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	10192	570593.50	5762327.36	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_1061	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	17882	571112.50	5762330.87	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1062	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	10327	570576.19	5762333.93	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_1063	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	10364	570116.11	5762334.45	16.7	Sub-bottom Contact	Low	
BB_FS_SBP_1064	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	12739	570662.32	5762337.81	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_1065	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	10733	570523.94	5762353.98	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1066	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	20469	570887.78	5762355.13	6.1	Sub-bottom Contact	Low	
BB_FS_SBP_1067	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	10157	570286.30	5762357.06	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_1068	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	2312	571167.97	5762359.83	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_1069	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	10862	570507.60	5762360.48	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_1070	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	11969	570601.15	5762361.58	13	Sub-bottom Contact	Low	
BB_FS_SBP_1071	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	10878	570054.61	5762362.85	19.6	Sub-bottom Contact	Low	
BB_FS_SBP_1072	ARAMIS_SK_SBP_TA2B066P1_1_LAT_20220723	2341	569700.11	5762367.23	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1073	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16805	571016.67	5762368.02	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_1074	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	11069	570481.57	5762371.17	13.5	Sub-bottom Contact	Low	

BB_FS_SBP_1075	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16710	571008.47	5762371.86	13.2	Sub-bottom Contact	Low	BB_FS_MAG_0654
BB_FS_SBP_1076	ARAMIS_SK_SBP_TA2B068P1_1_LAT_20220723	3771	569908.35	5762373.39	23.2	Sub-bottom Contact	Low	
BB_FS_SBP_1077	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	16643	569807.61	5762375.45	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_1078	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	11136	570023.47	5762376.53	23.5	Sub-bottom Contact	Low	
BB_FS_SBP_1079	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	19883	571206.67	5762376.59	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_1080	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	19815	571200.15	5762378.71	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_1081	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	19719	571191.13	5762382.28	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_1082	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	16866	569783.70	5762384.81	23.1	Sub-bottom Contact	Low	
BB_FS_SBP_1083	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16359	570977.65	5762385.63	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_1084	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16329	570974.94	5762386.75	14	Sub-bottom Contact	Low	BB_FS_MAG_0670
BB_FS_SBP_1085	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	12194	570748.79	5762387.46	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_1086	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16303	570972.64	5762387.74	13.7	Sub-bottom Contact	Low	BB_FS_MAG_0670
BB_FS_SBP_1087	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16277	570970.36	5762388.76	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_1088	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	7832	570648.84	5762389.46	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1089	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	11122	570532.37	5762389.95	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1090	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	8652	570307.77	5762390.55	11	Sub-bottom Contact	Low	
BB_FS_SBP_1091	ARAMIS_SK_SBP_TA2B087P1_1_LAT_20220714	2402	570940.43	5762390.86	13.5	Sub-bottom Contact	Low	
BB_FS_SBP_1092	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	12110	570739.80	5762391.32	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_1093	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	7911	570639.55	5762393.07	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_1094	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	7922	570638.27	5762393.54	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1095	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	10933	570517.01	5762396.09	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1096	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	16018	570947.32	5762397.72	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_1097	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	3198	571067.88	5762397.75	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_1098	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	10784	570504.86	5762400.41	11	Sub-bottom Contact	Low	
BB_FS_SBP_1099	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	8080	570619.71	5762400.48	15.1	Sub-bottom Contact	Low	
BB_FS_SBP_1100	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	8365	570281.89	5762400.55	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1101	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	8361	570281.53	5762400.68	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1102	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	11055	570173.01	5762402.83	10.2	Sub-bottom Contact	Low	
BB_FS_SBP_1103	ARAMIS_SK_SBP_TA2B067P1_1_LAT_20220723	17334	569734.07	5762404.08	24.2	Sub-bottom Contact	Low	
BB_FS_SBP_1104	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	3335	571052.76	5762404.49	16.6	Sub-bottom Contact	Low	
BB_FS_SBP_1105	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	11759	569949.75	5762404.69	23	Sub-bottom Contact	Low	
BB_FS_SBP_1106	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	5163	570832.11	5762405.51	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_1107	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	8174	570264.46	5762407.18	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_1108	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	8128	570260.29	5762408.74	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_1109	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	1786	571256.89	5762408.93	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_1110	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	3531	570272.12	5762409.96	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_1111	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	18961	571121.56	5762410.80	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_1112	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	5246	570821.62	5762411.07	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_1113	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	8331	570590.32	5762411.71	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_1114	ARAMIS_SK_SBP_TA2B069P1_1_LAT_20220723	12007	569920.11	5762413.95	20.3	Sub-bottom Contact	Low	
BB_FS_SBP_1115	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	7964	570245.38	5762414.50	11	Sub-bottom Contact	Low	
BB_FS_SBP_1116	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	24104	570220.40	5762415.01	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_1117	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	1949	571239.87	5762415.99	11.9	Sub-bottom Contact	Low	

BB_FS_SBP_1118	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	2076	571226.54	5762421.18	7.6	Sub-bottom Contact	Low	
BB_FS_SBP_1119	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	10089	570448.11	5762422.10	11	Sub-bottom Contact	Low	
BB_FS_SBP_1120	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	12103	570350.24	5762425.63	14.2	Sub-bottom Contact	Low	
BB_FS_SBP_1121	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	11524	570113.92	5762426.09	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_1122	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	8640	570554.40	5762426.10	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_1123	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	24255	570228.04	5762429.41	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1124	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	11620	570101.09	5762430.77	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_1125	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	8748	570541.92	5762431.24	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_1126	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	12244	570332.14	5762432.38	11	Sub-bottom Contact	Low	
BB_FS_SBP_1127	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	3940	570984.70	5762433.06	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_1128	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	9781	570424.02	5762433.76	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_1129	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	17278	571258.41	5762445.35	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1130	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	21487	570891.13	5762445.43	5.4	Sub-bottom Contact	Low	
BB_FS_SBP_1131	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	9055	570506.28	5762445.90	21.6	Sub-bottom Contact	Low	
BB_FS_SBP_1132	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	5826	570745.78	5762446.82	11.1	Sub-bottom Contact	Low	
BB_FS_SBP_1133	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	5840	570743.90	5762447.56	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_1134	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	17183	571250.63	5762449.71	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_1135	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	17783	571014.43	5762452.57	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1136	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	2902	571139.66	5762454.38	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1137	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	10593	570576.82	5762454.43	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_1138	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	3356	569906.54	5762459.34	22.3	Sub-bottom Contact	Low	
BB_FS_SBP_1139	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	3026	571126.75	5762459.45	6.5	Sub-bottom Contact	Low	
BB_FS_SBP_1140	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	12796	570261.23	5762459.68	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1141	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	6672	570133.34	5762459.76	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_1142	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	6250	570688.37	5762468.59	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_1143	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	17324	570973.19	5762469.63	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_1144	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	6267	570100.11	5762473.45	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_1145	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	6214	570095.65	5762474.84	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1146	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	13776	570749.45	5762476.36	9.9	Sub-bottom Contact	Low	BB_FS_MAG_0650
BB_FS_SBP_1147	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	9739	570426.73	5762478.22	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_1148	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	16469	571190.24	5762478.51	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_1149	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	2862	569856.20	5762478.54	23.3	Sub-bottom Contact	Low	
BB_FS_SBP_1150	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	9828	570417.20	5762483.52	18	Sub-bottom Contact	Low	
BB_FS_SBP_1151	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	13558	570730.35	5762483.69	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1152	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	13282	570199.24	5762484.00	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1153	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	5910	570069.48	5762484.10	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_1154	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	9879	570411.67	5762486.37	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_1155	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	2560	569825.88	5762491.03	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1156	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	3864	571039.35	5762494.02	10.9	Sub-bottom Contact	Low	
BB_FS_SBP_1157	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	13116	570691.19	5762498.31	13.2	Sub-bottom Contact	Low	
BB_FS_SBP_1158	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	2371	569806.59	5762499.33	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_1159	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	5452	570812.05	5762500.20	15.7	Sub-bottom Contact	Low	
BB_FS_SBP_1160	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	15765	571127.56	5762500.82	10	Sub-bottom Contact	Low	

BB_FS_SBP_1161	ARAMIS_SK_SBP_TA2B070P1_1_LAT_20220723	2327	569802.43	5762501.15	18	Sub-bottom Contact	Low	
BB_FS_SBP_1162	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	7524	570246.74	5762501.56	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1163	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	22123	570895.45	5762501.57	5.6	Sub-bottom Contact	Low	
BB_FS_SBP_1164	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	16373	570889.69	5762502.33	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_1165	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	13645	570153.16	5762502.64	11.8	Sub-bottom Contact	Low	
BB_FS_SBP_1166	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	12958	570677.32	5762504.27	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1167	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	15596	571112.46	5762505.96	21.1	Sub-bottom Contact	Low	
BB_FS_SBP_1168	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	7327	570231.53	5762507.44	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_1169	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	12780	570662.10	5762511.63	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1170	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	15978	570854.64	5762515.27	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_1171	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	5794	570773.46	5762515.54	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1172	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	5795	570773.35	5762515.58	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_1173	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	10606	570329.26	5762516.58	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_1174	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	12637	570649.82	5762517.21	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1175	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	8883	570401.30	5762524.34	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_1176	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	22383	570896.43	5762525.16	5.7	Sub-bottom Contact	Low	
BB_FS_SBP_1177	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	10855	570300.51	5762526.68	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_1178	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	25196	570268.92	5762526.97	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_1179	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	6088	570740.20	5762529.08	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1180	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	6143	570734.07	5762531.55	13.9	Sub-bottom Contact	Low	
BB_FS_SBP_1181	ARAMIS_SK_SBP_TA2B084P1a_1_LAT_20220714	25246	570271.07	5762532.48	10.2	Sub-bottom Contact	Low	BB_FS_MAG_0583
BB_FS_SBP_1182	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	6194	570728.23	5762533.91	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1183	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	6467	570163.91	5762534.29	11.9	Sub-bottom Contact	Low	
BB_FS_SBP_1184	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	12097	570602.63	5762535.78	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1185	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	6250	570721.94	5762536.38	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1186	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	11951	570589.91	5762540.49	12.4	Sub-bottom Contact	Low	
BB_FS_SBP_1187	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	11874	570583.03	5762543.14	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_1188	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	5125	570908.12	5762547.10	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_1189	ARAMIS_SK_SBP_TA2B071P1_1_LAT_20220723	13906	569806.12	5762547.72	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_1190	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	11678	570565.82	5762549.78	10	Sub-bottom Contact	Low	
BB_FS_SBP_1191	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	5190	570901.39	5762549.88	6.1	Sub-bottom Contact	Low	
BB_FS_SBP_1192	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	14970	570771.38	5762549.99	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_1193	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	8148	570329.36	5762557.95	11.4	Sub-bottom Contact	Low	
BB_FS_SBP_1194	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	8131	570327.77	5762558.75	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_1195	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	8047	570439.97	5762558.90	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_1196	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	6768	570663.01	5762559.32	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1197	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	14660	570744.64	5762559.45	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1198	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	13799	570953.34	5762561.29	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1199	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	8146	570426.32	5762564.28	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_1200	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	3500	569867.22	5762565.71	14.5	Sub-bottom Contact	Low	
BB_FS_SBP_1201	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	8228	570415.03	5762568.52	8.3	Sub-bottom Contact	Low	
BB_FS_SBP_1202	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	11794	570194.77	5762569.67	17.6	Sub-bottom Contact	Low	
BB_FS_SBP_1203	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	7022	570634.44	5762570.05	20.3	Sub-bottom Contact	Low	

BB_FS_SBP_1204	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	11838	570189.78	5762571.77	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_1205	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	10905	570498.68	5762578.32	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_1206	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	8474	570381.11	5762581.51	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_1207	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6031	570813.81	5762585.47	7.1	Sub-bottom Contact	Low	
BB_FS_SBP_1208	ARAMIS_SK_SBP_TA2B077P1_1_LAT_20220719	8577	570366.90	5762587.10	8.9	Sub-bottom Contact	Low	
BB_FS_SBP_1209	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	13064	570894.11	5762591.00	9.5	Sub-bottom Contact	Low	
BB_FS_SBP_1210	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6216	570794.42	5762592.95	7	Sub-bottom Contact	Low	
BB_FS_SBP_1211	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	12987	570887.78	5762593.65	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_1212	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	12425	570122.10	5762597.03	17.7	Sub-bottom Contact	Low	
BB_FS_SBP_1213	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	10334	570446.93	5762597.45	10	Sub-bottom Contact	Low	
BB_FS_SBP_1214	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6349	570780.51	5762598.48	14.6	Sub-bottom Contact	Low	
BB_FS_SBP_1215	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	13475	570643.97	5762598.79	8.5	Sub-bottom Contact	Low	
BB_FS_SBP_1216	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	4383	569990.97	5762603.34	11	Sub-bottom Contact	Low	
BB_FS_SBP_1217	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	6844	570195.32	5762604.34	11	Sub-bottom Contact	Low	
BB_FS_SBP_1218	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6529	570761.48	5762606.01	7.2	Sub-bottom Contact	Low	
BB_FS_SBP_1219	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	1815	570354.68	5762606.85	12	Sub-bottom Contact	Low	
BB_FS_SBP_1220	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6594	570754.70	5762608.85	12.2	Sub-bottom Contact	Low	
BB_FS_SBP_1221	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	12432	570840.78	5762612.05	17.8	Sub-bottom Contact	Low	
BB_FS_SBP_1222	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	8011	570525.30	5762613.20	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_1223	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	1713	570360.15	5762618.71	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1224	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	12913	570597.45	5762618.81	9	Sub-bottom Contact	Low	
BB_FS_SBP_1225	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	1856	569729.41	5762620.99	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1226	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	15977	569858.47	5762625.47	17.2	Sub-bottom Contact	Low	
BB_FS_SBP_1227	ARAMIS_SK_SBP_TA2B086P1_1_LAT_20220714	23572	570900.30	5762628.83	6.1	Sub-bottom Contact	Low	
BB_FS_SBP_1228	ARAMIS_SK_SBP_TA2B072P1_1_LAT_20220719	1522	569698.82	5762628.93	13.4	Sub-bottom Contact	Low	
BB_FS_SBP_1229	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	6964	570718.94	5762632.27	7.3	Sub-bottom Contact	Low	
BB_FS_SBP_1230	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	9376	570353.88	5762633.03	9.8	Sub-bottom Contact	Low	
BB_FS_SBP_1231	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	11625	570770.19	5762633.47	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_1232	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	13202	570031.16	5762633.88	11	Sub-bottom Contact	Low	
BB_FS_SBP_1233	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	6120	570121.84	5762633.97	14.7	Sub-bottom Contact	Low	
BB_FS_SBP_1234	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	12431	570556.12	5762634.17	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_1235	ARAMIS_SK_SBP_TA2B083P1_1_LAT_20220714	2176	570252.20	5762635.10	15.6	Sub-bottom Contact	Low	
BB_FS_SBP_1236	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	11558	570764.39	5762635.14	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_1237	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	9140	570331.67	5762642.62	13.6	Sub-bottom Contact	Low	
BB_FS_SBP_1238	ARAMIS_SK_SBP_TA2B084P1a_2_LAT_20220714	480	570316.38	5762642.66	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_1239	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	16661	569774.23	5762651.64	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1240	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	8929	570425.64	5762651.84	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1241	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	11925	570514.90	5762651.85	9.1	Sub-bottom Contact	Low	
BB_FS_SBP_1242	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	10879	570710.82	5762657.24	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_1243	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9050	570413.07	5762657.99	13.8	Sub-bottom Contact	Low	
BB_FS_SBP_1244	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	11614	570488.47	5762661.50	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_1245	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	7736	570636.28	5762662.06	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1246	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	1337	570379.36	5762662.65	12	Sub-bottom Contact	Low	

BB_FS_SBP_1247	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	7807	570628.75	5762664.09	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1248	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	7830	570626.31	5762664.70	10.4	Sub-bottom Contact	Low	
BB_FS_SBP_1249	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9231	570393.78	5762666.38	10	Sub-bottom Contact	Low	
BB_FS_SBP_1250	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	2505	569827.99	5762667.57	13	Sub-bottom Contact	Low	
BB_FS_SBP_1251	ARAMIS_SK_SBP_TA2B073P1_1_LAT_20220719	17076	569722.89	5762668.81	13.1	Sub-bottom Contact	Low	
BB_FS_SBP_1252	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	1280	570381.97	5762669.23	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_1253	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	8006	570608.06	5762669.38	6.5	Sub-bottom Contact	Low	
BB_FS_SBP_1254	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9441	570371.22	5762675.20	10.6	Sub-bottom Contact	Low	
BB_FS_SBP_1255	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	8240	570583.42	5762675.99	6.6	Sub-bottom Contact	Low	
BB_FS_SBP_1256	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9498	570365.10	5762677.53	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_1257	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	14188	569914.61	5762678.94	16	Sub-bottom Contact	Low	
BB_FS_SBP_1258	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	2144	569796.39	5762680.12	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1259	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9569	570357.40	5762680.30	13.7	Sub-bottom Contact	Low	
BB_FS_SBP_1260	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9610	570352.92	5762681.96	15.3	Sub-bottom Contact	Low	
BB_FS_SBP_1261	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	9810	570331.05	5762689.81	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_1262	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	9720	570618.92	5762696.87	10	Sub-bottom Contact	Low	
BB_FS_SBP_1263	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10521	570398.49	5762696.93	13.3	Sub-bottom Contact	Low	
BB_FS_SBP_1264	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10385	570387.12	5762701.17	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_1265	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10293	570379.37	5762704.63	8.8	Sub-bottom Contact	Low	
BB_FS_SBP_1266	ARAMIS_SK_SBP_TA2B085P1_1_LAT_20220714	976	570396.06	5762704.78	8.5	Sub-bottom Contact	Low	
BB_FS_SBP_1267	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	8952	570509.52	5762706.93	6.5	Sub-bottom Contact	Low	
BB_FS_SBP_1268	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10171	570369.65	5762708.84	8.7	Sub-bottom Contact	Low	
BB_FS_SBP_1269	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10138	570367.14	5762709.85	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_1270	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	10131	570366.57	5762710.10	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_1271	ARAMIS_SK_SBP_TA2B074P1_1_LAT_20220719	1215	569715.50	5762712.80	13	Sub-bottom Contact	Low	
BB_FS_SBP_1272	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	9369	570465.73	5762721.56	6	Sub-bottom Contact	Low	
BB_FS_SBP_1273	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	10673	570237.24	5762726.45	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_1274	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	8702	570532.65	5762729.83	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1275	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	10767	570226.98	5762730.75	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_1276	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	8616	570525.34	5762732.64	10.5	Sub-bottom Contact	Low	
BB_FS_SBP_1277	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	15337	569779.84	5762733.27	16.3	Sub-bottom Contact	Low	
BB_FS_SBP_1278	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	8571	570521.69	5762734.01	10.3	Sub-bottom Contact	Low	
BB_FS_SBP_1279	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	6539	570087.38	5762739.65	11.6	Sub-bottom Contact	Low	
BB_FS_SBP_1280	ARAMIS_SK_SBP_TA2B075P1_1_LAT_20220719	15496	569761.16	5762740.50	18.1	Sub-bottom Contact	Low	
BB_FS_SBP_1281	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	11007	570201.20	5762742.20	11.3	Sub-bottom Contact	Low	
BB_FS_SBP_1282	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	10083	570390.35	5762745.10	6.7	Sub-bottom Contact	Low	BB_FS_MAG_0759
BB_FS_SBP_1283	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	8007	570474.82	5762752.30	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_1284	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	11287	570170.86	5762755.76	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_1285	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	7738	570451.99	5762761.02	15	Sub-bottom Contact	Low	
BB_FS_SBP_1286	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	7736	570451.82	5762761.08	15.4	Sub-bottom Contact	Low	
BB_FS_SBP_1287	ARAMIS_SK_SBP_TA2B084P1a_2_LAT_20220714	1618	570368.52	5762763.58	12.7	Sub-bottom Contact	Low	
BB_FS_SBP_1288	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	5845	570022.61	5762765.28	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_1289	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	8370	570218.43	5762767.69	14.3	Sub-bottom Contact	Low	

BB_FS_SBP_1290	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	10612	570334.77	5762775.14	10.7	Sub-bottom Contact	Low	
BB_FS_SBP_1291	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	11810	570113.06	5762779.88	16.2	Sub-bottom Contact	Low	
BB_FS_SBP_1292	ARAMIS_SK_SBP_TA2B076P1_1_LAT_20220719	2405	569755.93	5762783.14	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_1293	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	11979	570094.07	5762787.24	21.7	Sub-bottom Contact	Low	
BB_FS_SBP_1294	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	10946	570299.73	5762789.99	12.1	Sub-bottom Contact	Low	
BB_FS_SBP_1295	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	6776	570356.14	5762801.49	11	Sub-bottom Contact	Low	
BB_FS_SBP_1296	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	6690	570345.98	5762805.42	14.4	Sub-bottom Contact	Low	
BB_FS_SBP_1297	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	6586	570333.55	5762810.24	12.9	Sub-bottom Contact	Low	
BB_FS_SBP_1298	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	12909	569988.35	5762826.35	21.9	Sub-bottom Contact	Low	
BB_FS_SBP_1299	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	6124	570277.38	5762829.96	10.8	Sub-bottom Contact	Low	
BB_FS_SBP_1300	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	13010	569977.17	5762830.39	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1301	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	13306	569944.47	5762842.81	12.6	Sub-bottom Contact	Low	
BB_FS_SBP_1302	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	13508	569922.30	5762851.63	9.6	Sub-bottom Contact	Low	
BB_FS_SBP_1303	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	3337	569798.64	5762852.53	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1304	ARAMIS_SK_SBP_TA2B078P1_1_LAT_20220718	3245	569790.45	5762855.23	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1305	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	5555	570210.31	5762856.64	14.3	Sub-bottom Contact	Low	
BB_FS_SBP_1306	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	5616	569991.40	5762859.31	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_1307	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	5234	570172.78	5762872.35	16.9	Sub-bottom Contact	Low	
BB_FS_SBP_1308	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	5197	569957.54	5762873.15	9	Sub-bottom Contact	Low	
BB_FS_SBP_1309	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	5198	570168.66	5762873.99	11.7	Sub-bottom Contact	Low	
BB_FS_SBP_1310	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	13027	570080.46	5762875.87	12.3	Sub-bottom Contact	Low	
BB_FS_SBP_1311	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	4630	569910.99	5762890.57	9.2	Sub-bottom Contact	Low	
BB_FS_SBP_1312	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	13513	570027.94	5762893.96	5.9	Sub-bottom Contact	Low	
BB_FS_SBP_1313	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	14543	569809.55	5762897.72	10.1	Sub-bottom Contact	Low	
BB_FS_SBP_1314	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	13678	570010.07	5762899.30	6.6	Sub-bottom Contact	Low	
BB_FS_SBP_1315	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	14815	569779.41	5762909.24	18.9	Sub-bottom Contact	Low	
BB_FS_SBP_1316	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	14036	569971.11	5762911.37	6.3	Sub-bottom Contact	Low	
BB_FS_SBP_1317	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	14094	569964.91	5762913.11	6.7	Sub-bottom Contact	Low	
BB_FS_SBP_1318	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	4254	570058.70	5762918.10	9.3	Sub-bottom Contact	Low	
BB_FS_SBP_1319	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	14256	569947.49	5762918.55	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_1320	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	4180	570050.09	5762921.50	11.5	Sub-bottom Contact	Low	
BB_FS_SBP_1321	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	3706	569834.43	5762922.14	9.4	Sub-bottom Contact	Low	
BB_FS_SBP_1322	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	15111	569747.37	5762922.47	19.4	Sub-bottom Contact	Low	
BB_FS_SBP_1323	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	15422	569713.21	5762935.55	15.9	Sub-bottom Contact	Low	
BB_FS_SBP_1324	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	3808	570005.93	5762937.39	9.9	Sub-bottom Contact	Low	
BB_FS_SBP_1325	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	3707	569993.72	5762941.18	18.3	Sub-bottom Contact	Low	
BB_FS_SBP_1326	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	3679	569990.30	5762942.19	10	Sub-bottom Contact	Low	
BB_FS_SBP_1327	ARAMIS_SK_SBP_TA2B079P1_1_LAT_20220718	15580	569695.93	5762942.47	19.8	Sub-bottom Contact	Low	
BB_FS_SBP_1328	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	14797	569888.96	5762942.79	12.8	Sub-bottom Contact	Low	
BB_FS_SBP_1329	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	3372	569953.24	5762953.75	9.7	Sub-bottom Contact	Low	
BB_FS_SBP_1330	ARAMIS_SK_SBP_TA2B080P1_1_LAT_20220717	2372	569725.05	5762966.55	8.4	Sub-bottom Contact	Low	
BB_FS_SBP_1331	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	15368	569827.35	5762971.27	7	Sub-bottom Contact	Low	
BB_FS_SBP_1332	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	15378	569826.25	5762971.71	8.5	Sub-bottom Contact	Low	

BB_FS_SBP_1333	ARAMIS_SK_SBP_TA2B081P1_1_LAT_20220717	16135	569746.02	5763005.97	8.1	Sub-bottom Contact	Low	
BB_FS_SBP_1334	ARAMIS_SK_SBP_TA2B082P1_1_LAT_20220712	1656	569765.50	5763036.50	15.8	Sub-bottom Contact	Low	

Appendix I

GAMBAS Marine Refraction System Specifications

GAMBAS® MARINE REFRACTION SYSTEM

1. GAMBAS® SYSTEM SPECIFICATIONS

The GAMBAS® system is a refraction and MASW data acquisition system developed by FUGRO FRANCE. A key component of the GAMBAS® system is the *stop-and-go* motion device which enables the sledge to remain stationary and the streamer to keep in close contact with the seabed during the shooting and recording sequences while the vessel continues sailing. The stop-and-go device is required for maximum system resolution.

The technique is not dependant on the water depth (limitation is the draught of the vessel) and has been operated to 70 m water depth.

For the GAMBAS® system, the stop-and-go device is integrated to the winch.

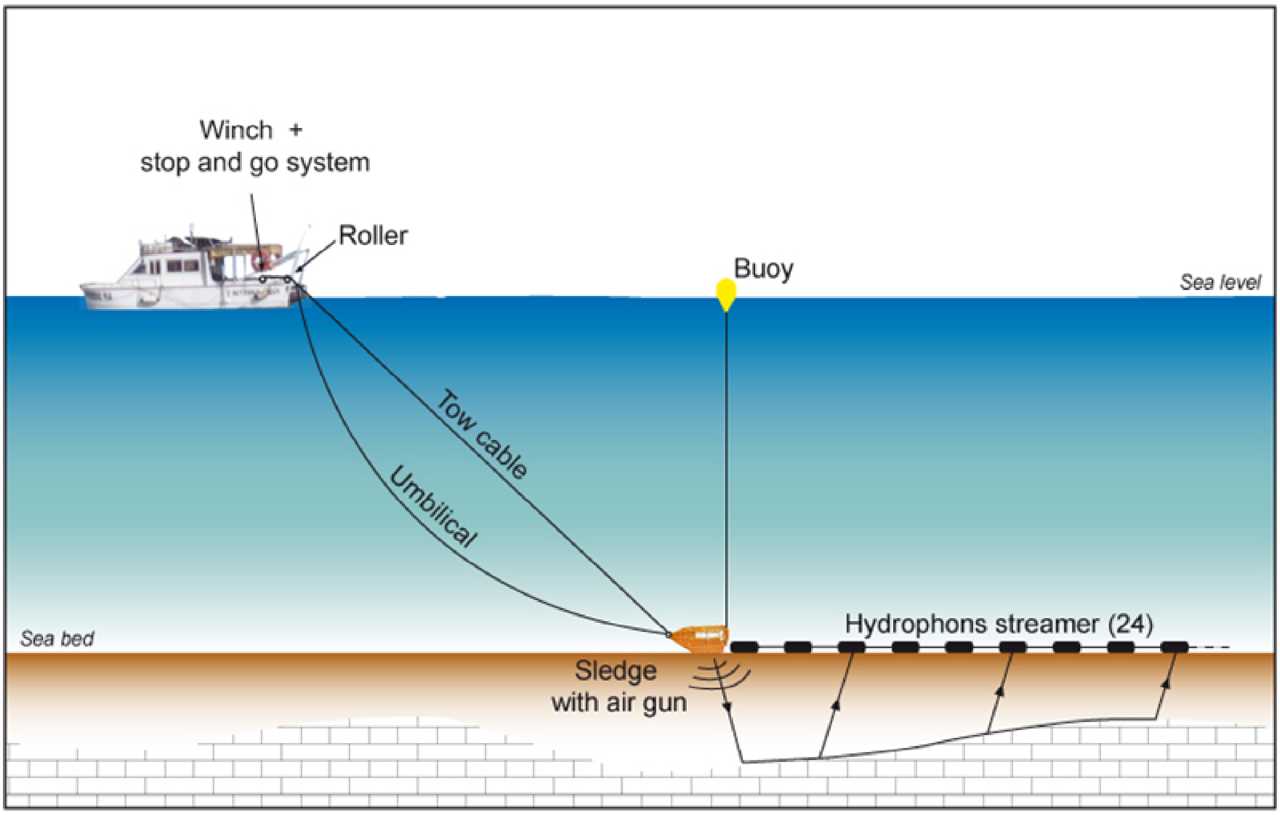


Figure 1: GAMBAS® General Arrangement

The GAMBAS® system operated by Fugro France is based on the high resolution seismic refraction technique which is specifically designed to investigate the first metres of sediments below the seabed. The tool towed on the sea bottom by the survey vessel discloses pseudo-continuous profiling of the soil stratigraphy over the target depth and a precise measurement of the compressional wave velocity associated to the various layers.

At each shot point (average spacing between shot is 20 m), the end processing provides a velocity profile expressed as a file of (hi – Vi) pairs where:

- ✓ hi is the thickness of layer i
- ✓ Vi is the compressional seismic velocity associated with layer i

For engineering purposes, the velocity fields are then organised into a coherent representation of the sub-soil stratigraphy, each layer being properly delineated and defined by a characteristic value of its compressional velocity.

This is obtained by selecting velocity classes associated with the different soil types identified along the profile.

Creation of velocity classes requires a statistical analysis of the velocity fields measured along the route. A correlation of the geotechnical results with the velocity fields normally improves the selection of the velocity classes.

2. GAMBAS® REFRACTION DATA PROCESSING AND INTERPRETATION

2.1 Preliminary Processing and Interpretation

The processing of Gambas® data is carried out using a Fugro software package – *"Starfix.Gambas"*. This software provides the P-waves seismic velocities and the thickness of the different layers of the sub-seabed at each shot location.

Shot by shot, the channels are displayed on the screen of the control PC. This allows the operator to check the quality of the signals and detect any source or hydrophone malfunctions.

The program can perform an automatic picking of first arrival. However, the available manual picking option is often used.

First arrival times are selected, then plotted against the source-hydrophone distances. The software selects automatically the number of layers (up to 5 layers can be identified) and computes the velocity and thickness of each layer.

A processing flow is further explained in the following figures.

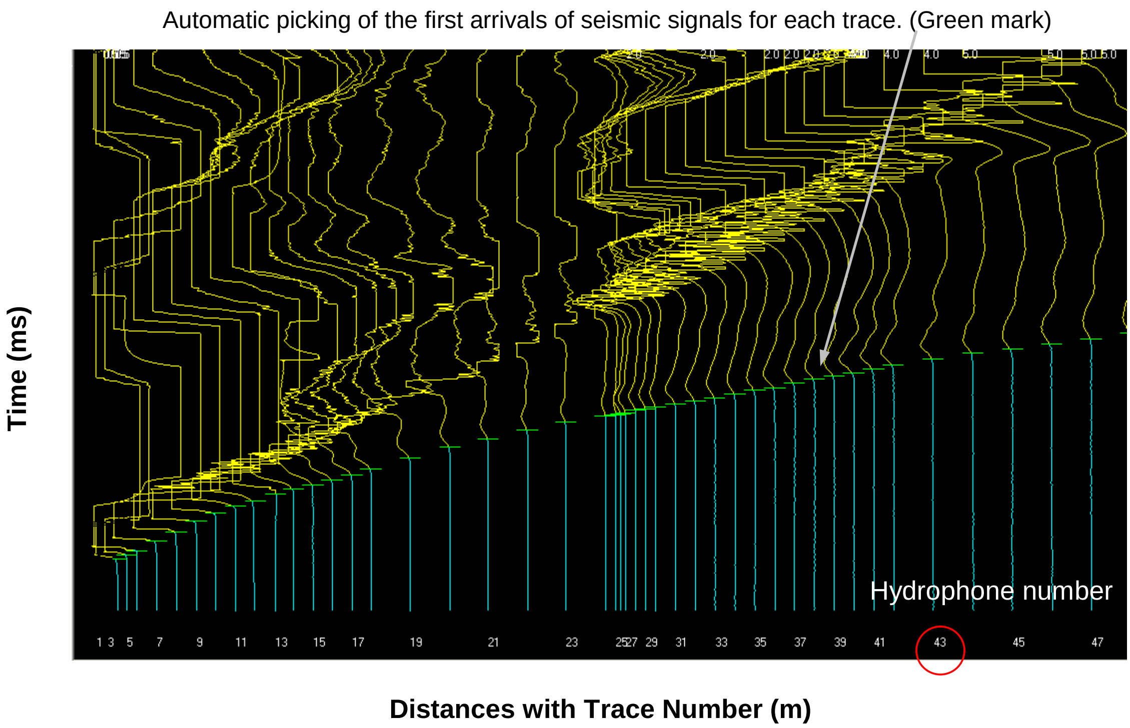
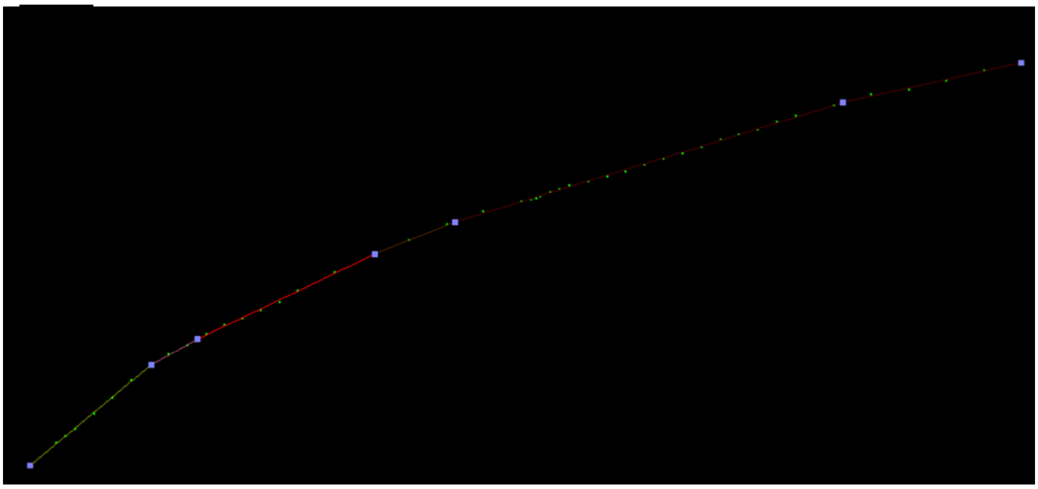


Figure 2: Selection of Seismic Arrivals

Time-distance curves are generated for each shot, and automatic interpretation is performed using the "intercept method".

Time (ms)

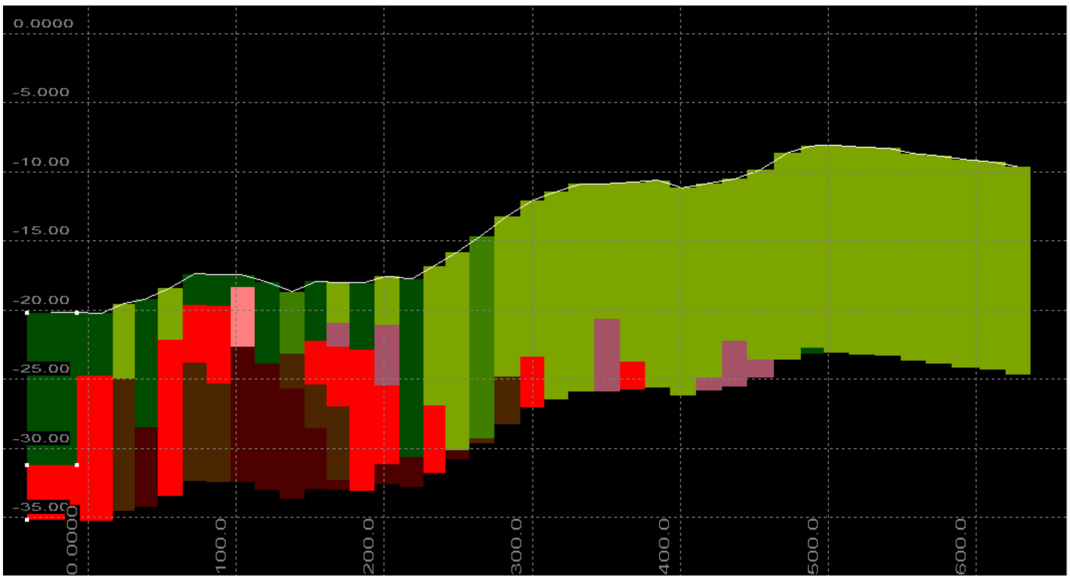


Distance (metres)

Figure 3: Automatic Interpretation – Time-Distance curve

Once this process is complete, a bar chart showing raw velocities and depths versus KPs, is displayed (see Figure 4 presented below).

Depth (m)



Distance (metres)

Figure 4: Bar Chart – Raw Velocities and Depths versus KPs

The full suite of Gambas® results, including:

- Time
- Shot number
- KP number
- Line number
- Bathymetry
- Raw velocities versus depth

is generated under “Starfix.Gambas®” as a proprietary binary format file. This file can be checked at any time during acquisition or in post processing.

2.2 Final Processing

The next stage of the processing consists in identifying and materialising on the bar graph, the areas of homogeneous velocities called *Velocity Classes*. Velocity classes are defined according to several criteria.

The number of velocity classes should be limited for practical considerations: 5 to 10 classes is generally more than adequate to describe simple to complex geological conditions.

Velocity classes should be (as much as possible) valid for representing the totality of the project data. Classes should correspond to well identified soil/rock conditions in connection with engineering considerations.

Ideally, the final selection of the velocity classes should be made when all geotechnical data are available and interpreted. This would allow for a full data integration process, and would guaranty that the above criteria are met.

2.3 MAIN LIMITATION OF THE REFRACTION METHOD

- The theory of seismic refraction only deals with velocity increasing with depth. A slow layer beneath a fast layer may not be determined.
- Seismic refraction provides averaged velocities, representative of a large volume of soil, depending on the streamer length and the shot spacing. It may not be appropriate to detect local structural variations (layers, slabs or protrusions), e.g.:
- a thin layer immediately overlying a fast refractor will not necessarily be detected cause arrivals from its surface may be overtaken by those from the faster horizon (the so-called ‘hidden layer’ effect);
  - thin, fast layers will not necessarily be detected, particularly if they lie at depth. The refracted signal is attenuated when travelling in a layer significantly thinner than the signal wavelength and first arrivals will therefore not be detectable;
  - a thin slab of hard rock (much thinner than the streamer length or shot spacing) may not be visible. If this slab is interbedded into soft sediment, the average velocity will slightly increase, but not enough, however, to show the protrusion;
  - local irregularities of the substratum will be probably smoothed.
- The lateral resolution could be limited very limited. Small size protrusions, located between two survey lines, may not be evidenced.
- The effective depth of penetration is a function of the streamer length but also a function of the sub-seabed velocity structure (especially the velocity ratio).
- Different lithologies, but with the same degree of consolidation, will not necessarily exhibit contrasting velocities. For example, the velocity in dense sand may be similar to the one in stiff clay.
- We generally assumed that the resulting model is located just below the streamer position. However, strictly speaking, it is important to notice that the result given represents the nearest orthogonal layer.

Appendix J

MASW Process of GAMBAS Data

MASW PROCESS
OF
GAMBAS® DATA

TABLE OF CONTENTS

1. THEORY OF THE MASW METHOD

1.1 Principle

The Multichannel Analysis of Surface Waves (MASW) method is a seismic investigation method which allows a non-invasive estimation of seismic shear wave velocity, a key parameter for the evaluation of elastic properties of soils and rocks.

Shear waves present the particularity of not being affected by the presence of gas within the soil; therefore the method provides results were seismic refraction fails to.

In seismic reflection method, surface waves are regarded as noise (ground-roll), they do however contain very valuable information on properties of the medium through which they propagate. These shear wave velocity variations propagates as a function of depth, which is directly related to the soil stiffness through the maximum shear modulus at small strain called G_0 (or G_{max}):

$$G_0 = \rho V_{Shear}^2$$

Where:
- ρ : density
- V_{Shear} : shear wave velocity

Surface waves analysis can be conducted in different ways. FGCF uses the recently developed and well documented MASW technique which is well suited for marine investigations. To collect MASW data, the standard spread is made up of a source that creates an acoustic wave and a hydrophones array (streamer) which records pressure variations versus time. Approximately, two thirds of the energy from an impact source propagates as surfaces waves (called Scholte waves at the water-ground interface and Rayleigh waves at the air-ground interface).

Considering vertical velocity variation, each frequency component of a surface wave has a different propagation velocity, called phase velocity. This property is called dispersion. The dispersive properties of the surface waves can be used to infer near-surface elastic properties in particular weathering and stiffness which are critical properties for geotechnical studies.

Dispersion curves are constructed by extracting the fundamental mode of the Scholte wave; it is the phase velocity as a function of frequency. Appropriate acquisition and processing procedure along with optimised source-receiver arrays are of prime importance to determine the surface wave dispersion curves with sufficient accuracy and confidence.

The calculation of true V_s is inferred from a process called inversion. As the Scholte wave is close to shear wave velocity, the algorithm initially developed for Rayleigh waves is applied to Scholte waves. The inversion enables to construct shear wave velocity profiles for the upper meters of sub seabed sediments. It is commonly admitted that:

$$V_{shear}=0.9\ V_s$$

Regarding the small difference between Rayleigh and Scholte waves, the inversion may lead to slightly underestimated velocity of the shallowest layer; the maximum difference is usually less than 5% and the correction usually falls below the uncertainty level of measurement.

1.2 Limitations

The MASW method's specific limitations are as follows:

- The MASW is a volume measurement which involves a large volume of soil located under the streamer, the method is then not suitable for resolving velocity variation smaller than a few meters;
- The inversion of the dispersion curve requires a preliminary knowledge of the soil conditions in order to create an initial earth model;
- This technique is well suited for shallow investigation. Deep penetration (>20-30 m) cannot be easily investigated;
- The MASW technique is not suited for very shallow investigation (<2-5 m)
- The interpretation of the V_s profile is assumed to be at the centre of the spread (i.e. the centre of the streamer for Gambas®)
- Direct detection of faults or cavities represents a difficult exercise in MASW, as for most engineering geophysical techniques.

2. DATA COLLECTION USING GAMBAS® SYSTEM

2.1 Principle and benefits of the Gambas® System

The Gambas® system is developed for in motion acquisition of seismic data which can be used through Seismic Refraction and Multichannel Analysis of Surface Waves (MASW) methods. These geophysical methods are specifically designed to investigate the near surface sediments and provide compressional and shear wave velocities, V_p and V_s respectively, and are not dependent on the water depth.

Intrinsic velocities of material are related to mechanical parameters used for engineering purposes. In general, V_p and V_s increase with densification of granular sediments, stiffness of clayey sediments, degree of cementation, occurrence of gravel and rock fragments. In case of rocks, velocities increase when weathering and fracturing decrease.

The contact between the hydrophone streamer and the sea bed is mandatory for high precision of the measures and shear wave velocity measurement. A key component of the Gambas® system is the stop-and-go motion which enables the sledge remaining stationary and the streamer in close contact with the seabed during the shooting and recording sequences while the vessel continues sailing.

The technique is not dependant on the water depth and has been operated from less than 2 m (limitation is the draught of the vessel) to 35 m water depth. An offshore set up is available with an increased capability of 65 m water depth.

The Gambas® enables a pseudo-continuous profiling with a vessel's speed of about 2 to 3 knots; with this speed shots are fired every 15 to 20 m.

2.2 MASW Processing of Gambas® Data

The MASW involves 4 main steps performed under dedicated softwares MASWCheck® (Fugro in-house software) and Surfseis® (developed by the Kansas Geological Survey):

- **Merge of bathymetric, positioning and seismic data, through MASWCheck®**

For each seismic shot, the actual position of the centre of the streamer derived from navigation data is projected on the theoretical line and position of seismic result are eventually expressed in KP along this line. Likewise, water depth at the centre of the streamer is extracted from the bathymetric data and applied to each shotpoint.

- **Signal pre-processing, through MASWCheck®**

Depending on the seismic film, a pre-process of the recorded signal may be needed and a series of filters and mutes be applied. The pre-processing step is manual and adapted to each individual record. The filtering and muting steps are of prime importance as they allow isolating the fundamental mode, where the dispersion curve will be picked out, from higher modes, considered as noise. Excluding all useless information which creates noise (areas outside the red area in Figure 2.1 here under) is the key operation for accurate and complete picking of the dispersion curve.

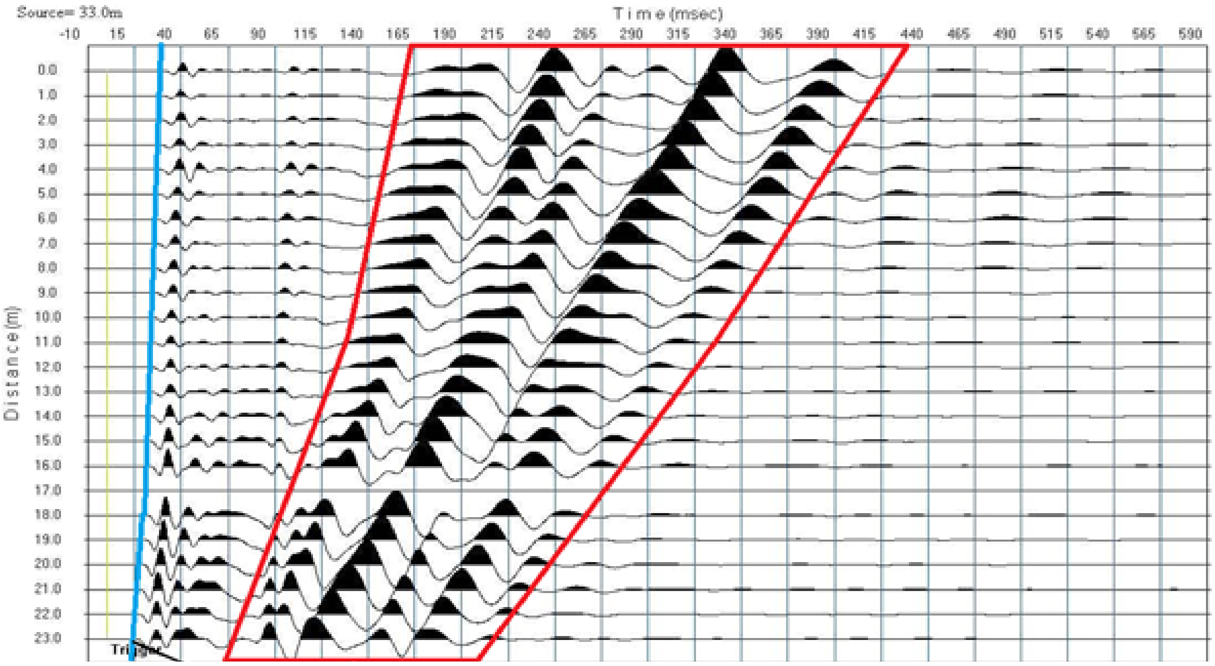


Figure 2-1: Example of seismic record.

On the above Figure 2.1, the MASW signal is contained into the red area; the blue line highlights the first arrivals (direct and refracted waves). The dispersion effect is revealed by the widening of the wavelength of the surface wave: the wavelet period increases when getting away from the source.

- **Construction of the dispersion curve, through MASWCheck®**

Once the MASW component of the signal identified and isolated into the time-distance domain, the resulting signal is plotted into the velocity-frequency domain. Maximum of energies are picked and linked together which results in the so-called dispersion curves (Figure 2.2).

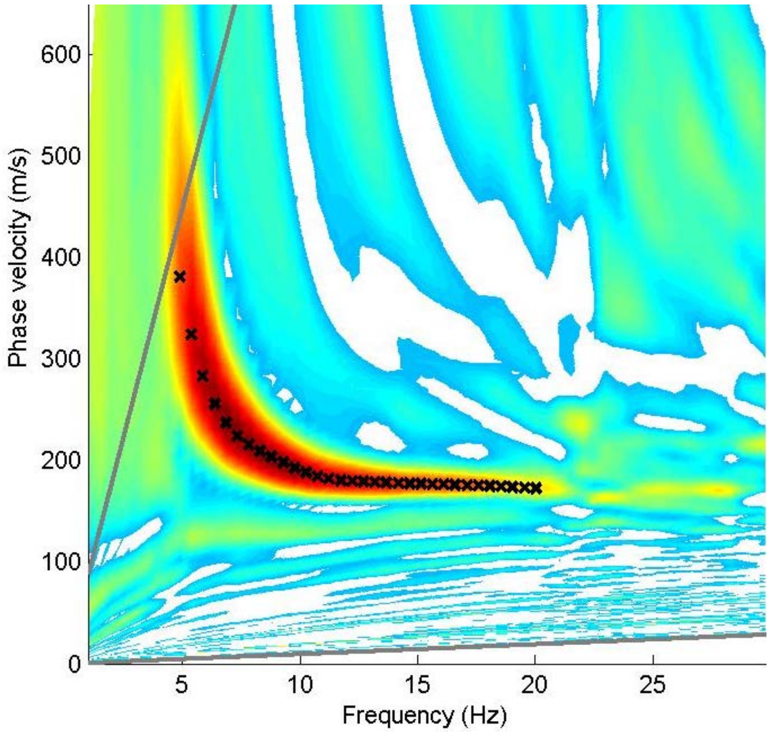


Figure 2-2 : Example of dispersion curve extracted from seismic data

- **Construction of 2D V_s-depth profile, through Surfseis®**

Once extracted, the dispersion curve is inversed with the Surfseis® software and a 1D V_s versus depth profile is created for a given seismic record; then all shots from a profile are assembled into a 2D profile where the velocities are weighted taking into account neighbour shots and then horizontally and vertically smoothed. This is called the inversion process.

The MASW is a volume measurement which involves the top tens of metres of soil located under the streamer, considering typical streamer length and distance between shots; the same portion of soil is usually investigated on 3 to 6 consecutive seismic shots.

Resulting V_s versus depth 2D profiles are treated with Surfer® as cross-sections and plotted with AutoCAD® or ArcGIS®. The resulting sections are the raw profiles, meaning that no geological interpretation is applied.

3. ASSESSMENT OF SIGNAL QUALITY AND RELIABILITY

3.1 Signal quality

The surface wave signal quality is related to the predominance of the fundamental mode. The better the fundamental mode can be discriminated from higher modes, the higher the precision of the resulting V_s profile and the thicker the resolved layer (see chapter 3.2 Resolved depth). When too close from the fundamental mode, the presence of higher modes leads to an overestimation of the shear-wave velocity or, at worst, prevents any extraction of a reliable dispersion curve.

Figure 3.1 here under shows 3 examples of surface wave signal. The signal quality increases from left to right:

- On the left-hand example the higher modes were not recorded or filtered during the pre-processing phase, and the fundamental mode is easily identified along a large frequency range
- on the middle example the higher mode is present but does not mask the fundamental mode
- on the right-hand example the higher mode is more powerful than the fundamental mode for frequencies higher than 25-30Hz and the dispersion curve cannot be further picked out.

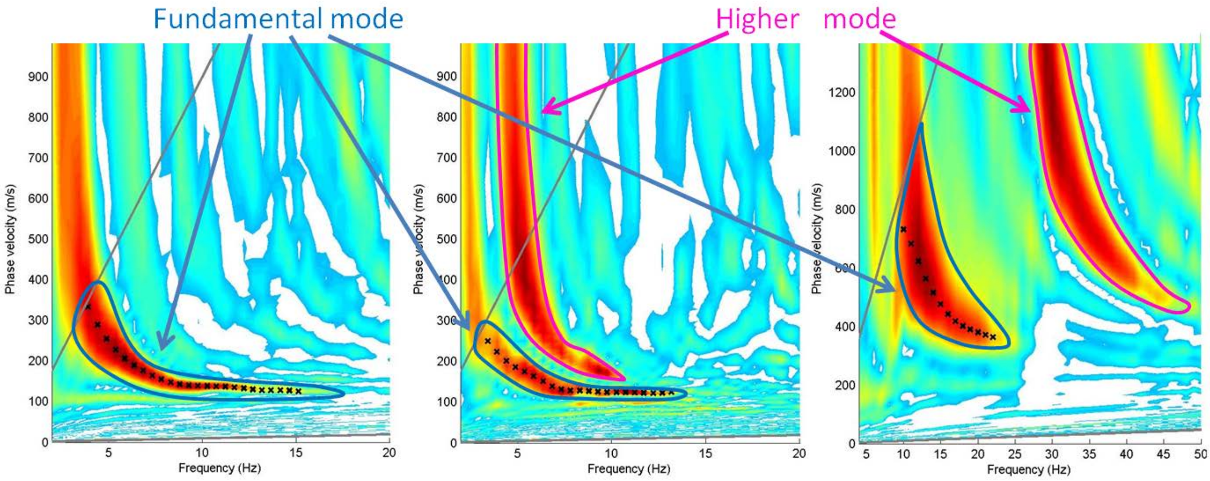


Figure 3-1 : Surface wave signals, fundamental and higher modes.

Based on experience in various geological contexts, Fugro confirmed that the surface waves signal quality is closely related to the local ground condition. A favourable context to well discriminated modes consists in a dispersive medium, i.e. presenting a smooth density / stiffness gradient toward depth, without any strong contrast. It results in shear wave velocities increasing regularly with depth. Fugro and could discriminate 3 types of geological contexts generating distinct responses in terms of surface waves signal:

a. Sedimentary layers are present from seabed and extend down to more than 20 m BSB; the fundamental mode is then well discriminated, an accurate and reliable shear wave velocity profile can be extracted from the surface waves signal.
b. A rocky substratum is present below the surficial sedimentary layer within the top 5 to 15 m BSB; higher modes are then close to the fundamental mode in low frequencies and shear wave velocities can be overestimated at depth.
c. The rocky substratum is present close to seafloor (sub-cropping or a few metres BSB), the fundamental mode cannot be extracted from the surface waves signal. In such context, the MASW method generally does not provide any results.

In order to enhance the appraisal of the fundamental mode for cases b and c, some mutes and filtering can be applied to the signal in order to remove noise and refracted and guided waves which will limit/remove the influence of the higher modes. As the surface waves are generated within a defined time range, the signal is muted and filtered prior to the time-distance to velocity-frequency transformation. The mutes are performed manually, considering each specific shot. Table 3.1 presents examples of MASW signal quality.

The extraction of dispersion curves through MASWCheck® is performed manually and independently for each shot; however the homogeneity of the dispersion curves is visually controlled in order to check that no discrepancy is derived from such manual process.

Any anomalous shot that couldn't be treated prior to or after inversion is rejected.

3.2 Resolved depth

The automatic result of the inversion process proposes a continuous V_s profile from seabed until the given target depth. However the theory of surface waves indicates that only a limited slice of soil is really investigated by the MASW method.

The study of the dispersion curve allows extracting two depth values which correspond to the maximum and minimum resolvable depths. The maximum phase velocity / frequency ratio, corresponding to low frequencies, is used to calculate the greater investigated depth while the minimum ratio, corresponding to high frequencies, is used for the minimum investigated depth:

$$\text{minimum resolved depth(m)} = \frac{\text{shortest wavelength (m)}}{3}$$

and

$$\text{maximum resolved depth(m)} = \frac{\text{longest wavelength (m)}}{3}$$

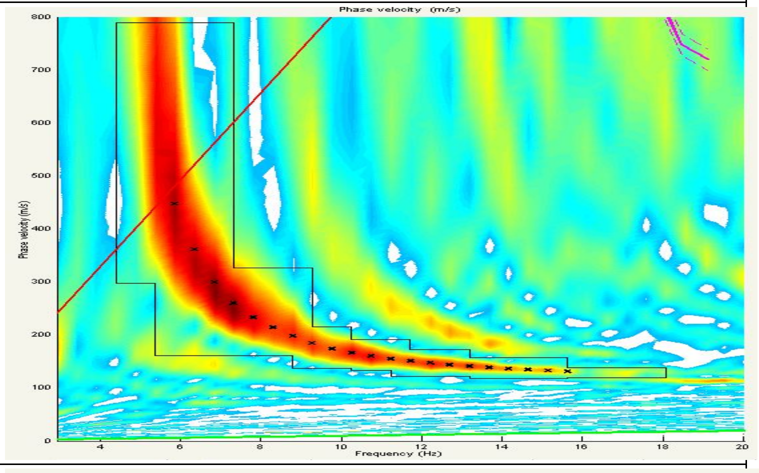
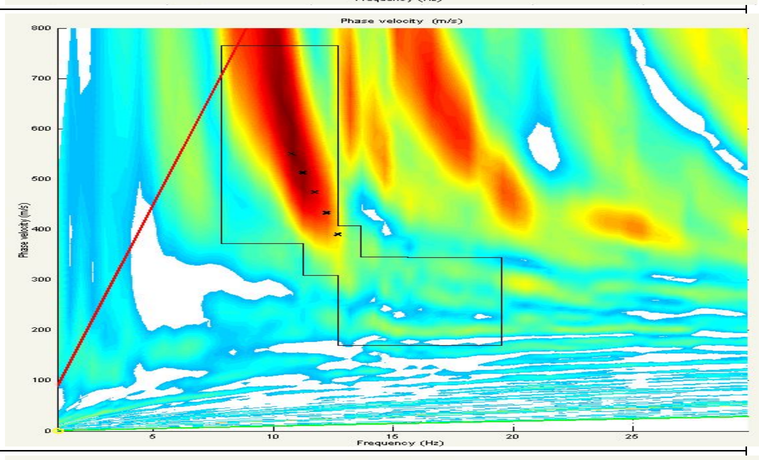
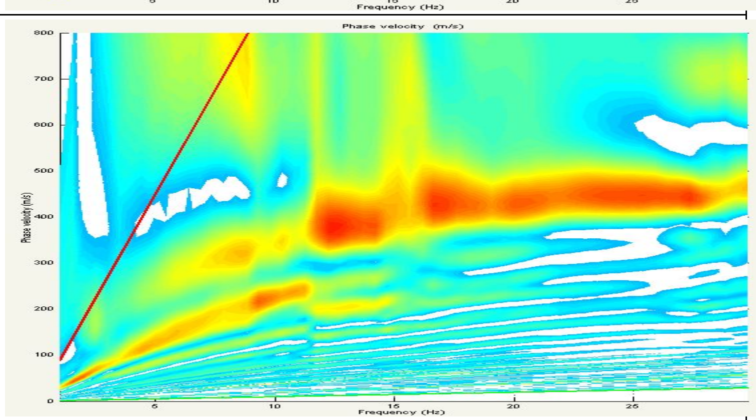
With:

$$\text{wavelength (m)} = \frac{\text{phase velocity (m/s)}}{\text{frequency (Hz)}}$$

The inversed velocities are considered as fully reliable in between the minimum and maximum resolved depth. Above and below these limits, the computed velocities results from extrapolation of measured values and less confidence shall be given.

Applied to each shotpoint, the minimum and maximum resolved depth values create 2 limits delimiting the fully reliable and less reliable parts of the results.

Table 3.1 : Examples of dispersion curves for various signal qualities

Signal Quality	Example of dispersion curve Surface Wave in the f-k domain
Very good Surface waves are generated along a large frequency range and a clear distinction is made between the fundamental and the higher modes: the results are accurate and the resolved layer is thick.	
Good Surface waves are generated along a restricted frequency range leading to limited extension of the resolved layer, however the fundamental mode is well discriminated and results are accurate	
Poor The fundamental mode can't be discriminated and the signal can't be interpreted. The shot is rejected.	

4. TYPICAL RESULTS

4.1 V_s profile

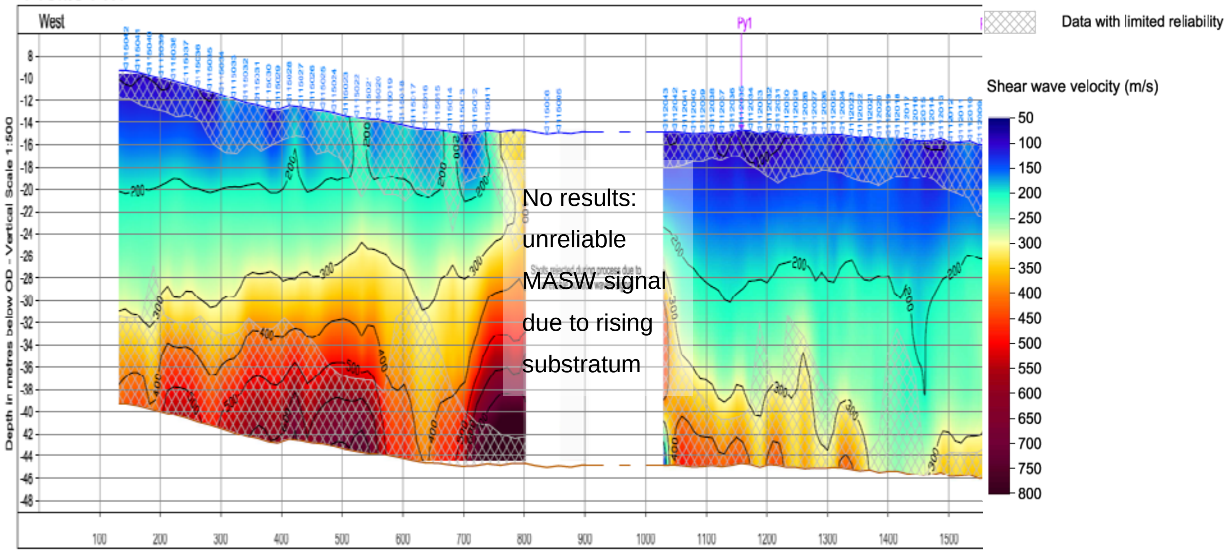


Figure 4-1: Example of V_s versus depth profile

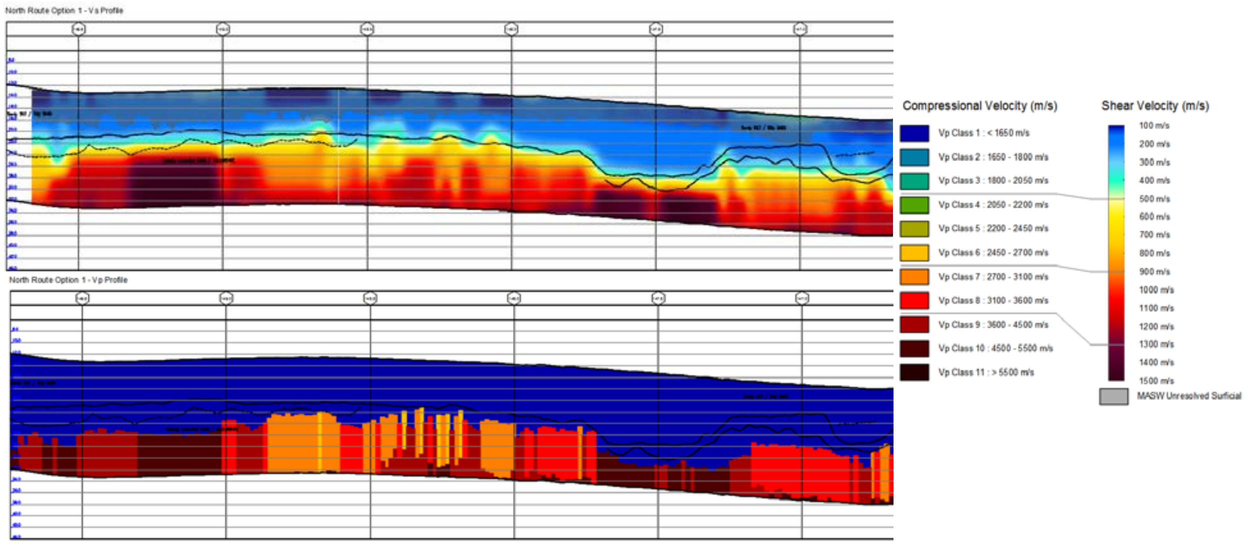


Figure 4-2: Example of V_s versus depth profile (top) correlated with V_p versus depth profile inferred from refraction results (bottom)

4.2 Ascii Files

V_s at given depths, corresponding to 1D inversion results can be delivered in the form of text, ascii files or excel sheet. Velocities with limited reliability, resulting from automatic extrapolation at near surface and at depth by the inversion software can also be provided; it will be clearly mentioned that less confidence shall be given to them. Anyhow, the numerical V_s values are not suitable for fine engineering and foundation design geotechnical and structure engineers shall be careful and aware of the limitation of the method when putting them in their soil model.

5. INTERPRETATION AND CORRELATION

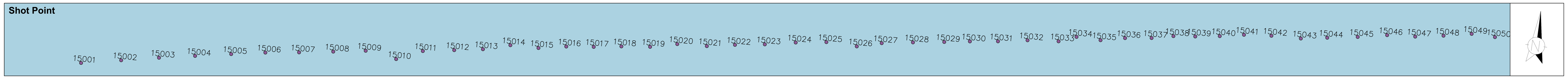
5.1 Inversion constrain

When some parameters of the soil are already known, the inversion can be constrained using known V_p, V_s, Poisson Ratio or Density as the initial model. As the Gambas® system allows acquisition of refracted and surface waves in a single path, the MASW inversion always benefits from the V_p profile inferred from the refraction process.

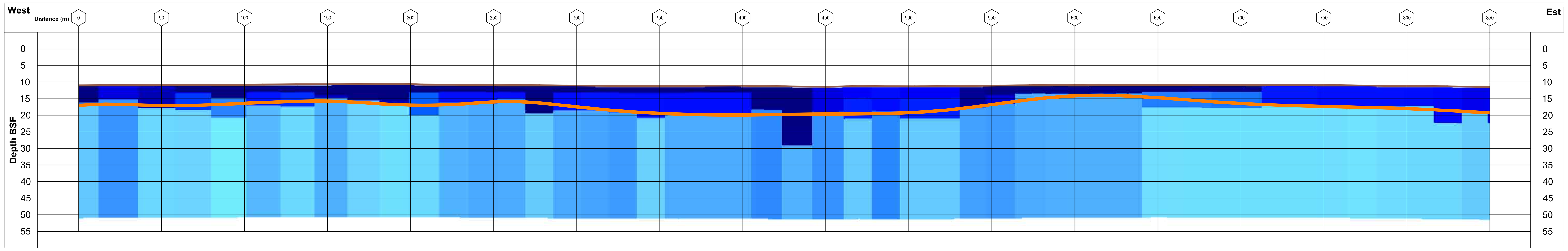
Appendix K

Refraction and MASW Charting

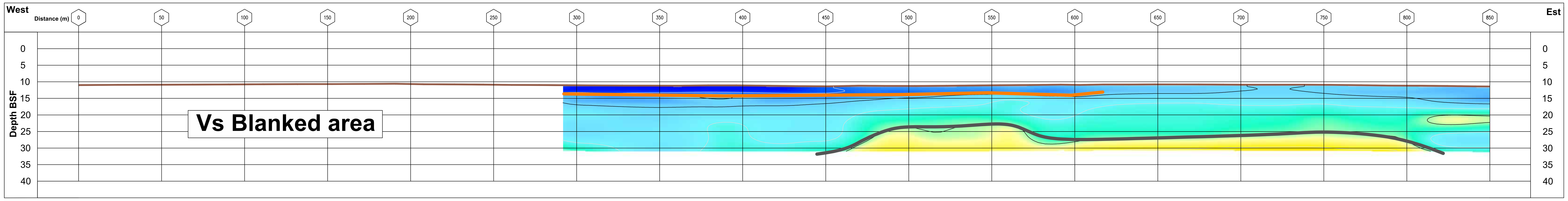
Profile TA2BR01P1

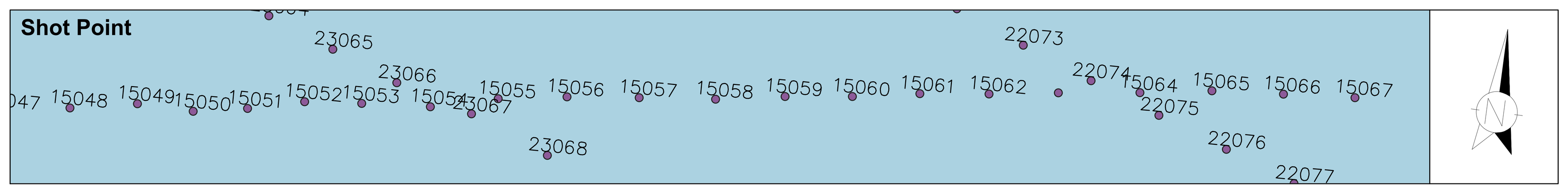


Refraction section

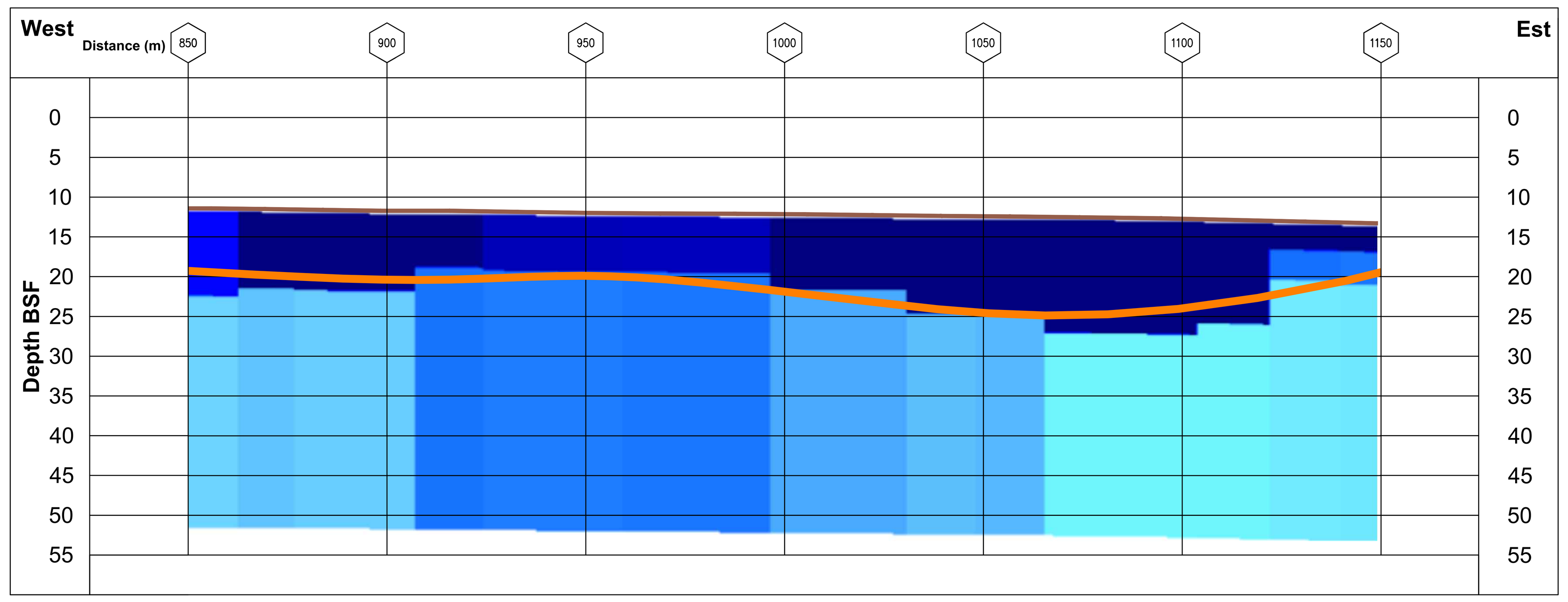


MASW section

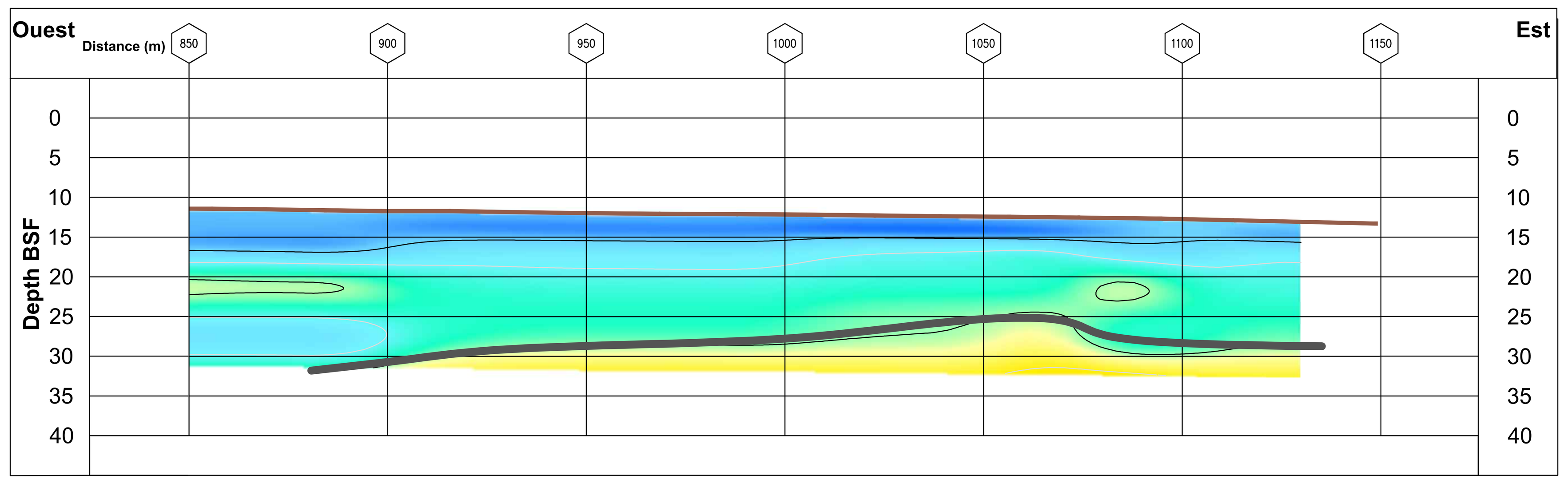




Refraction section



MASW section



LEGEND:

- Bathymetric profile
- Distance (m) (150)
- Gambas Shot Points (37076)
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

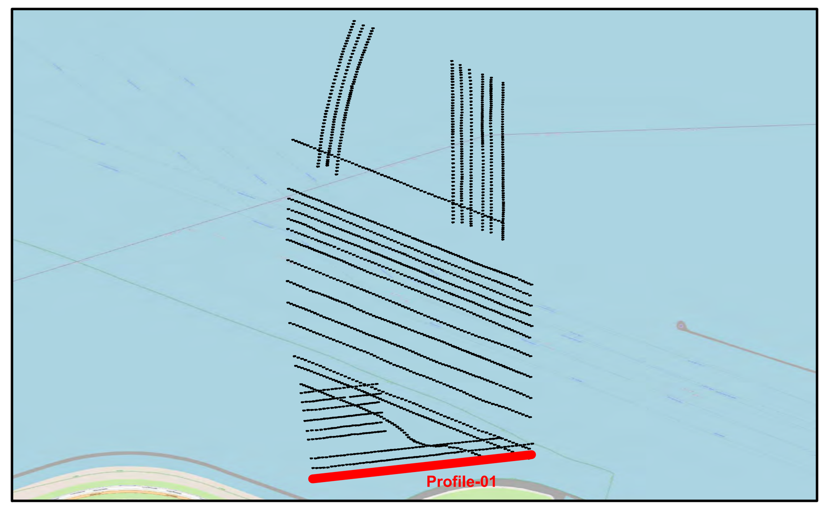
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

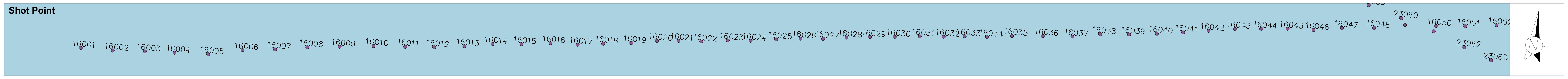
Metres: 50 0 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

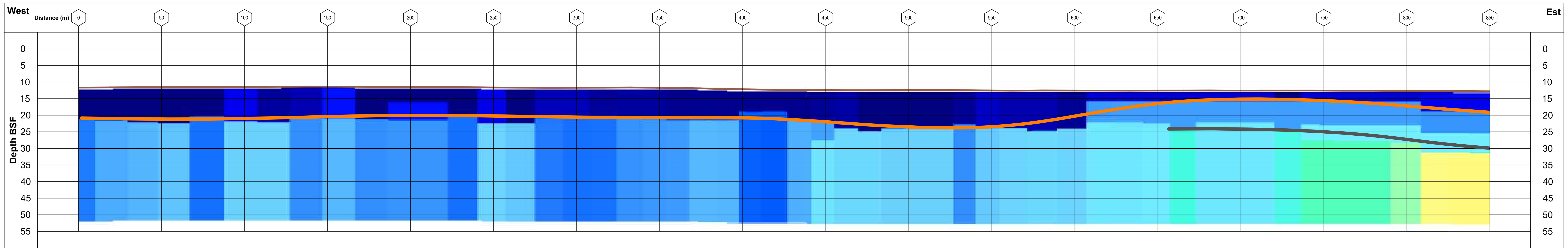
Vessel: Seeker			Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:		Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments		TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	01 of 25	F197217-REP-RES

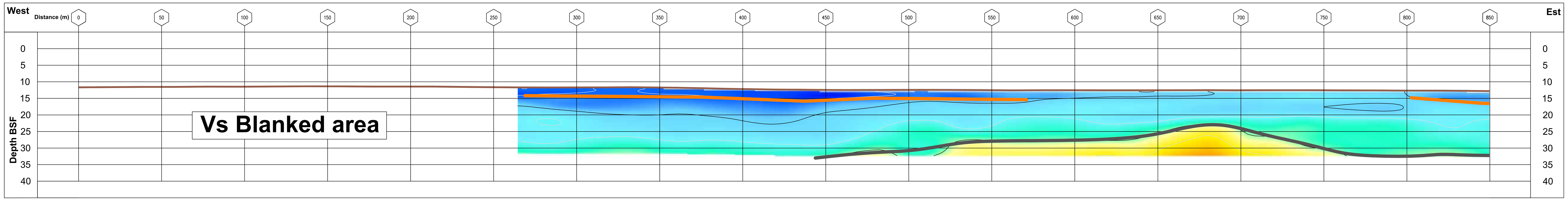
Profile TA2BR02P1

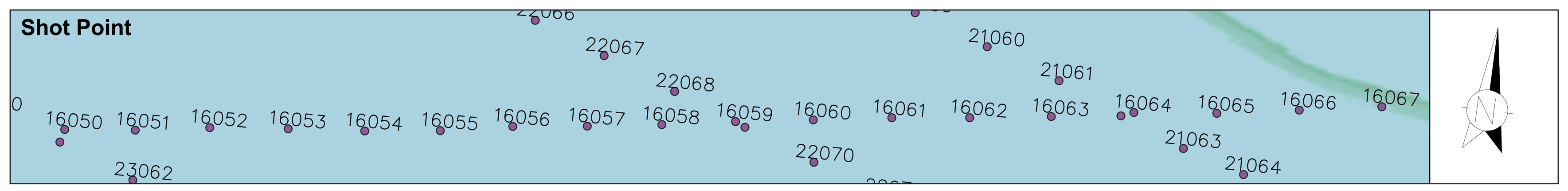


Refraction section

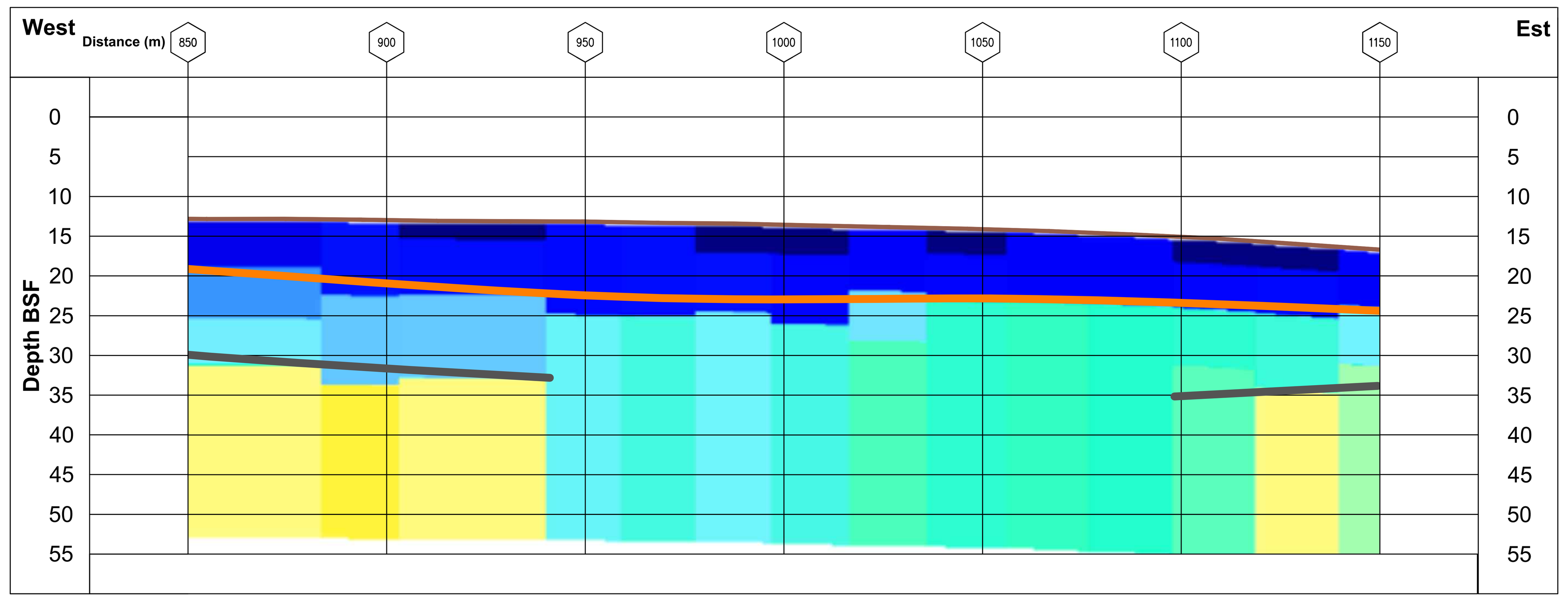


MASW section

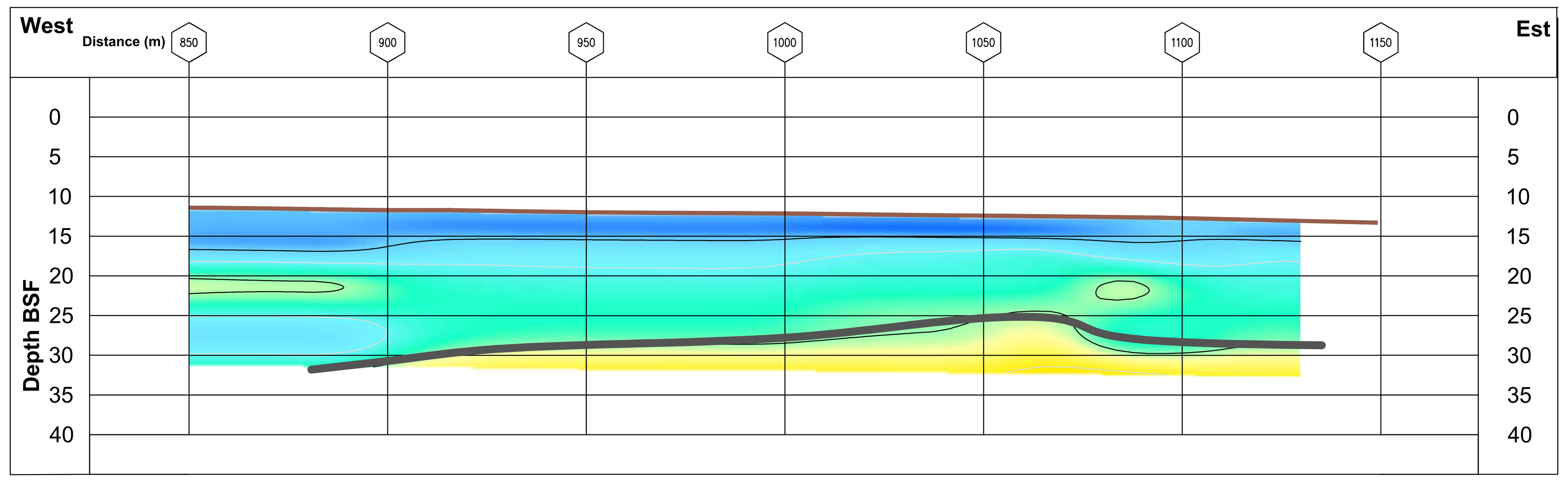




Refraction section



MASW section



LEGEND:

Bathymetric profile

Distance (m)

Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

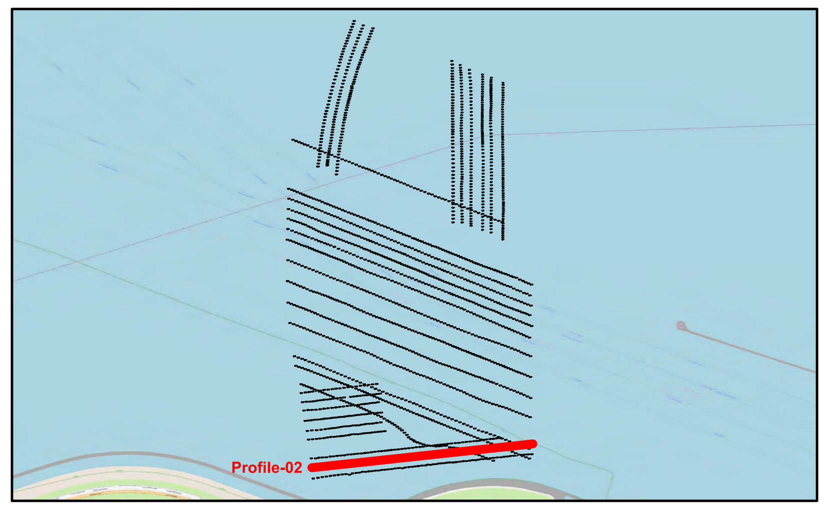
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

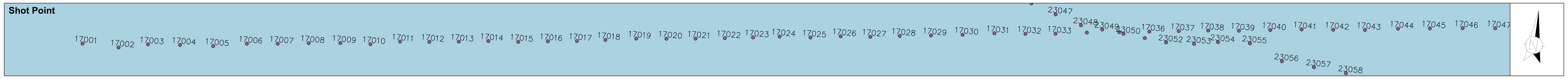
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

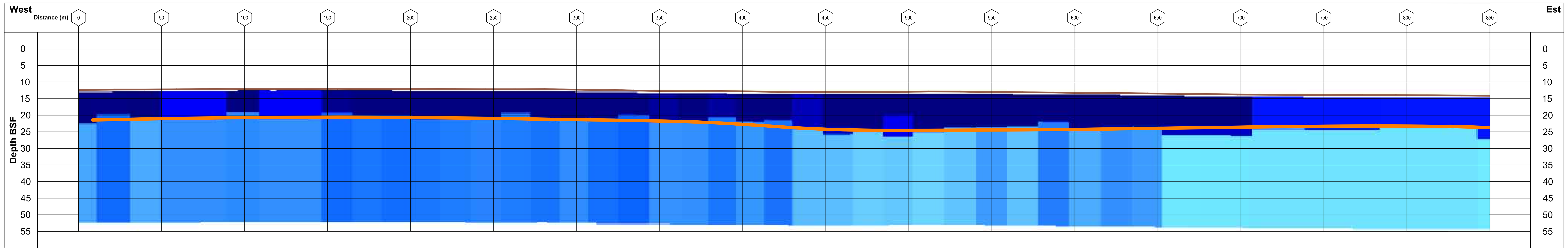
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	02 of 25	F197217-REP-RES

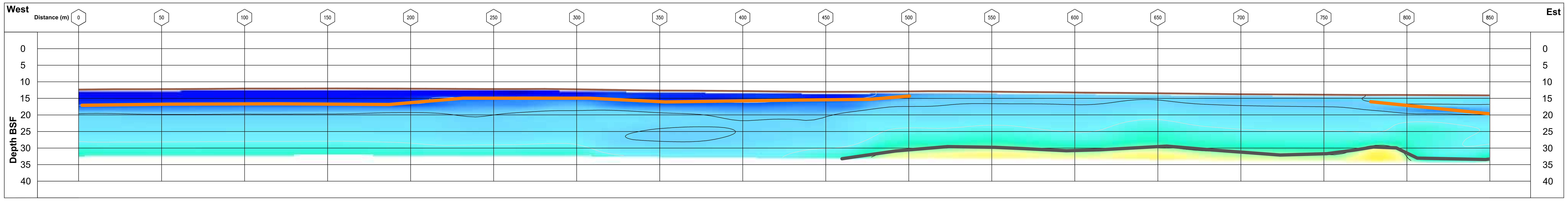
Line TA2BR03P1

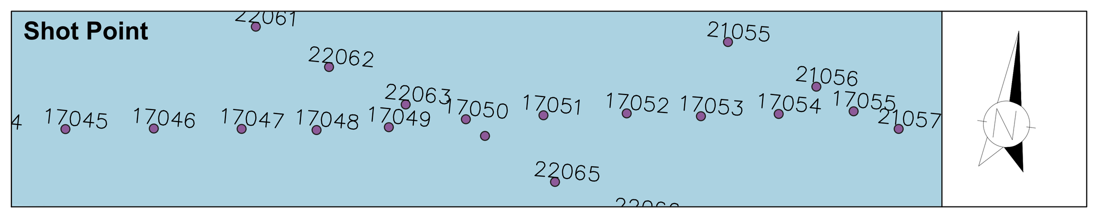


Refraction section

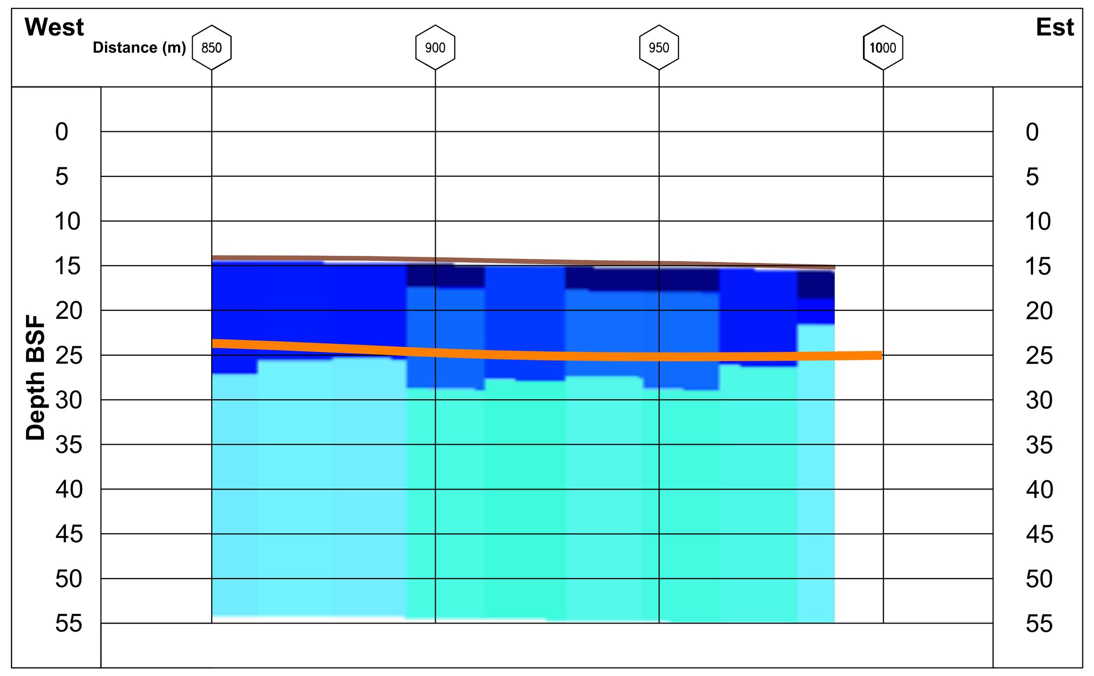


MASW section

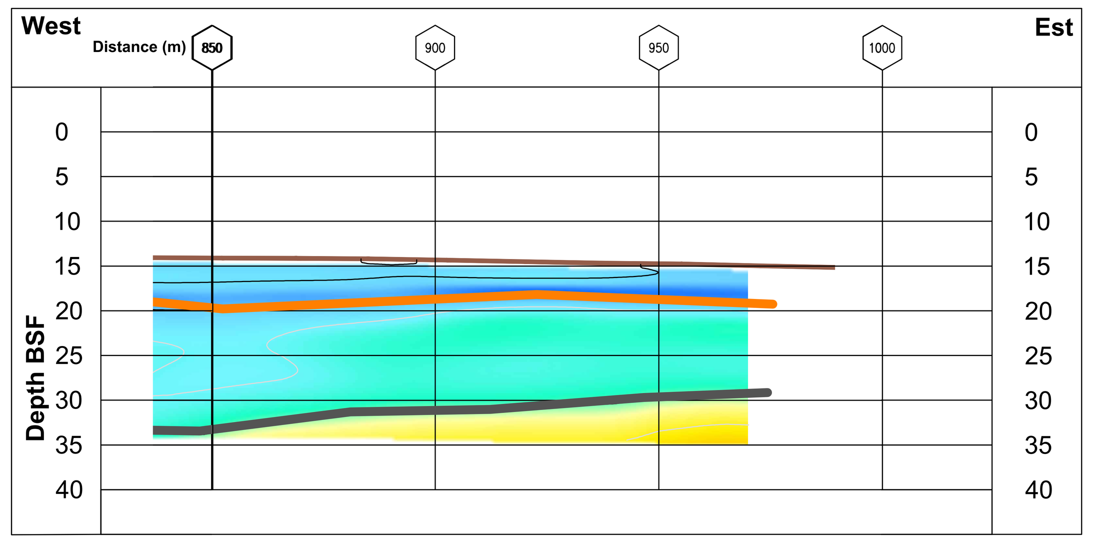




Refraction section



MASW section



LEGEND:

(line)	Bathymetric profile
150	Distance (m)
37076	Gambas Shot Points
(line)	MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area	Area with supposed gaz content in the sediment
Vs Blanked area	Area with no or degraded dispersion
(orange line)	Velocity limit between very soft and soft sediments
(black line)	Velocity limit between soft and moderately soft sediments

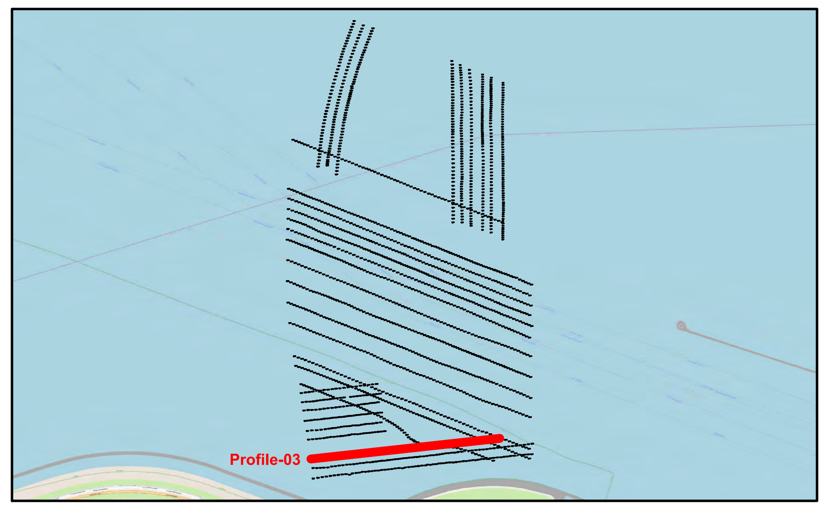
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

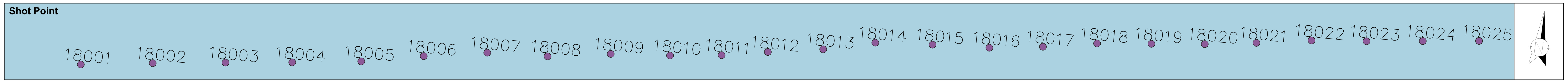
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

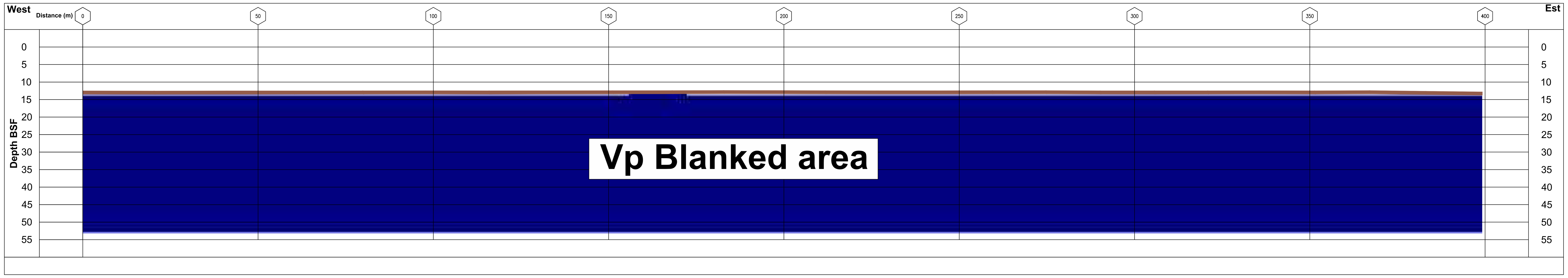
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	03 of 25	F197217-REP-RES

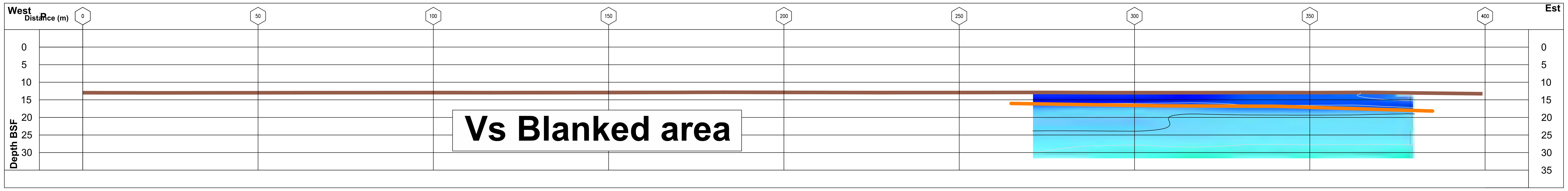
Line TA2BR05P1



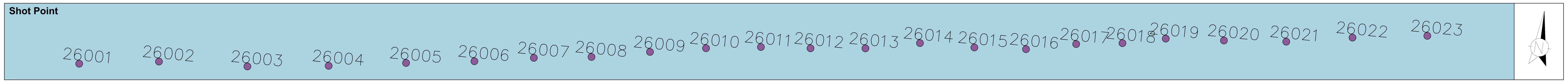
Refraction section



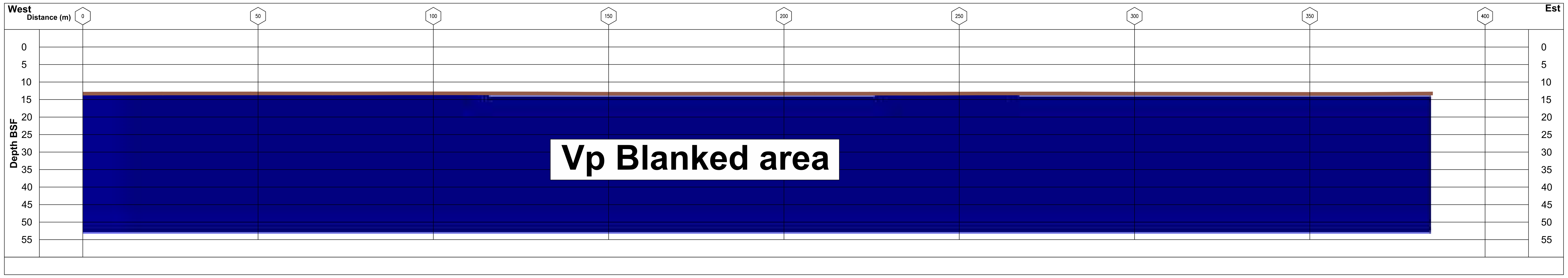
MASW section



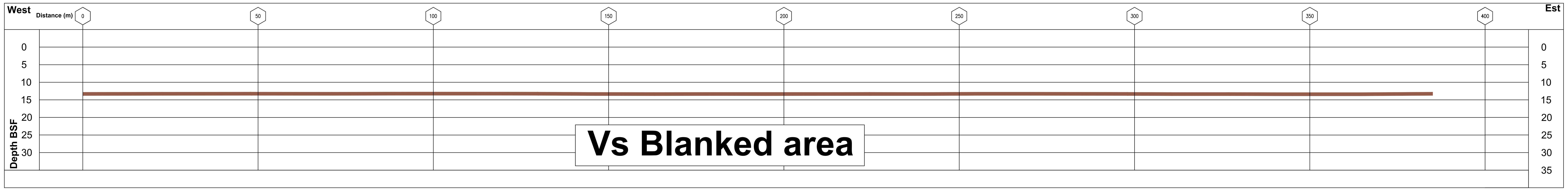
Line TA2BR06P1



Refraction section



MASW section



LEGEND:

- Bathymetric profile
- Distance (m)
- Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area: Area with supposed gaz content in the sediment
- Vs Blanked area: Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

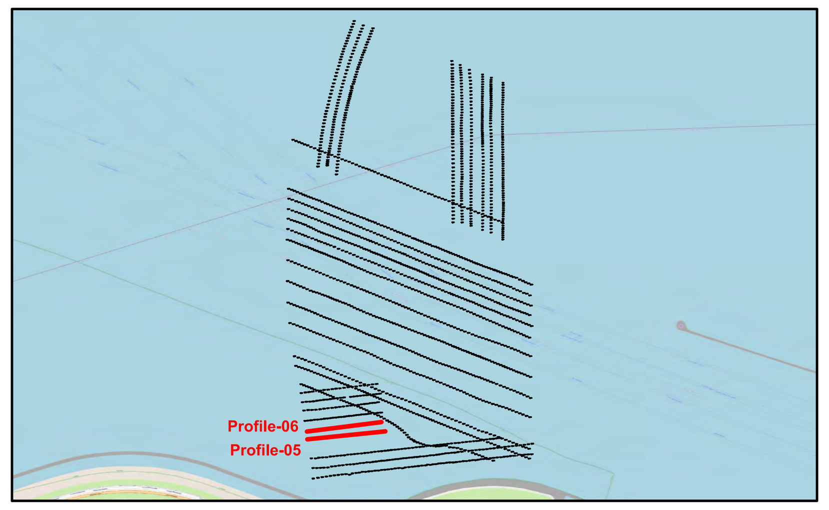
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



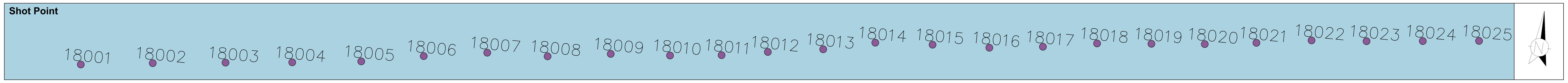
REFRACTION & MASW SITE INVESTIGATION ALIGNMENT CHARTS

Metres
25 0 25 50
SCALE 1 : 500 at A0 paper

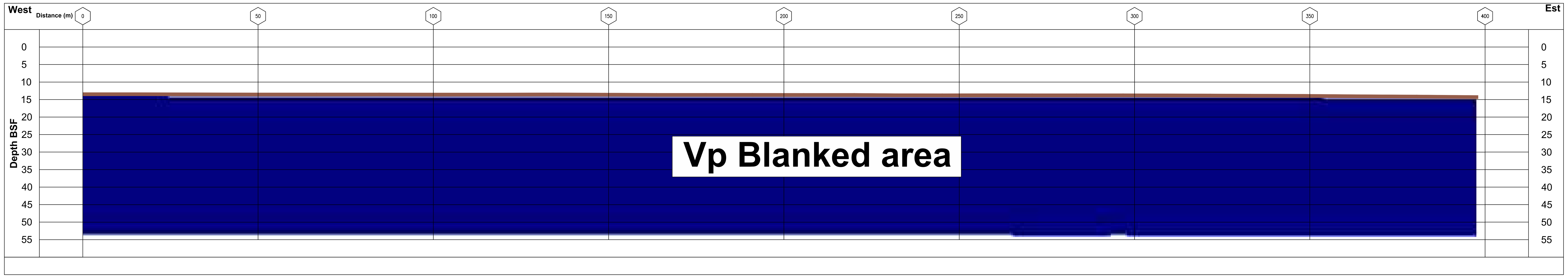
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	04 of 25	F197217-REP-RES

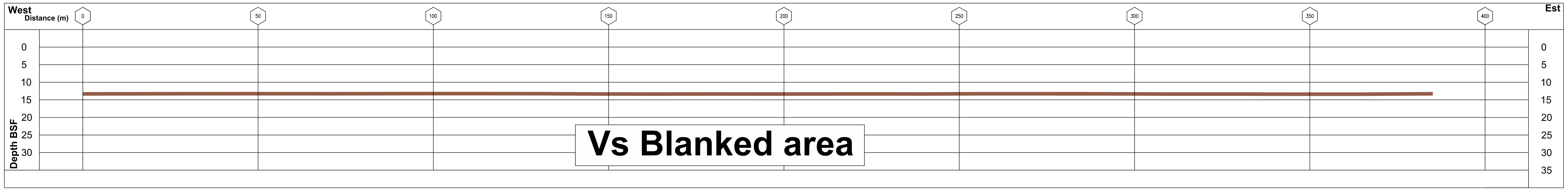
Line TA2BR07P1



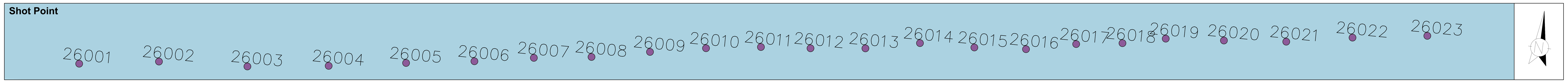
Refraction section



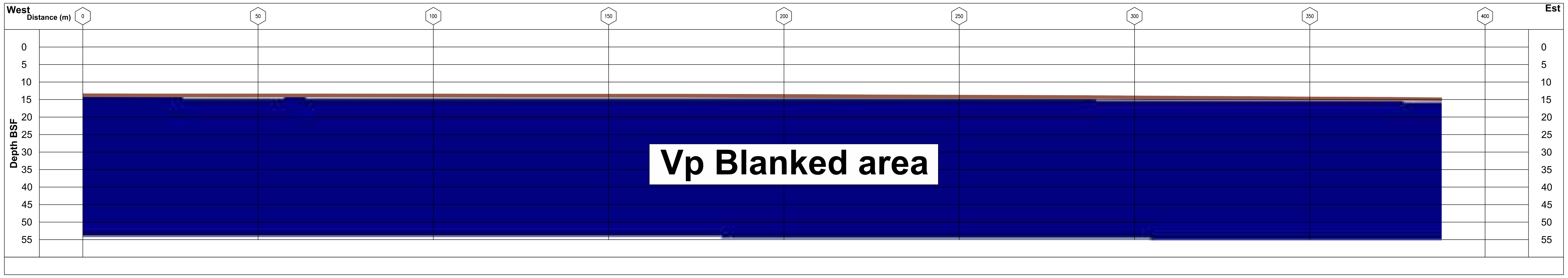
MASW section



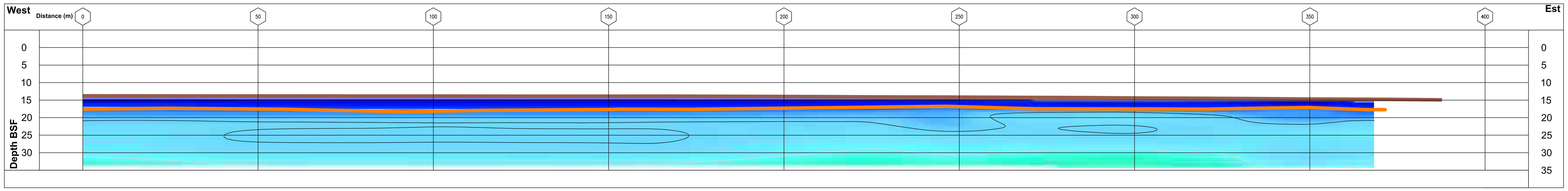
Line TA2BR08P1



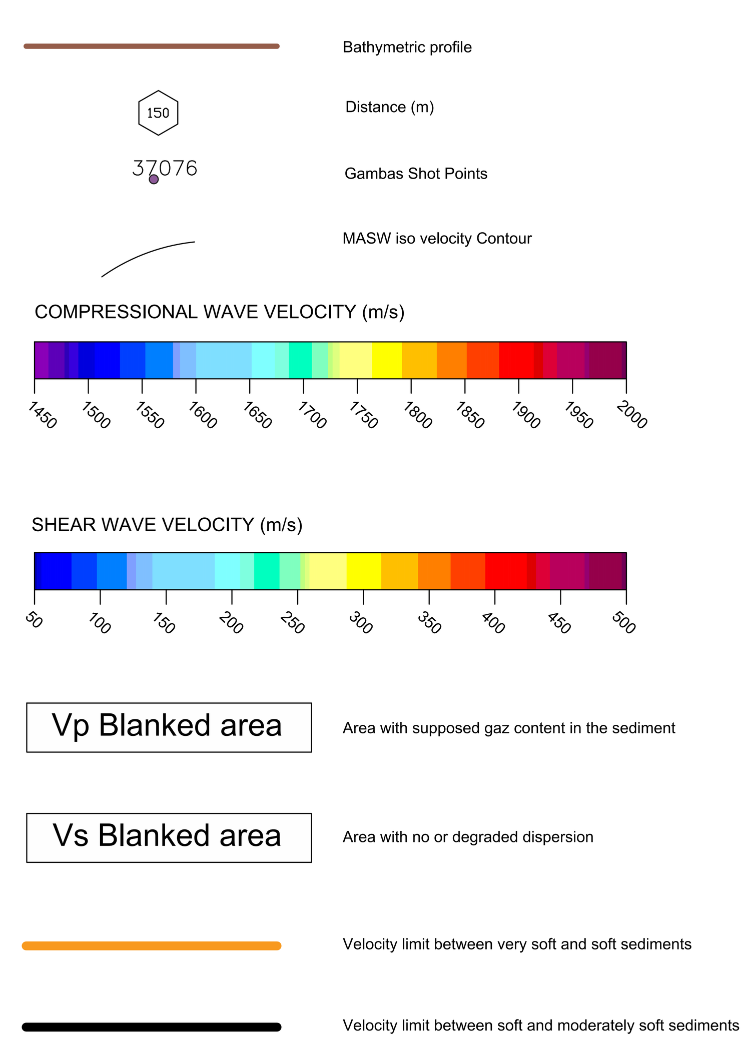
Refraction section



MASW section



LEGEND:



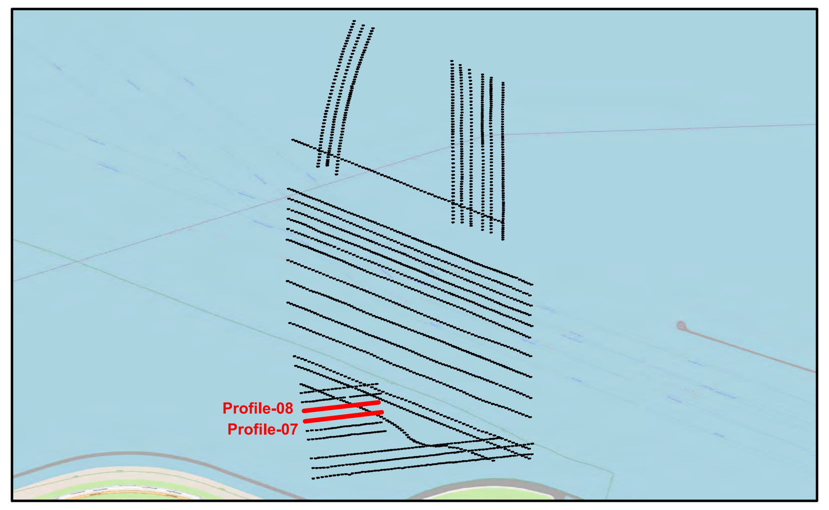
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

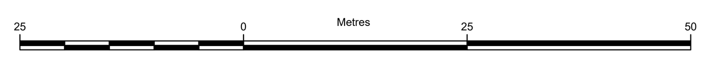
GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

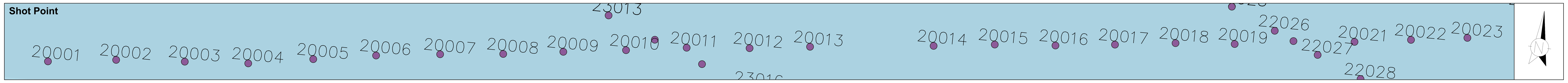


SCALE 1 : 500 at A0 paper

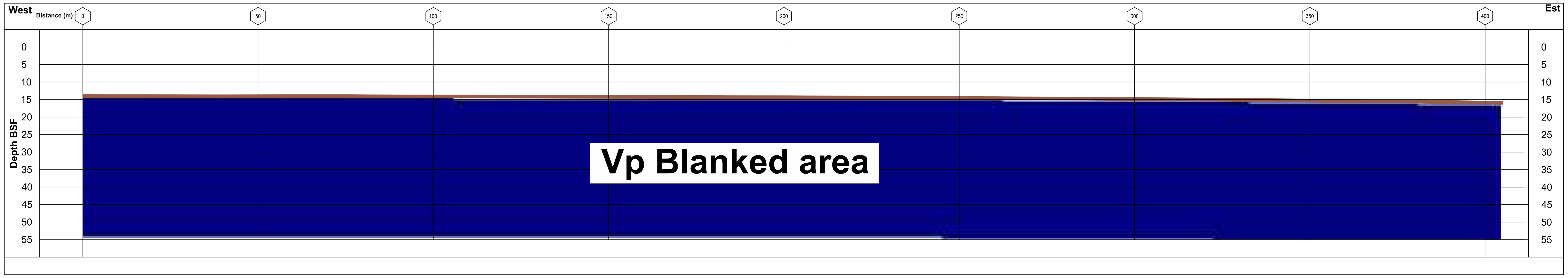
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	05 of 25	F197217-REP-RES

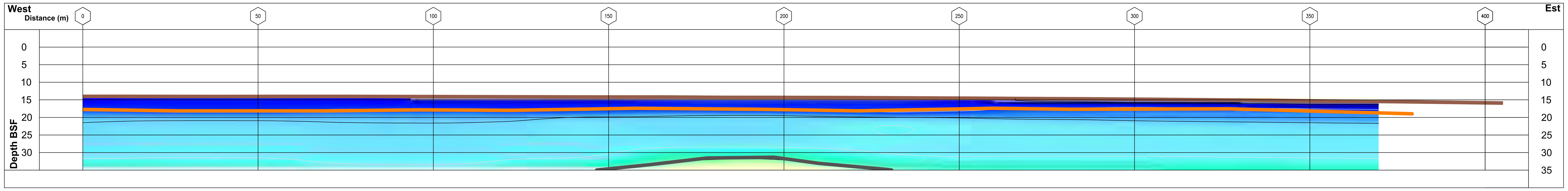
Line TA2BR09P1



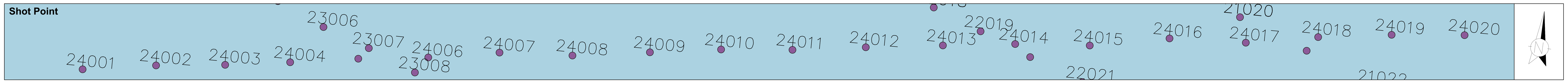
Refraction section



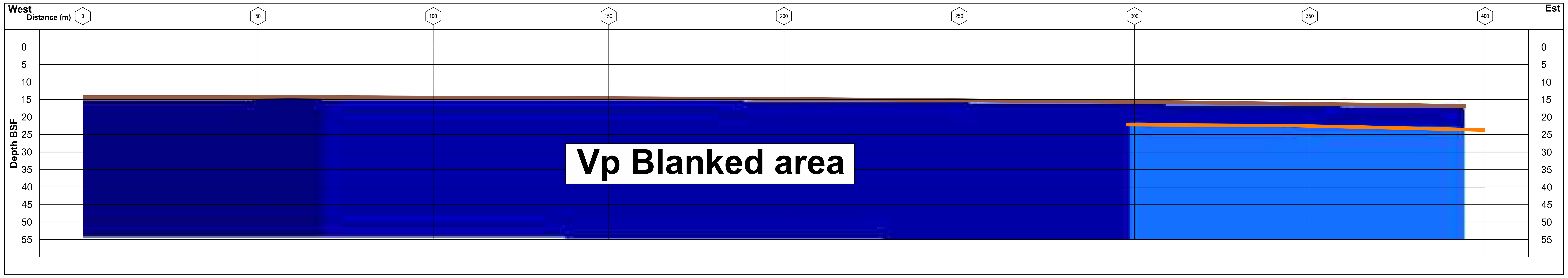
MASW section



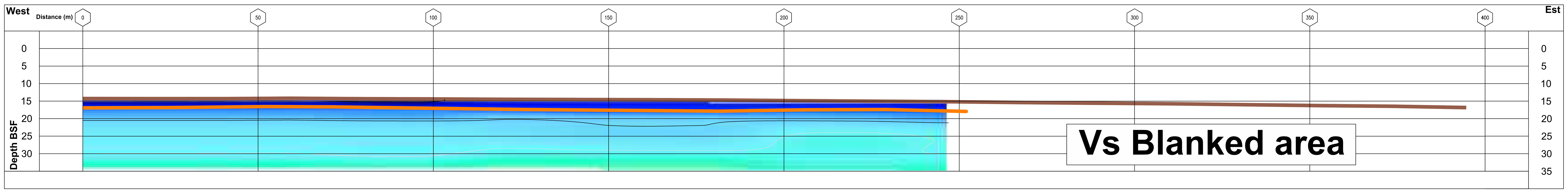
Line TA2BR10P1



Refraction section



MASW section



LEGEND:

- Bathymetric profile
- Distance (m)
- Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

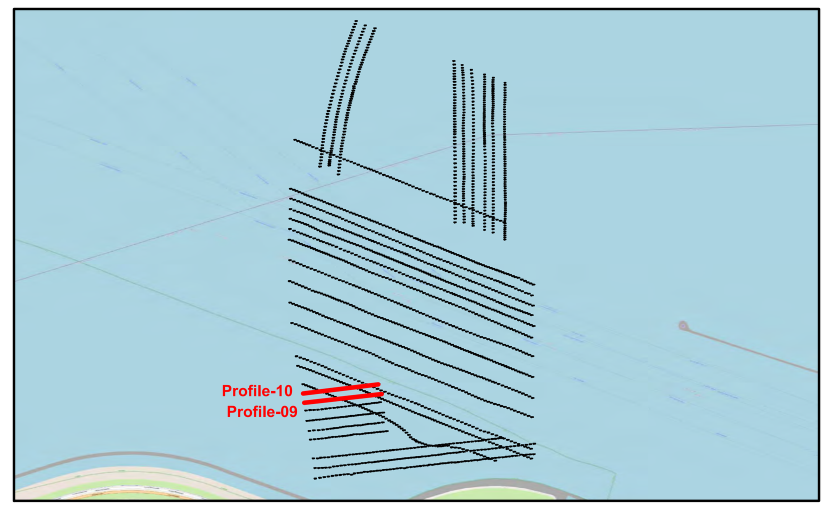
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

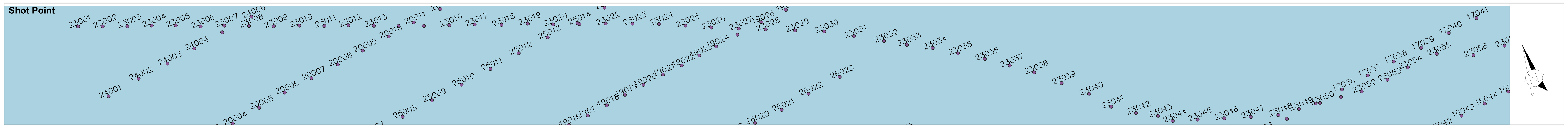
Metres 25 0 25 50

SCALE 1 : 500 at A0 paper

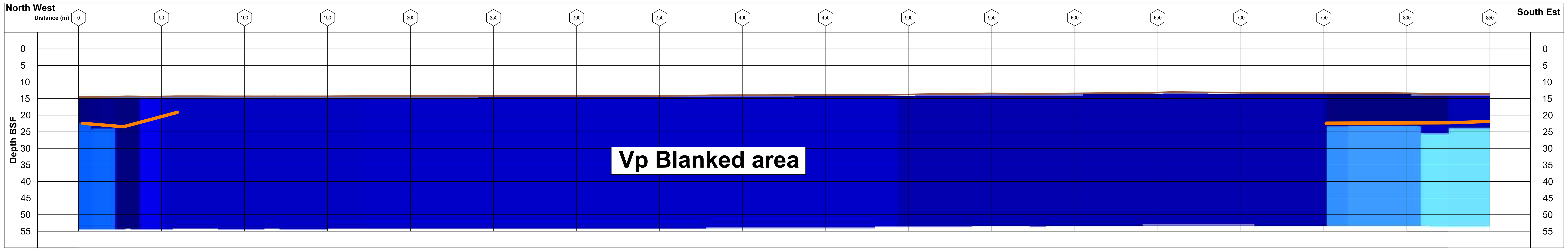
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	06 of 25	F197217-REP-RES

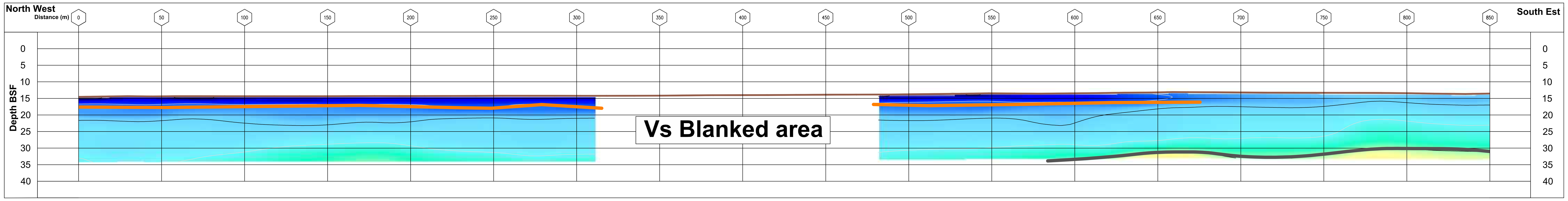
Profile TA2BR11P1

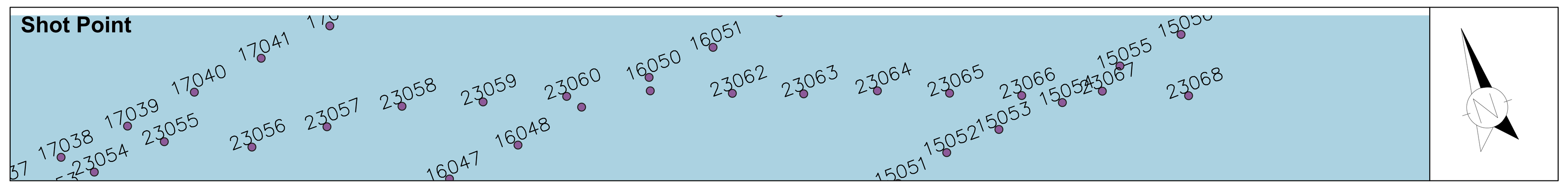


Refraction section

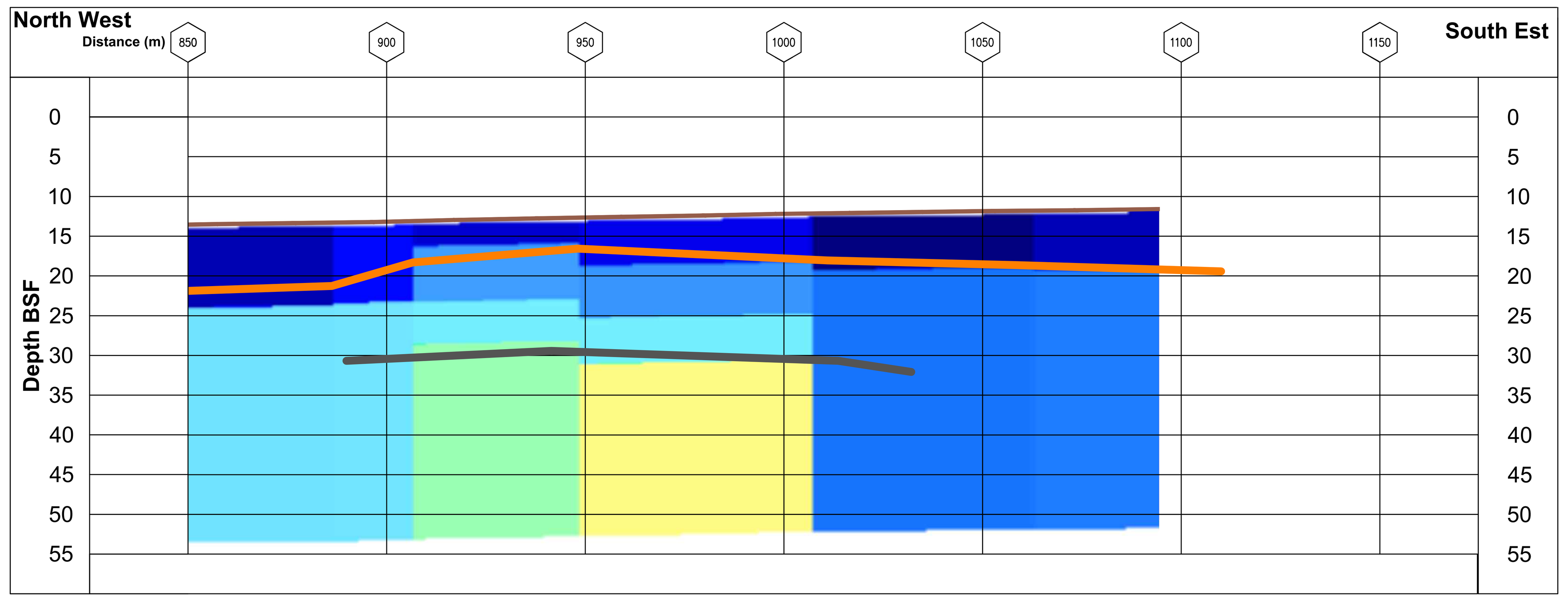


MASW section

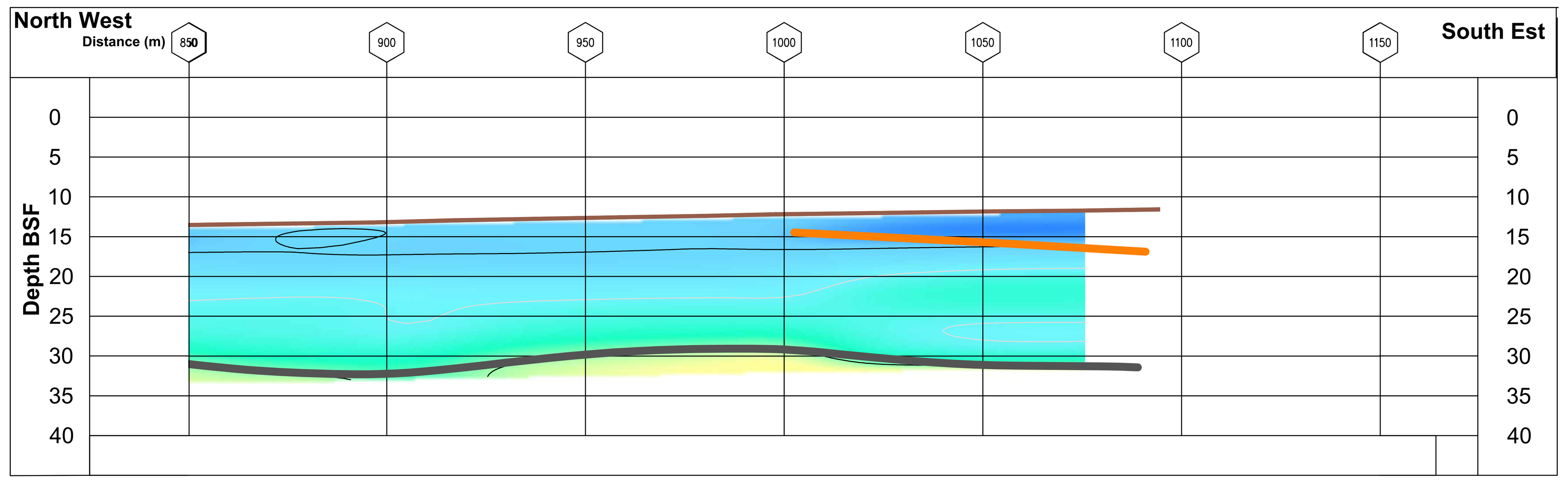




Refraction section



MASW section



LEGEND:

Bathymetric profile

Distance (m)

Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

SHEAR WAVE VELOCITY (m/s)

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

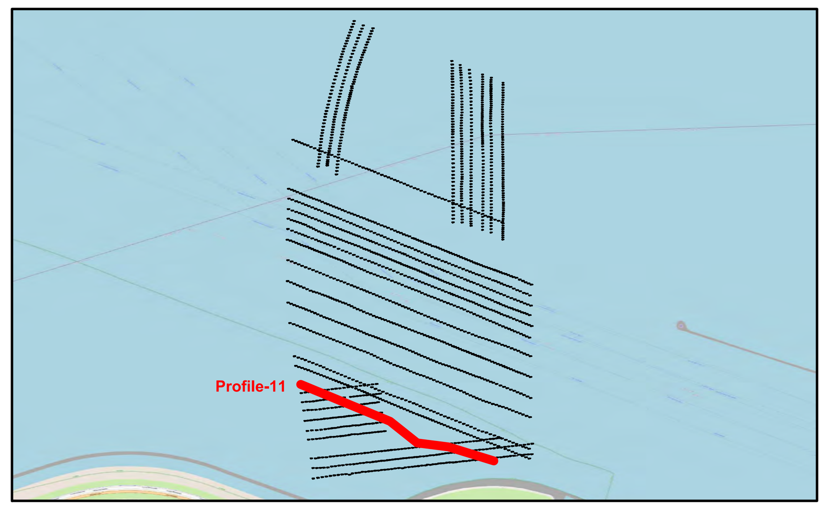
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



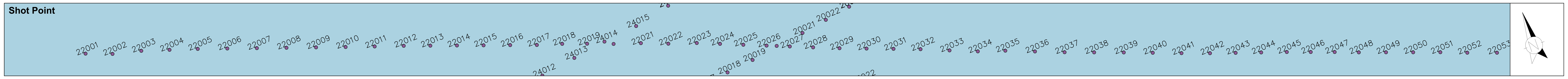
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

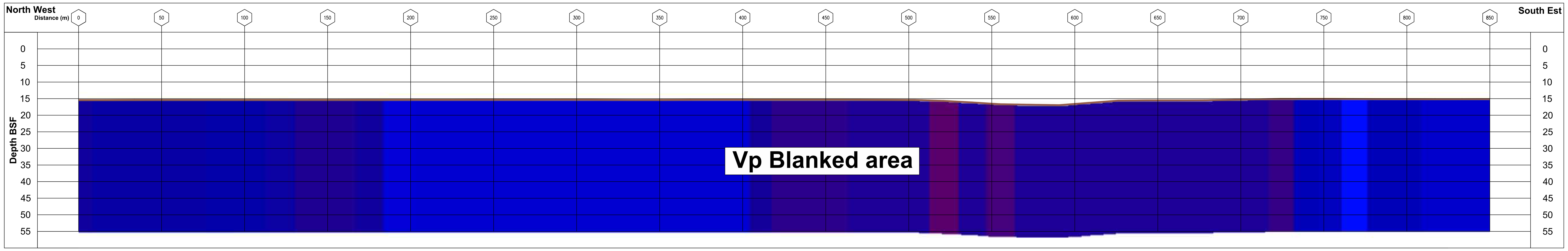
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	07 of 25	F197217-REP-RES

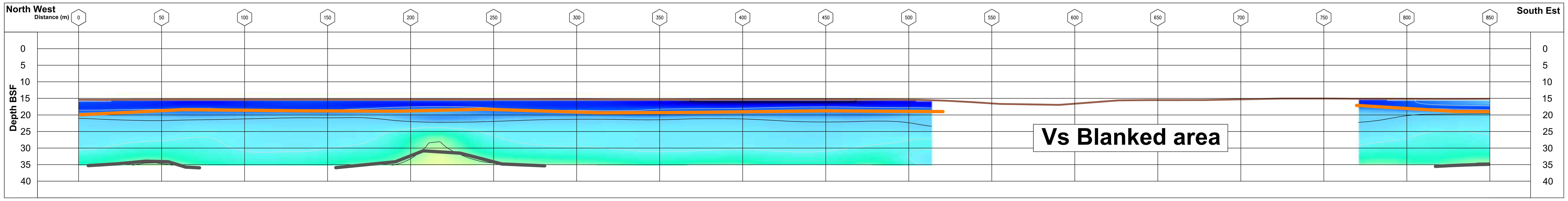
Profile TA2BR13P1

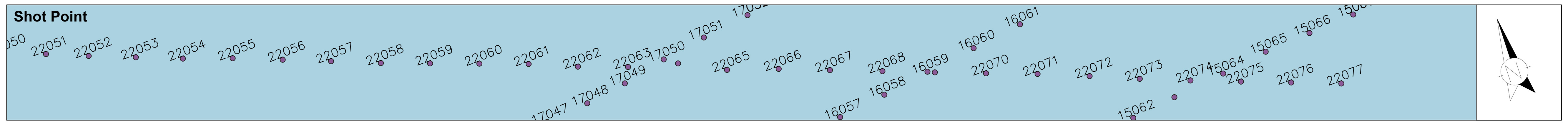


Refraction section

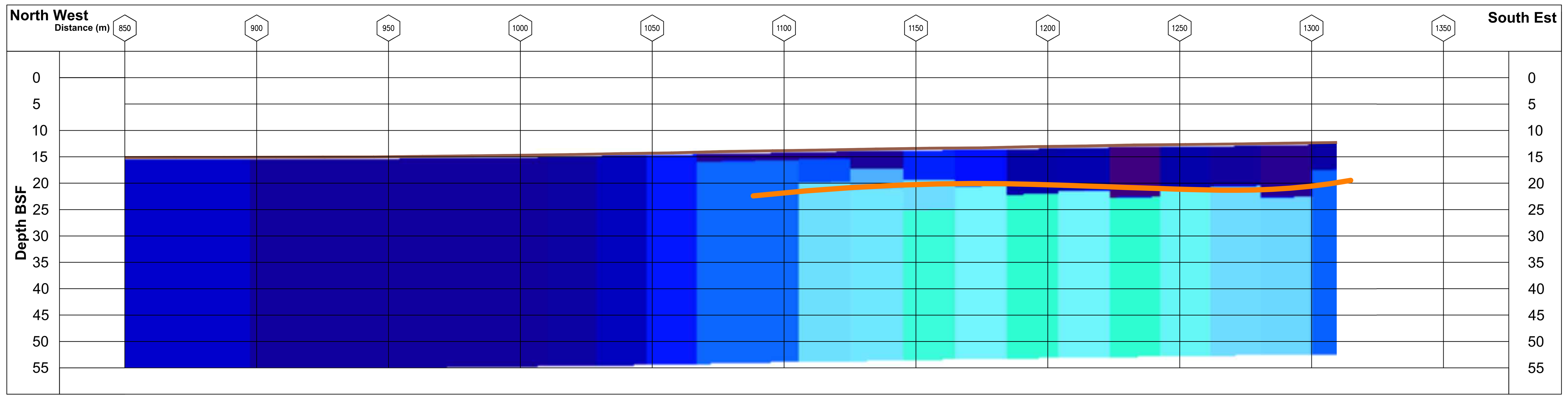


MASW section

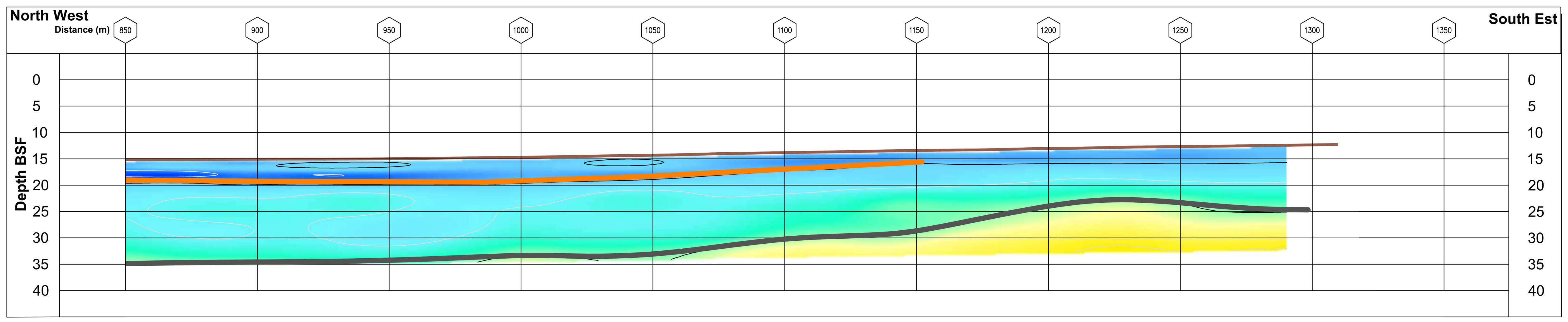




Refraction section



MASW section



LEGEND:

Bathymetric profile

150 Distance (m)

37076 Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

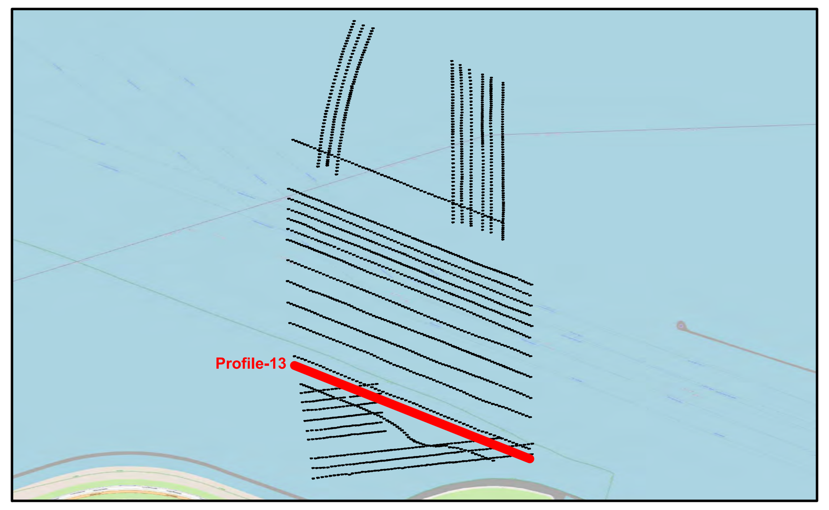
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

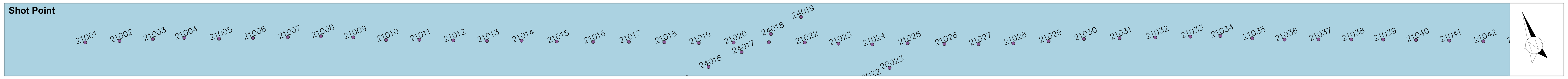
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

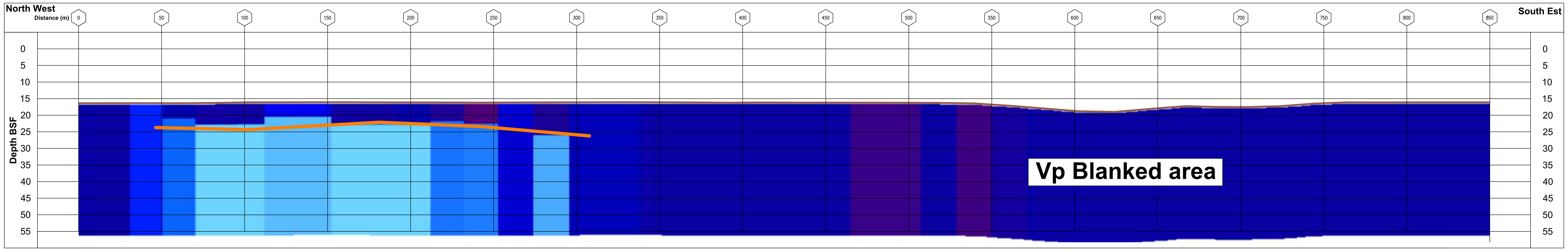
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	08 of 25	F197217-REP-RES

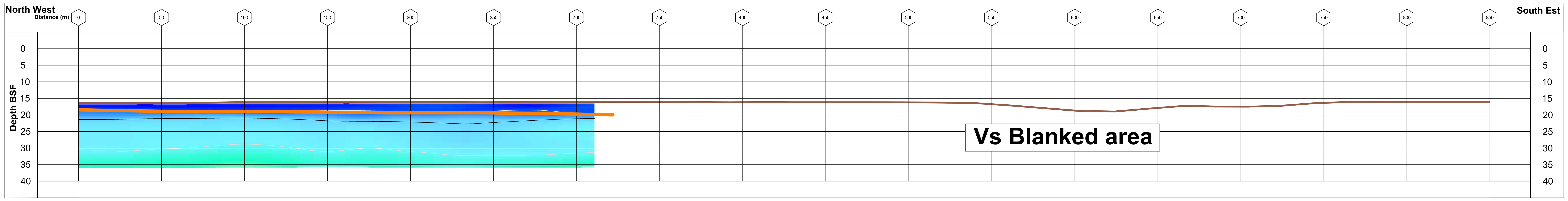
Profile TA2BR14P1

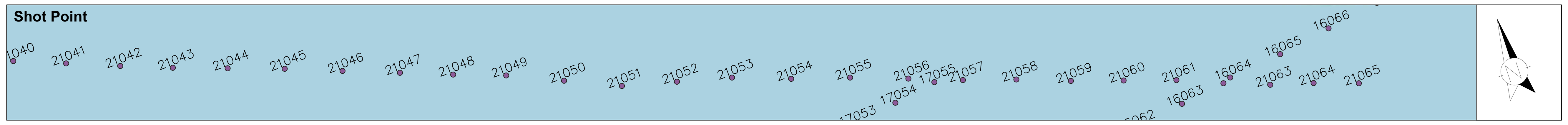


Refraction section



MASW section





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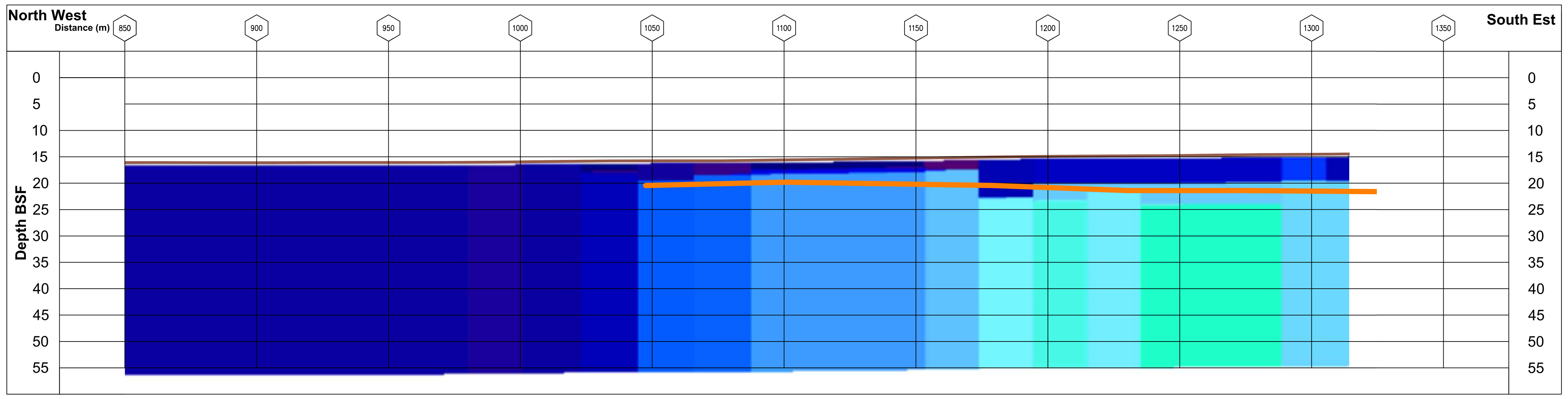
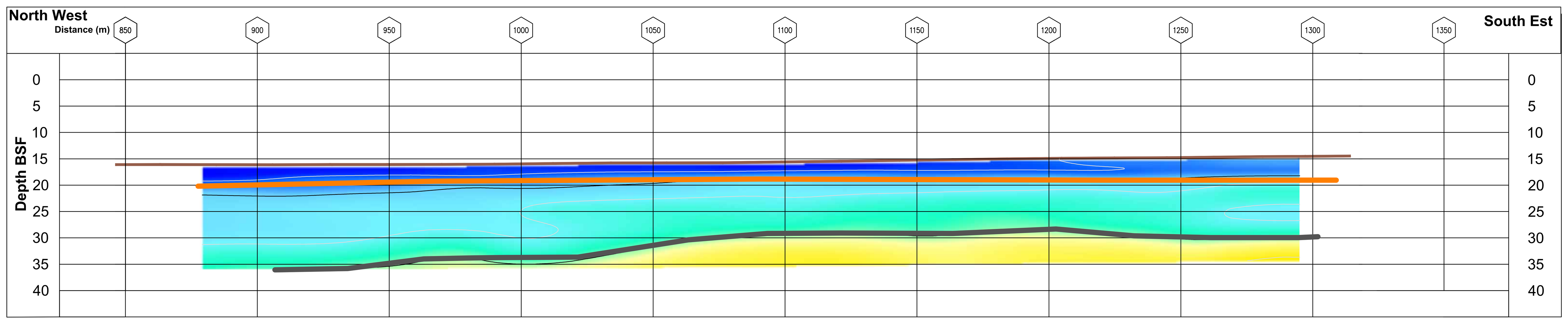


MASW section



LEGEND:

- Bathymetric profile
- Distance (m)
- Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

SHEAR WAVE VELOCITY (m/s)

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

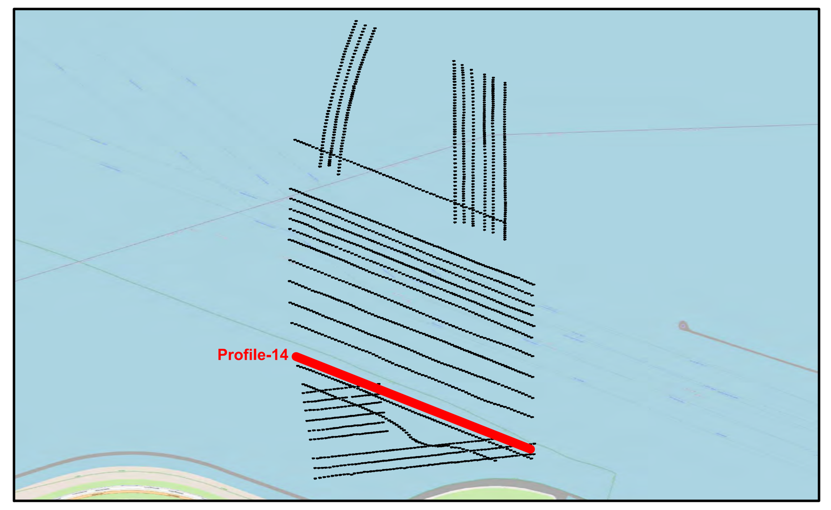
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



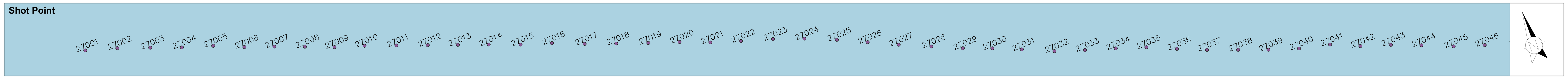
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	09 of 25	F197217-REP-RES

Profile TA2BR15P1



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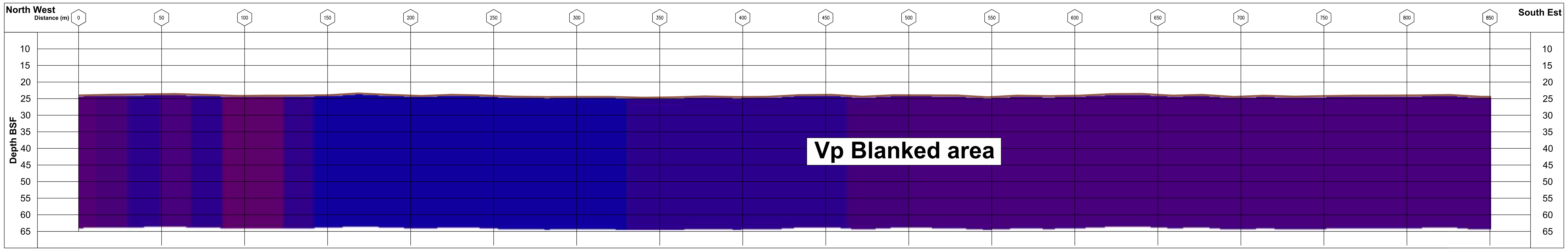
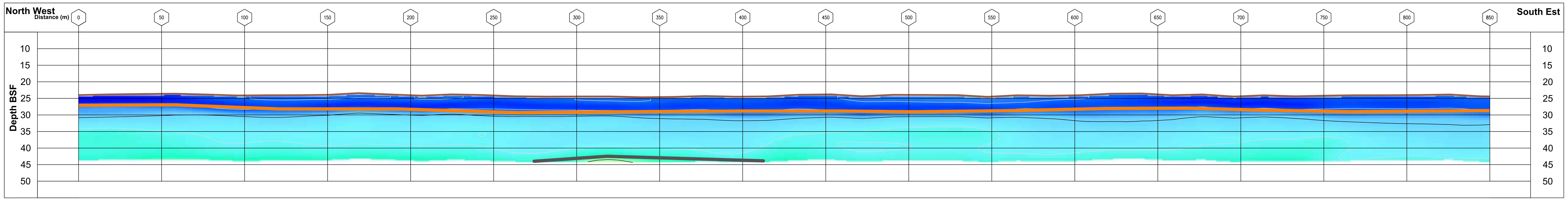
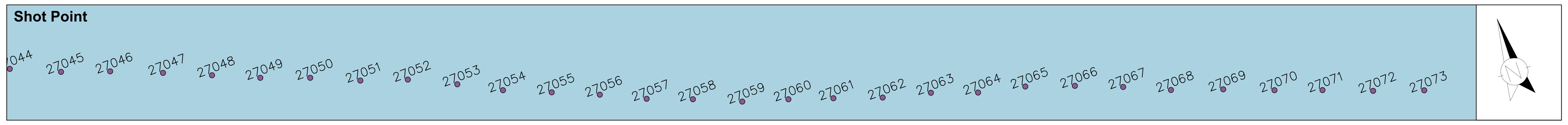


MASW section





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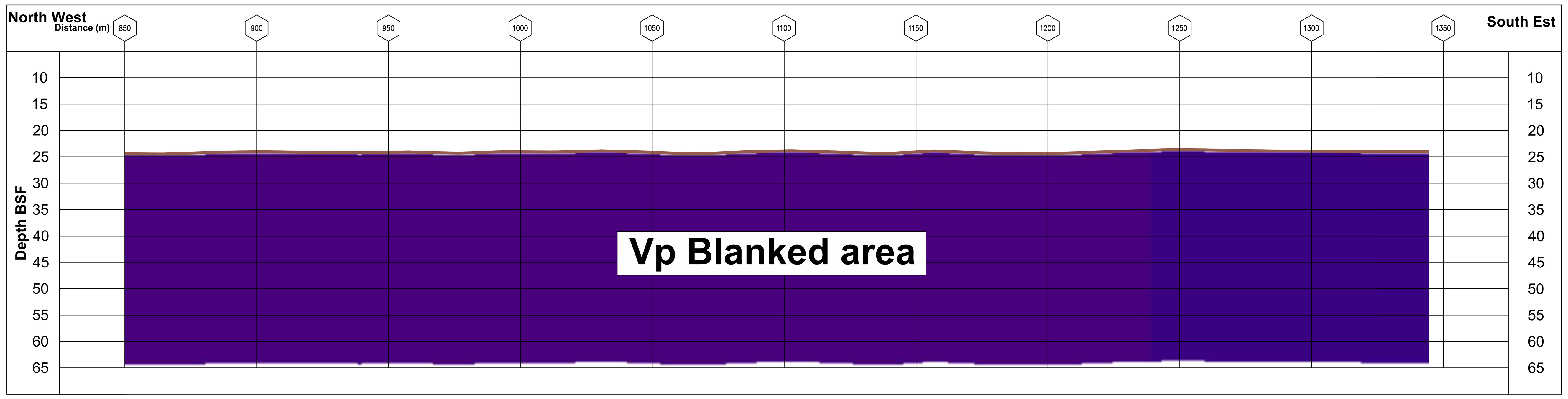

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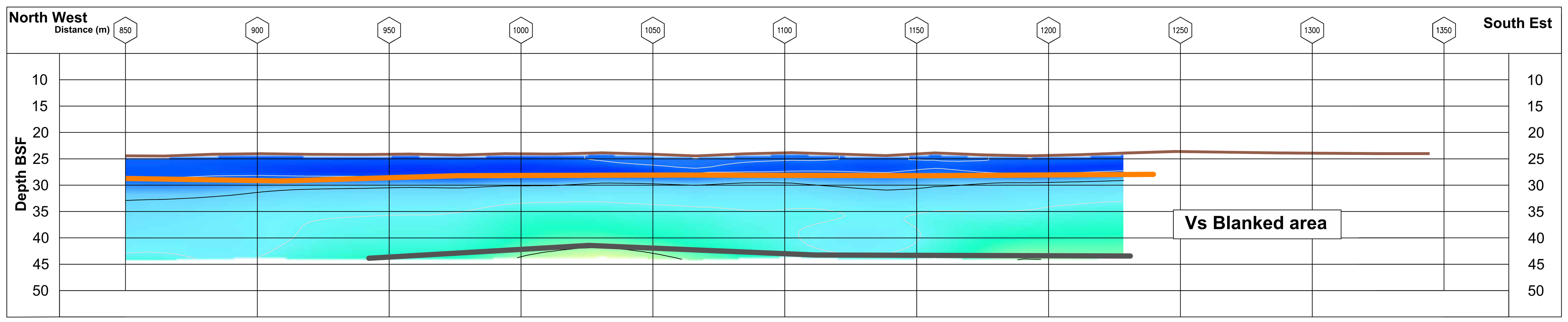


LEGEND:

Bathymetric profile

150 — Distance (m)

37076 — Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

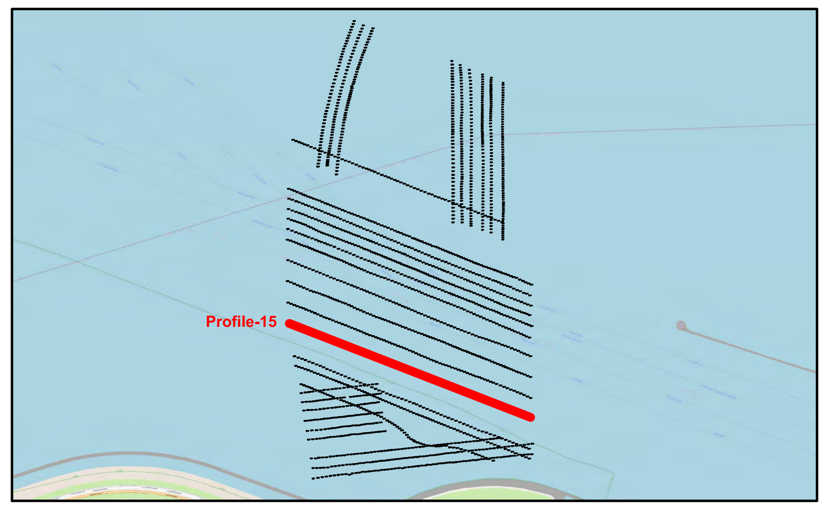
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

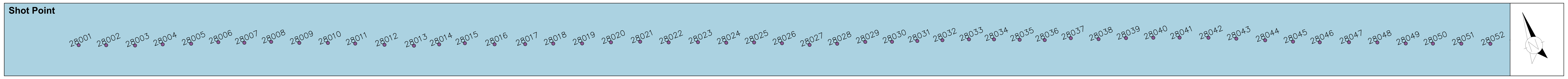
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	10 of 25	F197217-REP-RES

Profile TA2BR17P1



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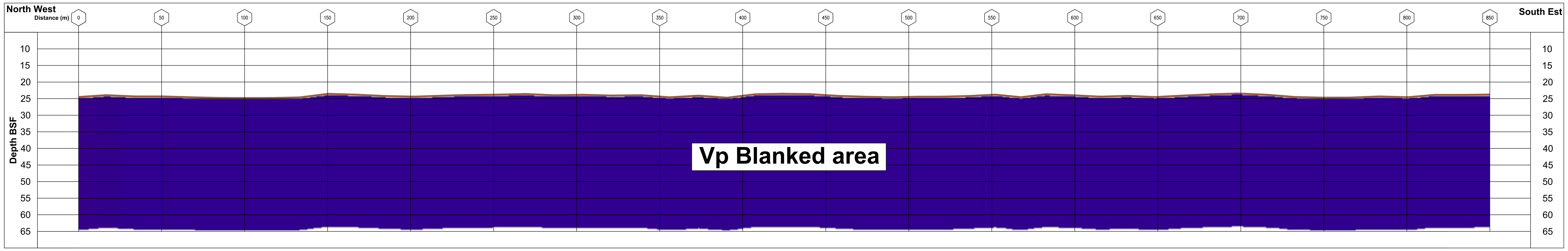
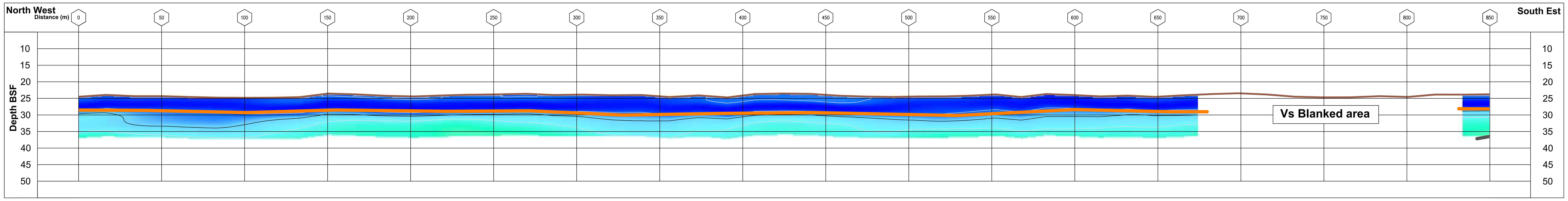
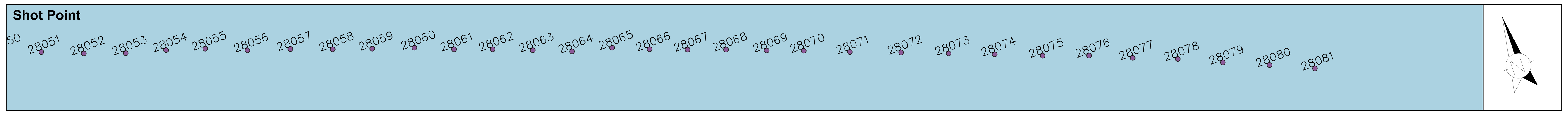


MASW section





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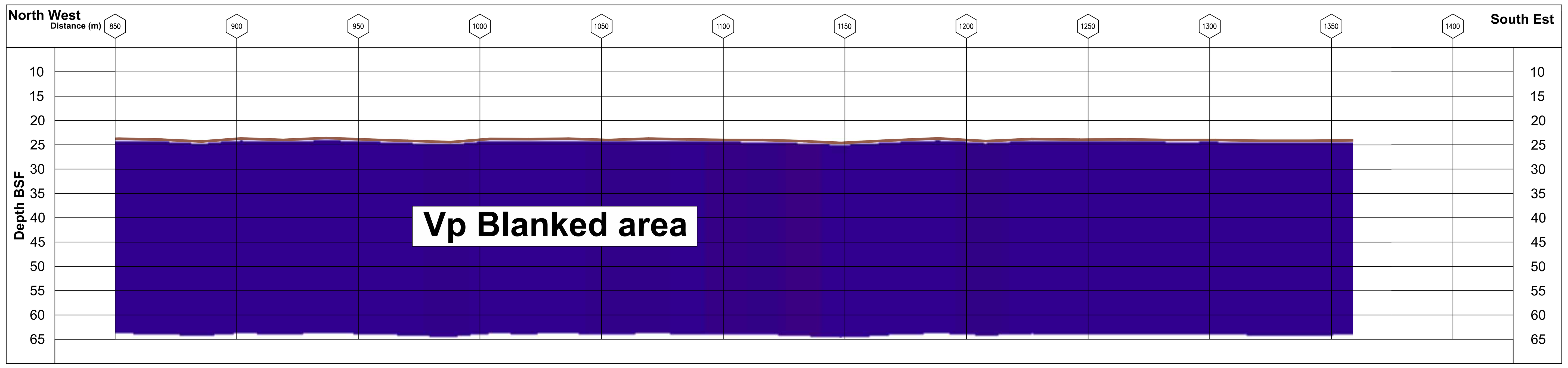
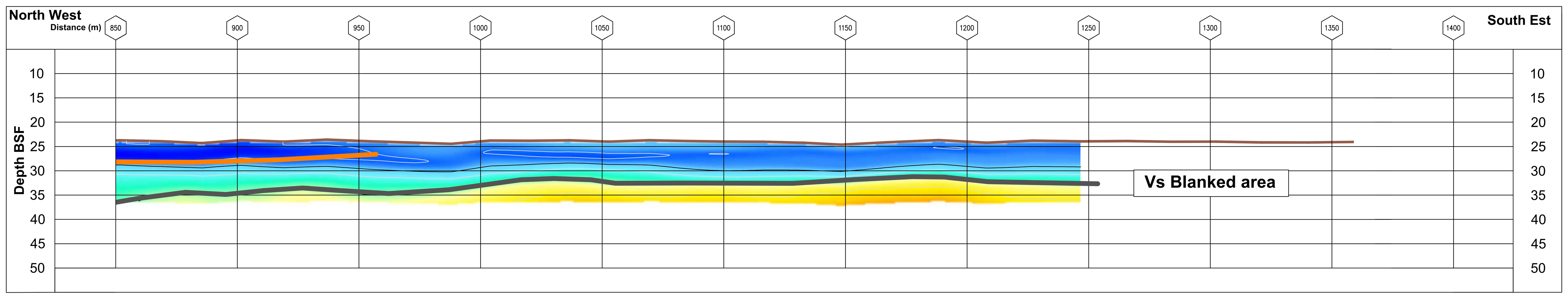
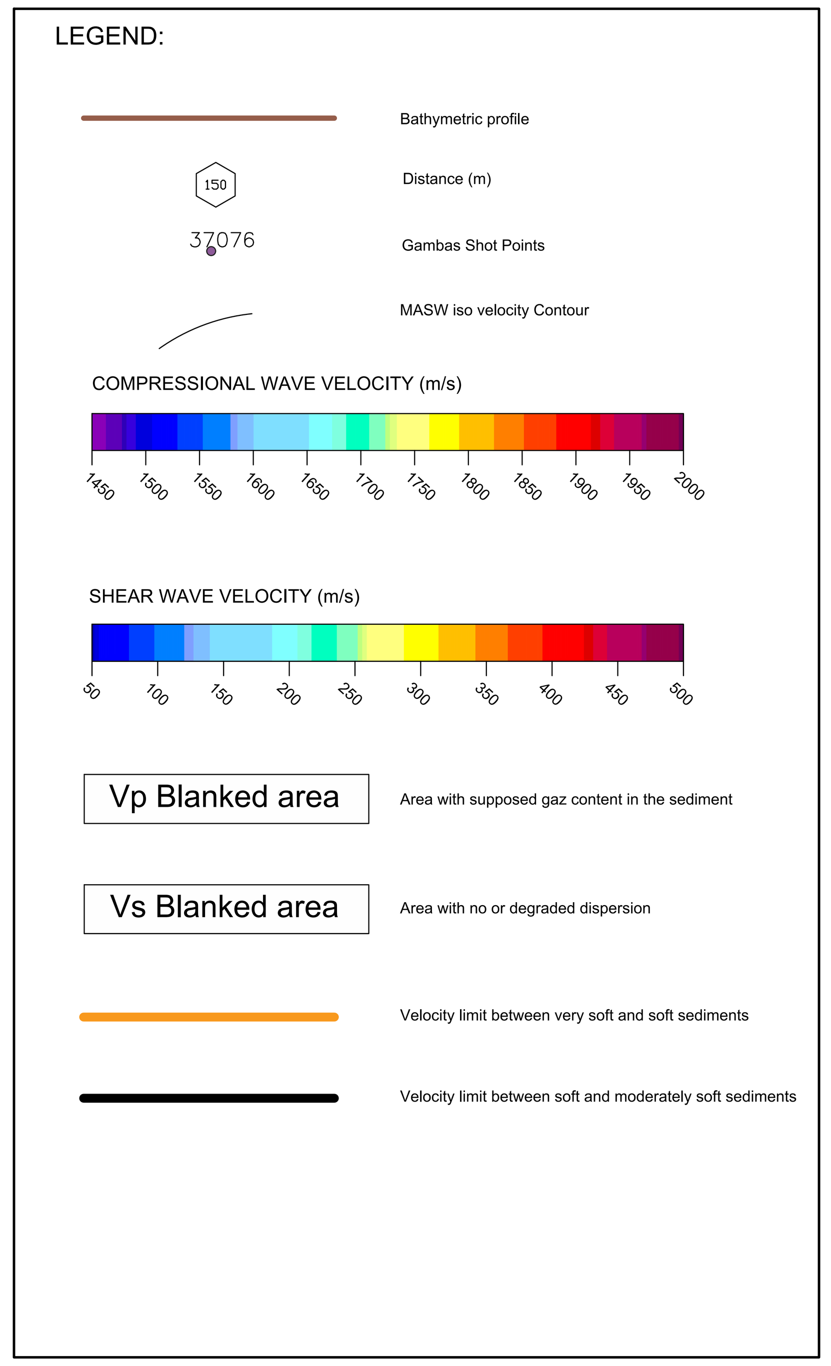


MASW section





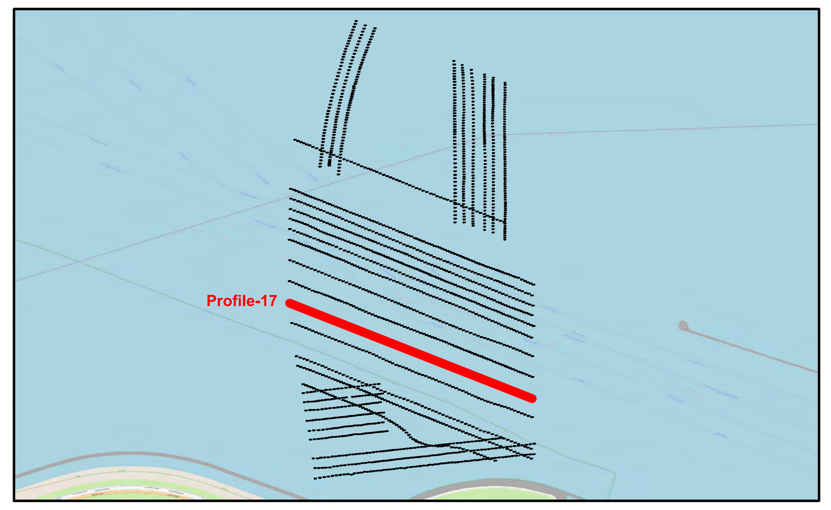
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



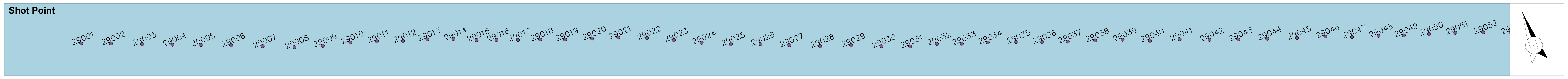
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

50 0 Metres 50 100

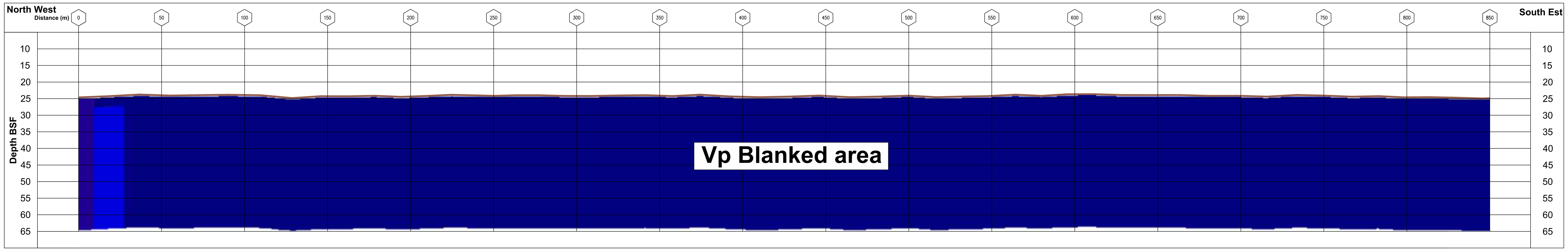
Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO
Client Ref: TotalEnergies	Drawing No: C	Chart: 11 of 25	Doc No: F197217-REP-RES			

Profile TA2BR19P1



Refraction section



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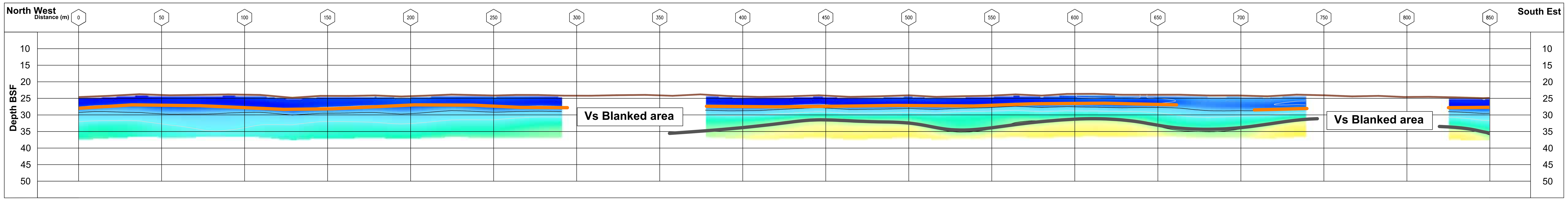

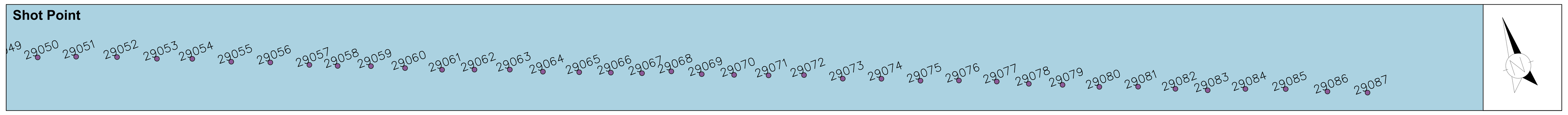

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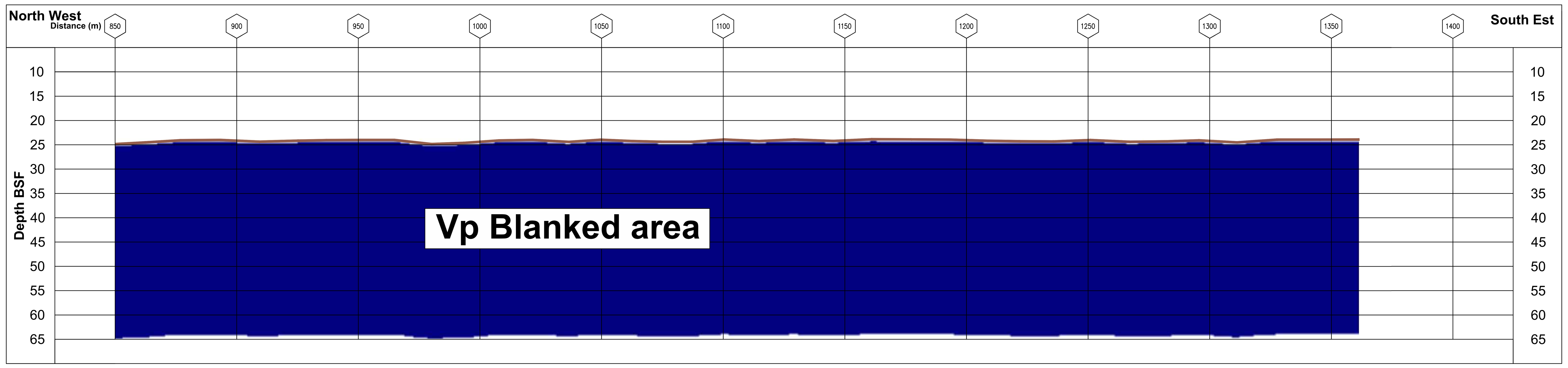
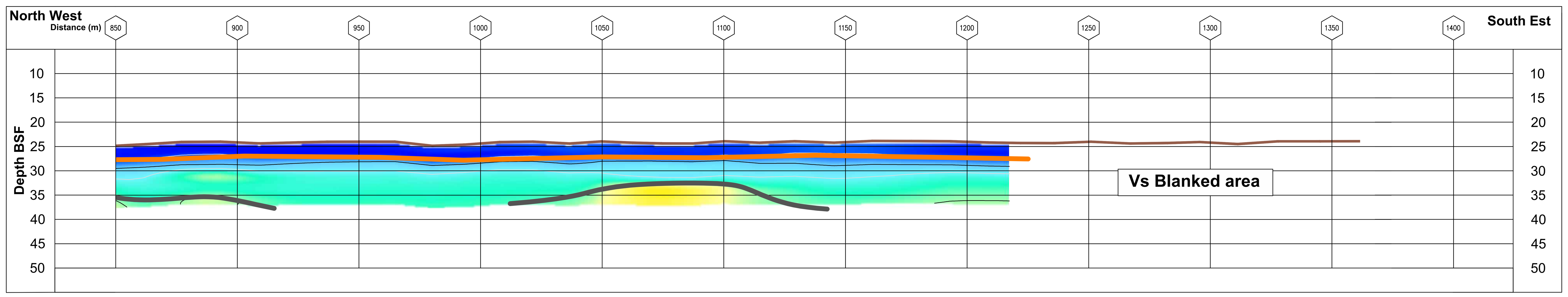
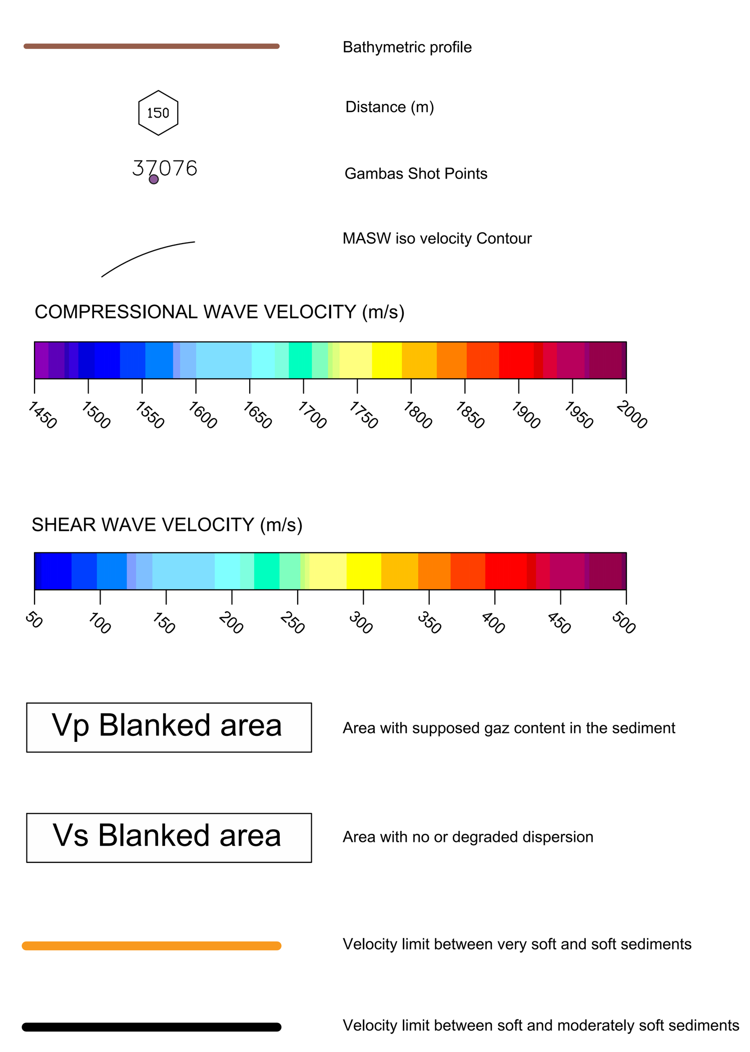


MASW section



LEGEND:



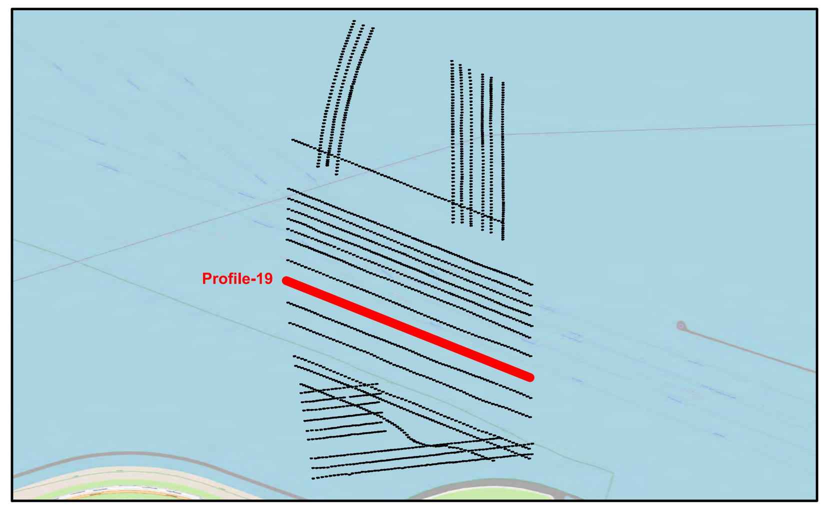
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

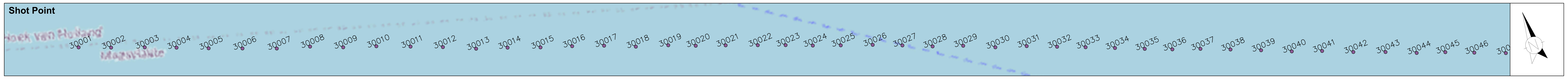
Metres
50 0 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	12 of 25	F197217-REP-RES

Profile TA2BR21P1



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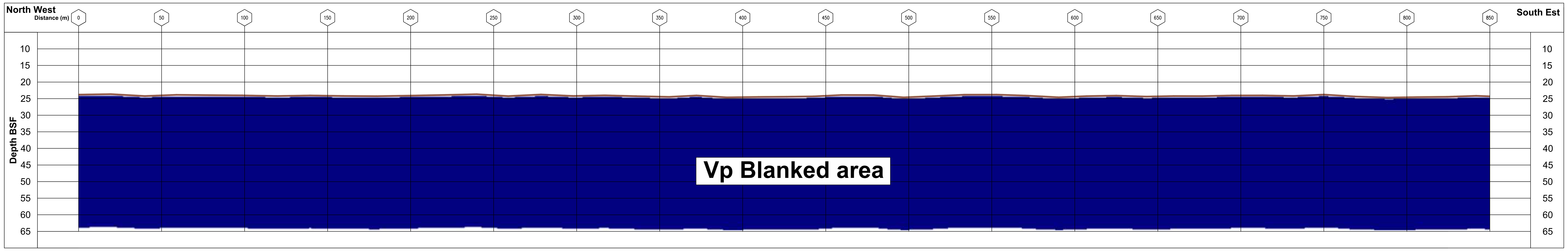
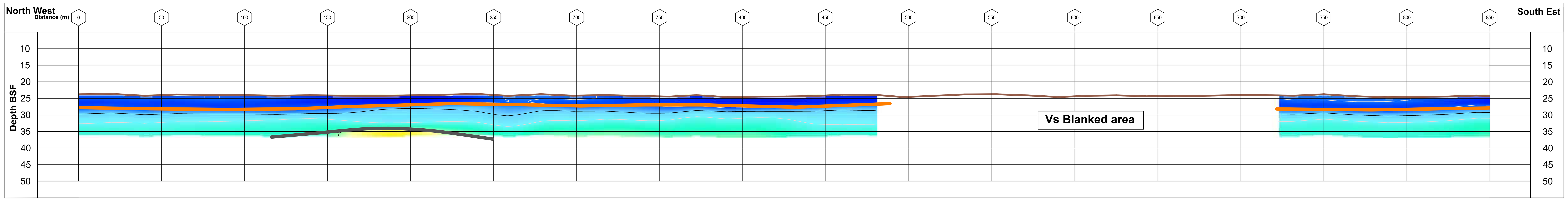
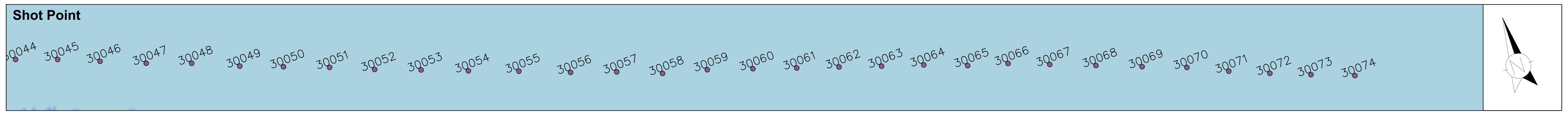


MASW section





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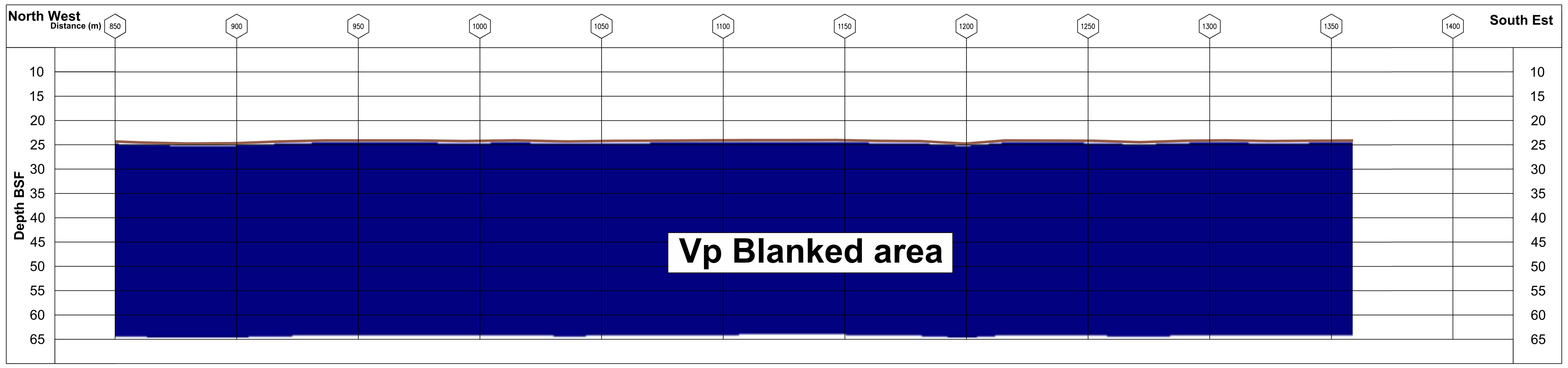
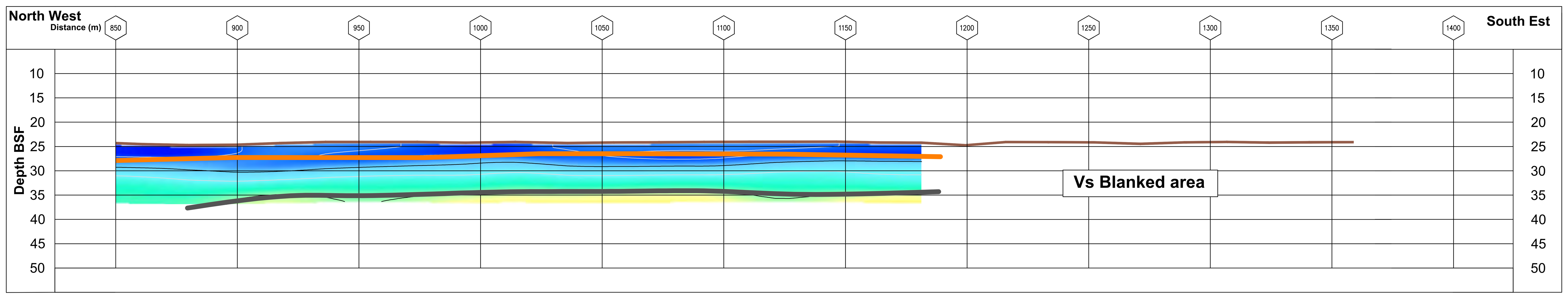
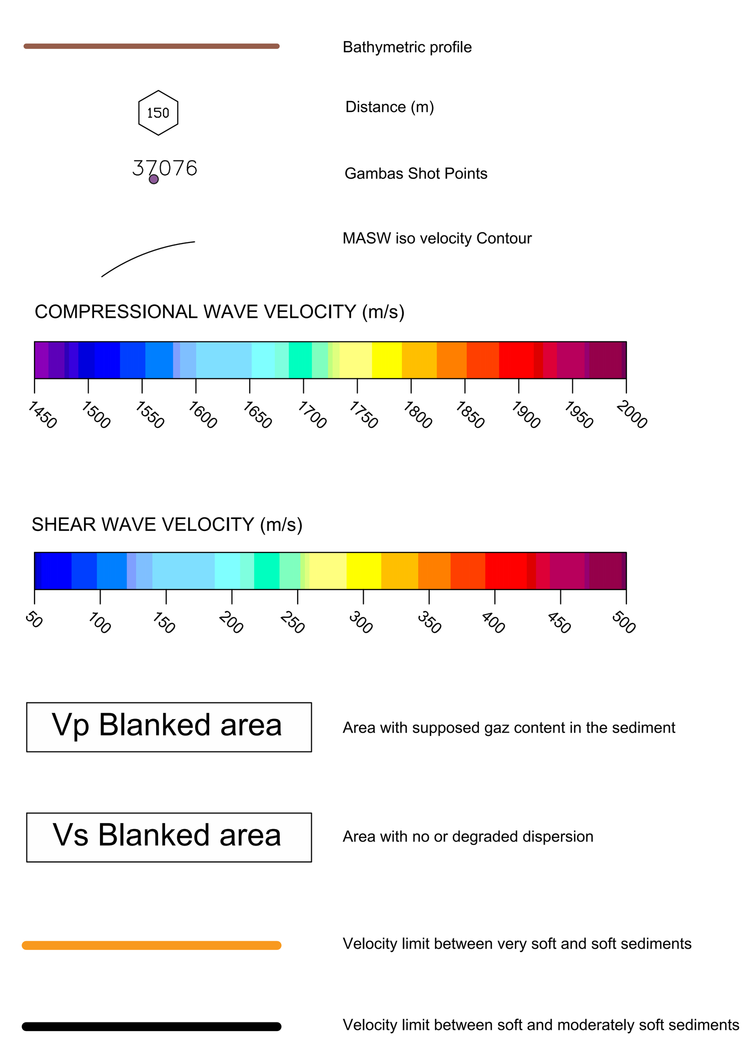


MASW section



LEGEND:



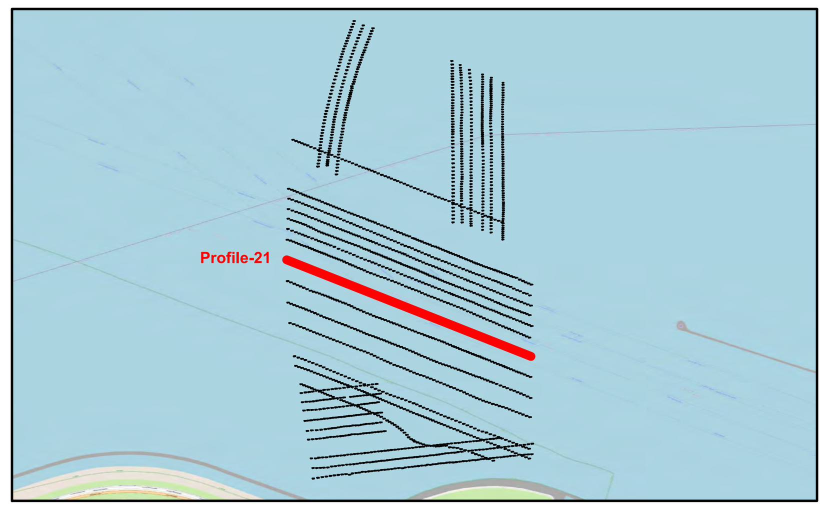
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



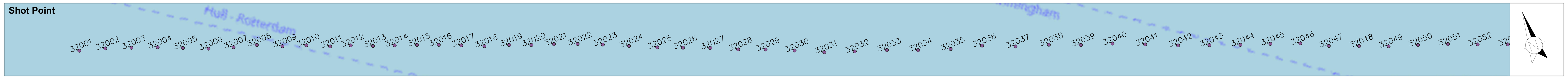
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

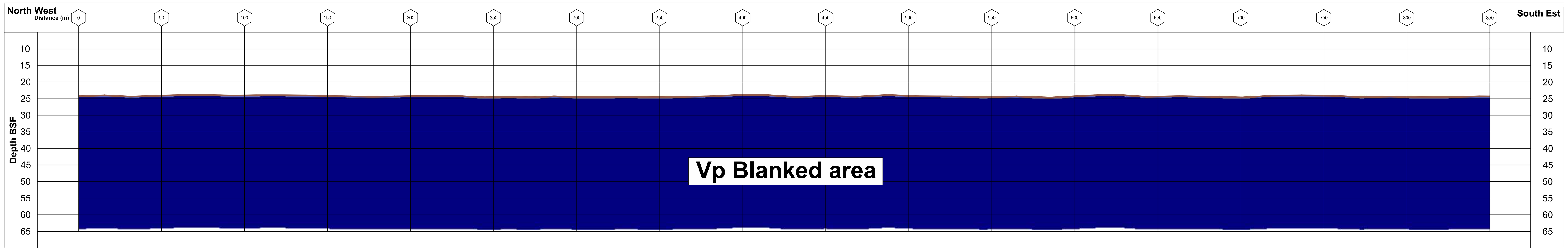
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	13 of 25	F197217-REP-RES

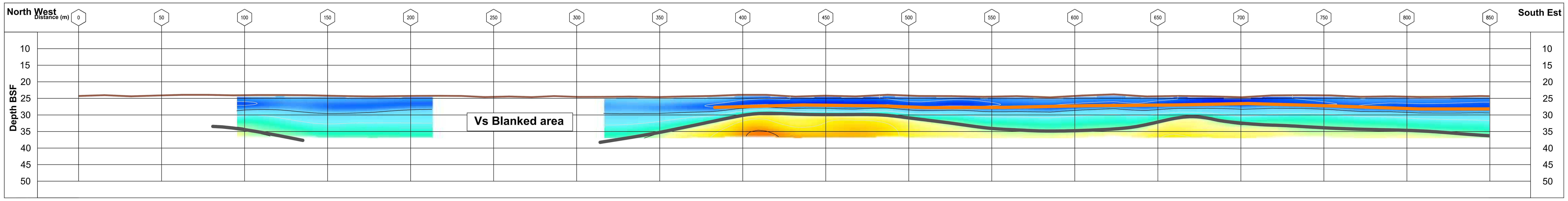
Profile TA2BR23P1

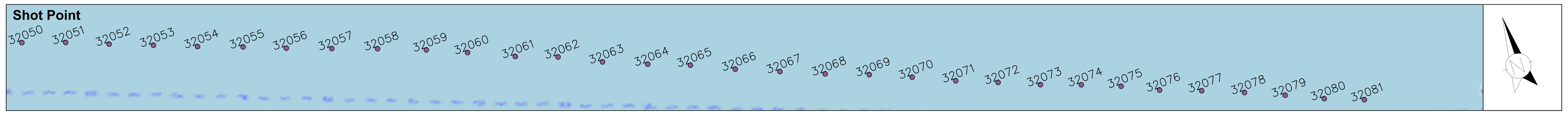


Refraction section

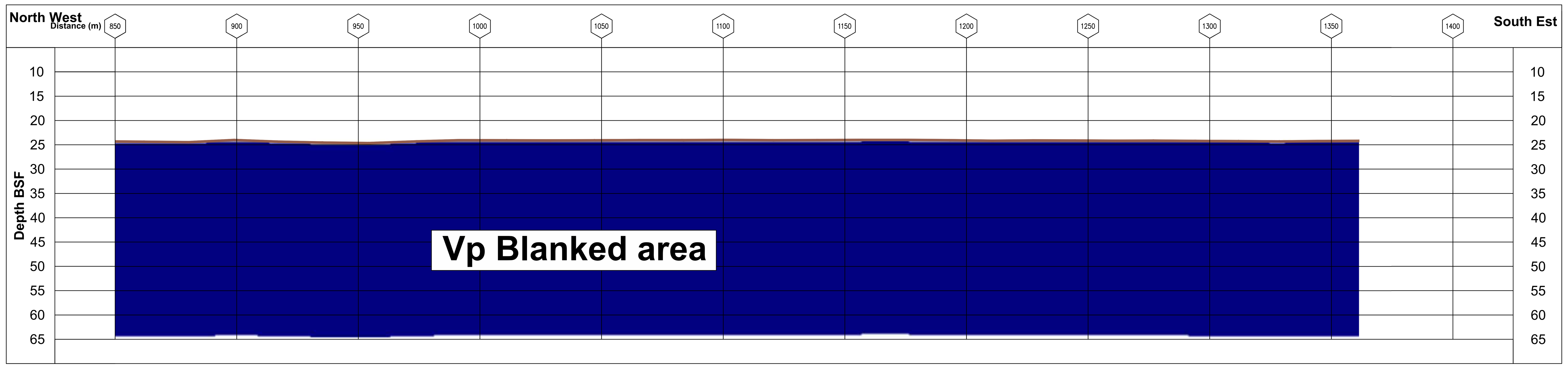


MASW section

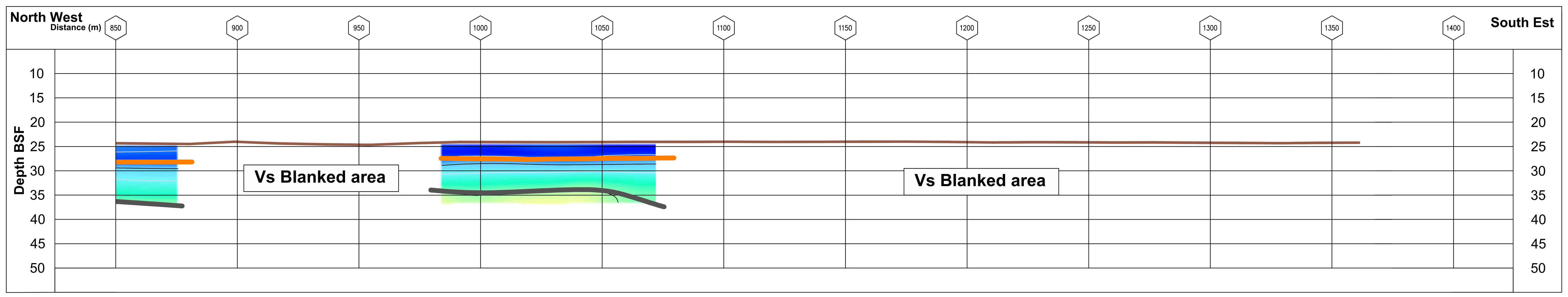




Refraction section



MASW section



LEGEND:

- Bathymetric profile
- 150 — Distance (m)
- 32076 — Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s): 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s): 50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

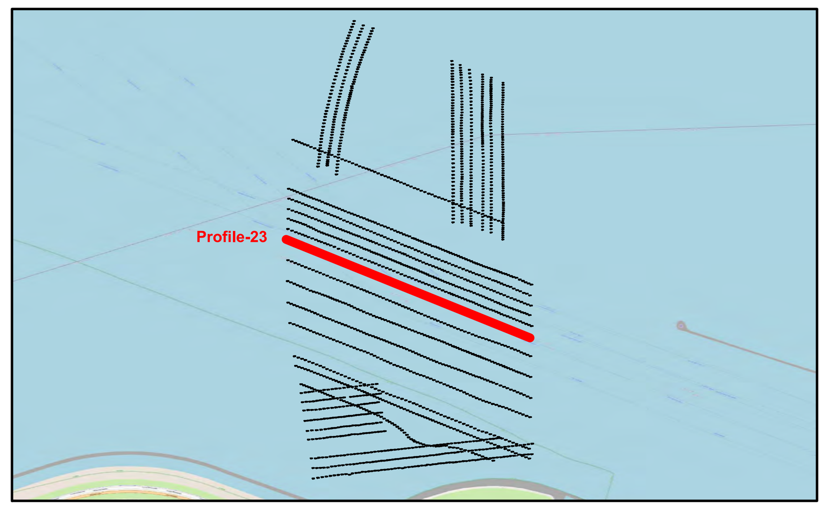
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Metres: 50 0 50 100

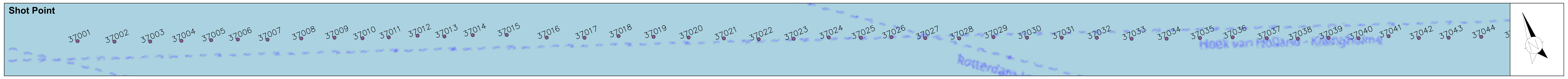
Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

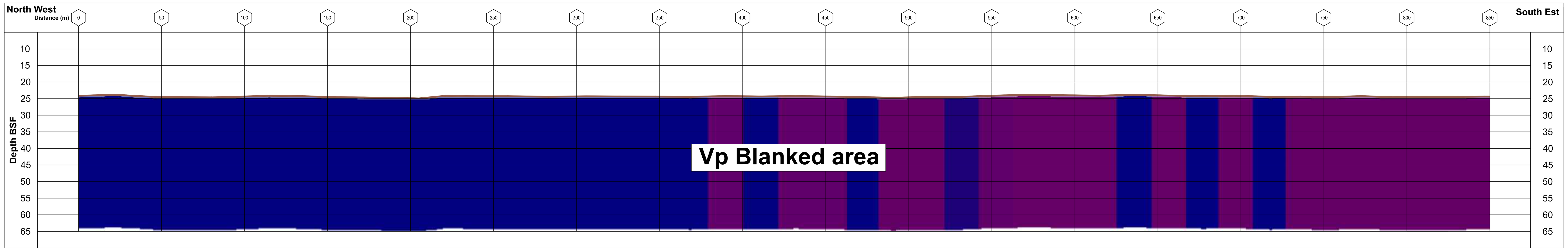
Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	14 of 25	F197217-REP-RES

Profile TA2BR24P1

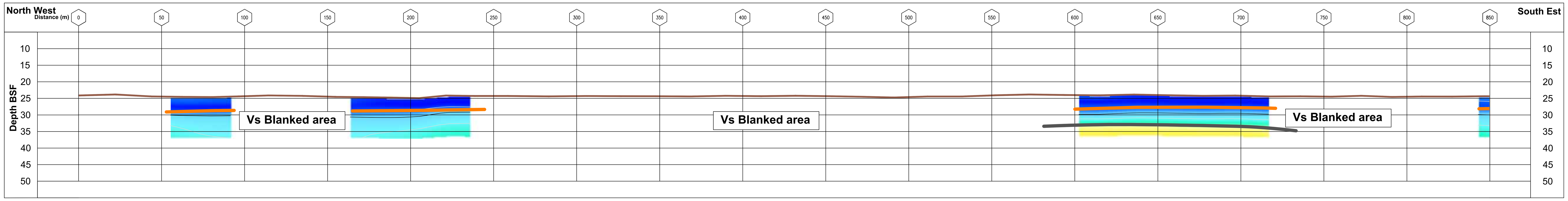
Shot Point



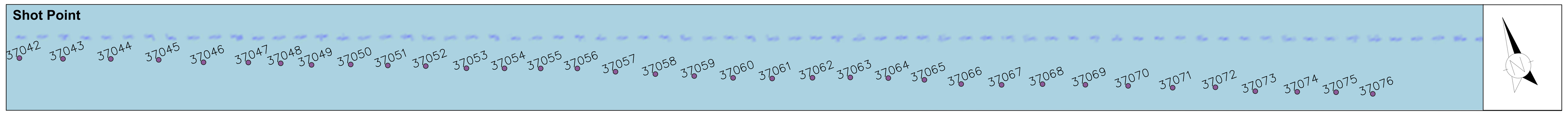
Refraction section



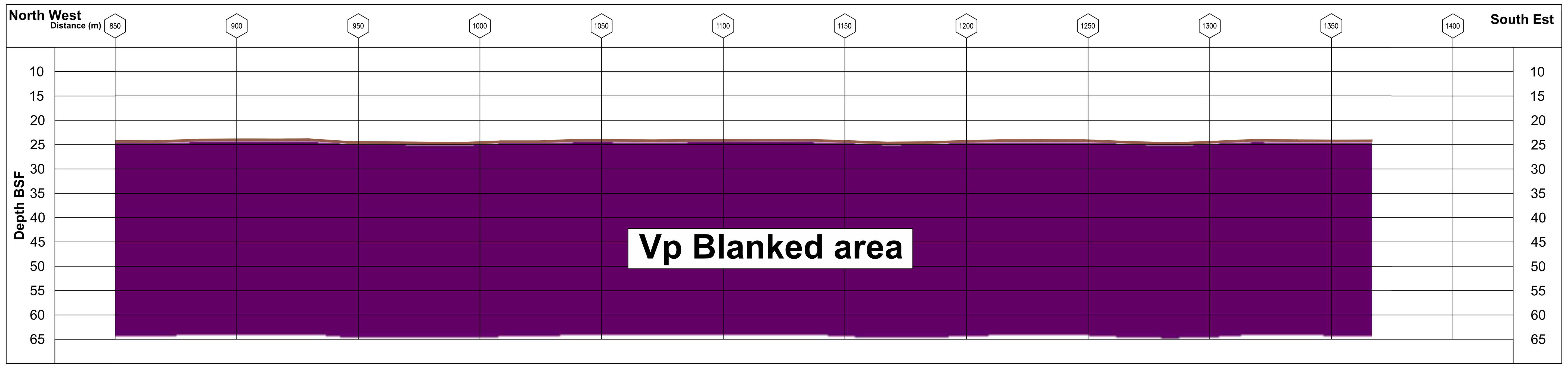
MASW section



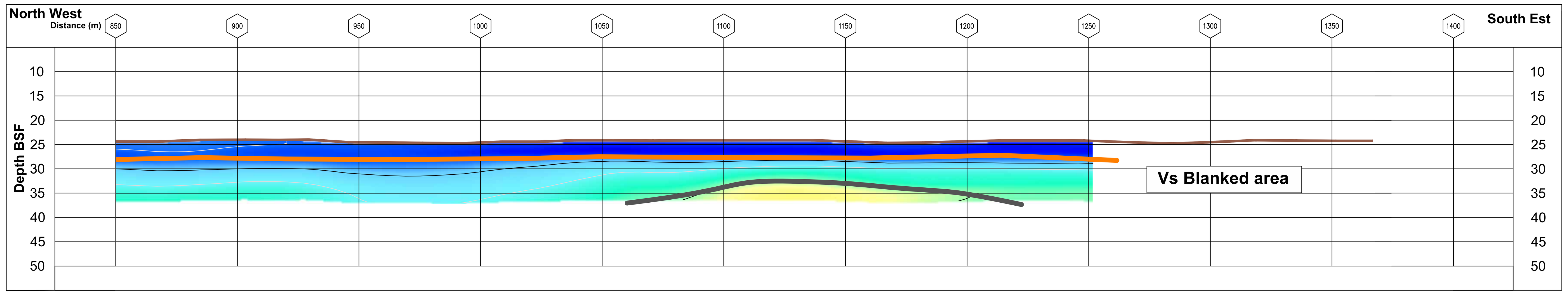
Shot Point



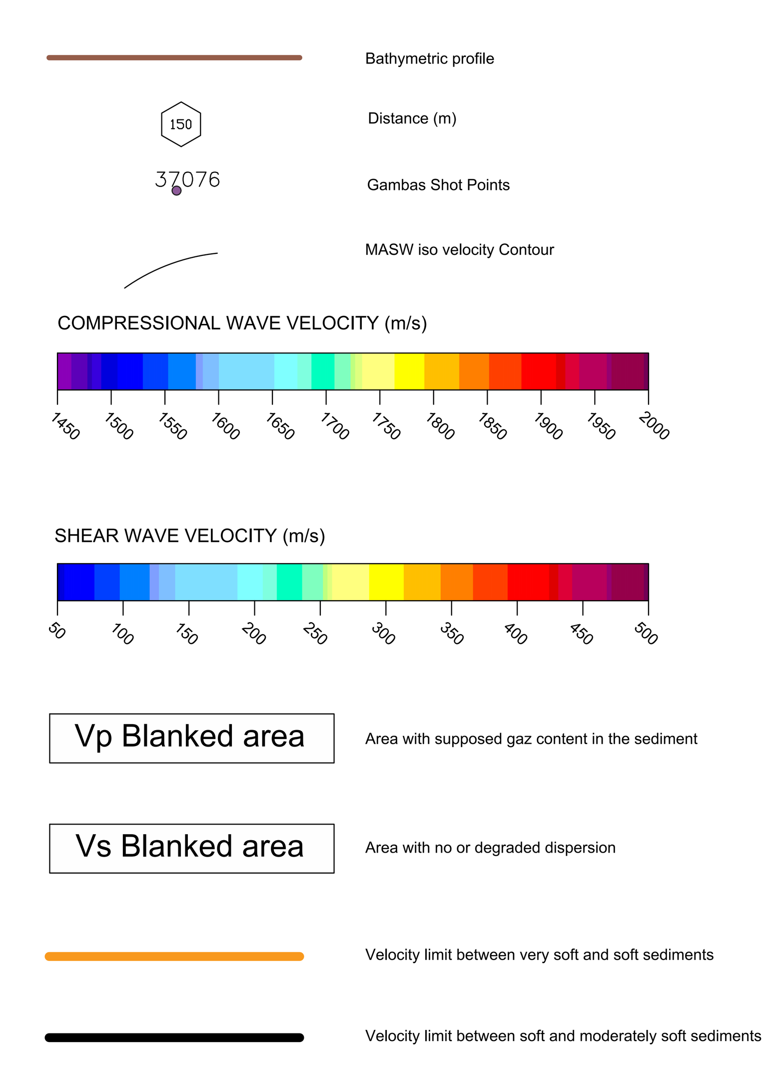
Refraction section



MASW section



LEGEND:



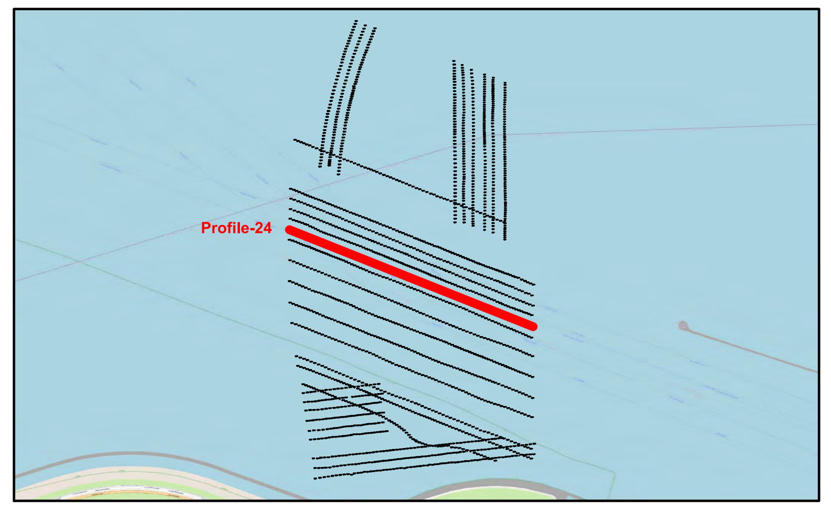
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

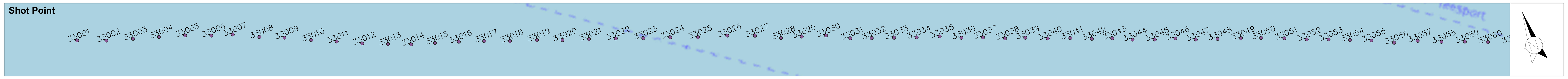
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

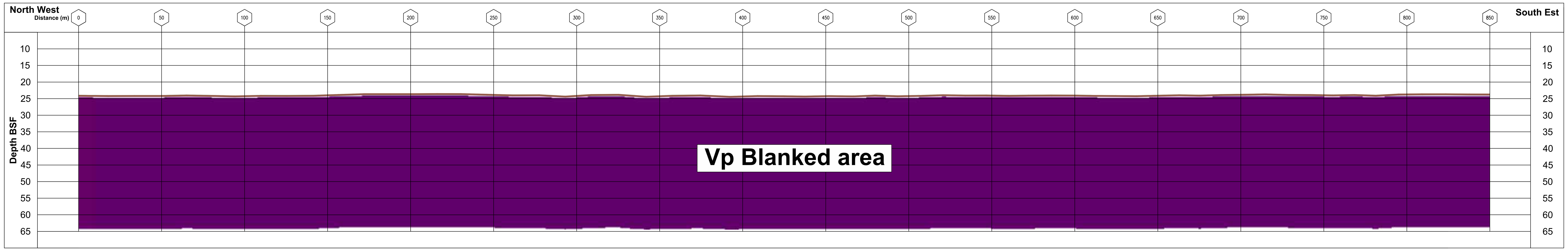
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	15 of 25	F197217-REP-RES

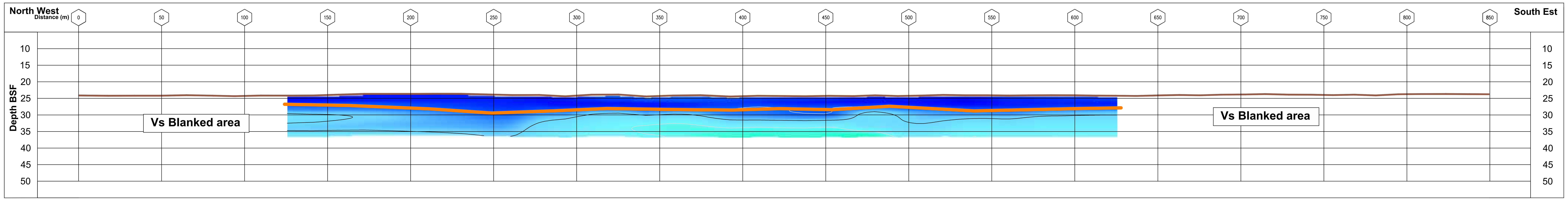
Profile TA2BR25P1

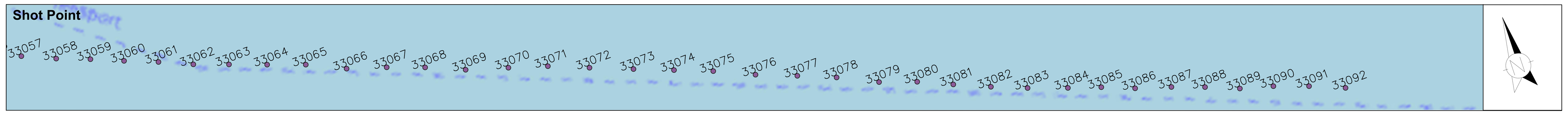


Refraction section

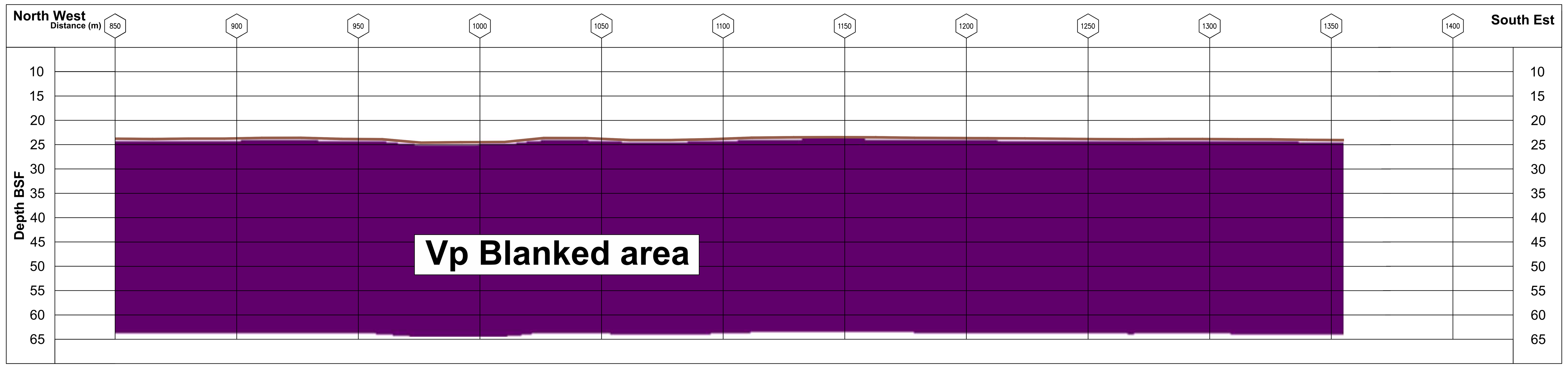


MASW section

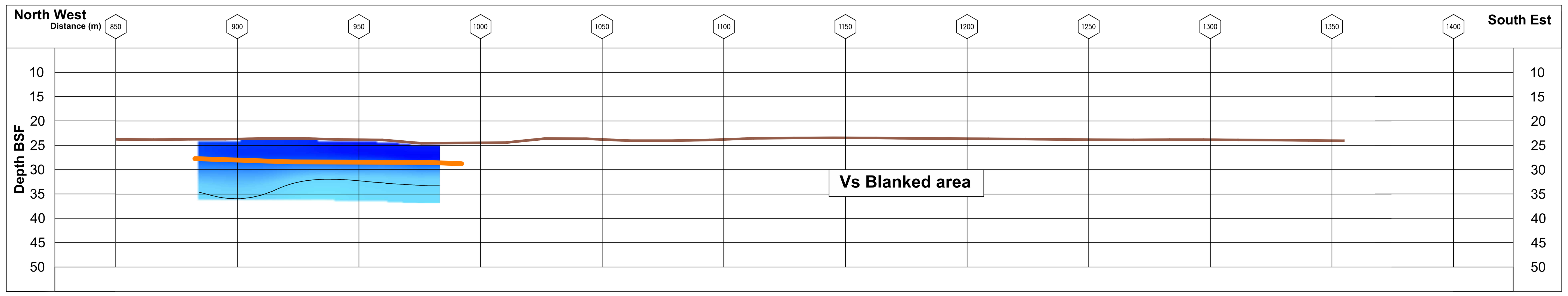




Refraction section



MASW section



LEGEND:

- Bathymetric profile
- Distance (m)
- Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

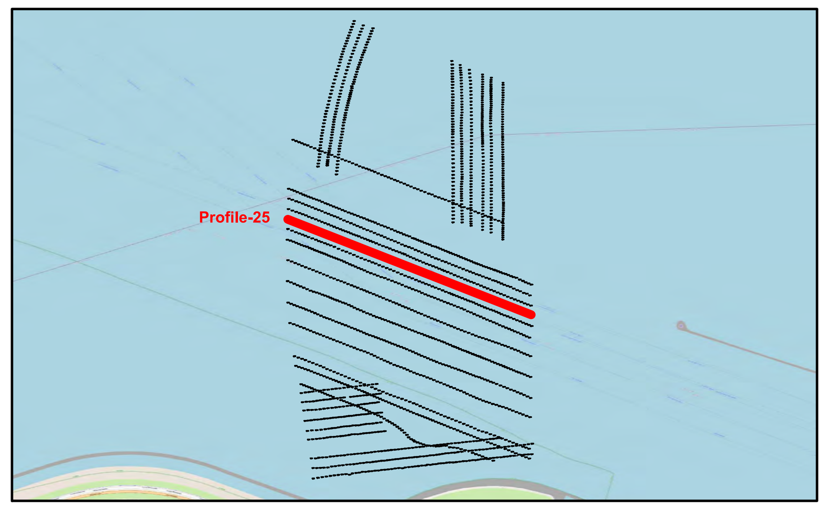
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

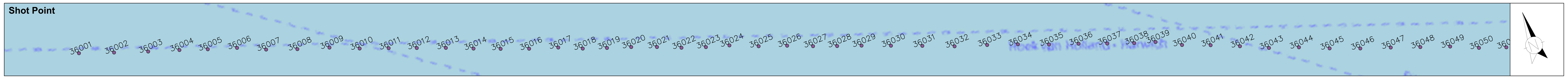
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

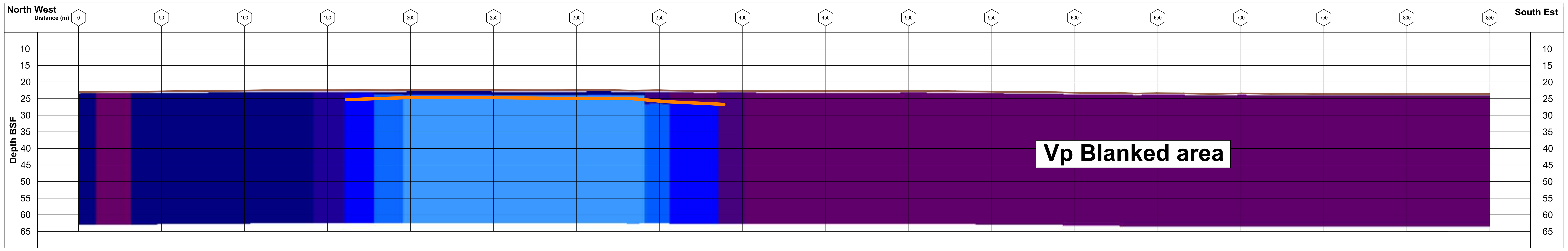
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	16 of 25	F197217-REP-RES

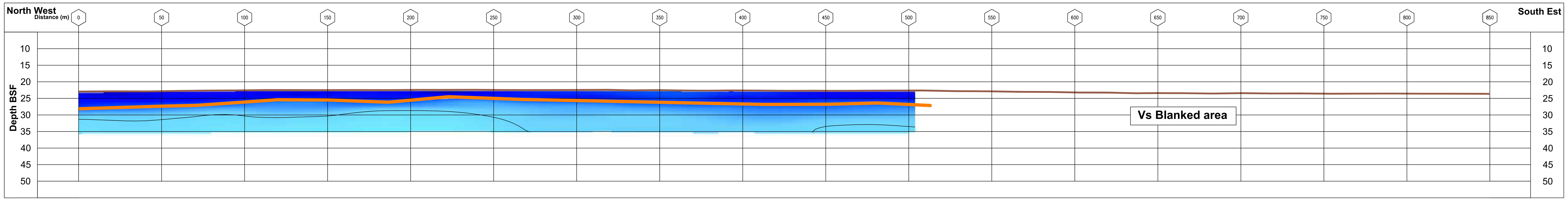
Profile TA2BR26P1

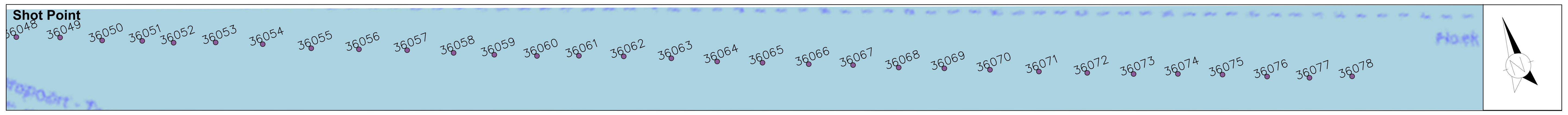


Refraction section

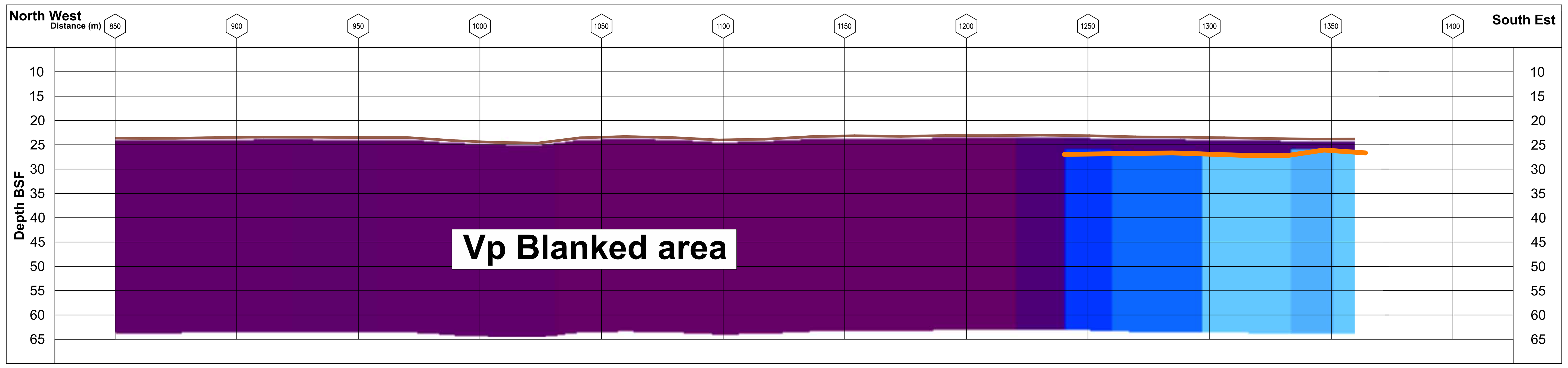


MASW section

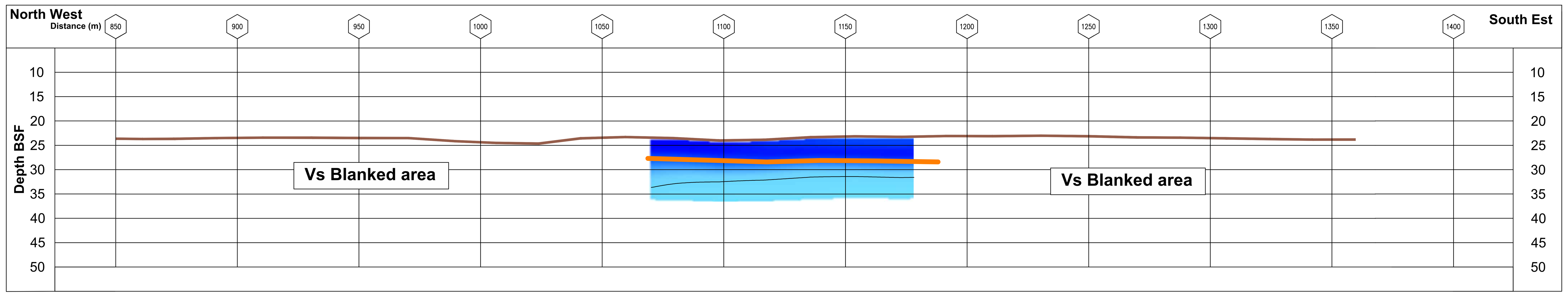




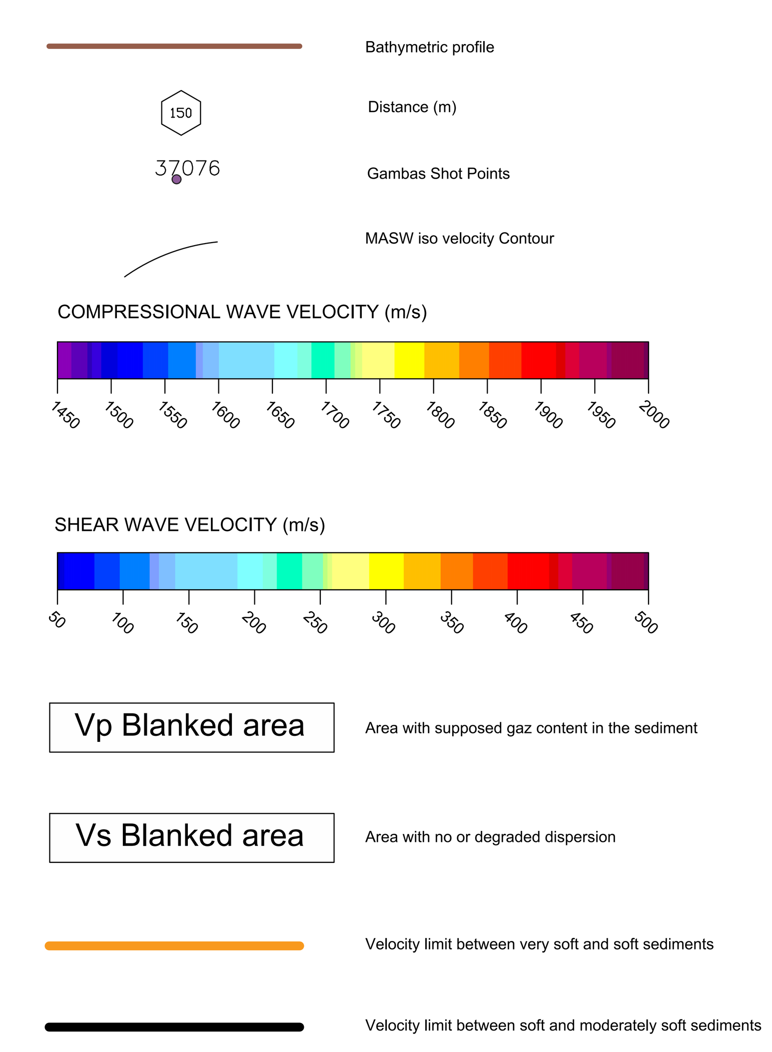
Refraction section



MASW section



LEGEND:



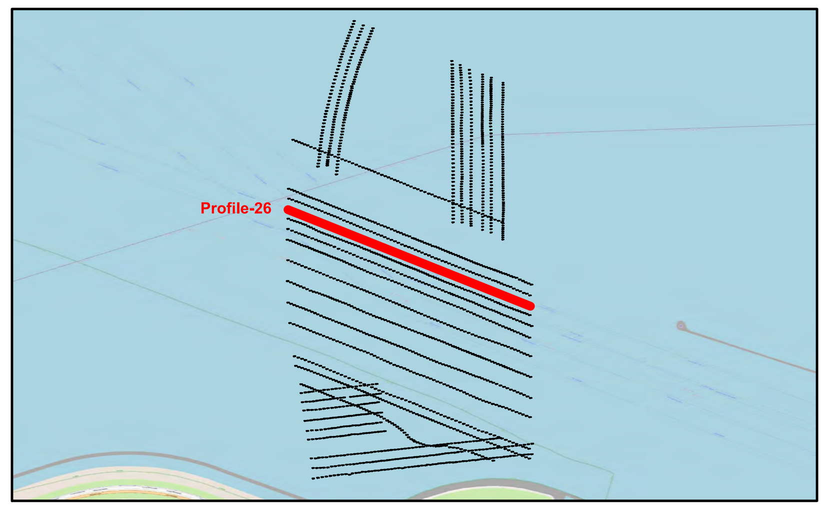
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



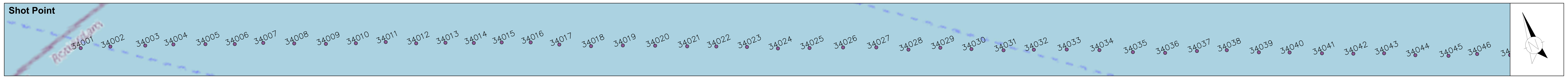
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

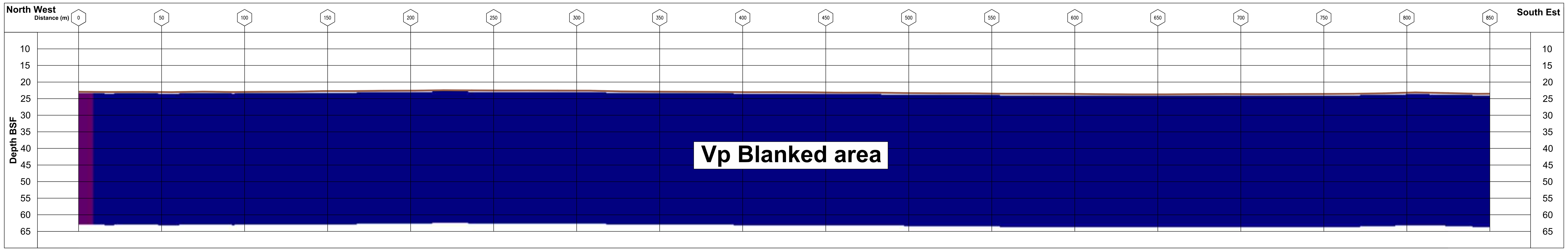
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	17 of 25	F197217-REP-RES

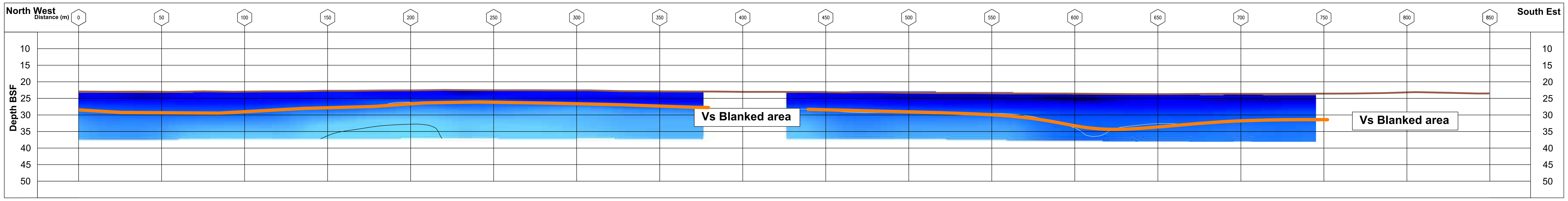
Profile TA2BR27P1

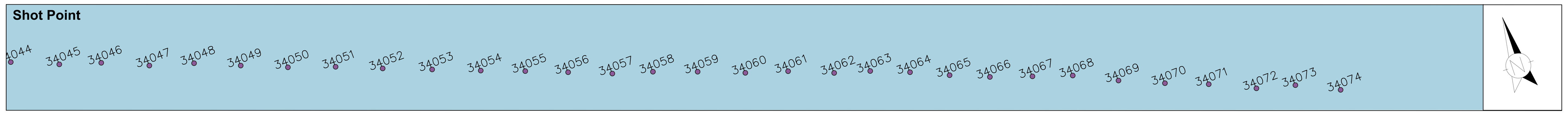


Refraction section

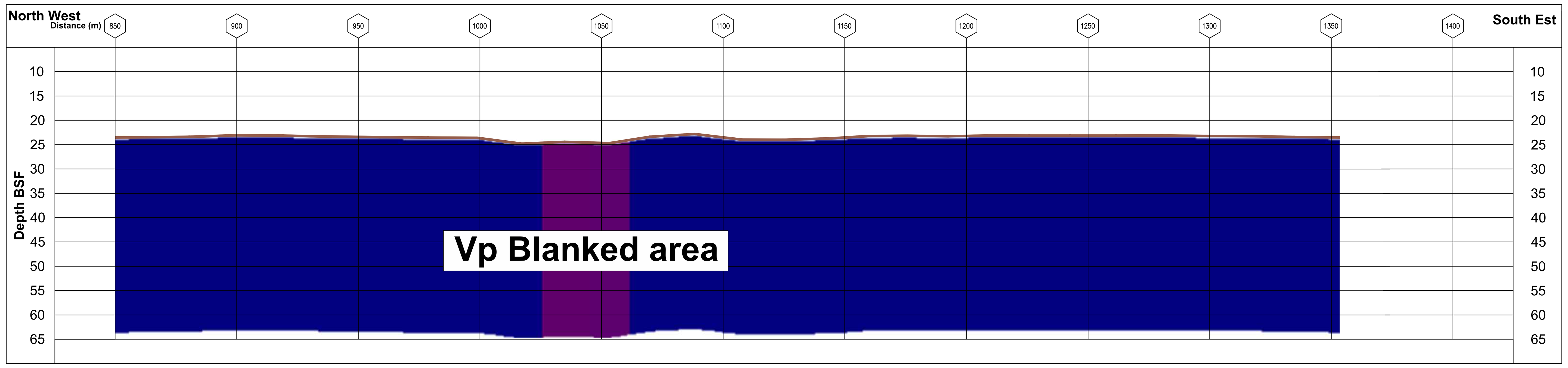


MASW section

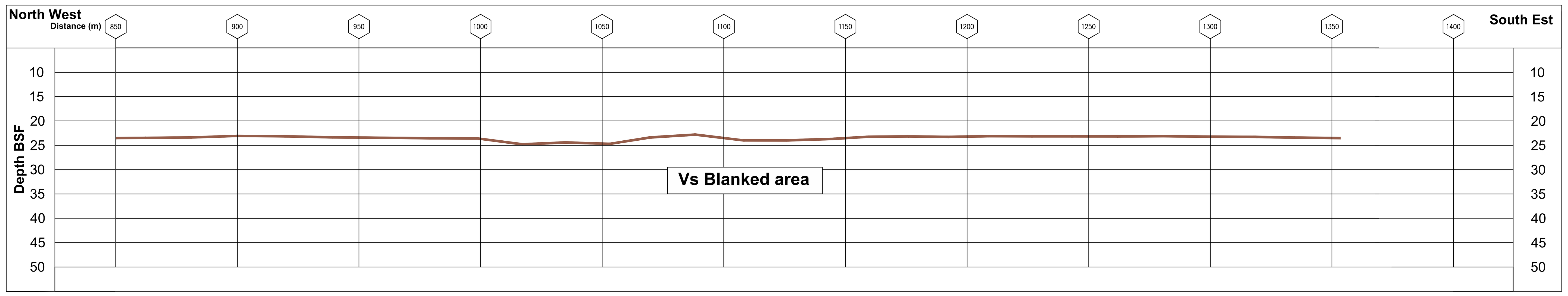




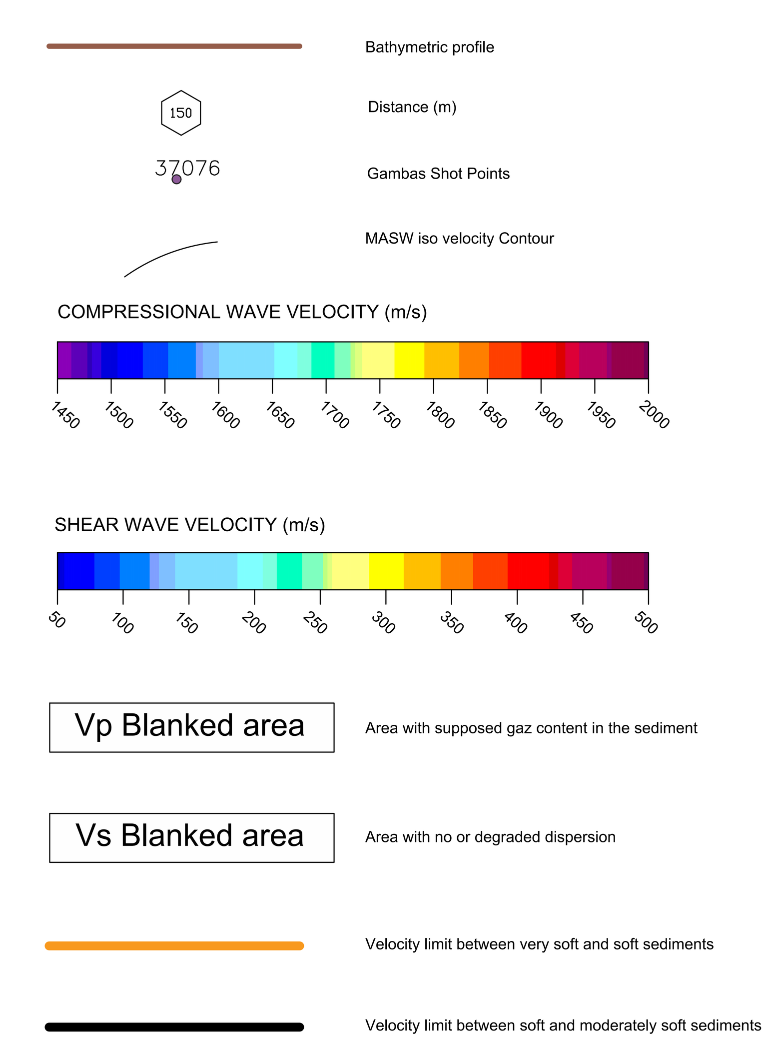
Refraction section



MASW section



LEGEND:



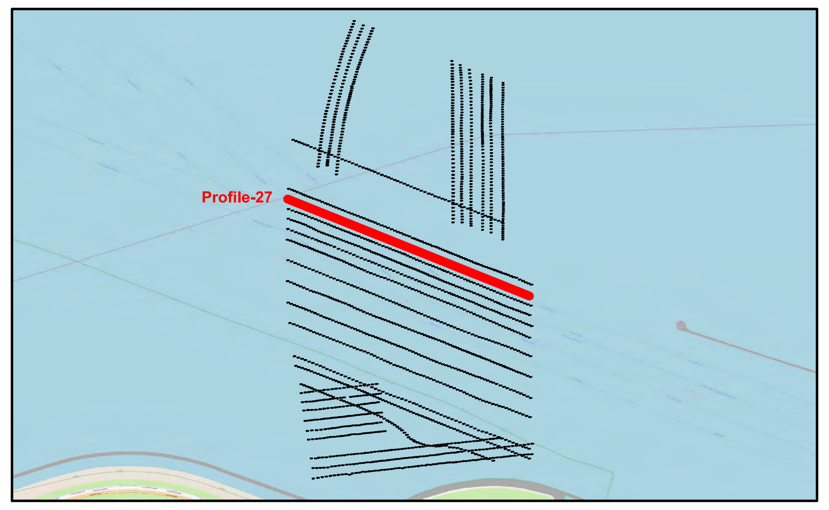
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



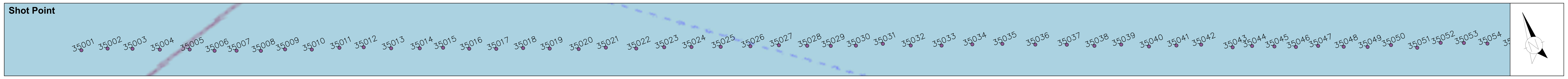
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

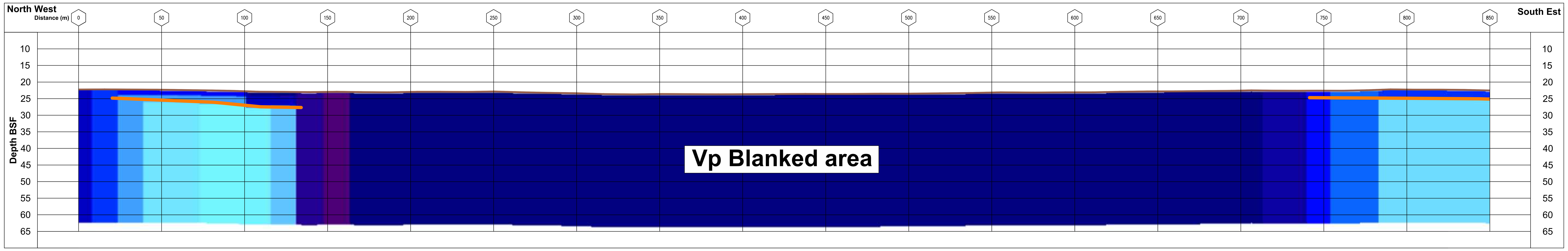
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	18 of 25	F197217-REP-RES

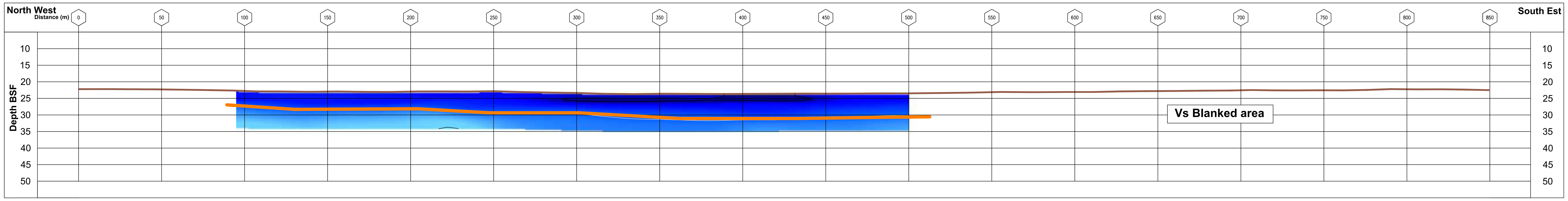
Profile TA2BR28P1

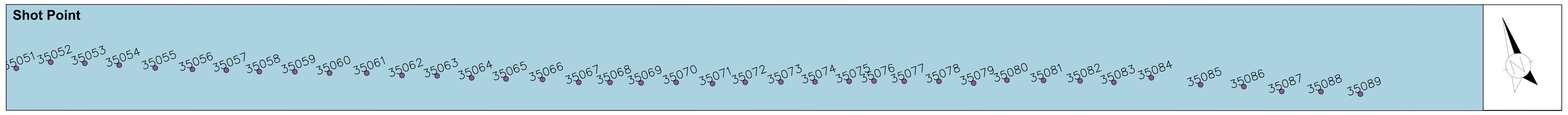


Refraction section

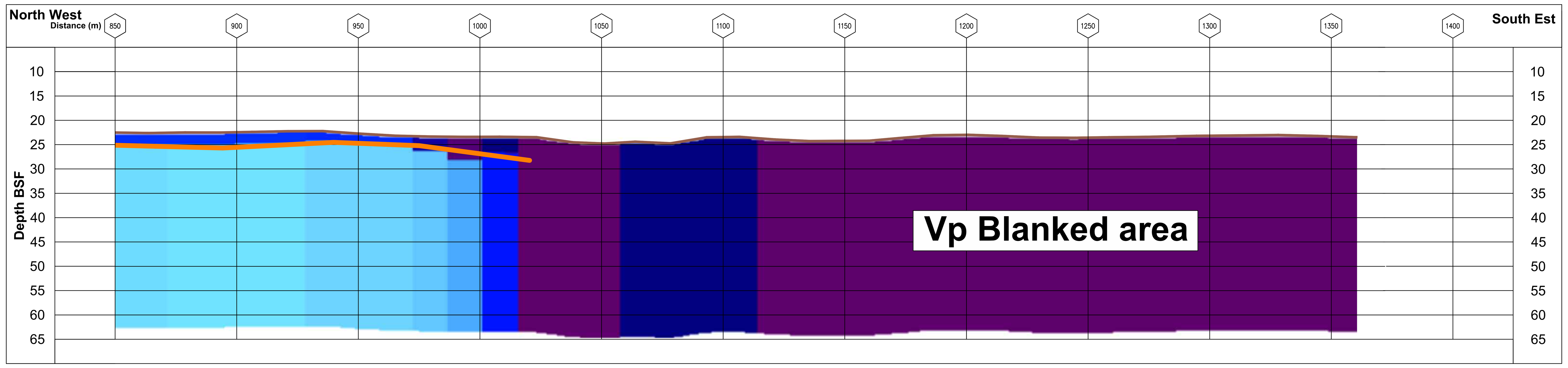


MASW section

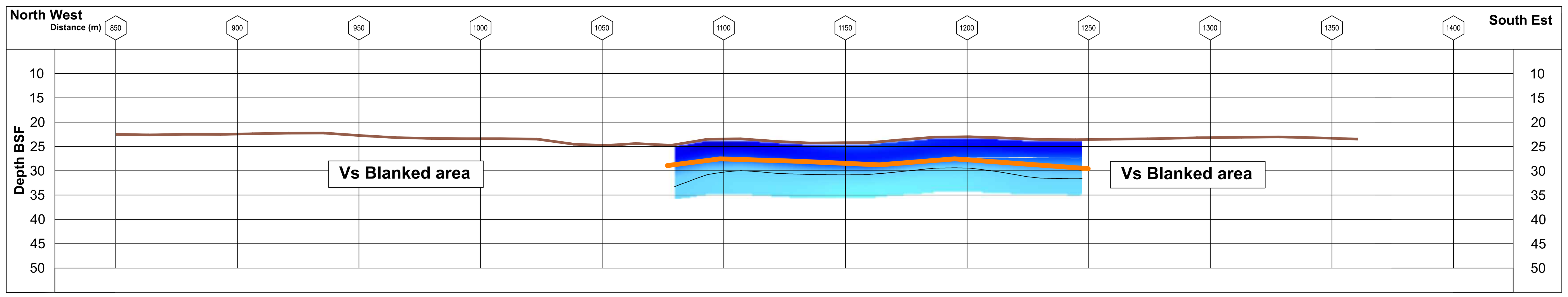




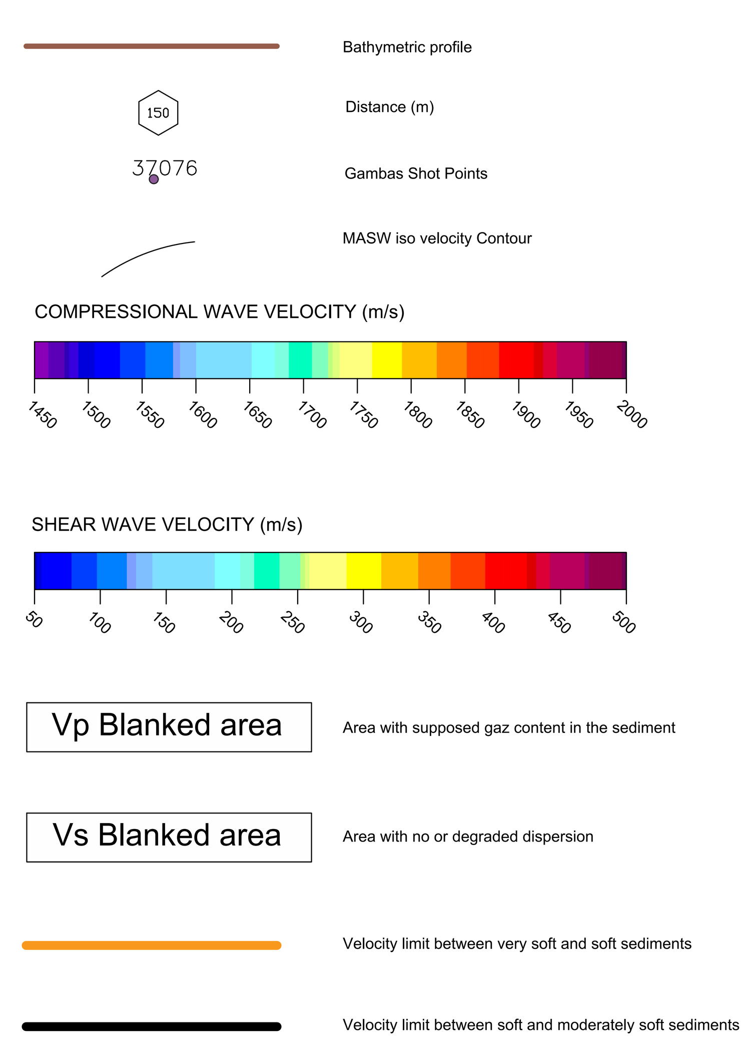
Refraction section



MASW section



LEGEND:



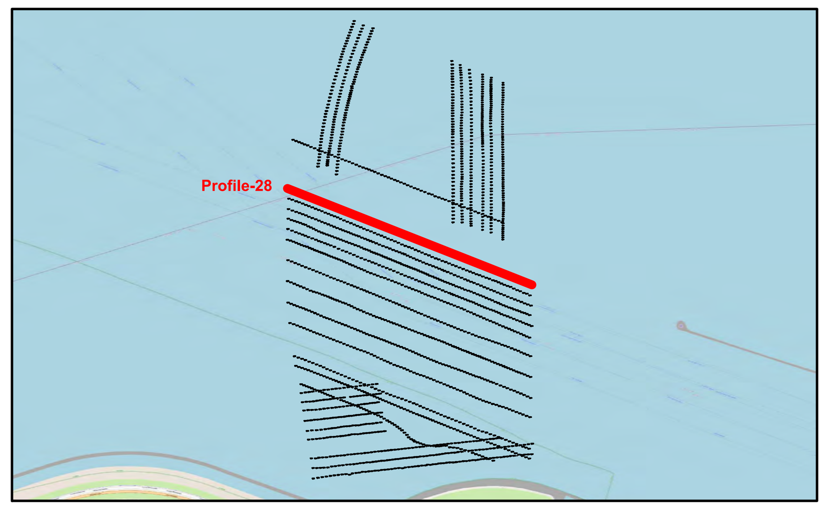
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000'' E
Latitude of Origin: 00°00' 00.000'' N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



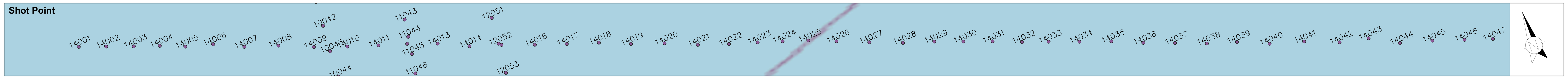
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

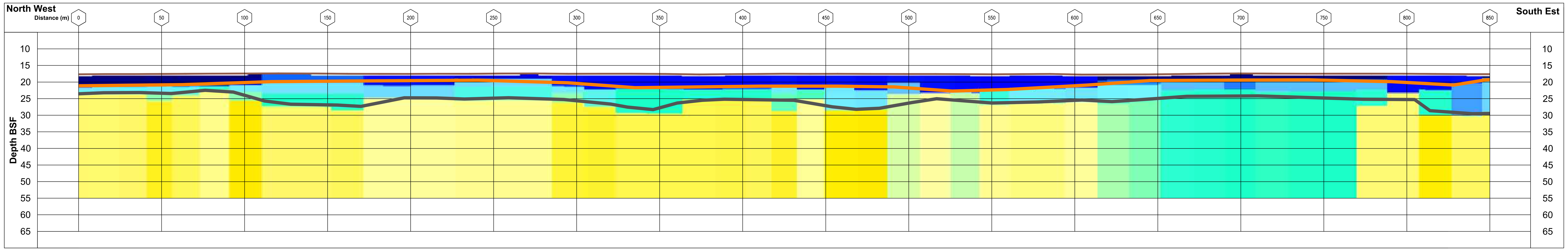
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	**19** of 25	F197217-REP-RES

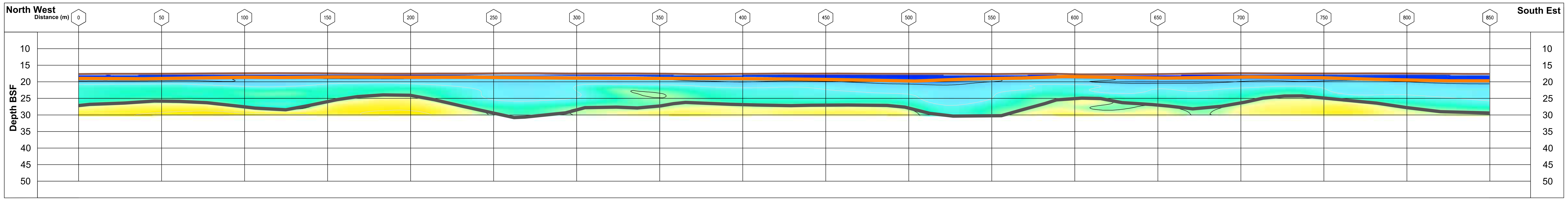
Profile TA2BR30P1

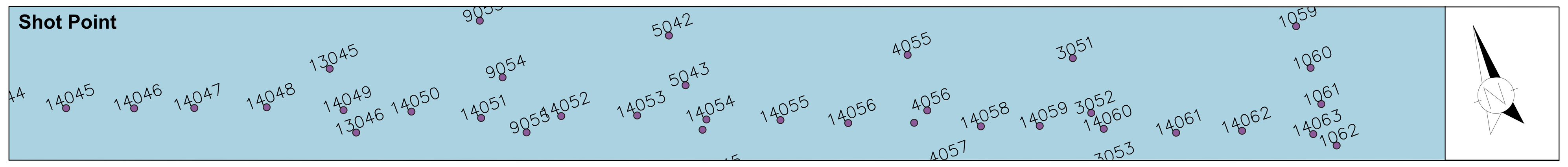


Refraction section

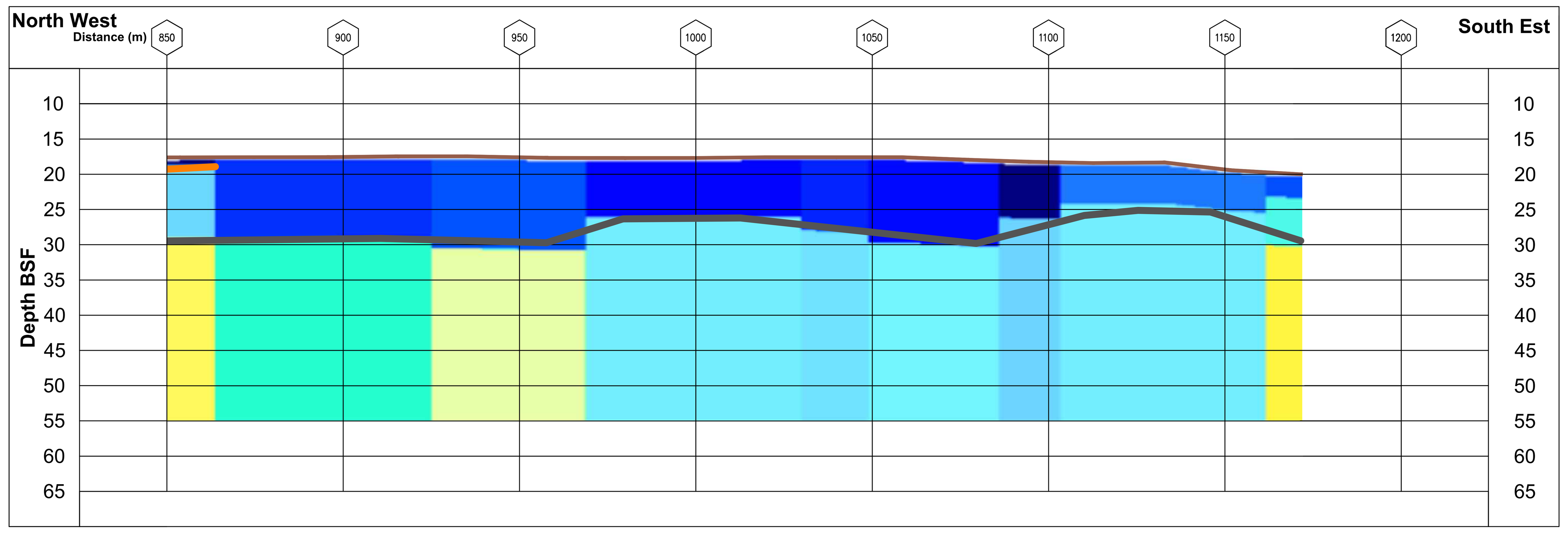


MASW section

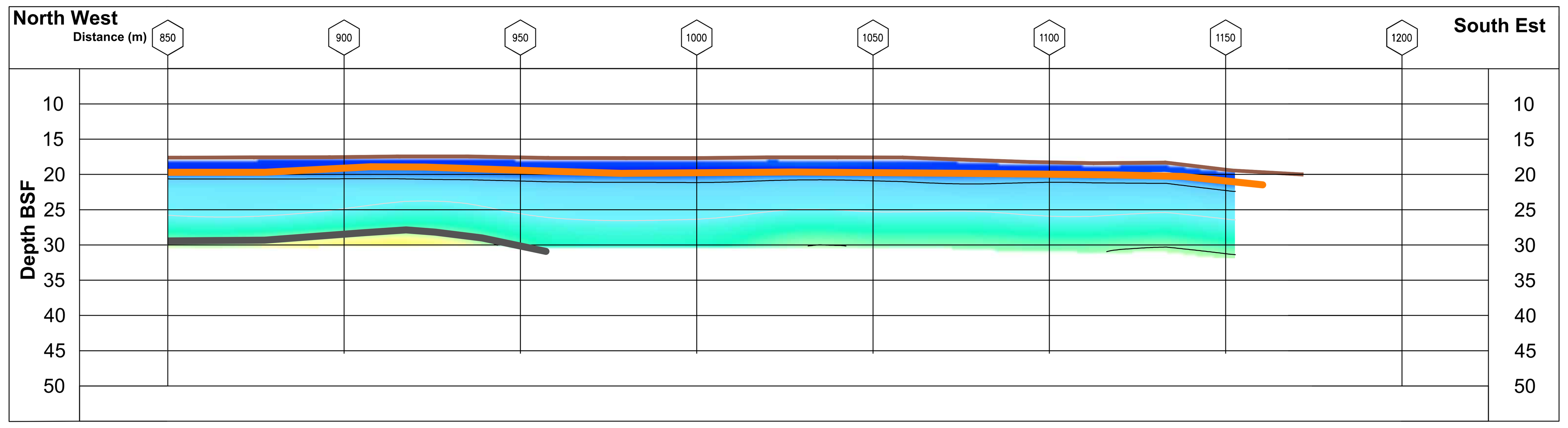




Refraction section



MASW section



LEGEND:

- Bathymetric profile
- 150 — Distance (m)
- 37076 — Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

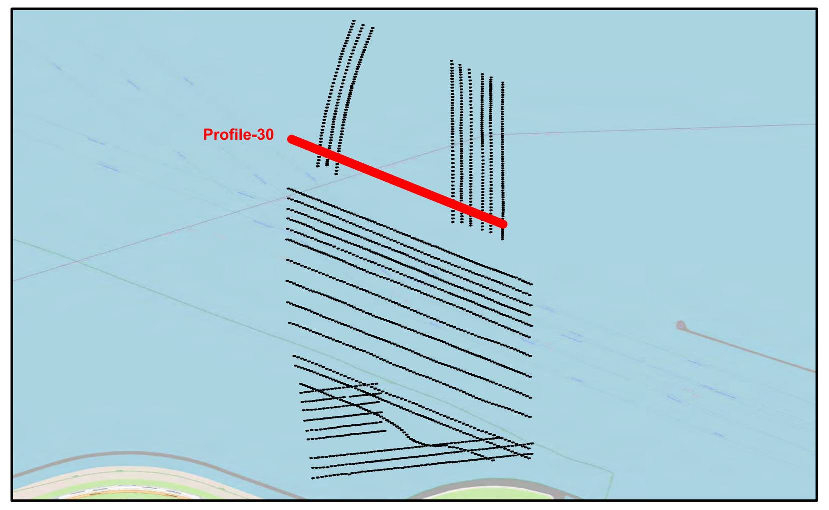
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

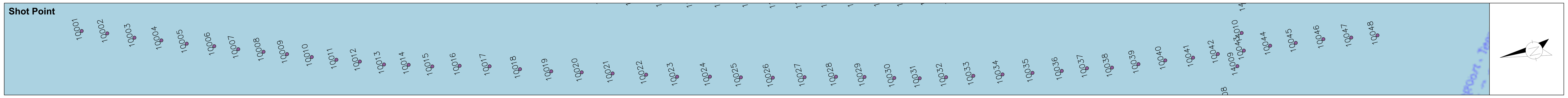
Metres: 50 0 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

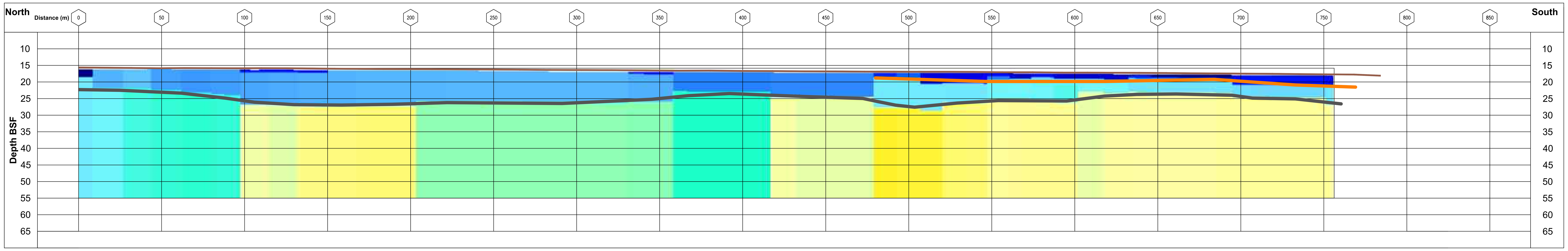
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	20 of 25	F197217-REP-RES

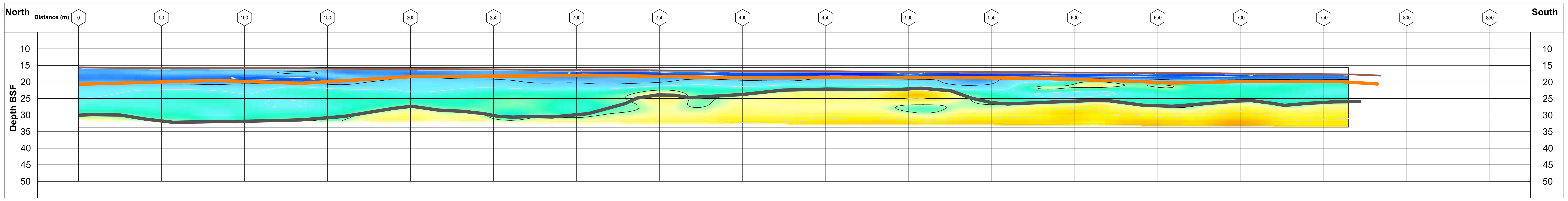
Profile TA2BR31P1



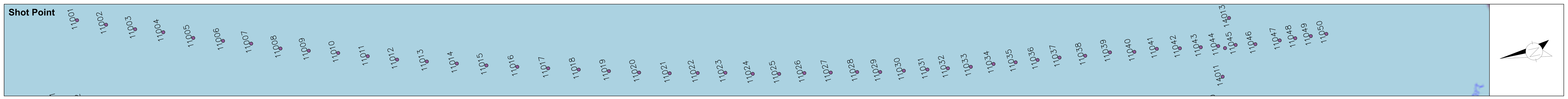
Refraction section



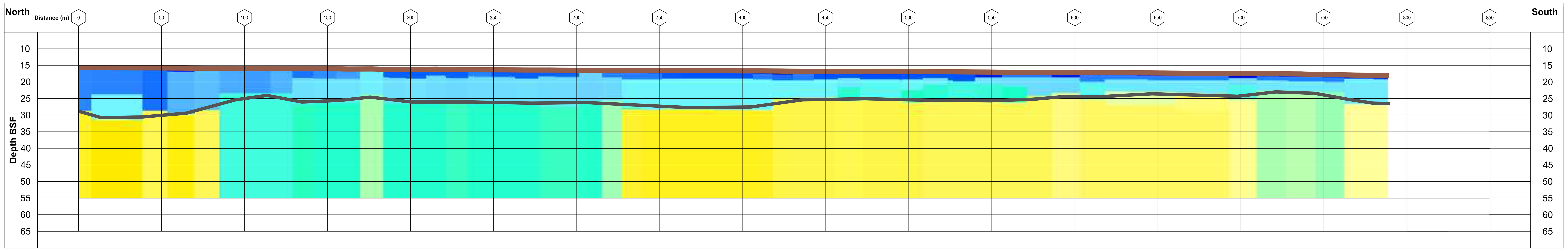
MASW section



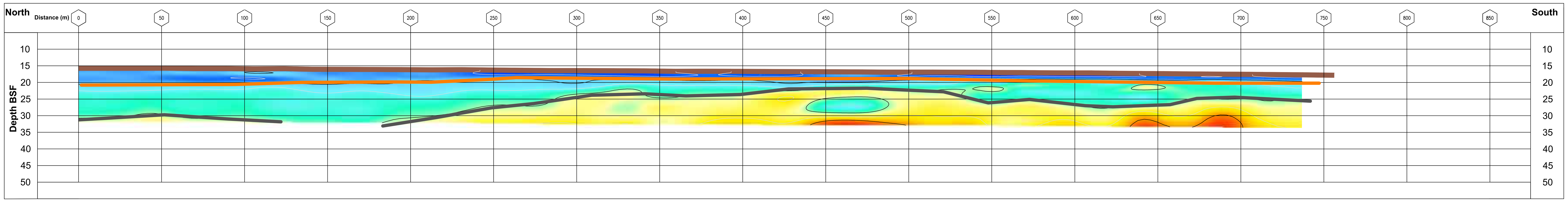
Profile TA2BR32P1



Refraction section



MASW section



LEGEND:

Bathymetric profile

Distance (m)

Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

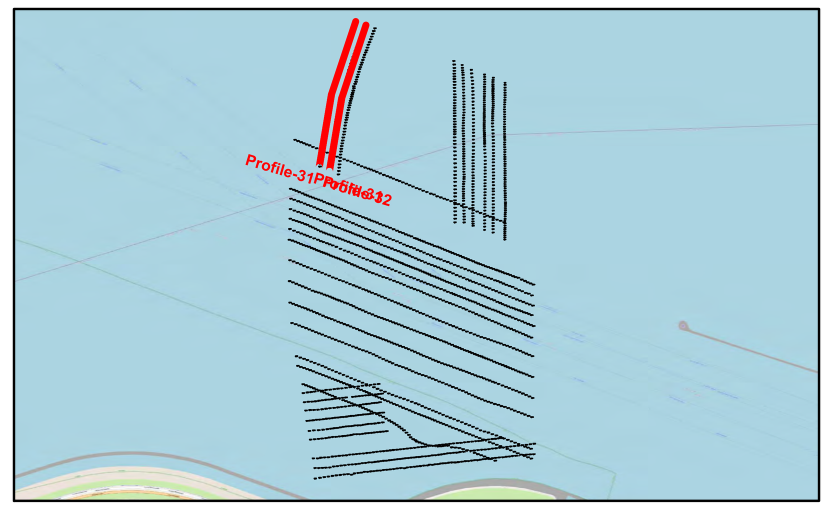
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



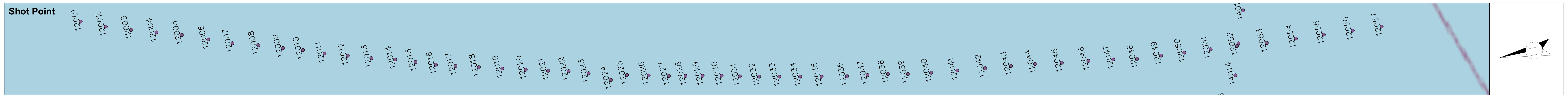
REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

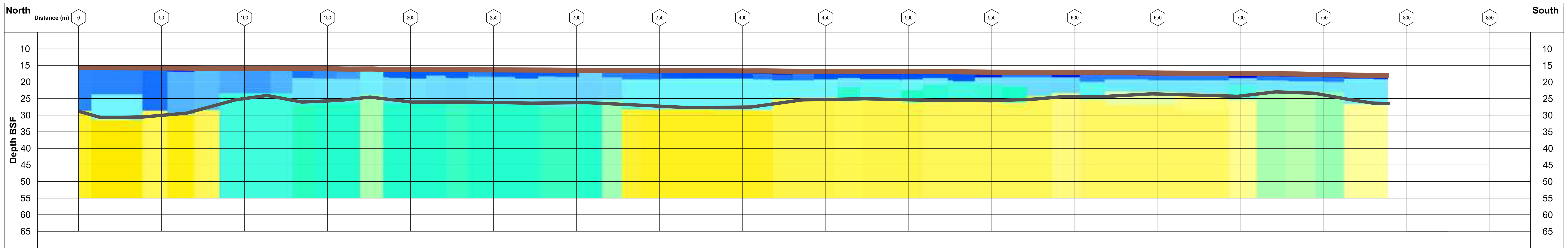
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref: TotalEnergies	Drawing No: C	Chart: 21 of 25	Doc No: F197217-REP-RES

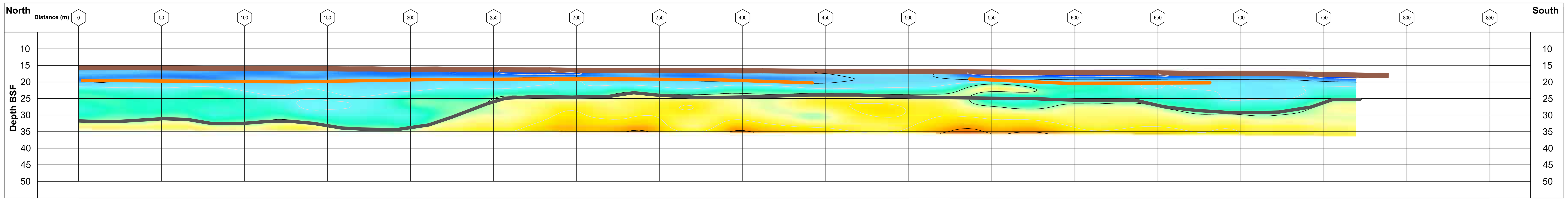
Profile TA2BR33P1



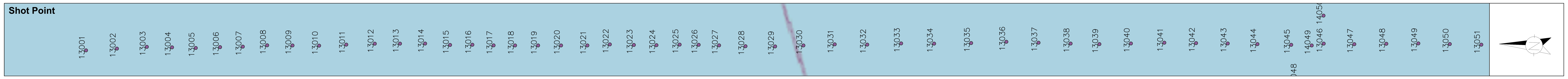
Refraction section



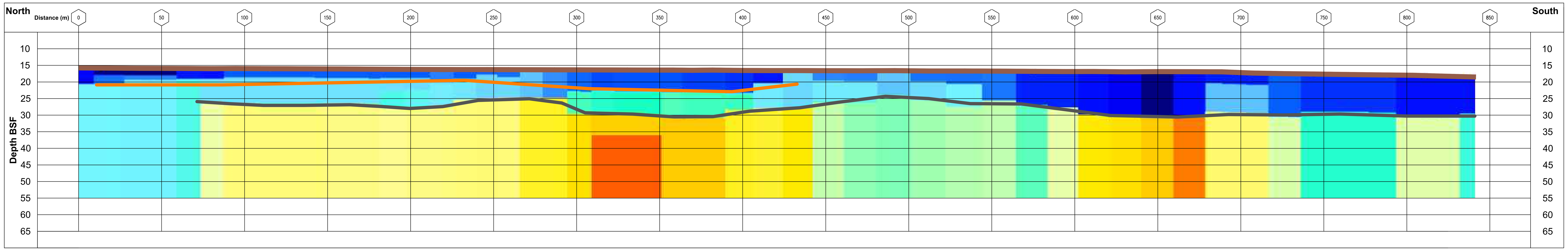
MASW section



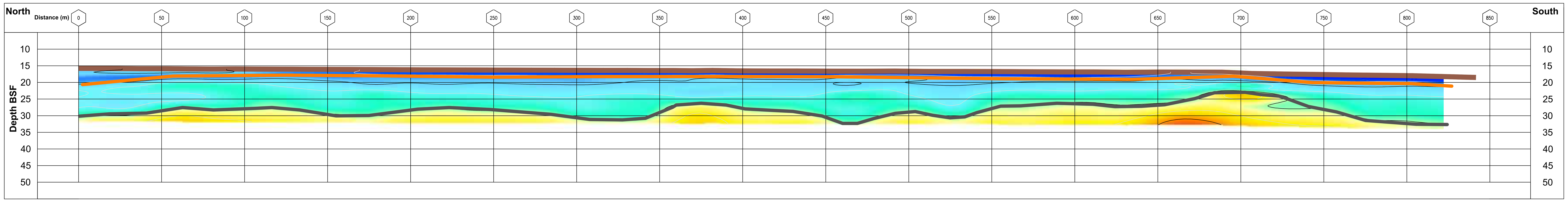
Profile TA2BR34P1



Refraction section



MASW section



LEGEND:

- Bathymetric profile
- 150 — Distance (m)
- 37076 — Gambas Shot Points
- MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

- Vp Blanked area — Area with supposed gaz content in the sediment
- Vs Blanked area — Area with no or degraded dispersion
- Velocity limit between very soft and soft sediments
- Velocity limit between soft and moderately soft sediments

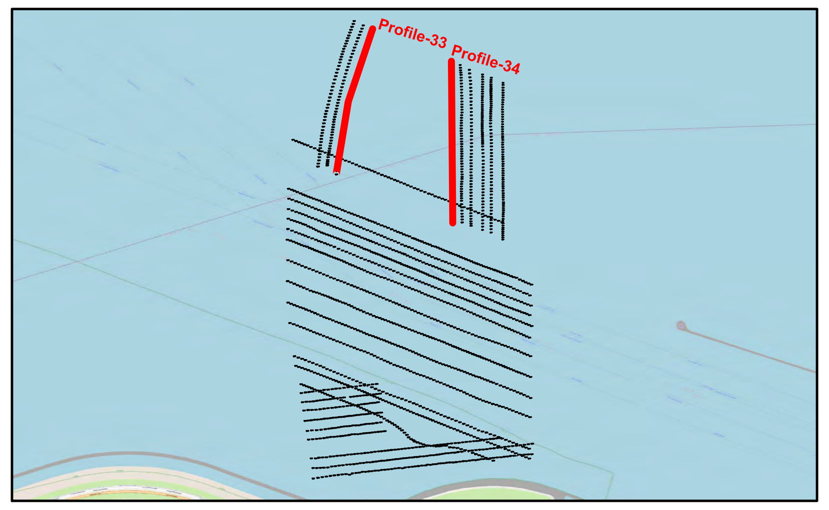
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

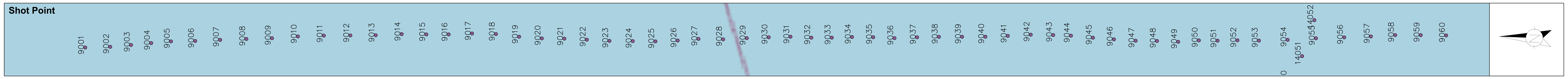
Metres: 50 0 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

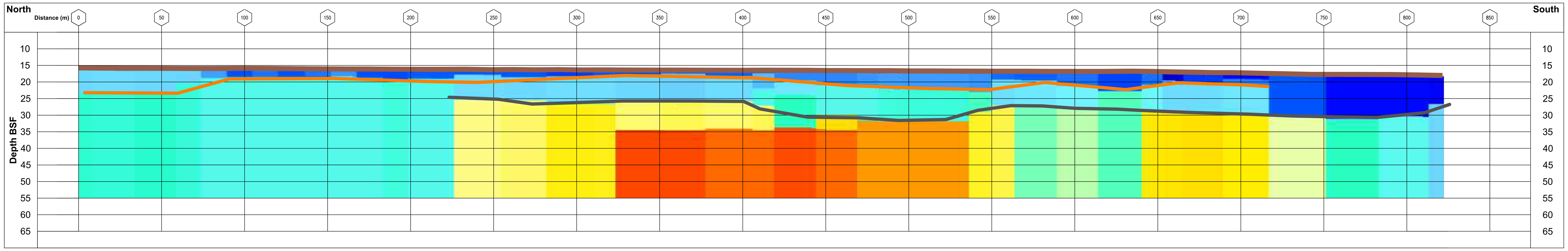
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	22 of 25	F197217-REP-RES

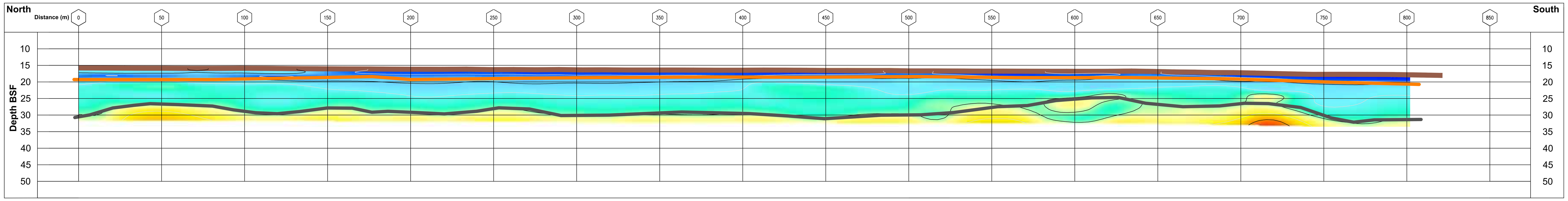
Profile TA2BR35P1



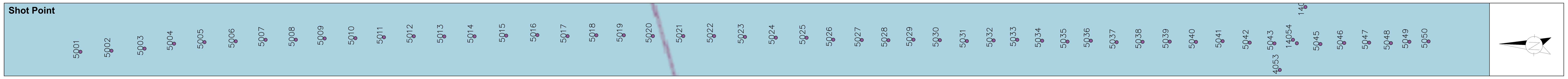
Refraction section



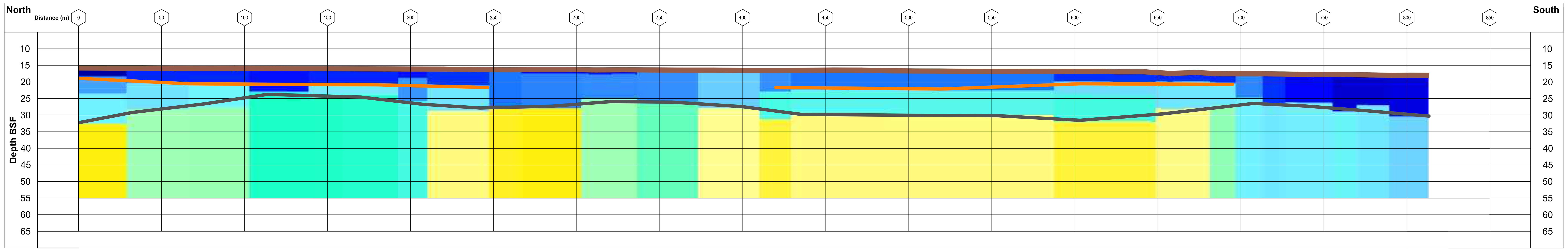
MASW section



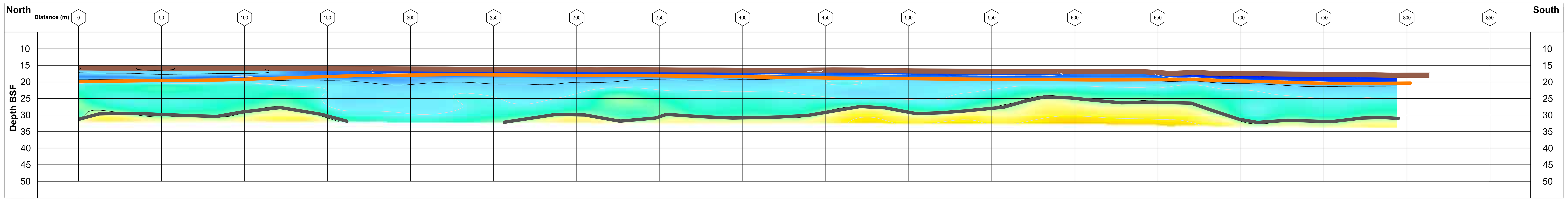
Profile TA2BR36P1



Refraction section



MASW section



LEGEND:

Bathymetric profile

Distance (m)

Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

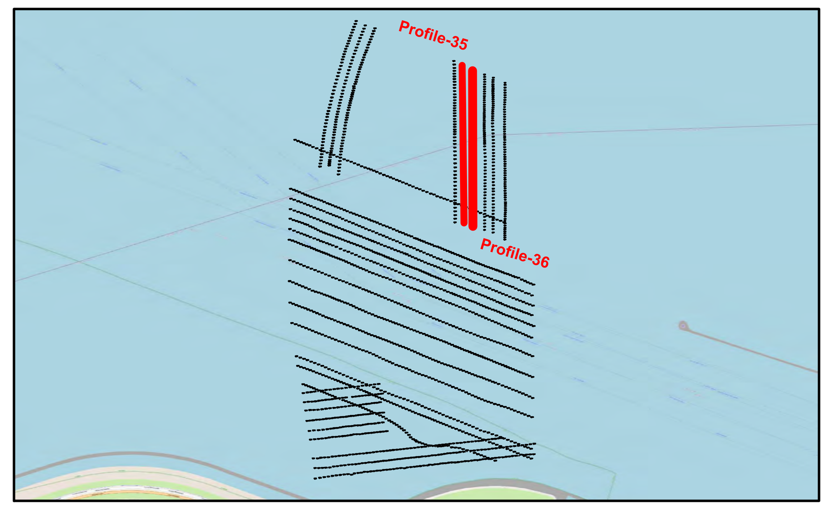
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

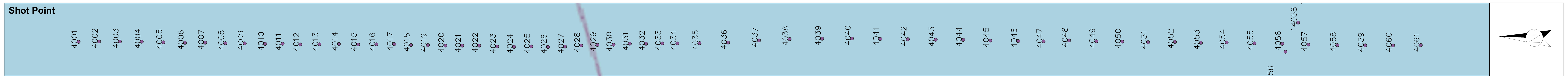
Metres: 50 0 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

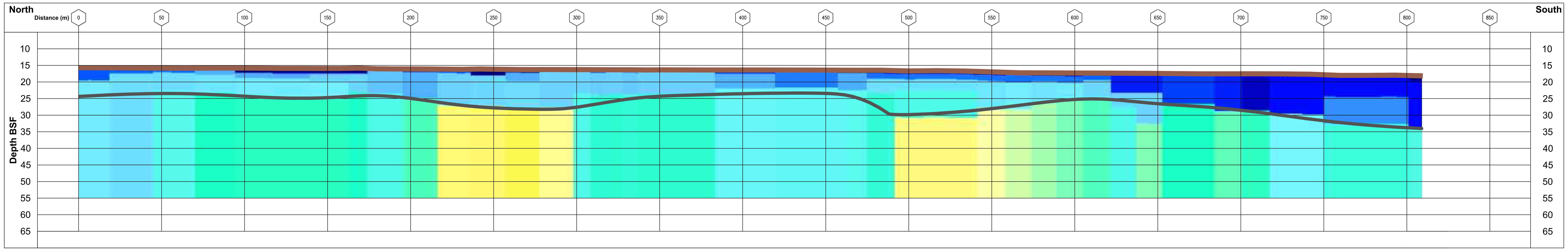
Vessel: Seeker		Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	23 of 25	F197217-REP-RES

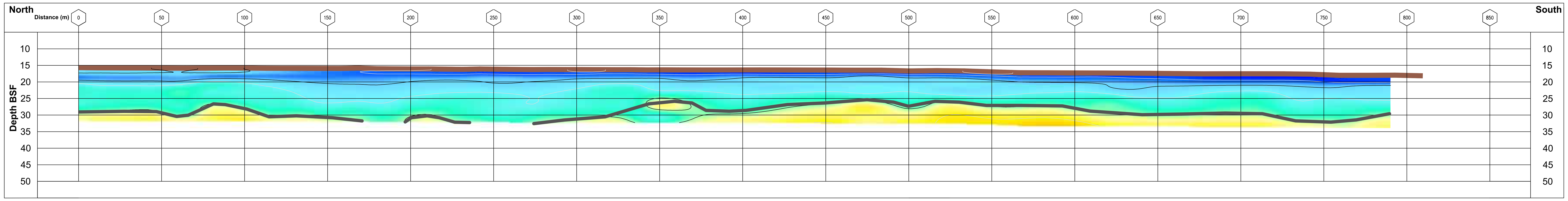
Profile TA2BR37P1



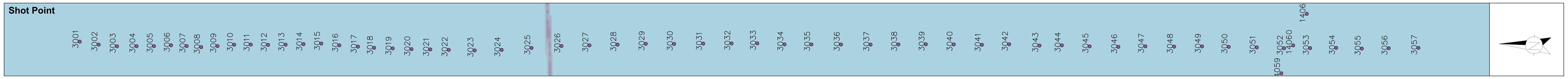
Refraction section



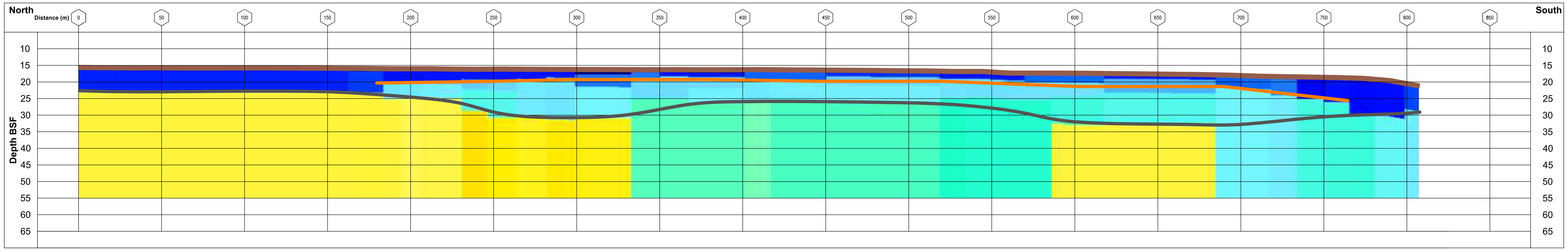
MASW section



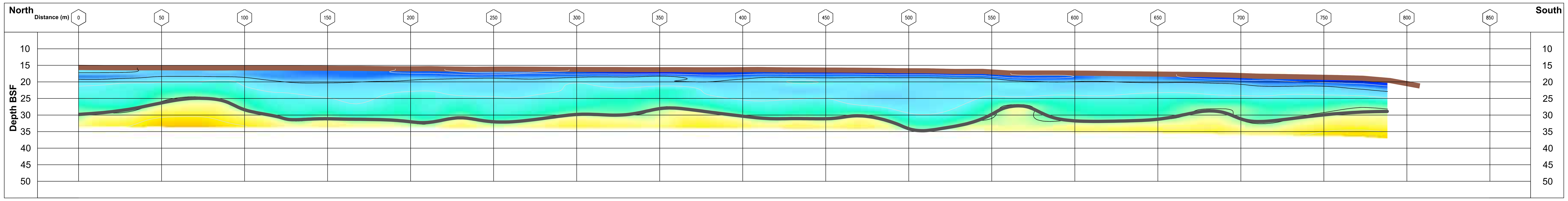
Profile TA2BR38P1



Refraction section



MASW section



LEGEND:

Bathymetric profile

Distance (m)

Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

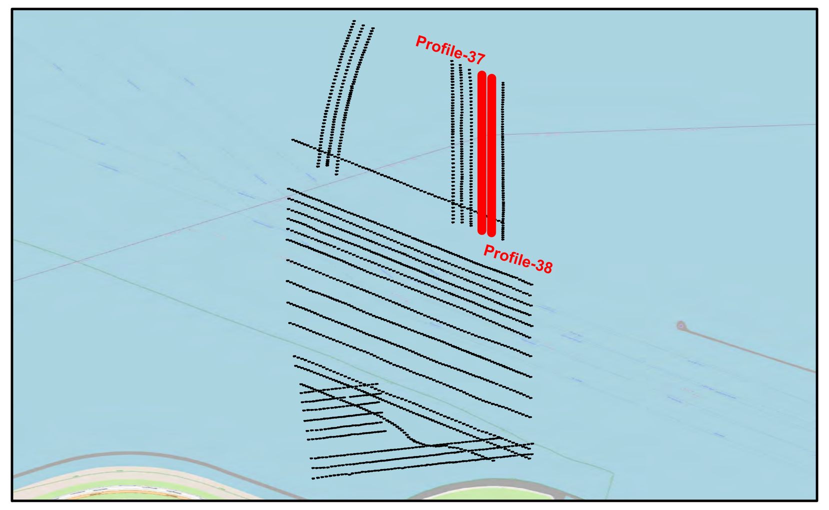
NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996



REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

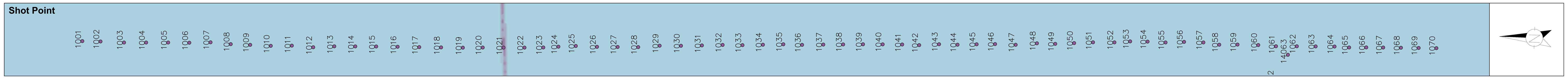
50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

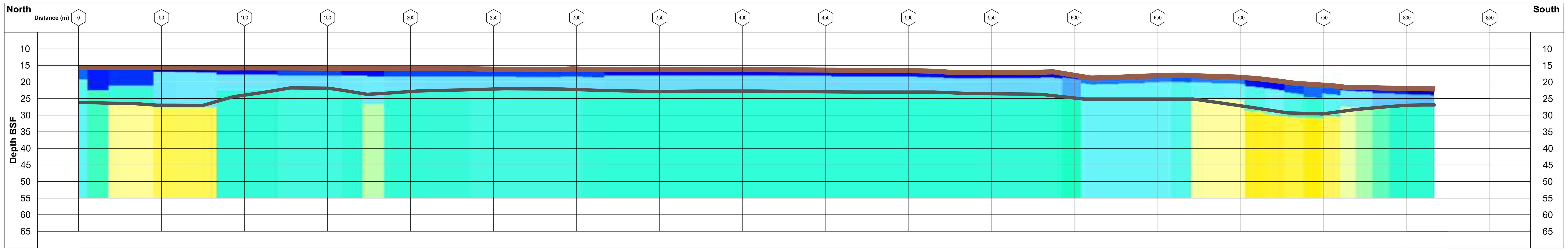
Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217				
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	24 of 25	F197217-REP-RES

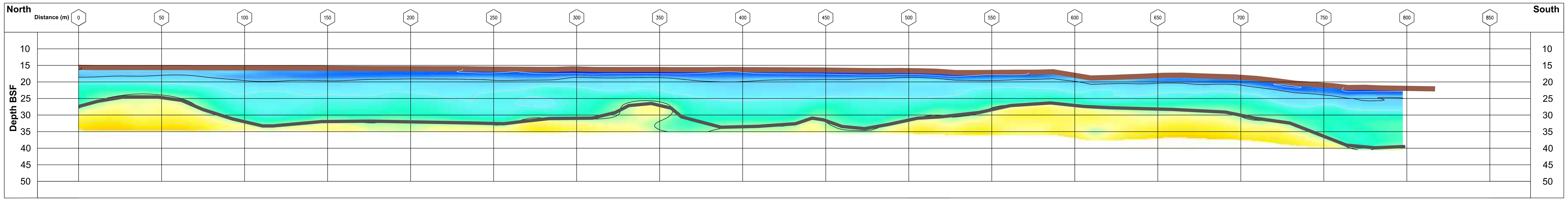
Profile TA2BR39P1



Refraction section



MASW section



LEGEND:

Bathymetric profile

150 Distance (m)

37076 Gambas Shot Points

MASW iso velocity Contour

COMPRESSIONAL WAVE VELOCITY (m/s)

1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000

SHEAR WAVE VELOCITY (m/s)

50 100 150 200 250 300 350 400 450 500

Vp Blanked area — Area with supposed gaz content in the sediment

Vs Blanked area — Area with no or degraded dispersion

Velocity limit between very soft and soft sediments

Velocity limit between soft and moderately soft sediments

NOTES:

Shotpoint refers to the position of the sled.
For each shot, MASW result is positioned at the center of the streamer

GEODETIC PARAMETERS:

Datum: ETRS 89 - EPSG 6258
Spheroid: GRS 1980
Semi major axis: a = 6 378 137.00 m
Inverse flattening: 1/f = 298.257 222 101

PROJECTION:
Map Projection: Transverse Marcator
Grid System: UTM zone 31N
Central Meridian (CM): 003°00' 00.000" E
Latitude of Origin: 00°00' 00.000" N
False Easting: 500 000 m
False Northing: 0 m
Scale factor at CM: 0.9996

REFRACTION & MASW SITE INVESTIGATION
ALIGNMENT CHARTS

50 0 Metres 50 100

Horizontal Scale 1 : 1000 at A0 paper
Vertical exageration x2

Vessel: Seeker	Survey Date: Oct. 2022	Project Ref: F197217			
Issue No:	Date:	Description:	Interpr:	Drawn:	Chkd:	Appr:
00	04/10/22	Issue for comments	TCH	TCH	SSO	SSO

Client Ref:	Drawing No:	Chart:	Doc No:
TotalEnergies	C	25 of 25	F197217-REP-RES

Appendix L

Deliverables Index

TotalAramis_BA_FS_SSS_HFMosaic_0pt1m_R0001_C0001_R01
TotalAramis_BC_FP_SSS_HFMosaic_0pt1m_R0001_C0001_R01
TotalAramis_BA_FS_SSS_Tracks_R01
TotalAramis_BC_FP_SSS_Tracks_R01
TotalAramis_BA_FS_MAG_Data_R01
TotalAramis_BA_FP_MAG_Data_R01
TotalAramis_BA_FS_MAG_Tracks_R01
TotalAramis_BC_FP_MAG_Tracks_R01
TotalAramis_BA_FS_SBP_Tracks_R01
TotalAramis_BC_FP_SBP_Tracks_R01
Contact Name: BA_FS_MAG_0001, BC_FP_MAG_0001
TotalAramis_BA_FS_SBP_Tracks_R01
TotalAramis_BC_FP_SBP_Tracks_R01

20220920_MBES_Total
20220921_MBES_Total

TotalAramis_Refraction_Seismic_GIS

Nearshore_UHRS

Appendix M

Fugro Seeker DPR

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	1	**Date:**	03/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	0
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	0
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	0
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	0	/	0
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	0
Safety meeting	0	/	0
Total Persons Onboard	3		
Crew Hours	36	/	36
Two Part HIRA (Held Onboard)	0	/	0
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	1	/	1
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Vessel induction for new joiner.

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	12:00	50.00%
Mobilisation Alongside	12:00	/	12:00	50.00%
Total	24:00	/	24:00	

Time Summary

Begin	End	Duration	Type	Description

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:00	07:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:00	19:00	12:00	Mobilisation Alongside	Vessel alongside. Mobilisation of geophysical equipment for WP2 continues. 2nd vessel Master joins and is inducted.
19:00	24:00	05:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
2.8 Geophysical	DR	64.0	0.0	0.0	km	0.0%
UXO Scouting with GRAD	DR	0.0	0.0	0.0	km	0.0%
Scouting with UHRS	DR	24.0	0.0	0.0	km	0.0%
Refraction and MASW using GAMBAS	DR	24.0	0.0	0.0	km	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	0	3	0	3
Total	0	3	0	3

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside in port.

Weather Forecast

N/A

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	600.00	0.00	15.00	585.00	15.00	L

Client Rep Comments

N/A

Party Chief Comments

N/A

Fugro Representative		Client Representative	
Ryan Taylor **Party Chief**	**04/07/2022**	**Roger Deutz** **N/A**	**04/07/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	2	**Date:**	04/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	0
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	0
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	0
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	0	/	0
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	1	/	1
Safety meeting	0	/	0
Total Persons Onboard	4		
Crew Hours	48	/	84
Two Part HIRA (Held Onboard)	1	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	1
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

KOM held. HIRA document reviewed.

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	24:00	50.00%
Mobilisation Alongside	12:00	/	24:00	50.00%
Total	24:00	/	48:00	

Time Summary

Begin	End	Duration	Type	Description

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:30	19:30	12:00	Mobilisation Alongside	Vessel alongside. Geophysical mobilisation continues. HA attends vessel for KOM.
19:30	24:00	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
2.8 Geophysical	DR	64.0	0.0	0.0	km	0.0%
UXO Scouting with GRAD	DR	0.0	0.0	0.0	km	0.0%
Scouting with UHRS	DR	24.0	0.0	0.0	km	0.0%
Refraction and MASW using GAMBAS	DR	24.0	0.0	0.0	km	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	3	1	0	4
Total	3	1	0	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside in port.

Weather Forecast

N/A

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	585.00	0.00	15.00	570.00	30.00	L

Client Rep Comments

N/A

Party Chief Comments

Good KOM with questions raised and answered.

Fugro Representative		Client Representative
		
Ryan Taylor **Party Chief**	**05/07/2022**	**04/07/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	3	**Date:**	05/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	0
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	0
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	2	/	2
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	4	/	4
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	0
Total Persons Onboard	5		
Crew Hours	60	/	144
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	1	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Vessel induction for new second Master.
Vessel drill - Fire
Vessel drill - Entanglement

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	36:00	50.00%
Mobilisation Alongside	12:00	/	36:00	50.00%
Total	24:00	/	72:00	

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:00	07:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:00	08:00	01:00	Mobilisation Alongside	Vessel alongside. Vessel induction and handovers.
08:00	08:30	00:30	Mobilisation Alongside	Depart berth and bunker fuel 445l. Return to berth.
08:30	19:00	10:30	Mobilisation Alongside	Continue mobilisation efforts. Wet test all survey equipment alongside. Check all inputs. Conduct navigation check and upload to office.
19:00	24:00	05:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.4 Mobilisation - Geophysical	LS	1:00	0:00	0:00	Hours	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
2.8 Geophysical	DR	64.0	0.0	0.0	km	0.0%
UXO Scouting with GRAD	DR	0.0	0.0	0.0	km	0.0%
Scouting with UHRS	DR	24.0	0.0	0.0	km	0.0%
Refraction and MASW using GAMBAS	DR	24.0	0.0	0.0	km	0.0%

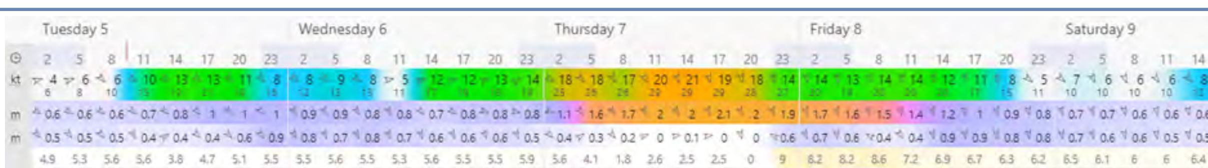
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	1	0	5
Total	4	1	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	570.00	445.00	15.00	1,000.00	45.00	L

Client Rep Comments

N/A

Party Chief Comments

Client Rep. visited vessel for introductions with survey team.

Fugro Representative

Ryan Taylor
Party Chief

05/07/2022

Client Representative

05/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	4	**Date:**	06/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	0
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	0
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	0	/	4
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	0
Total Persons Onboard	4		
Crew Hours	48	/	192
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

HOC 328049 - Unsafe condition. Cut out switch on side arm.
HOC 328052 - Unsafe condition. Ago winch clutch pin not engaged.

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	48:00	50.00%
Mobilisation Alongside	12:00	/	48:00	50.00%
Total	24:00	/	96:00	

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:30	19:30	12:00	Mobilisation Alongside	MS departs vessel. Continue mobilisation efforts alongside. Line plan received.
19:30	24:00	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	Days	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	Days	0.0%
1.4 Mobilisation - Geophysical	LS	1:00	0:00	0:00	Hours	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	Days	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	Days	0.0%
2.8 Geophysical	DR	64.0	0.0	0.0	km	0.0%
UXO Scouting with GRAD	DR	0.0	0.0	0.0	km	0.0%
Scouting with UHRS	DR	24.0	0.0	0.0	km	0.0%
Refraction and MASW using GAMBAS	DR	24.0	0.0	0.0	km	0.0%

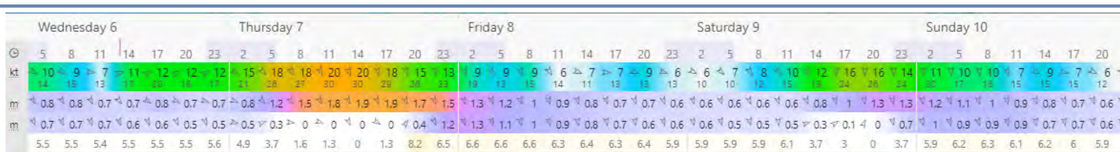
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	1	4
Total	5	0	1	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	10.00	990.00	55.00	L

Client Rep Comments

N/A

DOME

Party Chief Comments

Assistance received from Engineering department to trouble shoot side arm cut off switch issues. Engineer traveling to vessel to repair or replace faulty switch.

Fugro Representative

Ryan Taylor
Party Chief

06/07/2022

Client Representative

06/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	5	**Date:**	07/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	0
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	2	/	2
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	0	/	4
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	0
Total Persons Onboard	4		
Crew Hours	48	/	240
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	60:00	50.00%
Mobilisation Alongside	12:00	/	60:00	50.00%
Total	24:00	/	120:00	

Time Summary

Begin	End	Duration	Type	Description

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:30	19:30	12:00	Mobilisation Alongside	Vessel remains alongside. Weather conditions unsuitable for at sea equipment verifications. Crew general duties.
19:30	24:00	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	0.0	0.0	km	0.0%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	0:00	Hours	0.0%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

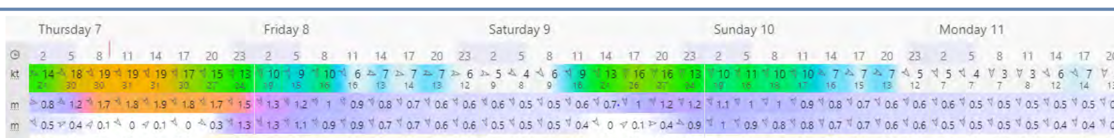
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	0	0	4
Total	4	0	0	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	990.00	0.00	0.00	990.00	55.00	L

Client Rep Comments

N/A

Party Chief Comments

Approx. 20l of waste oil and five fuel filters collected from vessel by Harbour approved waste collection agent.
HOC's noted in DPR 4 added to safety information tally today.

Fugro Representative

Ryan Taylor
Party Chief

07/07/2022

Client Representative

07/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	6	**Date:**	08/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	1
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	2
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	0	/	4
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	0
Total Persons Onboard	4		
Crew Hours	48	/	288
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

HOC 328257 Safe Act - deck cables rerouted to allow cabinet doors to be closed.

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	72:00	50.00%
Mobilisation Alongside	12:00	/	72:00	50.00%
Total	24:00	/	144:00	

Time Summary

Begin	End	Duration	Type	Description

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:30	19:30	12:00	Mobilisation Alongside	Vessel remains alongside. Weather conditions unsuitable for at sea verifications. Crew general duties. Engineer travels from UK to NL to attend vessel.
19:30	24:00	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	0.0	0.0	km	0.0%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	0:00	Hours	0.0%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

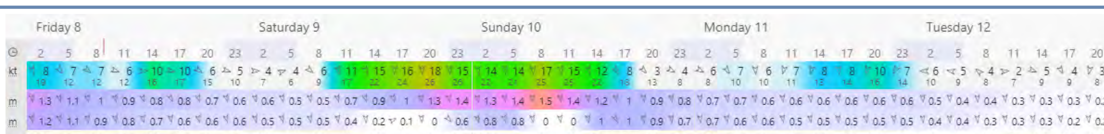
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	0	0	4
Total	4	0	0	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	990.00	0.00	0.00	990.00	55.00	L

DOME

Client Rep Comments

N/A

Party Chief Comments

Nothing to report.

Fugro Representative

Ryan Taylor
Party Chief

08/07/2022

Client Representative

08/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	7	**Date:**	09/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	2
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	2
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	0	/	0
Audit / Inspection	0	/	0
Toolbox Talk	2	/	6
Daily Meeting	0	/	0
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	0
Total Persons Onboard	0		
Crew Hours	0	/	288
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

HOC 328327 Safe act - Plastic waste observed in marina removed and disposed of ashore.
TBT Side arm deployment / recovery.

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	84:00	50.00%
Mobilisation Alongside	9:30	/	81:30	48.51%
WoW - Mobilisation	2:30	/	2:30	1.49%
Total	24:00	/	168:00	

DOME

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
07:30	17:00	09:30	Mobilisation Alongside	Engineer makes repairs to vessel side arm. Weather conditions unsuitable for at sea verifications. Crew general duties.
17:00	19:30	02:30	WoW - Mobilisation	Repairs completed. Vessel fully operationally capable. Waiting on weather to conduct at sea verifications.
19:30	24:00	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	0.0	0.0	km	0.0%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	2:30	2:30	Hours	4.9%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	0:00	Hours	0.0%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

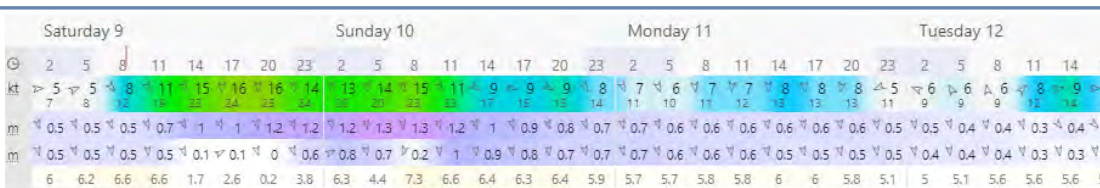
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	1	0	5
Total	4	1	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



DOME

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	990.00	0.00	0.00	990.00	55.00	L

Client Rep Comments

N/A

Party Chief Comments

Engineer makes repairs to side arm. Tested and functional. Vessel fully operationally capable for at sea calibrations once weather conditions become suitable.

Fugro Representative

Ryan Taylor
Party Chief
09/07/2022

Client Representative

09/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	8	**Date:**	10/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	1	/	1
Audit / Inspection	0	/	0
Toolbox Talk	2	/	8
Daily Meeting	1	/	6
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	1
Total Persons Onboard	5		
Crew Hours	60	/	408
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	2
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Weekly safety meeting + cross departmental tour conducted.
HOC 328341 Unsafe condition - R-clips rusted and fragile.
HOC 328342 Safe act. Good communication and action from support team to rectify vessel issue.
x2 TBT's

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	1:00	0.52%
Port Call - Overnight	12:00	/	96:00	50.00%
Mobilisation Alongside	0:00	/	81:30	42.45%
WoW - Mobilisation	11:00	/	13:30	7.03%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Total	24:00	/	192:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
06:00	06:30	00:30	Crew Travel to / from Accommodation	Crew travel to vessel in Scheveningen.
06:30	17:30	11:00	WoW - Mobilisation	Crew onboard vessel. Daily checks. Review weather forecasts. Conditions unsuitable for at sea verifications. Crew general duties. Weekly safety meeting conducted. Engineer departs vessel for return to UK.
17:30	18:00	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
18:00	24:00	06:00	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	0.0	0.0	km	0.0%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	14:30	Hours	28.4%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	0:00	Hours	0.0%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

POB Status

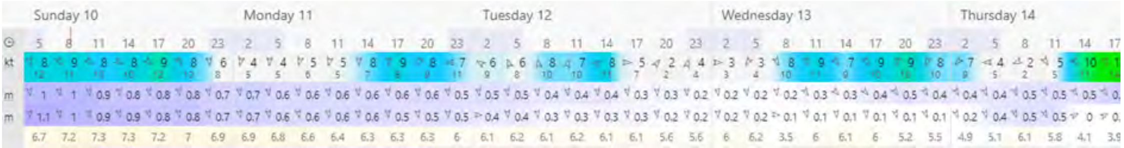
	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	1	4
Total	5	0	1	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port.

Weather Forecast

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	990.00	0.00	0.00	990.00	55.00	L

Client Rep Comments

N/A

Party Chief Comments

Daily meeting total updated to cover meetings held 05/07 to 10/07

Fugro Representative

Ryan Taylor
Party Chief

10/07/2022

Client Representative

10/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	9	**Date:**	11/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC+01:00
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	2
Cross Department Tour	0	/	1
Audit / Inspection	0	/	0
Toolbox Talk	9	/	17
Daily Meeting	1	/	7
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	1
Total Persons Onboard	5		
Crew Hours	60	/	468
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	1	/	3
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Vessel induction for RD
Crew complete LFT's - all negative.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	2:00	0.93%
Port Call - Overnight	12:00	/	108:00	50.00%
Vessel Duties	1:40	/	1:40	0.77%
Mobilisation Alongside	0:00	/	81:30	37.73%
Mobilisation Calibrations	7:10	/	7:10	3.32%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Mobilisation Transit	2:10	/	2:10	1.00%
WoW - Mobilisation	0:00	/	13:30	6.25%
Total	24:00	/	216:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
05:30	06:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel
06:00	07:00	01:00	Vessel Duties	All crew onboard. Morning meeting. Review weather forecasts. Pre-sail checks. Vessel induction for Client Rep.
07:00	07:25	00:25	Mobilisation Transit	Depart port and transit to verification location
07:25	07:35	00:10	Mobilisation Calibrations	Arrive on location. TBT SVP dip.
07:35	08:10	00:35	Mobilisation Calibrations	Running MBES recce lines. MMO watch.
08:10	09:30	01:20	Mobilisation Calibrations	TBT deploy Side arm. Soft start Innomar. Running SBP cross lines over pipeline feature.
09:30	11:00	01:30	Mobilisation Calibrations	TBT deploy SSS+Magnetometer. Run Magnetometer cross lines over charted pipeline feature. Move further offshore to avoid traffic.
11:00	11:55	00:55	Mobilisation Calibrations	Move offshore to avoid additional traffic. Run SSS lines around known target location.
11:55	12:10	00:15	Mobilisation Calibrations	TBT recover SSS+Magnetometer. TBR recover side arm.
12:10	13:00	00:50	Mobilisation Transit	Depart initial verification site and transit to locate suitable target for SSS verification and MBES patch test.
13:00	14:10	01:10	Mobilisation Calibrations	Wreck target located. Running MBES patch test lines.
14:10	15:10	01:00	Mobilisation Calibrations	TBT deploy side arm. TBT deploy SSS+Magnetometer.
15:10	15:25	00:15	Mobilisation Calibrations	TBT recover SSS+Magnetometer. TBT recover Side arm.
15:25	16:20	00:55	Mobilisation Transit	Depart MBES verification site and transit to Scheveningen.
16:20	17:00	00:40	Vessel Duties	Vessel alongside in Scheveningen. Vessel wash down & shut down. Back up survey data for upload to office.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel and travel to crew house.
17:30	24:00	06:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	0.0	0.0	km	0.0%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	26:30	Hours	52.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	0:00	Hours	0.0%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

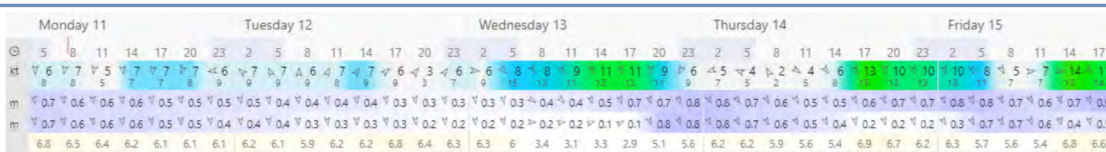
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	1	0	5
Total	4	1	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	300	320	330	-	
Wind Speed	Knots	15	13	10	-	
Sig Wave	m	0.7	0.6	0.6	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	990.00	0.00	340.00	650.00	395.00	L

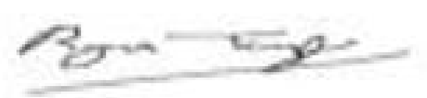
Client Rep Comments

N/A

Party Chief Comments

All DPR's to date have been in UTC + 1. Local PC clocks changed to UTC at end of day - all DPR's to be in UTC going forwards.

Fugro Representative



Ryan Taylor
Party Chief

11/07/2022

Client Representative

11/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	10	**Date:**	12/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	1	/	3
Cross Department Tour	0	/	1
Audit / Inspection	0	/	0
Toolbox Talk	10	/	27
Daily Meeting	1	/	8
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	1
Total Persons Onboard	5		
Crew Hours	60	/	528
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	3
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

x10 TBT's conducted.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	3:00	1.25%
Port Call - Overnight	12:00	/	120:00	50.00%
Transit	1:35	/	1:35	0.66%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:25	/	0:25	0.17%
Deployment / Recovery	0:20	/	0:20	0.14%
Recce	1:05	/	1:05	0.45%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Vessel Duties	1:15	/	2:55	1.22%
SVP Dip	0:15	/	0:15	0.10%
Mobilisation Alongside	0:00	/	81:30	33.96%
Mobilisation Calibrations	4:15	/	11:25	4.76%
Mobilisation Transit	1:20	/	3:30	1.46%
WoW - Mobilisation	0:00	/	13:30	5.63%
Standby Marine Mammal Observance	0:30	/	0:30	0.21%
Total	24:00	/	240:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:30	00:30	Vessel Duties	All crew onboard. Morning meeting conducted. Weather forecasts reviewed. Vessel pre-sail checks conducted.
05:30	05:55	00:25	Mobilisation Transit	Depart port and transit to verification location north of Scheveningen.
05:55	06:00	00:05	Mobilisation Calibrations	Arrive on location. SVP dip conducted.
06:00	06:30	00:30	Standby Marine Mammal Observance	Conduct MMO watch
06:30	06:40	00:10	Mobilisation Calibrations	TBT deploy side arm.
06:40	07:00	00:20	Mobilisation Calibrations	Soft start Innomar. TBT deploy SSS+Magnetometer.
07:00	09:20	02:20	Mobilisation Calibrations	Running additional SBP and Magnetometer lines.
09:20	09:25	00:05	Mobilisation Calibrations	TBT recover SSS+Magnetometer.
09:25	10:20	00:55	Mobilisation Transit	Transit to additional verification site.
10:20	10:50	00:30	Mobilisation Calibrations	Running additional SBP verification lines.
10:50	10:55	00:05	Mobilisation Calibrations	TBT deploy SSS.
10:55	11:30	00:35	Mobilisation Calibrations	Running additional SSS verification lines.
11:30	11:35	00:05	Mobilisation Calibrations	TBT recover SSS.
11:35	12:25	00:50	Transit	Additional verifications completed. Transit to survey area to carry out MBES recce lines.
12:25	12:40	00:15	SVP Dip	Arrive on location. Checking vessel traffic situation with port control. TBT and SVP dip.
12:40	13:45	01:05	Recce	Running MBES recce lines around survey area to north of shipping channel. Investigate charted wreck on site.
13:45	13:50	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
13:50	14:15	00:25	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running main survey lines.
14:15	14:30	00:15	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover sidearm.
14:30	15:15	00:45	Transit	Depart site and transit to Scheveningen.
15:15	16:00	00:45	Vessel Duties	Vessel alongside. Wash down and shut down. Back up survey data for upload to office.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	1.8	1.8	km	1.3%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	6:00	32:30	Hours	63.7%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	1.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	6:00	6:00	Hours	9.4%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

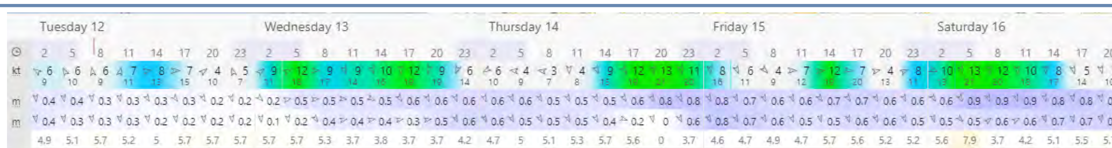
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	315	315	340	-	
Wind Speed	Knots	10	08	07	-	
Sig Wave	m	0.3	0.3	0.2	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	650.00	0.00	150.00	500.00	545.00	L

Client Rep Comments

N/A

Party Chief Comments

Nothing to report.

Fugro Representative		Client Representative	
			
Ryan Taylor **Party Chief**	**12/07/2022**	**N/A** **N/A**	**12/07/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	11	**Date:**	13/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	3
Cross Department Tour	0	/	1
Audit / Inspection	0	/	0
Toolbox Talk	9	/	36
Daily Meeting	1	/	9
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	1
Total Persons Onboard	4		
Crew Hours	48	/	576
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	3
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

x9 TBT's completed

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	4:00	1.52%
Port Call - Overnight	11:40	/	131:40	49.87%
Transit	1:55	/	3:30	1.33%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	5:25	/	5:50	2.21%
Deployment / Recovery	0:30	/	0:50	0.32%
Recce	1:20	/	2:25	0.92%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Vessel Duties	1:00	/	3:55	1.48%
SVP Dip	0:30	/	0:45	0.28%
Mobilisation Alongside	0:00	/	81:30	30.87%
Mobilisation Calibrations	0:00	/	11:25	4.32%
Mobilisation Transit	0:00	/	3:30	1.33%
WoW - Mobilisation	0:00	/	13:30	5.11%
Standby Marine Mammal Observance	0:40	/	1:10	0.44%
Total	24:00	/	264:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:30	00:30	Vessel Duties	All crew onboard, Morning meeting. Review weather forecasts. Pre-sail checks.
05:30	06:20	00:50	Transit	Depart port and transit to survey area.
06:20	06:30	00:10	SVP Dip	Arrive on location at north side of shipping channel. TBT SVP dip.
06:30	07:10	00:40	Recce	Run MBES only recce from north area across channel to south area.
07:10	07:20	00:10	SVP Dip	TBT SVP dip
07:20	08:00	00:40	Standby Marine Mammal Observation	MMO watch. Vessel marks positions of on site obstructions and continues MBES recce along sea wall.
08:00	08:40	00:40	Recce	MBES recce along seawall continues. TBT deploy sidearm. Soft start Innomar.
08:40	08:50	00:10	Deployment / Recovery	TBT deploy SSS+Magnetometer
08:50	11:35	02:45	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running main survey lines
11:35	11:40	00:05	Deployment / Recovery	TBT recover SSS+Magnetometer.
11:40	11:50	00:10	SVP Dip	TBT SVP dip.
11:50	11:55	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
11:55	14:35	02:40	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running survey lines.
14:35	14:45	00:10	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover sidearm.
14:45	15:50	01:05	Transit	Weather increases as forecast. Depart survey site and transit to Scheveningen.
15:50	16:20	00:30	Vessel Duties	Vessel fast alongside in Scheveningen. Vessel shut down. Back up data for upload to office.
16:20	16:50	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:50	24:00	07:10	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	138.5	16.6	18.4	km	13.3%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	32:30	Hours	63.7%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	12:00	18:00	Hours	28.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

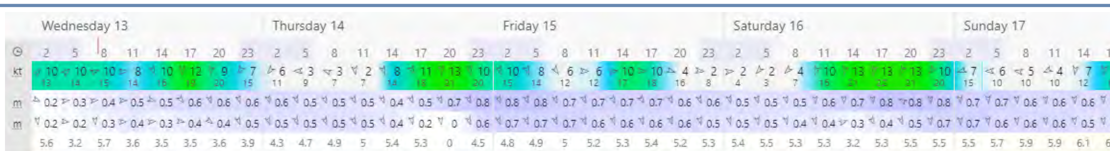
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	1	4
Total	5	0	1	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	270	300	340	-	
Wind Speed	Knots	7	8	16	-	
Sig Wave	m	0.3	0.5	0.7	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	150.00	350.00	695.00	L

Client Rep Comments

N/A

Party Chief Comments

R. Deutz departed vessel.

Fugro Representative

Ryan Taylor
Party Chief

13/07/2022

Client Representative

13/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	12	**Date:**	14/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	3
Cross Department Tour	0	/	1
Audit / Inspection	0	/	0
Toolbox Talk	6	/	42
Daily Meeting	1	/	10
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	1
Total Persons Onboard	4		
Crew Hours	48	/	624
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	3
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

x6 TBT's completed.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	5:00	1.74%
Port Call - Overnight	12:00	/	143:40	49.88%
Transit	2:05	/	5:35	1.94%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	3:25	/	9:15	3.21%
Deployment / Recovery	0:10	/	1:00	0.35%
Recce	0:00	/	2:25	0.84%

Summary of Activities

Activity	Today	/	To Date	Progress
Vessel Duties	1:00	/	4:55	1.71%
SVP Dip	0:30	/	1:15	0.43%
Mobilisation Alongside	0:00	/	81:30	28.30%
Mobilisation Calibrations	0:00	/	11:25	3.96%
Mobilisation Transit	0:00	/	3:30	1.22%
WoW - Mobilisation	0:00	/	13:30	4.69%
WoW - Alongside	2:25	/	2:25	0.84%
Standby Marine Mammal Observance	0:50	/	2:00	0.69%
Standby Marine Traffic	0:35	/	0:35	0.20%
Total	24:00	/	288:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:30	00:30	Vessel Duties	All crew onboard. Morning meeting. Pre-sail checks. Review weather forecasts.
05:30	06:00	00:30	Vessel Duties	Depart berth and move to bunker barge for fuel. Bunker fuel 527l. Draft checked.
06:00	06:50	00:50	Transit	Depart Scheveningen and transit to survey area south of shipping channel.
06:50	07:00	00:10	SVP Dip	Arrive on location. TBT SVP dip.
07:00	07:10	00:10	Deployment / Recovery	TBT deploy sidearm.
07:10	07:40	00:30	Standby Marine Mammal Observance	Conduct MMO watch
07:40	08:00	00:20	Standby Marine Mammal Observance	Soft start Innomar system.
08:00	08:15	00:15	Standby Marine Traffic	Plan to run SBP+MBES lines crossing shipping channel during period of reduced vessel traffic.
08:15	08:40	00:25	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running cross line.
08:40	08:50	00:10	SVP Dip	Variation noted in SoS - additional SVP required. TBT SVP.
08:50	09:25	00:35	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running cross lines.
09:25	09:35	00:10	Standby Marine Traffic	Waiting on shipping movements as requested by Maas entrance.
09:35	10:35	01:00	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running cross lines.
10:35	10:45	00:10	Standby Marine Traffic	Waiting on vessel movements.
10:45	12:10	01:25	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running cross lines.
12:10	12:20	00:10	SVP Dip	Conduct SVP dip. Assess weather conditions with different line headings.
12:20	13:35	01:15	Transit	Weather conditions increasing in line with forecast. Depart site and transit to Scheveningen.
13:35	16:00	02:25	WoW - Alongside	Vessel alongside in Scheveningen. Crew general duties.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	15.8	34.2	km	24.3%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	2:25	34:55	Hours	68.5%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	9:35	27:35	Hours	43.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

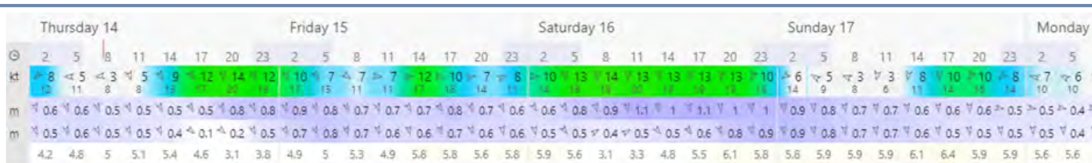
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	0	0	4
Total	4	0	0	4

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	var	350	340	-	
Wind Speed	Knots	4	10	16	-	
Sig Wave	m	0.2	0.5	0.8	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	473.00	527.00	0.00	1,000.00	572.00	L

Client Rep Comments

N/A

Party Chief Comments

Nothing to report.

Fugro Representative

Ryan Taylor
Party Chief

14/07/2022

Client Representative

14/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	13	**Date:**	15/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	3
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	3
Cross Department Tour	0	/	1
Audit / Inspection	0	/	0
Toolbox Talk	2	/	44
Daily Meeting	1	/	11
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	1
Total Persons Onboard	5		
Crew Hours	60	/	684
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	1	/	4
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Vessel induction conducted for new joiner.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	6:00	1.92%
Port Call - Overnight	12:00	/	155:40	49.89%
Transit	0:00	/	5:35	1.79%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	9:15	2.96%
Deployment / Recovery	0:00	/	1:00	0.32%
Recce	0:00	/	2:25	0.77%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Vessel Duties	0:30	/	5:25	1.74%
SVP Dip	0:00	/	1:15	0.40%
Mobilisation Alongside	0:00	/	81:30	26.12%
Mobilisation Calibrations	0:00	/	11:25	3.66%
Mobilisation Transit	0:00	/	3:30	1.12%
WoW - Mobilisation	0:00	/	13:30	4.33%
WoW - Alongside	10:30	/	12:55	4.14%
Standby Marine Mammal Observance	0:00	/	2:00	0.64%
Standby Marine Traffic	0:00	/	0:35	0.19%
Total	24:00	/	312:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:30	00:30	Vessel Duties	All crew onboard. Morning meeting. Review weather forecasts. Vessel checks. Safety induction for new CR.
05:30	16:00	10:30	WoW - Alongside	Conditions unsuitable for survey operations. Vessel reamains in port. Crew general duties. Run trials on USBL system. TBT deploy Sidearm. TBT recover sidearm.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	0.0	34.2	km	24.3%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	46:55	Hours	92.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	27:35	Hours	43.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	4	1	0	5
Total	4	1	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	0.00	800.00	772.00	L

Client Rep Comments

N/A

Party Chief Comments

x5 Replacement life jackets received to vessel.

Fugro Representative

Ryan Taylor
Party Chief
15/07/2022

Client Representative

Martin Pendleton
Client Rep.
15/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	14	**Date:**	16/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	1	/	4
Cross Department Tour	1	/	2
Audit / Inspection	0	/	0
Toolbox Talk	2	/	46
Daily Meeting	1	/	12
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	2
Total Persons Onboard	5		
Crew Hours	60	/	744
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	4
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Weekly safety meeting+cross departmental tour conducted.
HOC 329456 Safe Act - Vessel scrub down to remove excessive bird fouling.
Vessel safety drill conducted - abandonment to life raft or water.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:30	/	6:30	1.93%
Port Call - Overnight	12:30	/	168:10	50.05%
Transit	0:00	/	5:35	1.66%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	9:15	2.75%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	1:00	0.30%
Recce	0:00	/	2:25	0.72%
Vessel Duties	0:00	/	5:25	1.61%
SVP Dip	0:00	/	1:15	0.37%
Mobilisation Alongside	0:00	/	81:30	24.26%
Mobilisation Calibrations	0:00	/	11:25	3.40%
Mobilisation Transit	0:00	/	3:30	1.04%
WoW - Mobilisation	0:00	/	13:30	4.02%
WoW - Alongside	11:00	/	23:55	7.12%
Standby Marine Mammal Observance	0:00	/	2:00	0.60%
Standby Marine Traffic	0:00	/	0:35	0.17%
Total	24:00	/	336:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
05:30	06:00	00:30	Port Call - Overnight	Crew travel to vessel.
06:00	17:00	11:00	WoW - Alongside	Conditions unsuitable for survey operations. Vessel remains in port. Crew general duties. Continue trials on USBL system. TBT deploy Sidearm. TBT recover sidearm
17:00	17:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
17:30	24:00	06:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	0.0	34.2	km	24.3%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	58:55	Hours	115.5%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	27:35	Hours	43.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

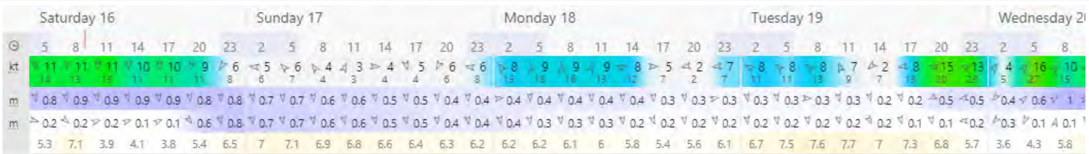
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port.

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	0.00	800.00	772.00	L

Client Rep Comments

Party Chief Comments

Nothing to report.

Fugro Representative

Ryan Taylor
Party Chief
16/07/2022

Client Representative

Martin Pendleton
Client Rep.
16/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	15	**Date:**	17/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	9	/	55
Daily Meeting	1	/	13
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	804
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	4
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

x9 TBT's completed.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	7:30	2.08%
Port Call - Overnight	12:00	/	180:10	50.05%
Transit	2:15	/	7:50	2.18%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	5:15	/	14:30	4.03%
Infill - SSS	0:15	/	0:15	0.07%
Deployment / Recovery	0:30	/	1:30	0.42%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Recce	0:00	/	2:25	0.67%
Vessel Duties	0:55	/	6:20	1.76%
SVP Dip	0:25	/	1:40	0.46%
Mobilisation Alongside	0:00	/	81:30	22.64%
Mobilisation Calibrations	0:00	/	11:25	3.17%
Mobilisation Transit	0:00	/	3:30	0.97%
WoW - Mobilisation	0:00	/	13:30	3.75%
WoW - Alongside	0:00	/	23:55	6.64%
Standby Marine Mammal Observance	0:50	/	2:50	0.79%
Standby Marine Traffic	0:35	/	1:10	0.32%
Total	24:00	/	360:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:25	00:25	Vessel Duties	All crew onboard vessel. Morning meeting. Pre-sail checks. Review weather forecasts.
05:25	06:30	01:05	Transit	Depart port and transit to site.
06:30	06:40	00:10	SVP Dip	Arrive on location. TBT SVP dip.
06:40	06:50	00:10	Deployment / Recovery	TBT deploy side arm.
06:50	07:20	00:30	Standby Marine Mammal Observance	MMO watch conducted.
07:20	07:40	00:20	Standby Marine Mammal Observance	Soft start Innomar. TBT deploy SSS+Magnetometer.
07:40	07:55	00:15	Infill - SSS	Run office supplied SSS+Magnetometer infill line.
07:55	11:05	03:10	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines
11:05	11:20	00:15	Standby Marine Traffic	Waiting for incoming vessel traffic to clear.
11:20	12:25	01:05	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running survey lines.
12:25	12:45	00:20	Standby Marine Traffic	Waiting for vessel traffic to clear.
12:45	13:00	00:15	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running survey lines.
13:00	13:05	00:05	Deployment / Recovery	TBT recover SSS+Magnetometer.
13:05	13:15	00:10	SVP Dip	TBT SVP dip.
13:15	13:30	00:15	Transit	Traffic increasing. Depart shipping channel area and move to north side of channel.
13:30	13:35	00:05	SVP Dip	Arrive on north side of channel. TBT SVP dip.
13:35	13:40	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
13:40	14:25	00:45	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running survey lines.
14:25	14:35	00:10	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover side arm.
14:35	15:30	00:55	Transit	Depart survey site and transit to Scheveningen
15:30	16:00	00:30	Vessel Duties	Vessel alongside in Scheveningen. Shut down and wash down. Back up data for upload to office. Bunker fresh water 200l.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	23.1	57.3	km	40.6%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	3:40	62:35	Hours	122.7%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	8:20	35:55	Hours	56.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

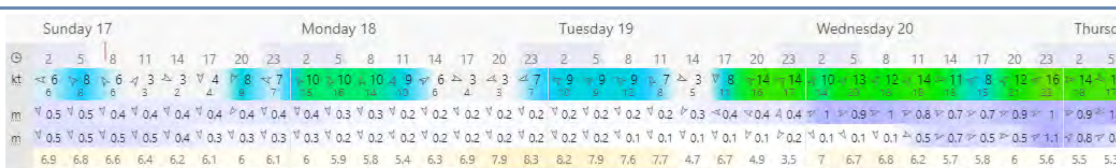
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	100	var	var	-	
Wind Speed	Knots	8	5	4	-	
Sig Wave	m	0.6	0.5	0.4	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	300.00	500.00	1,072.00	L

Client Rep Comments

N/A

Party Chief Comments

Party Chief Comments

Good communication between Maas control and vessel during operations within the shipping channel.

Fugro Representative

Ryan Taylor
Party Chief

17/07/2022

Client Representative

Martin Pendleton
Client Rep.

17/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	16	**Date:**	18/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	8	/	63
Daily Meeting	1	/	14
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	864
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	4
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

All crew take LFT's - all negative results.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	8:30	2.21%
Port Call - Overnight	12:00	/	192:10	50.04%
Transit	2:15	/	10:05	2.63%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	5:15	/	19:45	5.14%
Infill - SSS	0:00	/	0:15	0.07%
Deployment / Recovery	0:35	/	2:05	0.54%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Recce	0:00	/	2:25	0.63%
Vessel Duties	1:00	/	7:20	1.91%
SVP Dip	0:30	/	2:10	0.56%
Mobilisation Alongside	0:00	/	81:30	21.22%
Mobilisation Calibrations	0:00	/	11:25	2.97%
Mobilisation Transit	0:00	/	3:30	0.91%
WoW - Mobilisation	0:00	/	13:30	3.52%
WoW - Alongside	0:00	/	23:55	6.23%
Standby Marine Mammal Observance	0:50	/	3:40	0.95%
Standby Marine Traffic	0:35	/	1:45	0.46%
Total	24:00	/	384:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:30	00:30	Vessel Duties	All crew onboard. Morning meeting. Pre-sail checks. Review forecasts. Wash down vessel due to bird fouling.
05:30	06:35	01:05	Transit	Depart port and transit to site.
06:35	06:50	00:15	SVP Dip	Arrive on location. Coordinate with Maas control for an SVP dip in channel. TBT SVP dip. Clear away from channel.
06:50	07:05	00:15	Deployment / Recovery	TBT deploy side arm.
07:05	07:35	00:30	Standby Marine Mammal Observance	Conduct MMO watch.
07:35	07:55	00:20	Standby Marine Mammal Observance	Conduct Innomar soft start. TBT deploy SSS+Magnetometer.
07:55	10:00	02:05	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
10:00	10:25	00:25	Standby Marine Traffic	Waiting for incoming traffic to clear channel.
10:25	11:10	00:45	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
11:10	11:15	00:05	Standby Marine Traffic	Waiting for permission to turn due to traffic.
11:15	12:35	01:20	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running survey lines.
12:35	12:40	00:05	Standby Marine Traffic	Waiting for traffic to pass.
12:40	12:55	00:15	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
12:55	13:05	00:10	Transit	Depart shipping channel and move to north of survey area.
13:05	13:10	00:05	Deployment / Recovery	TBT recover SSS+Magnetometer.
13:10	13:25	00:15	SVP Dip	TBT SVP dip.
13:25	13:30	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
13:30	14:20	00:50	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
14:20	14:30	00:10	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover sidearm.
14:30	15:30	01:00	Transit	Depart site and transit to Scheveningen.
15:30	16:00	00:30	Vessel Duties	Vessel secure alongside. Shutdown and back up data for upload.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	21.9	79.2	km	56.2%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	3:40	66:15	Hours	129.9%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	8:20	44:15	Hours	69.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

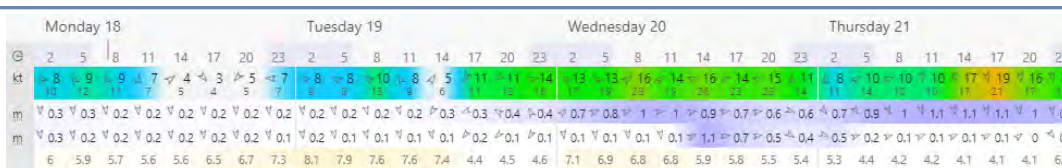
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	180	170	170	-	
Wind Speed	Knots	6	5	7		
Sig Wave	m	0.2	0.2	0.3	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	1,072.00	L

Client Rep Comments

N/A

Party Chief Comments

Party Chief Comments

Nothing to report

Fugro Representative

Ryan Taylor
Party Chief

18/07/2022

Client Representative

18/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	17	**Date:**	19/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	11	/	74
Daily Meeting	1	/	15
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	924
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	1	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Vessel induction for RP.
11 TBT's conducted.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	9:30	2.33%
Port Call - Overnight	12:00	/	204:10	50.04%
Transit	1:55	/	12:00	2.94%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	3:50	/	23:35	5.78%
Infill - SSS	0:00	/	0:15	0.06%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:30	/	2:35	0.63%
Recce	0:00	/	2:25	0.59%
Vessel Duties	3:05	/	10:25	2.55%
SVP Dip	0:30	/	2:40	0.65%
Mobilisation Alongside	0:00	/	81:30	19.98%
Mobilisation Calibrations	0:00	/	11:25	2.80%
Mobilisation Transit	0:00	/	3:30	0.86%
WoW - Mobilisation	0:00	/	13:30	3.31%
WoW - Alongside	0:00	/	23:55	5.86%
Standby Marine Mammal Observance	0:55	/	4:35	1.12%
Standby Marine Traffic	0:15	/	2:00	0.49%
Total	24:00	/	408:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	07:55	02:55	Vessel Duties	Crew onboard vessel. Morning meeting. Pre-sail checks. Move to fuel barge and bunker fuel 759l. Move back to berth. TBT deployment and recovery of sidearm. Handovers between surveyors. PR departs vessel. Induction for RP.
07:55	08:50	00:55	Transit	Depart port and transit to site.
08:50	09:05	00:15	SVP Dip	Arrive on location. TBT SVP dip.
09:05	09:10	00:05	Deployment / Recovery	TBT deploy side arm.
09:10	09:45	00:35	Standby Marine Mammal Observance	Conduct MMO watch.
09:45	10:05	00:20	Standby Marine Mammal Observance	Soft start Innomar. TBT deploy SSS+Magnetometer.
10:05	11:50	01:45	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
11:50	11:55	00:05	Deployment / Recovery	TBT recover SSS+Magnetometer.
11:55	12:05	00:10	SVP Dip	TBT SVP dip.
12:05	12:10	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
12:10	13:40	01:30	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
13:40	13:55	00:15	Standby Marine Traffic	Required to vacate shipping channel due to incoming wind turbine barge on tow.
13:55	14:30	00:35	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines north of channel.
14:30	14:45	00:15	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover side arm.
14:45	14:50	00:05	SVP Dip	TBT SVP dip.
14:50	15:50	01:00	Transit	Depart site and transit to Scheveningen.
15:50	16:00	00:10	Vessel Duties	Vessel alongside. Shut down and data back ups for upload.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	17.4	96.6	km	68.5%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	3:05	69:20	Hours	135.9%
3.5 Sailing and Standby Rate UXO Scouting	DR	0:00	0:00	0:00	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
with GRAD						
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	8:55	53:10	Hours	83.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

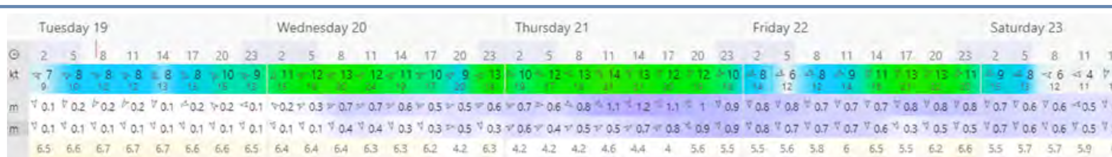
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	120	110	130	-	
Wind Speed	Knots	8	7	9	-	
Sig Wave	m	0.2	0.3	0.2	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	241.00	759.00	200.00	800.00	1,531.00	L

Client Rep Comments

N/A

Party Chief Comments

Nothing to report.

Fugro Representative		Client Representative	
Ryan Taylor Party Chief	19/07/2022		19/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	18	**Date:**	20/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	0	/	74
Daily Meeting	1	/	16
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	984
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	10:30	2.43%
Port Call - Overnight	12:00	/	216:10	50.04%
Transit	0:00	/	12:00	2.78%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	23:35	5.46%
Infill - SSS	0:00	/	0:15	0.06%
Deployment / Recovery	0:00	/	2:35	0.60%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Recce	0:00	/	2:25	0.56%
Vessel Duties	0:00	/	10:25	2.41%
SVP Dip	0:00	/	2:40	0.62%
Mobilisation Alongside	0:00	/	81:30	18.87%
Mobilisation Calibrations	0:00	/	11:25	2.64%
Mobilisation Transit	0:00	/	3:30	0.81%
WoW - Mobilisation	0:00	/	13:30	3.13%
WoW - Alongside	11:00	/	34:55	8.08%
Standby Marine Mammal Observance	0:00	/	4:35	1.06%
Standby Marine Traffic	0:00	/	2:00	0.46%
Total	24:00	/	432:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	16:00	11:00	WoW - Alongside	All crew onboard. Daily meeting. Pre-sail checks. Review weather forecasts. Conditions unsuitable for survey operations. Crew remain onboard and monitor forecasts for improvements - no suitable weather for operations. Crew general duties.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	0.0	96.6	km	68.5%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	81:20	Hours	159.5%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	53:10	Hours	83.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

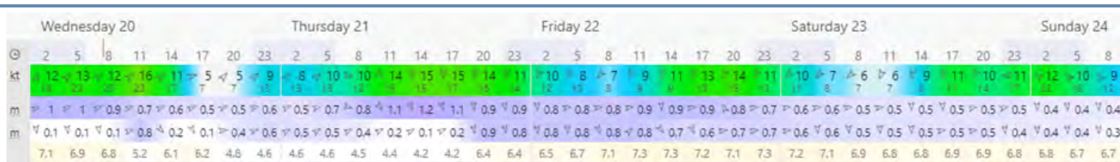
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	-	-	-	-	Vessel in port
Wind Direction	Coords	-	-	-	-	Vessel in port
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	10.00	790.00	1,541.00	L

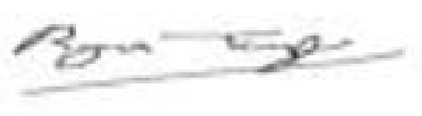
Client Rep Comments

N/A

Party Chief Comments

Spare UPS delivered to vessel. Fitted and tested. Additional immersion suits and life jackets also delivered.

Fugro Representative



Ryan Taylor
Party Chief
20/07/2022

Client Representative

20/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	19	**Date:**	21/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	0	/	74
Daily Meeting	1	/	17
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	1044
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	0
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	11:30	2.52%
Port Call - Overnight	12:00	/	228:10	50.04%
Transit	0:00	/	12:00	2.63%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	23:35	5.17%
Infill - SSS	0:00	/	0:15	0.05%
Deployment / Recovery	0:00	/	2:35	0.57%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Recce	0:00	/	2:25	0.53%
Vessel Duties	0:00	/	10:25	2.28%
SVP Dip	0:00	/	2:40	0.58%
Mobilisation Alongside	0:00	/	81:30	17.87%
Mobilisation Calibrations	0:00	/	11:25	2.50%
Mobilisation Transit	0:00	/	3:30	0.77%
WoW - Mobilisation	0:00	/	13:30	2.96%
WoW - Alongside	11:00	/	45:55	10.07%
Standby Marine Mammal Observance	0:00	/	4:35	1.01%
Standby Marine Traffic	0:00	/	2:00	0.44%
Total	24:00	/	456:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
05:30	06:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
06:00	17:00	11:00	WoW - Alongside	All crew onboard. Review weather forecasts. Morning meeting. Conditions unsuitable for survey operations. Crew general duties.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
17:30	24:00	06:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	0.0	96.6	km	68.5%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	93:20	Hours	183.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	53:10	Hours	83.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	790.00	0.00	0.00	790.00	1,541.00	L

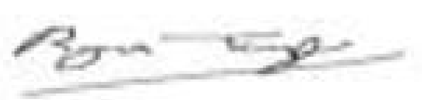
Client Rep Comments

N/A

Party Chief Comments

At clients request vessel crew transport Client Rep. to Geomarine warehouse to view UHRS equipment.

Fugro Representative



Ryan Taylor
Party Chief

22/07/2022

Client Representative

21/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	20	**Date:**	22/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	0	/	74
Daily Meeting	1	/	18
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	0	/	1044
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	1	/	1
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	12:30	2.60%
Port Call - Overnight	12:00	/	240:10	50.03%
Transit	0:00	/	12:00	2.50%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	23:35	4.91%
Infill - SSS	0:00	/	0:15	0.05%
Deployment / Recovery	0:00	/	2:35	0.54%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Recce	0:00	/	2:25	0.50%
Vessel Duties	0:00	/	10:25	2.17%
SVP Dip	0:00	/	2:40	0.56%
Mobilisation Alongside	0:00	/	81:30	16.98%
Mobilisation Calibrations	0:00	/	11:25	2.38%
Mobilisation Transit	0:00	/	3:30	0.73%
WoW - Mobilisation	0:00	/	13:30	2.81%
WoW - Alongside	11:00	/	56:55	11.86%
Standby Marine Mammal Observance	0:00	/	4:35	0.95%
Standby Marine Traffic	0:00	/	2:00	0.42%
Total	24:00	/	480:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel.
06:00	17:00	11:00	WoW - Alongside	All crew onboard vessel. Review weather forecast, complete vessel checks, morning meeting. Conditions unsuitable for survey ops. Crew general duties.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Crew departed vessel. Travel to accommodation.
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	141.0	0.0	96.6	km	68.5%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	105:20	Hours	206.5%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	53:10	Hours	83.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

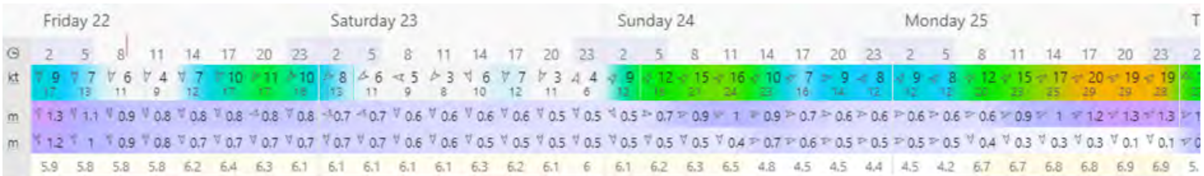
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	-	-	-	-	Vessel in port
Wind Speed	Knots	-	-	-	-	Vessel in port
Sig Wave	m	-	-	-	-	Vessel in port.

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	790.00	0.00	0.00	790.00	1,541.00	L

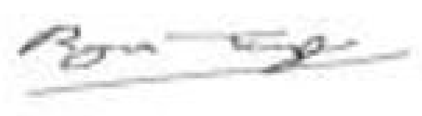
Client Rep Comments

N/A

Party Chief Comments

Additional MBES infill lines received.

Fugro Representative



Ryan Taylor
Party Chief

22/07/2022

Client Representative

22/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	21	**Date:**	23/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	4
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	4
Cross Department Tour	0	/	2
Audit / Inspection	0	/	0
Toolbox Talk	6	/	80
Daily Meeting	1	/	19
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	2
Total Persons Onboard	5		
Crew Hours	60	/	1104
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	1
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

x6 TBT's conducted.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	13:30	2.68%
Port Call - Overnight	12:00	/	252:10	50.03%
Transit	2:25	/	14:25	2.86%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	5:15	/	28:50	5.72%
Infill - MBES	0:15	/	0:15	0.05%
Infill - SSS	0:00	/	0:15	0.05%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:30	/	3:05	0.61%
Recce	0:00	/	2:25	0.48%
Vessel Duties	0:50	/	11:15	2.23%
SVP Dip	0:20	/	3:00	0.60%
Mobilisation Alongside	0:00	/	81:30	16.17%
Mobilisation Calibrations	0:00	/	11:25	2.27%
Mobilisation Transit	0:00	/	3:30	0.69%
WoW - Mobilisation	0:00	/	13:30	2.68%
WoW - At Sea	0:10	/	0:10	0.03%
WoW - Alongside	0:00	/	56:55	11.29%
Standby Marine Mammal Observance	0:50	/	5:25	1.07%
Standby Marine Traffic	0:25	/	2:25	0.48%
Total	24:00	/	504:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	05:25	00:25	Vessel Duties	All crew onboard. Review weather forecasts. Pre-sail checks. Morning meeting.
05:25	06:25	01:00	Transit	Depart port and transit to site.
06:25	06:35	00:10	WoW - At Sea	Arrive on location. Run line headings while assessing sea conditions. Conditions unsuitable for equipment deployment. Sea state 0.8-1.4m
06:35	06:50	00:15	Transit	Attempt to run MBES infills. Transit to infill location.
06:50	07:00	00:10	SVP Dip	TBT SVP dip.
07:00	07:10	00:10	Standby Marine Traffic	Awaiting permission to access channel.
07:10	07:20	00:10	Infill - MBES	Running MBES infill lines.
07:20	07:25	00:05	Standby Marine Traffic	Waiting for vessel to clear.
07:25	07:30	00:05	Infill - MBES	Continue running MBES infill lines.
07:30	07:40	00:10	Transit	Cross to north side of channel with permission.
07:40	07:50	00:10	Deployment / Recovery	TBT deploy side arm in sheltered location near breakwater.
07:50	08:20	00:30	Standby Marine Mammal Observance	Conduct MMO watch
08:20	08:40	00:20	Standby Marine Mammal Observance	Soft start Innomar. Weather seen to improve slightly.
08:40	08:45	00:05	Deployment / Recovery	TBT deploy SSS+Magnetometer.
08:45	11:30	02:45	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Running main survey lines.
11:30	11:40	00:10	Standby Marine Traffic	Waiting for Yacht to clear ahead.
11:40	14:10	02:30	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Continue running main survey lines.
14:10	14:25	00:15	Deployment / Recovery	TBT recover SSS+Magnetometer. TBT recover sidearm.
14:25	14:35	00:10	SVP Dip	TBT SVP dip
14:35	15:35	01:00	Transit	Depart site and transit to Scheveningen.
15:35	16:00	00:25	Vessel Duties	Vessel alongside. Wash down and shut down. Back up data for upload to shore.
16:00	16:30	00:30	Crew Travel to / from Accommodation	All crew depart vessel.
16:30	24:00	07:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	26.0	122.6	km	92.2%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	3:50	109:10	Hours	214.1%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	8:10	61:20	Hours	95.8%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

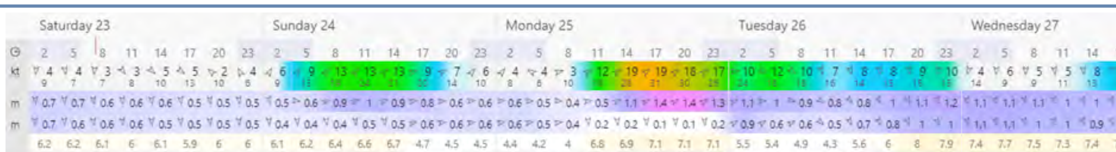
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	340	10	330		
Wind Speed	Knots	4	3	8		
Sig Wave	m	0.8	0.6	0.7	-	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	790.00	0.00	290.00	500.00	1,831.00	L

Client Rep Comments

N/A

Party Chief Comments

Party Chief Comments

DPR Geophysical Line KM completion updated to 133.0

Fugro Representative

Ryan Taylor
Party Chief

23/07/2022

Client Representative

23/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	22	**Date:**	24/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	3	/	7
Cross Department Tour	1	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	20
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1164
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	1	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Weekly safety meeting + cross departmental tour conducted.
Soundbite training - use of online DPR
Vessel drills - Flooding / Collision / Spills
HOC 331027 Safe act. A-frame position when in port.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	14:30	2.75%
Port Call - Overnight	11:00	/	263:10	49.84%
Transit	0:25	/	14:50	2.81%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	5.46%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - MBES	0:00	/	0:15	0.05%
Infill - SSS	0:00	/	0:15	0.05%
Deployment / Recovery	0:00	/	3:05	0.58%
Recce	0:00	/	2:25	0.46%
Vessel Duties	1:10	/	12:25	2.35%
SVP Dip	0:00	/	3:00	0.57%
Mobilisation Alongside	0:00	/	81:30	15.44%
Mobilisation Calibrations	0:00	/	11:25	2.16%
Mobilisation Transit	0:00	/	3:30	0.66%
WoW - Mobilisation	0:00	/	13:30	2.56%
WoW - At Sea	0:20	/	0:30	0.09%
WoW - Alongside	10:05	/	67:00	12.69%
Standby Marine Mammal Observance	0:00	/	5:25	1.03%
Standby Marine Traffic	0:00	/	2:25	0.46%
Total	24:00	/	528:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
04:30	05:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
05:00	06:10	01:10	Vessel Duties	All crew onboard. Morning meeting. Pre-sail checks. Review weather forecasts. Conduct safety meeting. Conduct vessel safety drills.
06:10	06:35	00:25	Transit	Depart berth and attempt transit to site.
06:35	06:55	00:20	WoW - At Sea	Transit aborted - sea state 1 - 1.5m short period. Return to Scheveningen.
06:55	17:00	10:05	WoW - Alongside	Vessel alongside waiting on weather. Monitor conditions and forecasts for improvements.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Crew depart vessel.
17:30	24:00	06:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	121:10	Hours	237.6%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

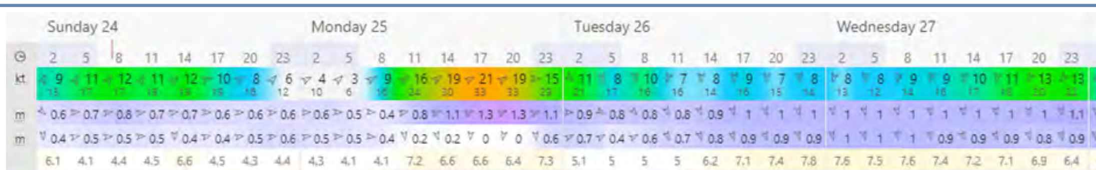
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	-	-	-	-	Vessel in port.
Wind Direction	Coords	-	-	-	-	Vessel in port.
Sig Wave	m	-	-	-	-	Vessel in port.

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	50.00	450.00	1,881.00	L

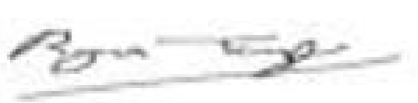
Client Rep Comments

N/A

Party Chief Comments

Stb generator ECU showing fault. Switch to using port generator. Assistance requested to fault find issue asap. Vessel remains fully operational.

Fugro Representative



Ryan Taylor
Party Chief

24/07/2022

Client Representative

24/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	23	**Date:**	25/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	21
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1224
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	15:30	2.81%
Port Call - Overnight	12:00	/	275:10	49.85%
Transit	0:00	/	14:50	2.69%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	5.22%
Infill - MBES	0:00	/	0:15	0.05%
Infill - SSS	0:00	/	0:15	0.05%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.56%
Recce	0:00	/	2:25	0.44%
Vessel Duties	0:00	/	12:25	2.25%
SVP Dip	0:00	/	3:00	0.54%
Mobilisation Alongside	0:00	/	81:30	14.76%
Mobilisation Calibrations	0:00	/	11:25	2.07%
Mobilisation Transit	0:00	/	3:30	0.63%
WoW - Mobilisation	0:00	/	13:30	2.45%
WoW - At Sea	0:00	/	0:30	0.09%
WoW - Alongside	11:00	/	78:00	14.13%
Standby Marine Mammal Observance	0:00	/	5:25	0.98%
Standby Marine Traffic	0:00	/	2:25	0.44%
Total	24:00	/	552:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.
05:30	06:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel.
06:00	17:00	11:00	WoW - Alongside	All crew onboard. Morning meeting. Vessel checks. Review weather forecasts - conditions unsuitable for survey operations. Vessel remains alongside waiting on weather. Crew general duties. Engineer attends to fault find Stb generator ECU error.
17:00	17:30	00:30	Crew Travel to / from Accommodation	All crew depart vessel.
17:30	24:00	06:30	Port Call - Overnight	Vessel alongside in Scheveningen overnight.

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	12:00	133:10	Hours	261.1%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

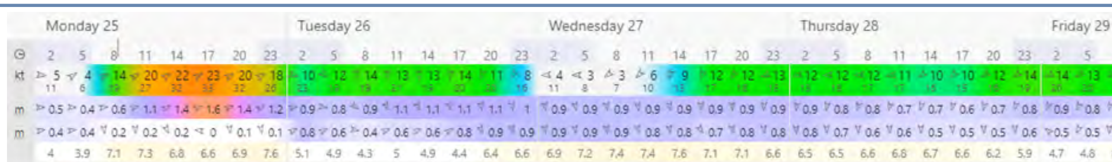
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	-	-	-	-	Vessel in port
Wind Speed	Knots	-	-	-	-	Vessel in port
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	450.00	0.00	0.00	450.00	1,881.00	L

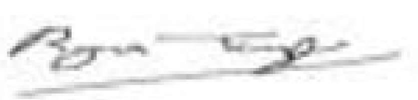
Client Rep Comments

N/A

Party Chief Comments

Engineer reports issue with Stb generator starter motor solenoid. Replacement sourced, fitted and tested.

Fugro Representative



Ryan Taylor
Party Chief

25/07/2022

Client Representative

25/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	24	**Date:**	26/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	22
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1284
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to Report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	16:30	2.86%
Port Call - Overnight	12:00	/	287:10	49.86%
Transit	0:00	/	14:50	2.58%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	5.01%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.54%
Recce	0:00	/	2:25	0.42%
Vessel Duties	0:00	/	12:25	2.16%
SVP Dip	0:00	/	3:00	0.52%
Mobilisation Alongside	0:00	/	81:30	14.15%
Mobilisation Calibrations	0:00	/	11:25	1.98%
Mobilisation Transit	0:00	/	3:30	0.61%
WoW - Mobilisation	0:00	/	13:30	2.34%
WoW - At Sea	0:00	/	0:30	0.09%
WoW - Alongside	11:00	/	89:00	15.45%
Standby Marine Mammal Observance	0:00	/	5:25	0.94%
Standby Marine Traffic	0:00	/	2:25	0.42%
Total	24:00	/	576:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:00	17:00	11:00	WoW - Alongside	Weather conditions not workable. Bunkered Fuel. Engineer replaced both generator batteries.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	145:10	Hours	284.6%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

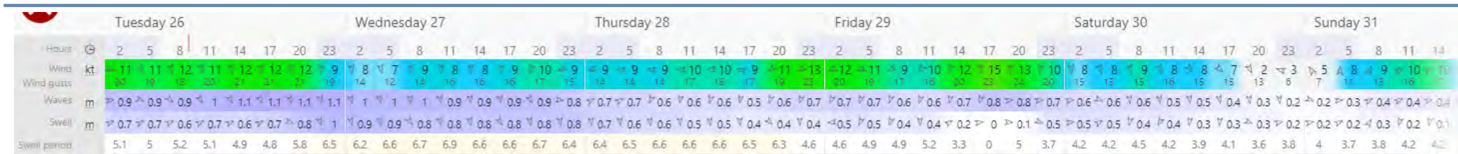
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Tuesday 26	2	5	8	11	14	17	20	23
Wind (kt)	11	11	12	11	12	12	12	9
Wind gusts	20	19	18	20	21	21	21	19
Waves (m)	0.9	0.9	0.9	1	1.1	1.1	1.1	1.1
Swell (m)	0.7	0.7	0.6	0.7	0.6	0.7	0.8	1
Swell period	5.1	5	5.2	5.1	4.9	4.8	5.8	6.5

Wednesday 27	2	5	8	11	14	17	20	23
Wind (kt)	8	7	9	8	8	9	10	9
Wind gusts	14	12	14	16	16	16	17	15
Waves (m)	1	1	1	0.9	0.9	0.9	0.9	0.8
Swell (m)	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8
Swell period	6.2	6.6	6.7	6.9	6.6	6.6	6.7	6.4

Thursday 28	2	5	8	11	14	17	20	23
Wind (kt)	9	9	9	10	10	9	11	13
Wind gusts	14	14	14	17	18	17	19	23
Waves (m)	0.7	0.7	0.6	0.6	0.6	0.5	0.6	0.7
Swell (m)	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4
Swell period	6.4	6.5	6.6	6.6	6.6	6.5	6.3	4.6

Friday 29	2	5	8	11	14	17	20	23
Wind (kt)	12	11	9	10	12	15	13	10
Wind gusts	20	19	17	16	20	23	24	20
Waves (m)	0.7	0.7	0.6	0.6	0.7	0.8	0.8	0.7
Swell (m)	0.5	0.5	0.4	0.4	0.2	0	0.1	0.5
Swell period	4.6	4.9	4.9	5.2	3.3	0	5	3.7

Saturday 30	2	5	8	11	14	17	20	23
Wind (kt)	8	8	9	8	8	7	2	3
Wind gusts	15	13	15	16	15	15	13	6
Waves (m)	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.2
Swell (m)	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2
Swell period	4.2	4.2	4.5	4.2	3.9	4.1	3.6	3.8

Sunday 31	2	5	8	11	14
Wind (kt)	5	8	9	10	10
Wind gusts	7	11	13	16	[illegible]
Waves (m)	0.2	0.3	0.4	0.4	0.4
Swell (m)	0.2	0.2	0.3	0.2	0.1
Swell period	4	3.7	3.8	4.2	4.2

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	515.00	485.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

No additional comments Adjusted time in Production Summary - 3.4 Sailing and Standby Rate Geophsyical to take in missed entry in time

Party Chief Comments

Fugro Representative

Roger Pewsey
Party Chief

26/07/2022

Client Representative

01/08/2022

26/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	24	**Date:**	26/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	22
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1284
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to Report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	16:30	2.86%
Port Call - Overnight	12:00	/	287:10	49.86%
Transit	0:00	/	14:50	2.58%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	5.01%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.54%
Recce	0:00	/	2:25	0.42%
Vessel Duties	0:00	/	12:25	2.16%
SVP Dip	0:00	/	3:00	0.52%
Mobilisation Alongside	0:00	/	81:30	14.15%
Mobilisation Calibrations	0:00	/	11:25	1.98%
Mobilisation Transit	0:00	/	3:30	0.61%
WoW - Mobilisation	0:00	/	13:30	2.34%
WoW - At Sea	0:00	/	0:30	0.09%
WoW - Alongside	11:00	/	89:00	15.45%
Standby Marine Mammal Observance	0:00	/	5:25	0.94%
Standby Marine Traffic	0:00	/	2:25	0.42%
Total	24:00	/	576:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:00	17:00	11:00	WoW - Alongside	Weather conditions not workable. Bunkered Fuel. Engineer replaced both generator batteries.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	133:10	Hours	261.1%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

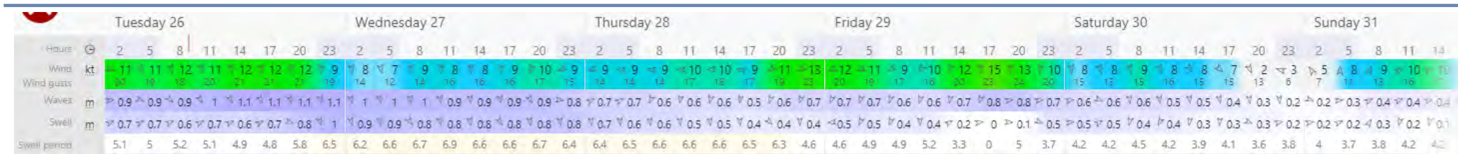
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel in port

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	515.00	485.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

No additional comments

Party Chief Comments

Fugro Representative

Roger Pewsey
Party Chief
26/07/2022

Client Representative

26/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	25	**Date:**	27/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	23
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1344
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Notification of safety stand down to take place on 29/7. No lifting to take place until otherwise notified.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	17:30	2.92%
Port Call - Overnight	12:00	/	299:10	49.86%
Transit	0:00	/	14:50	2.47%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	4.81%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.51%
Recce	0:00	/	2:25	0.40%
Vessel Duties	0:00	/	12:25	2.07%
SVP Dip	0:00	/	3:00	0.50%
Mobilisation Alongside	0:00	/	81:30	13.58%
Mobilisation Calibrations	0:00	/	11:25	1.90%
Mobilisation Transit	0:00	/	3:30	0.58%
WoW - Mobilisation	0:00	/	13:30	2.25%
WoW - At Sea	0:00	/	0:30	0.08%
WoW - Alongside	11:00	/	100:00	16.67%
Standby Marine Mammal Observance	0:00	/	5:25	0.90%
Standby Marine Traffic	0:00	/	2:25	0.40%
Total	24:00	/	600:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Conditions unsuitable for survey. Engineer crew change, Gareth Davies replaced Ryan Taylor. Roger Pewsey replaced Ryan Taylor as PC.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	157:10	Hours	308.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						

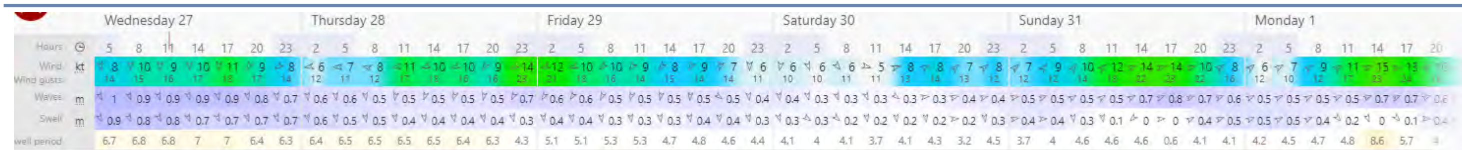
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

Adjusted time in Production Summary - 3.4 Sailing and Standby Rate Geophsyical to take in missed entry in time

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

28/07/2022

Client Representative

01/08/2022

27/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	25	**Date:**	27/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	23
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1344
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Notification of safety stand down to take place on 29/7. No lifting to take place until otherwise notified.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	17:30	2.92%
Port Call - Overnight	12:00	/	299:10	49.86%
Transit	0:00	/	14:50	2.47%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	4.81%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.51%
Recce	0:00	/	2:25	0.40%
Vessel Duties	0:00	/	12:25	2.07%
SVP Dip	0:00	/	3:00	0.50%
Mobilisation Alongside	0:00	/	81:30	13.58%
Mobilisation Calibrations	0:00	/	11:25	1.90%
Mobilisation Transit	0:00	/	3:30	0.58%
WoW - Mobilisation	0:00	/	13:30	2.25%
WoW - At Sea	0:00	/	0:30	0.08%
WoW - Alongside	11:00	/	100:00	16.67%
Standby Marine Mammal Observance	0:00	/	5:25	0.90%
Standby Marine Traffic	0:00	/	2:25	0.40%
Total	24:00	/	600:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Conditions unsuitable for survey. Engineer crew change, Gareth Davies replaced Ryan Taylor. Roger Pewsey replaced Ryan Taylor as PC.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	133:10	Hours	261.1%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

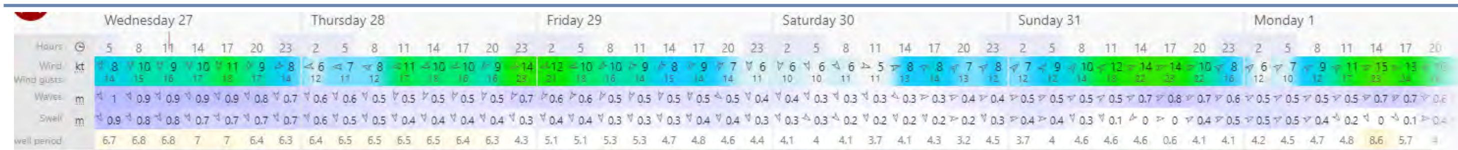
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

28/07/2022

Client Representative

27/07/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	26	**Date:**	28/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	24
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1404
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	18:30	2.96%
Port Call - Overnight	11:30	/	310:40	49.79%
Transit	0:00	/	14:50	2.38%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	4.62%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.49%
Recce	0:00	/	2:25	0.39%
Vessel Duties	0:00	/	12:25	1.99%
SVP Dip	0:00	/	3:00	0.48%
Mobilisation Alongside	0:00	/	81:30	13.06%
Mobilisation Calibrations	0:00	/	11:25	1.83%
Mobilisation Transit	0:00	/	3:30	0.56%
WoW - Mobilisation	0:00	/	13:30	2.16%
WoW - At Sea	0:00	/	0:30	0.08%
WoW - Alongside	11:30	/	111:30	17.87%
Standby Marine Mammal Observance	0:00	/	5:25	0.87%
Standby Marine Traffic	0:00	/	2:25	0.39%
Total	24:00	/	624:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheviningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:30	11:30	WoW - Alongside	Waiting on weather. Monitored conditions using live buoys and wind data, conditions did not improve enough for ops. Skipper Handover Jo Rawlings to Mark Shelley
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel to accomodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	169:10	Hours	331.7%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						

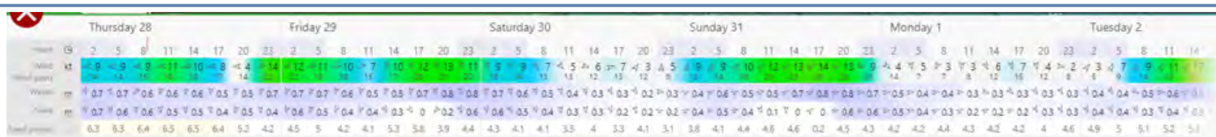
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Live buoy data was worse than forecast and did not fall below 0.75m

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

Adjusted time in Production Summary - 3.4 Sailing and Standby Rate Geophsyical to take in missed entry in time

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

29/07/2022

Client Representative

01/08/2022

28/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	26	**Date:**	28/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	24
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	3
Total Persons Onboard	5		
Crew Hours	60	/	1404
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	18:30	2.96%
Port Call - Overnight	11:30	/	310:40	49.79%
Transit	0:00	/	14:50	2.38%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	4.62%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.49%
Recce	0:00	/	2:25	0.39%
Vessel Duties	0:00	/	12:25	1.99%
SVP Dip	0:00	/	3:00	0.48%
Mobilisation Alongside	0:00	/	81:30	13.06%
Mobilisation Calibrations	0:00	/	11:25	1.83%
Mobilisation Transit	0:00	/	3:30	0.56%
WoW - Mobilisation	0:00	/	13:30	2.16%
WoW - At Sea	0:00	/	0:30	0.08%
WoW - Alongside	11:30	/	111:30	17.87%
Standby Marine Mammal Observance	0:00	/	5:25	0.87%
Standby Marine Traffic	0:00	/	2:25	0.39%
Total	24:00	/	624:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Schevinigen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:30	11:30	WoW - Alongside	Waiting on weather. Monitored conditions using live buoys and wind data, conditions did not improve enough for ops. Skipper Handover Jo Rawlings to Mark Shelley
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel to accomodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	133:10	Hours	261.1%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						

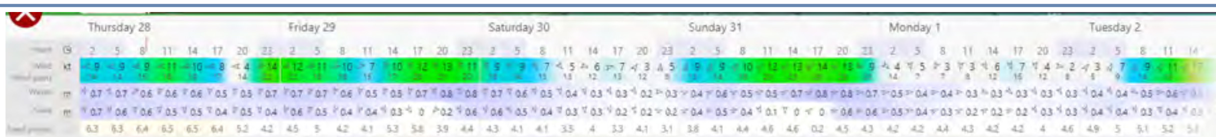
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Live buoy data was worse than forecast and did not fall below 0.75m

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	1,816.00	L

Client Rep Comments

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

29/07/2022

Client Representative

28/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	27	**Date:**	29/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	0	/	80
Daily Meeting	1	/	25
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	4
Total Persons Onboard	5		
Crew Hours	60	/	1464
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Carried out safety stand down for lifting operations. Reiterated importance of TRA, procedures, and stop the job policy for lifting operations.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	19:30	3.01%
Port Call - Overnight	11:30	/	322:10	49.72%
Transit	4:24	/	19:14	2.97%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	28:50	4.45%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	0:15	0.04%

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.48%
Recce	0:00	/	2:25	0.37%
Vessel Duties	0:00	/	12:25	1.92%
SVP Dip	0:00	/	3:00	0.46%
Mobilisation Alongside	0:00	/	81:30	12.58%
Mobilisation Calibrations	0:00	/	11:25	1.76%
Mobilisation Transit	0:00	/	3:30	0.54%
WoW - Mobilisation	0:00	/	13:30	2.08%
WoW - At Sea	0:00	/	0:30	0.08%
WoW - Alongside	6:36	/	118:06	18.23%
Standby Marine Mammal Observance	0:00	/	5:25	0.84%
Standby Marine Traffic	0:00	/	2:25	0.37%
Standby Other	0:30	/	0:30	0.08%
Total	24:00	/	648:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Crew travel to vessel
06:00	08:00	02:00	Transit	Departed for site to assess conditions. Conditions poor. Temperature warning on stbd engine. Transited to port to carry out checks
08:00	09:13	01:13	WoW - Alongside	Waiting on weather. Carried out checks on stbd engine. No obvious issues.
09:13	10:30	01:17	Transit	Carried out sea trial of stbd engine. Ran with no issues. Transited to site as conditions had improved slightly (wave height approx 0.7)
10:30	11:00	00:30	Standby Other	Compulsory safety stand down for all Fugro vessels to discuss lifting saftey.
11:00	12:07	01:07	Transit	Conditions deteriorated on site, 0.8m Hs and worsening. Transited back to port. Engine showed no further issues.
12:07	17:30	05:23	WoW - Alongside	Alongside in Scheveningen
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel to accomodation
18:00	24:00	06:00	Port Call - Overnight	Alonside in Scheveninginen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	122.6	km	92.2%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	61:20	Hours	95.8%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	181:10	Hours	355.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

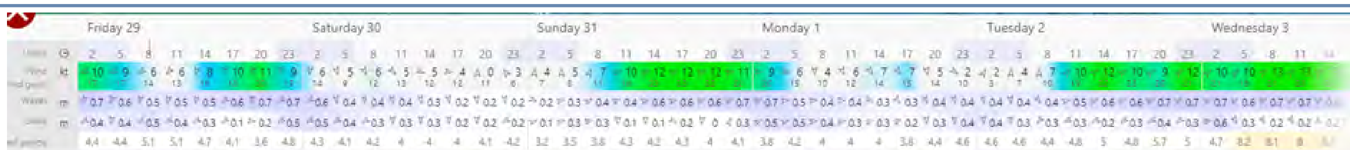
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.8	0.7	0.8	0.8	Assesed conditions on site, worse than forecast.

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	100.00	900.00	1,916.00	L

Client Rep Comments

Adjusted time in Production Summary - 3.4 Sailing and Standby Rate Geophsyical to take in missed entry in time.

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

30/07/2022

Client Representative

29/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	28	**Date:**	30/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	3
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	7
Cross Department Tour	0	/	3
Audit / Inspection	0	/	0
Toolbox Talk	6	/	86
Daily Meeting	1	/	26
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	4
Total Persons Onboard	5		
Crew Hours	60	/	1524
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	20:30	3.05%
Port Call - Overnight	11:30	/	333:40	49.65%
Transit	2:01	/	21:15	3.16%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	3:24	/	32:14	4.80%
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	1:44	/	1:59	0.30%

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.46%
Recce	0:00	/	2:25	0.36%
Vessel Duties	0:00	/	12:25	1.85%
SVP Dip	0:00	/	3:00	0.45%
Mobilisation Alongside	0:00	/	81:30	12.13%
Mobilisation Calibrations	0:00	/	11:25	1.70%
Mobilisation Transit	0:00	/	3:30	0.52%
WoW - Mobilisation	0:00	/	13:30	2.01%
WoW - At Sea	0:00	/	0:30	0.07%
WoW - Alongside	0:00	/	118:06	17.57%
Standby Marine Mammal Observance	0:30	/	5:55	0.88%
Standby Marine Traffic	0:00	/	2:25	0.36%
Standby Data QC	3:51	/	3:51	0.57%
Standby Other	0:00	/	0:30	0.07%
Total	24:00	/	672:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Alongside in Scheveningen
04:30	05:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
05:00	06:09	01:09	Transit	Vessel checks and transit to site
06:09	06:39	00:30	Standby Marine Mammal Observance	MMO
06:39	10:03	03:24	2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	Completed remaining Main lines
10:03	11:47	01:44	Infill - SSS	Completed remaining infill
11:47	13:40	01:53	Standby Data QC	Awaiting coverage checks from remote processor
13:40	14:32	00:52	Transit	Transit to port following prelim coverage checks
14:32	16:30	01:58	Standby Data QC	Awaiting final coverage check
16:30	17:00	00:30	Crew Travel to / from Accommodation	Travel to accommodation
17:00	24:00	07:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	10.4	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	5:08	66:28	Hours	103.9%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	6:52	188:02	Hours	368.7%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

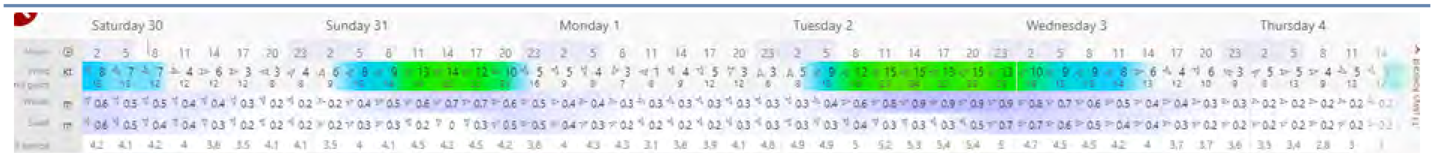
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.6	0.5	0.5	0.5	Currents in Maas entrance exacerbated wave motion

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	900.00	0.00	400.00	500.00	2,316.00	L

Client Rep Comments

Party Chief Comments

Awaiting final data checks and signoff before commencing UXO mobilisation

Fugro Representative

Roger Pewsey
Party Chief
31/07/2022

Client Representative

30/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	29	**Date:**	31/07/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	1	/	8
Cross Department Tour	1	/	4
Audit / Inspection	0	/	0
Toolbox Talk	0	/	86
Daily Meeting	1	/	27
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	5
Total Persons Onboard	5		
Crew Hours	60	/	1584
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Safety meeting carried out. Vessel drill for entanglement of miniwing during ops. Crew carried out COVID lateral flow tests, all negative.

1 HOC for partial blockage to fire extinguisher access by items on shelf. This was corrected by moving items concerned to a more appropriate location

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	21:30	3.09%
Port Call - Overnight	12:00	/	345:40	49.66%
Transit	0:00	/	21:15	3.05%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	4.63%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - MBES	0:00	/	0:15	0.04%
Infill - SSS	0:00	/	1:59	0.28%
Deployment / Recovery	0:00	/	3:05	0.44%
Recce	0:00	/	2:25	0.35%
Vessel Duties	0:00	/	12:25	1.78%
SVP Dip	0:00	/	3:00	0.43%
Mobilisation Alongside	0:00	/	81:30	11.71%
Mobilisation Calibrations	0:00	/	11:25	1.64%
Mobilisation Transit	0:00	/	3:30	0.50%
WoW - Mobilisation	0:00	/	13:30	1.94%
WoW - At Sea	0:00	/	0:30	0.07%
WoW - Alongside	11:00	/	129:06	18.55%
Standby Marine Mammal Observance	0:00	/	5:55	0.85%
Standby Marine Traffic	0:00	/	2:25	0.35%
Standby Data QC	0:00	/	3:51	0.55%
Standby Other	0:00	/	0:30	0.07%
Total	24:00	/	696:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Conditions unsutable for operations. 1 SBP infill line remains. Mag and SSS coverage complete. Intend to proceed with UXO mob and collect SBP infill at a later date, pending approval.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	66:28	Hours	103.9%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

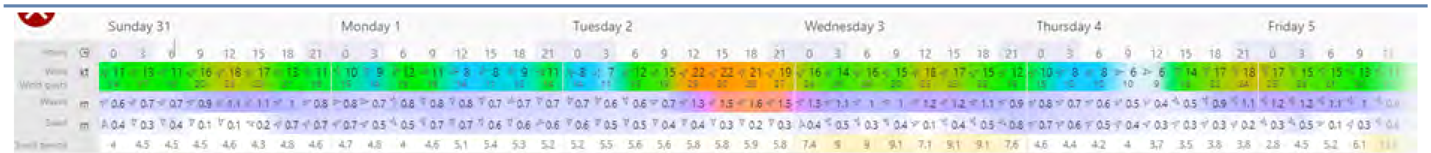
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	2,316.00	L

Client Rep Comments

Party Chief Comments

No further comments

Fugro Representative

Roger Pewsey
Party Chief

31/07/2022

Client Representative

31/07/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	30	**Date:**	01/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	0	/	86
Daily Meeting	1	/	28
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	5		
Crew Hours	60	/	1644
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Attempted to commence mobilisation of UXO scope. This required crane ops. Agent and contractor unwilling to provide safe lift plan or risk assessment. These are requirements for Fugro and the Harbour master. Lifting ops may not continue until this is resolved.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	22:30	3.13%
Port Call - Overnight	12:00	/	357:40	49.68%
Transit	0:00	/	21:15	2.95%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	4.48%
Infill - MBES	0:00	/	0:15	0.03%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.28%
Deployment / Recovery	0:00	/	3:05	0.43%
Recce	0:00	/	2:25	0.34%
Vessel Duties	0:00	/	12:25	1.72%
SVP Dip	0:00	/	3:00	0.42%
Mobilisation Alongside	11:00	/	92:30	12.85%
Mobilisation Calibrations	0:00	/	11:25	1.59%
Mobilisation Transit	0:00	/	3:30	0.49%
WoW - Mobilisation	0:00	/	13:30	1.88%
WoW - At Sea	0:00	/	0:30	0.07%
WoW - Alongside	0:00	/	129:06	17.93%
Standby Marine Mammal Observance	0:00	/	5:55	0.82%
Standby Marine Traffic	0:00	/	2:25	0.34%
Standby Data QC	0:00	/	3:51	0.53%
Standby Other	0:00	/	0:30	0.07%
Total	24:00	/	720:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	Mobilisation Alongside	Made preparations for demob/ mob of equipment. Lifting ops for equipment could not take place due to lack of documentation. In talks with agent to resolve this.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Schevingingen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	66:28	Hours	103.9%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

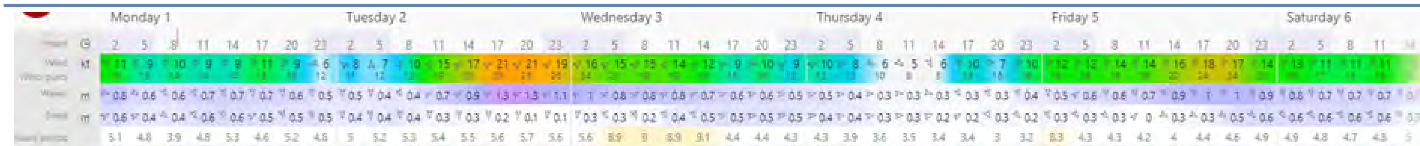
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	2,316.00	L

Client Rep Comments

Production summary - No times inserted today. 1.4 Mobilisation - Geophysical is at 100%

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

02/08/2022

Client Representative

01/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	31	**Date:**	02/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	1	/	87
Daily Meeting	1	/	29
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	5		
Crew Hours	60	/	1704
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Safe lift plan carried out with lifting contractor. They did not have documentation in advance.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	23:30	3.16%
Port Call - Overnight	12:00	/	369:40	49.69%
Transit	0:00	/	21:15	2.86%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	4.33%
Infill - MBES	0:00	/	0:15	0.03%
Infill - SSS	0:00	/	1:59	0.27%

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.41%
Recce	0:00	/	2:25	0.32%
Vessel Duties	0:00	/	12:25	1.67%
SVP Dip	0:00	/	3:00	0.40%
Mobilisation Alongside	11:00	/	103:30	13.91%
Mobilisation Calibrations	0:00	/	11:25	1.53%
Mobilisation Transit	0:00	/	3:30	0.47%
WoW - Mobilisation	0:00	/	13:30	1.81%
WoW - At Sea	0:00	/	0:30	0.07%
WoW - Alongside	0:00	/	129:06	17.35%
Standby Marine Mammal Observance	0:00	/	5:55	0.80%
Standby Marine Traffic	0:00	/	2:25	0.32%
Standby Data QC	0:00	/	3:51	0.52%
Standby Other	0:00	/	0:30	0.07%
Total	24:00	/	744:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	Mobilisation Alongside	Arrangement to receive UXO equipment on vessel. UXO equipment delivered to vessel. SSS and AGO winch offloaded
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	66:28	Hours	103.9%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

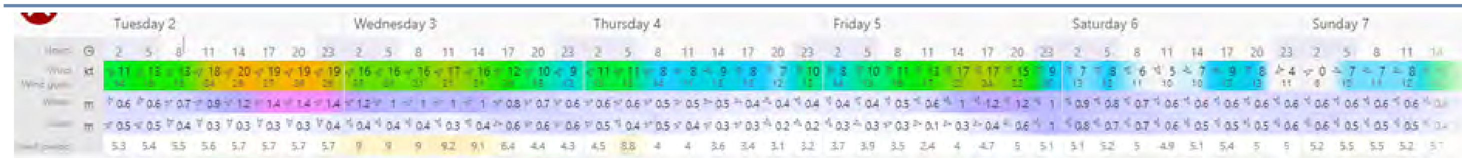
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	2,316.00	L

Client Rep Comments

Party Chief Comments

0 hours in

Fugro Representative

Roger Pewsey
Party Chief

03/08/2022

Client Representative

02/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	32	**Date:**	03/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	2	/	89
Daily Meeting	1	/	30
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	5		
Crew Hours	60	/	1764
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	24:30	3.19%
Port Call - Overnight	12:00	/	381:40	49.70%
Transit	0:00	/	21:15	2.77%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	4.20%
Infill - MBES	0:00	/	0:15	0.03%
Infill - SSS	0:00	/	1:59	0.26%

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.40%
Recce	0:00	/	2:25	0.31%
Vessel Duties	0:00	/	12:25	1.62%
SVP Dip	0:00	/	3:00	0.39%
Mobilisation Alongside	11:00	/	114:30	14.91%
Mobilisation Calibrations	0:00	/	11:25	1.49%
Mobilisation Transit	0:00	/	3:30	0.46%
WoW - Mobilisation	0:00	/	13:30	1.76%
WoW - At Sea	0:00	/	0:30	0.07%
WoW - Alongside	0:00	/	129:06	16.81%
Standby Marine Mammal Observance	0:00	/	5:55	0.77%
Standby Marine Traffic	0:00	/	2:25	0.31%
Standby Data QC	0:00	/	3:51	0.50%
Standby Other	0:00	/	0:30	0.07%
Total	24:00	/	768:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	Mobilisation Alongside	Successful installation of miniwing. Wet test carried out. Load testing booked for tomorrow
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	66:28	Hours	103.9%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

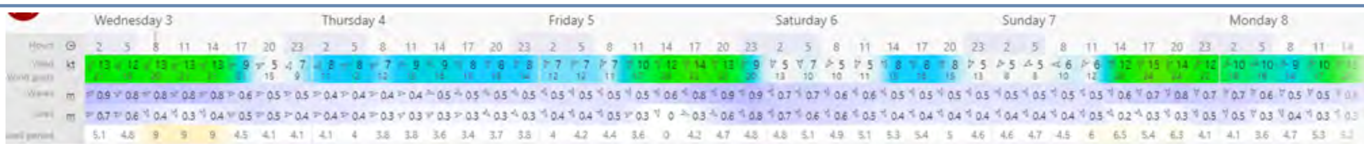
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	2,316.00	L

Client Rep Comments

Party Chief Comments

No value entered in production summary. Mob time code already 100%

Fugro Representative

Roger Pewsey
Party Chief

04/08/2022

Client Representative

03/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	33	**Date:**	04/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen Haven NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	8	/	97
Daily Meeting	1	/	31
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	5		
Crew Hours	6	/	1770
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	0

HSE Comments

Carried out mock deployment to test ease of use for shackle to connect miniwing to a frame winch (normally a grab and go hook is used)

Near miss- emergency stop on a frame winch not applied after use. Switch was knocked by lifejacket being hung on adjacent hook causing winch to activate unexpectedly.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	25:30	3.22%
Port Call - Overnight	12:00	/	393:40	49.71%
Transit	1:51	/	23:06	2.92%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	4.07%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - MBES	1:11	/	1:26	0.18%
Infill - SSS	0:00	/	1:59	0.25%
Deployment / Recovery	0:00	/	3:05	0.39%
Recce	0:00	/	2:25	0.31%
Vessel Duties	0:46	/	13:11	1.66%
SVP Dip	0:00	/	3:00	0.38%
Mobilisation Alongside	5:29	/	119:59	15.15%
Mobilisation Calibrations	1:43	/	13:08	1.66%
Mobilisation Transit	0:00	/	3:30	0.44%
WoW - Mobilisation	0:00	/	13:30	1.70%
WoW - At Sea	0:00	/	0:30	0.06%
WoW - Alongside	0:00	/	129:06	16.30%
Standby Marine Mammal Observance	0:00	/	5:55	0.75%
Standby Marine Traffic	0:00	/	2:25	0.31%
Standby Data QC	0:00	/	3:51	0.49%
Standby Other	0:00	/	0:30	0.06%
Total	24:00	/	792:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	11:29	05:29	Mobilisation Alongside	Load testing of winch bed and inspection of LOLER items
11:29	12:20	00:51	Transit	Transit to Maas entrance
12:20	14:03	01:43	Mobilisation Calibrations	Wet test of UXO gear and clearance of SIT area
14:03	15:14	01:11	Infill - MBES	Completed remaining geophys infill
15:14	16:14	01:00	Transit	Transit Maas to Scheveningen
16:14	17:00	00:46	Vessel Duties	Alongside in Scevenigen
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to Fletcher Hotel, Scheveningen
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	1:11	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	7:46	7:46	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

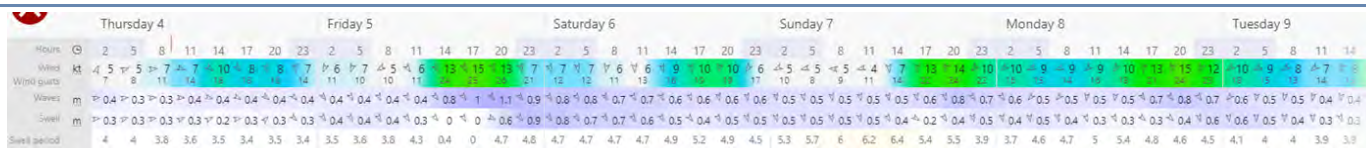
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.5	0.5	0.5	0.5	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	85.00	415.00	2,401.00	L

Client Rep Comments

Party Chief Comments

0 added in production summary for UXO mob- field already at 100%

Completed UXO mob. Now on UXO acquisition and standby phase

Fugro Representative

Roger Pewsey
Party Chief

05/08/2022

Client Representative

04/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	34	**Date:**	05/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	0	/	97
Daily Meeting	1	/	32
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	60	/	1830
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	1	/	1

HSE Comments

Near miss added above regarding item mentioned in yesterday's DPR. On 4th August the A frame winch operated unexpectedly because accidental contact with the remote.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	26:30	3.25%
Port Call - Overnight	12:00	/	405:40	49.71%
Transit	0:00	/	23:06	2.83%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.95%
Infill - MBES	0:00	/	1:26	0.18%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.24%
Deployment / Recovery	0:00	/	3:05	0.38%
Recce	0:00	/	2:25	0.30%
Vessel Duties	0:00	/	13:11	1.62%
SVP Dip	0:00	/	3:00	0.37%
Mobilisation Alongside	0:00	/	119:59	14.70%
Mobilisation Calibrations	0:00	/	13:08	1.61%
Mobilisation Transit	0:00	/	3:30	0.43%
WoW - Mobilisation	0:00	/	13:30	1.65%
WoW - At Sea	0:00	/	0:30	0.06%
WoW - Alongside	11:00	/	140:06	17.17%
Standby Marine Mammal Observance	0:00	/	5:55	0.73%
Standby Marine Traffic	0:00	/	2:25	0.30%
Standby Data QC	0:00	/	3:51	0.47%
Standby Other	0:00	/	0:30	0.06%
Total	24:00	/	816:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Weather too poor to conduct SIT. Crew general duties
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	19:46	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

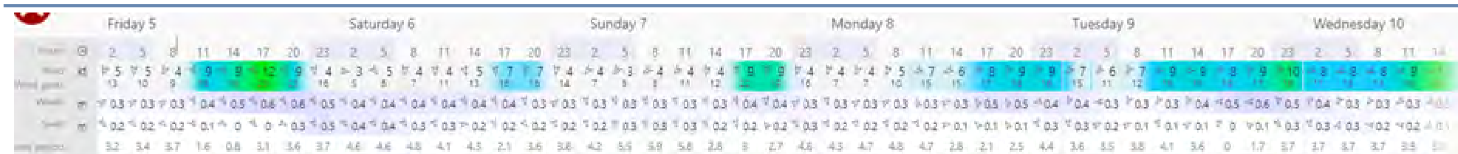
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	415.00	585.00	0.00	1,000.00	2,401.00	L

Client Rep Comments

Party Chief Comments

No further comments

Fugro Representative

Roger Pewsey
Party Chief

06/08/2022

Client Representative

05/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	35	**Date:**	06/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	8
Cross Department Tour	0	/	4
Audit / Inspection	0	/	0
Toolbox Talk	0	/	97
Daily Meeting	1	/	33
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	5		
Crew Hours	60	/	1890
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	5
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	27:10	3.23%
Port Call - Overnight	12:00	/	417:40	49.72%
Transit	0:00	/	23:06	2.75%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.84%
Infill - MBES	0:00	/	1:26	0.17%
Infill - SSS	0:00	/	1:59	0.24%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Deployment / Recovery	0:00	/	3:05	0.37%
Recce	0:00	/	2:25	0.29%
Vessel Duties	0:00	/	13:11	1.57%
SVP Dip	0:00	/	3:00	0.36%
Mobilisation Alongside	0:00	/	119:59	14.28%
Mobilisation Calibrations	0:00	/	13:08	1.56%
Mobilisation Transit	0:00	/	3:30	0.42%
WoW - Mobilisation	0:00	/	13:30	1.61%
WoW - At Sea	0:00	/	0:30	0.06%
WoW - Alongside	11:20	/	151:26	18.03%
Standby Marine Mammal Observance	0:00	/	5:55	0.70%
Standby Marine Traffic	0:00	/	2:25	0.29%
Standby Data QC	0:00	/	3:51	0.46%
Standby Other	0:00	/	0:30	0.06%
Total	24:00	/	840:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	05:50	00:20	Crew Travel to / from Accommodation	Travel to vessel
05:50	17:10	11:20	WoW - Alongside	Grew general duties and admin.
17:10	17:30	00:20	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	0:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	31:46	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
MASW						
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

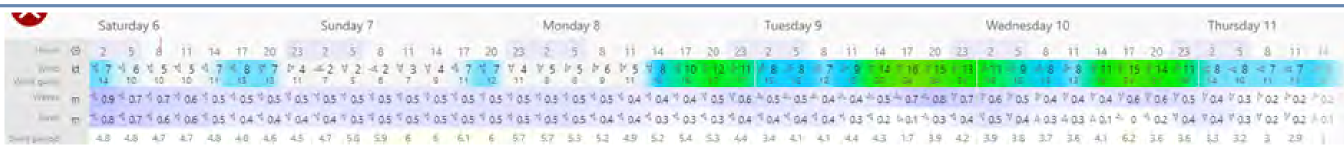
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	2,401.00	L

Client Rep Comments

Party Chief Comments

No additional comments

Fugro Representative

Roger Pewsey
Party Chief

07/08/2022

Client Representative

06/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	36	**Date:**	07/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	1	/	9
Cross Department Tour	1	/	5
Audit / Inspection	0	/	0
Toolbox Talk	9	/	106
Daily Meeting	1	/	34
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	1962
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	1	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Safety meeting and vessel drill (abandonment). Induction for Peter Bahnerth.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	27:50	3.22%
Port Call - Overnight	12:00	/	429:40	49.75%
Transit	1:45	/	24:51	2.88%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.73%
2.9 UXO with GRAD	6:06	/	6:06	0.71%
Infill - MBES	0:00	/	1:26	0.17%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.23%
Deployment / Recovery	0:00	/	3:05	0.36%
Recce	0:00	/	2:25	0.28%
Vessel Duties	1:27	/	14:38	1.69%
SVP Dip	0:00	/	3:00	0.35%
Mobilisation Alongside	0:00	/	119:59	13.89%
Mobilisation Calibrations	0:00	/	13:08	1.52%
Mobilisation Transit	0:00	/	3:30	0.41%
WoW - Mobilisation	0:00	/	13:30	1.56%
WoW - At Sea	0:00	/	0:30	0.06%
WoW - Alongside	0:00	/	151:26	17.53%
Standby Marine Mammal Observance	0:00	/	5:55	0.69%
Standby Marine Traffic	0:00	/	2:25	0.28%
Standby Data QC	1:45	/	5:36	0.65%
Standby Other	0:00	/	0:30	0.06%
Total	23:43	/	863:43	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Alonside in Scheveningen
04:30	04:50	00:20	Crew Travel to / from Accommodation	Travel to vessel
04:50	05:53	01:03	Vessel Duties	Induction, weekly safety meeting
05:53	06:42	00:49	Transit	Transit to site
06:42	10:11	03:29	2.9 UXO with GRAD	Conducted SIT
10:11	11:56	01:45	Standby Data QC	Awaited SIT results
11:56	14:33	02:37	2.9 UXO with GRAD	Recovered SIT, commenced ops in geotech location
14:50	15:46	00:56	Transit	Transit to Scheveningen
15:46	16:10	00:24	Vessel Duties	Data backup and tidying of vessel
16:10	16:30	00:20	Crew Travel to / from Accommodation	Travel to accomodation
16:30	24:00	07:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.4	0.4	km	0.9%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	12:00	12:00	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	31:46	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

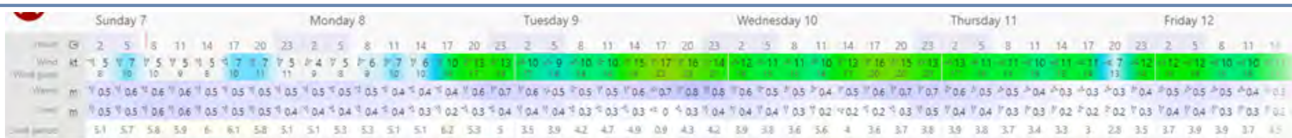
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	0	6
Total	5	1	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.8	0.8	0.6	0.5	Long period swell with no wind- ok for ops

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	800.00	200.00	3,201.00	L

Client Rep Comments

Party Chief Comments

Nothing to report

Fugro Representative

Roger Pewsey
Party Chief

08/08/2022

Client Representative

07/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	37	**Date:**	08/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	0
Toolbox Talk	7	/	113
Daily Meeting	1	/	35
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2034
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	28:30	3.21%
Port Call - Overnight	12:00	/	441:40	49.75%
Transit	2:02	/	26:53	3.03%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.63%
2.9 UXO with GRAD	7:02	/	13:08	1.48%
Infill - MBES	0:00	/	1:26	0.16%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.22%
Deployment / Recovery	0:00	/	3:05	0.35%
Recce	0:00	/	2:25	0.27%
Vessel Duties	0:36	/	15:14	1.72%
SVP Dip	0:00	/	3:00	0.34%
Mobilisation Alongside	0:00	/	119:59	13.52%
Mobilisation Calibrations	0:00	/	13:08	1.48%
Mobilisation Transit	0:00	/	3:30	0.39%
WoW - Mobilisation	0:00	/	13:30	1.52%
WoW - At Sea	0:00	/	0:30	0.06%
WoW - Alongside	1:40	/	153:06	17.25%
Standby Marine Mammal Observance	0:00	/	5:55	0.67%
Standby Marine Traffic	0:00	/	2:25	0.27%
Standby Data QC	0:00	/	5:36	0.63%
Standby Other	0:00	/	0:30	0.06%
Total	24:00	/	887:43	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	06:36	00:36	Vessel Duties	Admin and preparations for sailing
06:36	07:32	00:56	Transit	Transit to site
07:32	14:34	07:02	2.9 UXO with GRAD	UXO Ops. Weather increased forcing recovery
14:34	15:40	01:06	Transit	Transit to port
15:40	17:20	01:40	WoW - Alongside	Waiting on weather in Scheveiningen
17:20	17:40	00:20	Crew Travel to / from Accommodation	Travel to accomodation
17:40	24:00	06:20	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	2.5	2.9	km	6.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopshyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	10:20	22:20	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	1:40	33:26	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

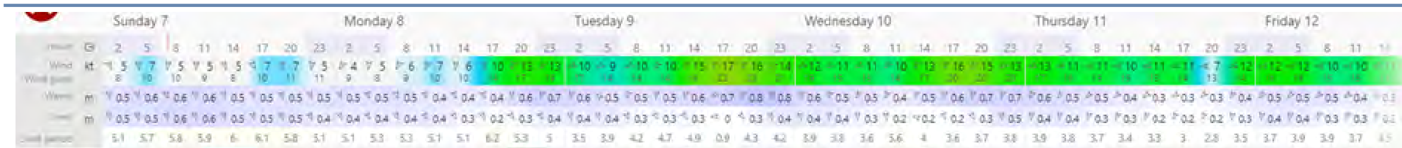
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.4	0.4	0.6	0.7	Conditions worsened in afternoon

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	250.00	550.00	2,851.00	L

Client Rep Comments

Party Chief Comments

No Additional comments

Fugro Representative

Roger Pewsey
Party Chief

09/08/2022

Client Representative

08/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	38	**Date:**	09/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	0
Toolbox Talk	0	/	113
Daily Meeting	1	/	36
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2106
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	29:10	3.20%
Port Call - Overnight	11:40	/	453:20	49.71%
Transit	2:39	/	29:32	3.24%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.53%
2.9 UXO with GRAD	0:00	/	13:25	1.47%
Infill - MBES	0:00	/	1:26	0.16%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.22%
Deployment / Recovery	0:00	/	3:05	0.34%
Recce	0:00	/	2:25	0.26%
Vessel Duties	0:00	/	15:14	1.67%
SVP Dip	0:00	/	3:00	0.33%
Mobilisation Alongside	0:00	/	119:59	13.16%
Mobilisation Calibrations	0:00	/	13:08	1.44%
Mobilisation Transit	0:00	/	3:30	0.38%
WoW - Mobilisation	0:00	/	13:30	1.48%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	9:01	/	162:07	17.78%
Standby Marine Mammal Observance	0:00	/	5:55	0.65%
Standby Marine Traffic	0:00	/	2:25	0.26%
Standby Data QC	0:00	/	5:36	0.61%
Standby Other	0:00	/	0:30	0.05%
Total	24:00	/	912:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:40	04:40	Port Call - Overnight	Alongside in Scheveningen
04:40	05:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
05:00	07:39	02:39	Transit	Sailed to site to assess condtions. Not suitable for miniwing deployment and recover. Rising forecast.
07:39	16:40	09:01	WoW - Alongside	Alongside in Scheveningen
16:40	17:00	00:20	Crew Travel to / from Accommodation	Travel to accomodation
17:00	24:00	07:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	2.9	km	6.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	12:00	212:02	Hours	415.8%
UXO Scouting with GRAD	DR	0:00	0:00	22:20	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	45:26	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

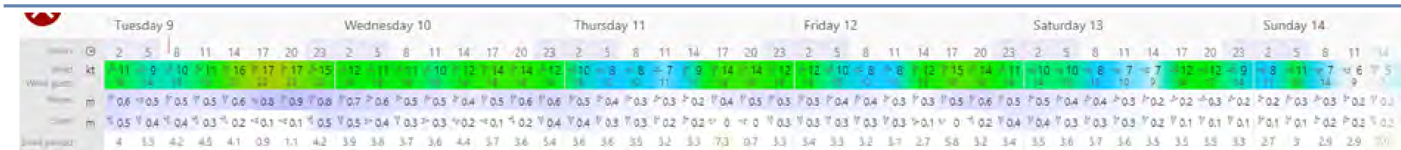
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.6	-	-	-	Sailed to assess conditions in morning, not suitable for deployment or recovery

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	377.00	623.00	0.00	1,000.00	3,024.00	L

Client Rep Comments

Party Chief Comments

No additional comments.

Fugro Representative

Roger Pewsey
Party Chief

10/08/2022

Client Representative

09/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	39	**Date:**	10/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	1	/	1
Toolbox Talk	0	/	113
Daily Meeting	1	/	37
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2178
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Lifting inspector did not certify roof winch for side arm recovery. Strength of winch deemed excessive for davit arm assembly, despite having been certified previously. Replacement hand powered winch to be shipped from UK and installed ASAP. Vessel may not carry out operations until this has been rectified.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	29:50	3.19%
Port Call - Overnight	11:40	/	465:00	49.68%
Transit	0:00	/	29:32	3.16%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.44%
2.9 UXO with GRAD	0:00	/	13:25	1.43%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - MBES	0:00	/	1:26	0.15%
Infill - SSS	0:00	/	1:59	0.21%
Deployment / Recovery	0:00	/	3:05	0.33%
Recce	0:00	/	2:25	0.26%
Vessel Duties	0:00	/	15:14	1.63%
SVP Dip	0:00	/	3:00	0.32%
Mobilisation Alongside	0:00	/	119:59	12.82%
Mobilisation Calibrations	0:00	/	13:08	1.40%
Mobilisation Transit	0:00	/	3:30	0.37%
WoW - Mobilisation	0:00	/	13:30	1.44%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	0:00	/	162:07	17.32%
Standby Marine Mammal Observance	0:00	/	5:55	0.63%
Standby Marine Traffic	0:00	/	2:25	0.26%
Standby Data QC	0:00	/	5:36	0.60%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	11:40	/	11:40	1.25%
Total	24:00	/	936:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:40	11:40	Downtime Vessel	Unable to carry out ops due to lack of certification for essential winch
17:40	18:00	00:20	Crew Travel to / from Accommodation	Travel to accomodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	2.9	km	6.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	22:20	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	45:26	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

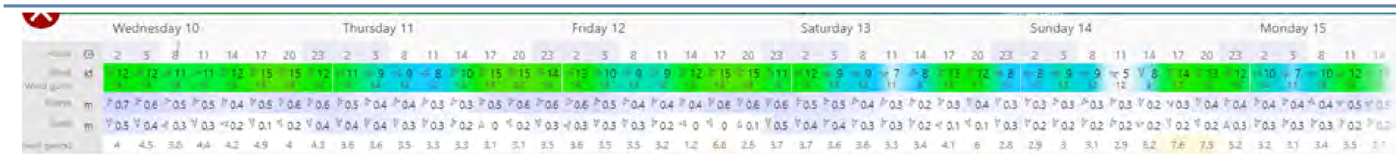
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	3,024.00	L

Client Rep Comments

Party Chief Comments

No values added in production summary as we are vessel/ equipment down time.

Fugro Representative

Roger Pewsey
Party Chief

11/08/2022

Client Representative

10/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	40	**Date:**	11/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	1
Toolbox Talk	0	/	113
Daily Meeting	1	/	38
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2250
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Awaiting delivery of Pfaff hand winch which will conform to lifting gear inspectors requirements for certification.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	30:30	3.18%
Port Call - Overnight	12:00	/	477:00	49.69%
Transit	0:00	/	29:32	3.08%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.36%
2.9 UXO with GRAD	0:00	/	13:25	1.40%
Infill - MBES	0:00	/	1:26	0.15%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.21%
Deployment / Recovery	0:00	/	3:05	0.32%
Recce	0:00	/	2:25	0.25%
Vessel Duties	0:00	/	15:14	1.59%
SVP Dip	0:00	/	3:00	0.31%
Mobilisation Alongside	0:00	/	119:59	12.50%
Mobilisation Calibrations	0:00	/	13:08	1.37%
Mobilisation Transit	0:00	/	3:30	0.36%
WoW - Mobilisation	0:00	/	13:30	1.41%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	0:00	/	162:07	16.89%
Standby Marine Mammal Observance	0:00	/	5:55	0.62%
Standby Marine Traffic	0:00	/	2:25	0.25%
Standby Data QC	0:00	/	5:36	0.58%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	11:20	/	23:00	2.40%
Total	24:00	/	960:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:20	11:20	Downtime Vessel	Awaited delivery of replacement winch for side arm davit. This was delayed by DHL delivery and did not meet the vessel.
17:20	17:40	00:20	Crew Travel to / from Accommodation	Travel to accommodation
17:40	24:00	06:20	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	2.9	km	6.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	22:20	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	45:26	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

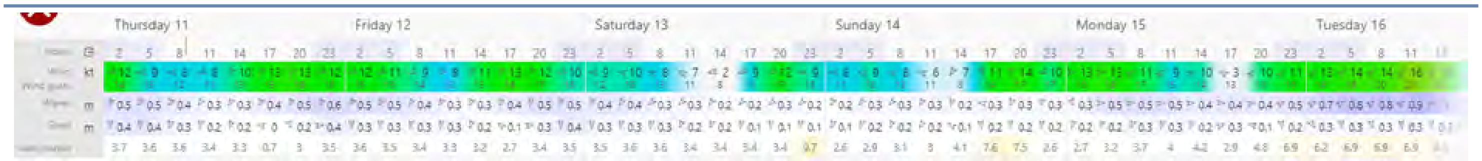
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel Alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	3,024.00	L

Client Rep Comments

Party Chief Comments

No values added in production summary as vessel is on down time

Fugro Representative

Roger Pewsey
Party Chief

12/08/2022

Client Representative

11/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	41	**Date:**	12/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	1
Toolbox Talk	0	/	113
Daily Meeting	1	/	39
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2322
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

No additional comments

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	31:10	3.17%
Port Call - Overnight	11:40	/	488:40	49.66%
Transit	0:00	/	29:32	3.00%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.28%
2.9 UXO with GRAD	0:00	/	13:25	1.36%
Infill - MBES	0:00	/	1:26	0.15%

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.20%
Deployment / Recovery	0:00	/	3:05	0.31%
Recce	0:00	/	2:25	0.25%
Vessel Duties	0:00	/	15:14	1.55%
SVP Dip	0:00	/	3:00	0.30%
Mobilisation Alongside	0:00	/	119:59	12.19%
Mobilisation Calibrations	0:00	/	13:08	1.33%
Mobilisation Transit	0:00	/	3:30	0.36%
WoW - Mobilisation	0:00	/	13:30	1.37%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	0:00	/	162:07	16.48%
Standby Marine Mammal Observance	0:00	/	5:55	0.60%
Standby Marine Traffic	0:00	/	2:25	0.25%
Standby Data QC	0:00	/	5:36	0.57%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	11:40	/	34:40	3.52%
Total	24:00	/	984:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:40	11:40	Downtime Vessel	Replacement winch did not arrive due to incorrect documents from courier. Unable to proceed with installation and ops.
17:40	18:00	00:20	Crew Travel to / from Accommodation	Travel to accomodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	0.0	2.9	km	6.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	22:20	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	45:26	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

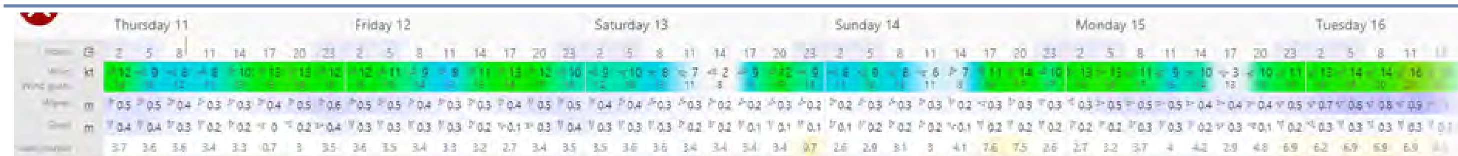
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	3,024.00	L

Client Rep Comments

Party Chief Comments

No values added in production summary due to vessel down time- awaiting delivery of hand winch to replace electric winch for side arm deployment

Fugro Representative

Roger Pewsey
Party Chief
13/08/2022

Client Representative

12/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	42	**Date:**	13/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	1
Toolbox Talk	8	/	121
Daily Meeting	1	/	40
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2394
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Michael Leupen from Total visited vessel prior to sailing to inspect pfaff hand winch. Accepted new installation but asked for roof eye bolt to be replaced as it had no SWL visible on it (lifting gear inspector did previously certify this). Replacement fitted immediately.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:40	/	31:50	3.16%
Port Call - Overnight	12:00	/	500:40	49.67%
Transit	2:42	/	32:14	3.20%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.20%
2.9 UXO with GRAD	5:14	/	18:39	1.85%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - MBES	0:00	/	1:26	0.14%
Infill - SSS	0:00	/	1:59	0.20%
Deployment / Recovery	0:00	/	3:05	0.31%
Recce	0:00	/	2:25	0.24%
Vessel Duties	0:00	/	15:14	1.51%
SVP Dip	0:00	/	3:00	0.30%
Mobilisation Alongside	0:00	/	119:59	11.90%
Mobilisation Calibrations	0:00	/	13:08	1.30%
Mobilisation Transit	0:00	/	3:30	0.35%
WoW - Mobilisation	0:00	/	13:30	1.34%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	0:00	/	162:07	16.08%
Standby Marine Mammal Observance	0:00	/	5:55	0.59%
Standby Marine Traffic	0:00	/	2:25	0.24%
Standby Client	2:44	/	2:44	0.27%
Standby Data QC	0:00	/	5:36	0.56%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	0:40	/	35:20	3.51%
Total	24:00	/	1008:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	06:40	00:40	Downtime Vessel	Installed and tested hand winch
06:40	09:24	02:44	Standby Client	Michael Leupen visited vessel to inspect winch installation.
09:24	10:23	00:59	Transit	Transit to site
10:23	15:37	05:14	2.9 UXO with GRAD	UXO acquisition
15:37	17:20	01:43	Transit	Transit to Scheveningen, vessel housekeeping
17:20	17:40	00:20	Crew Travel to / from Accommodation	Travel to Accomodation
17:40	24:00	06:20	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	6.1	9.0	km	20.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	5:14	27:34	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	5:26	50:52	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

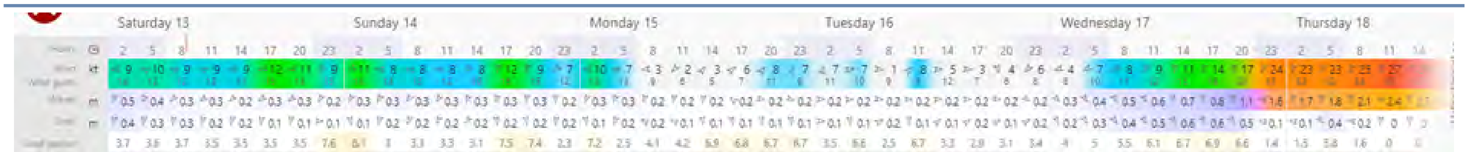
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.3	0.3	0.3	0.3	Conditions good

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	350.00	650.00	3,374.00	L

Client Rep Comments

Party Chief Comments

Mag signal low in E and SE heading. Poss due to currents interfering with miniwing flight. Will make small changes to tow configuration and assess effects.

Fugro Representative

Roger Pewsey
Party Chief

14/08/2022

Client Representative

13/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	43	**Date:**	14/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	0
Vessel Drill - Specify in comments	0	/	9
Cross Department Tour	0	/	5
Audit / Inspection	0	/	1
Toolbox Talk	6	/	127
Daily Meeting	1	/	41
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	5
Total Persons Onboard	6		
Crew Hours	72	/	2466
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:50	/	32:40	3.17%
Port Call - Overnight	12:00	/	512:40	49.68%
Transit	2:57	/	35:11	3.41%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.12%
2.9 UXO with GRAD	8:13	/	26:52	2.60%
Infill - MBES	0:00	/	1:26	0.14%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.19%
Deployment / Recovery	0:00	/	3:05	0.30%
Recce	0:00	/	2:25	0.23%
Vessel Duties	0:00	/	15:14	1.48%
SVP Dip	0:00	/	3:00	0.29%
Mobilisation Alongside	0:00	/	119:59	11.63%
Mobilisation Calibrations	0:00	/	13:08	1.27%
Mobilisation Transit	0:00	/	3:30	0.34%
WoW - Mobilisation	0:00	/	13:30	1.31%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	0:00	/	162:07	15.71%
Standby Marine Mammal Observance	0:00	/	5:55	0.57%
Standby Marine Traffic	0:00	/	2:25	0.23%
Standby Client	0:00	/	2:44	0.26%
Standby Data QC	0:00	/	5:36	0.54%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	0:00	/	35:20	3.42%
Total	24:00	/	1032:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:40	05:40	Port Call - Overnight	Alongside in Scheveningen
05:40	06:00	00:20	Crew Travel to / from Accommodation	Travel to vessel
06:00	07:35	01:35	Transit	Prepared vessel for sailing, admin. Transit to site
07:35	15:48	08:13	2.9 UXO with GRAD	UXO acquisition
15:48	17:10	01:22	Transit	Transit to Scheveningen. Vessel housekeeping and data backup
17:10	17:40	00:30	Crew Travel to / from Accommodation	Travel to accommodation
17:40	24:00	06:20	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	45.1	14.1	23.1	km	51.2%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	8:13	35:47	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	3:47	54:39	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

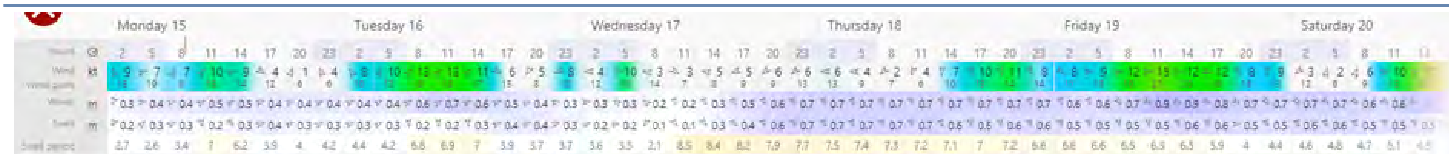
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.3	0.3	0.3	0.3	Conditions good

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	650.00	0.00	250.00	400.00	3,624.00	L

Client Rep Comments

Party Chief Comments

Corrected low mag signal problem by adjusting miniwing flaps. Better flight characteristics and mag signal good in both directions

Fugro Representative

Roger Pewsey
Party Chief

15/08/2022

Client Representative

14/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	44	**Date:**	15/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	1	/	1
Vessel Drill - Specify in comments	1	/	10
Cross Department Tour	1	/	6
Audit / Inspection	0	/	1
Toolbox Talk	1	/	128
Daily Meeting	1	/	42
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2538
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Weekly safety meeting and cross department tour.
Vessel fire drill
1 HOC- crack noticed in A frame face plate. Believed to be cosmetic but Damen engineer to visit vessel to inspect tomorrow.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	33:40	3.19%
Port Call - Overnight	12:00	/	524:40	49.68%
Transit	0:00	/	35:11	3.33%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	3.05%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	26:52	2.54%
Infill - MBES	0:00	/	1:26	0.14%
Infill - SSS	0:00	/	1:59	0.19%
Deployment / Recovery	0:00	/	3:05	0.29%
Recce	0:00	/	2:25	0.23%
Vessel Duties	0:00	/	15:14	1.44%
SVP Dip	0:00	/	3:00	0.28%
Mobilisation Alongside	0:00	/	119:59	11.36%
Mobilisation Calibrations	0:00	/	13:08	1.24%
Mobilisation Transit	0:00	/	3:30	0.33%
WoW - Mobilisation	0:00	/	13:30	1.28%
WoW - At Sea	0:00	/	0:30	0.05%
WoW - Alongside	11:00	/	173:07	16.39%
Standby Marine Mammal Observance	0:00	/	5:55	0.56%
Standby Marine Traffic	0:00	/	2:25	0.23%
Standby Client	0:00	/	2:44	0.26%
Standby Data QC	0:00	/	5:36	0.53%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	0:00	/	35:20	3.35%
Total	24:00	/	1056:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Checkout hotel. Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Sailed to assess conditions, unworkable and forecast worsening. Waited on weather in Scheveningen
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travelled to Accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	23.1	km	39.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	35:47	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	66:39	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

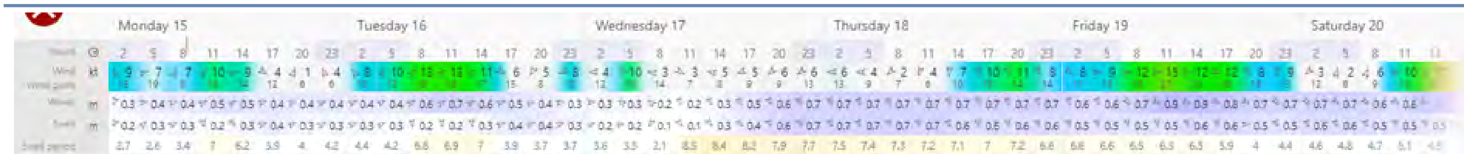
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	2	2	6
Total	6	2	2	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.7	-	-	-	Weather poor outside harbour entrance

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	400.00	600.00	0.00	1,000.00	3,624.00	L

Client Rep Comments

Party Chief Comments

New client rep Lindsay Millington joined vessel.
New UXO expert Henrik Hak joined vessel

Fugro Representative

Roger Pewsey
Party Chief

16/08/2022

Client Representative

15/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	45	**Date:**	16/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	5	/	133
Daily Meeting	1	/	43
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2610
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	34:40	3.21%
Port Call - Overnight	12:00	/	536:40	49.69%
Transit	2:12	/	37:23	3.46%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.98%
2.9 UXO with GRAD	4:15	/	31:07	2.88%
Infill - MBES	0:00	/	1:26	0.13%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.18%
Deployment / Recovery	0:00	/	3:05	0.29%
Recce	0:00	/	2:25	0.22%
Vessel Duties	0:00	/	15:14	1.41%
SVP Dip	0:00	/	3:00	0.28%
Mobilisation Alongside	0:00	/	119:59	11.11%
Mobilisation Calibrations	0:00	/	13:08	1.22%
Mobilisation Transit	0:00	/	3:30	0.32%
WoW - Mobilisation	0:00	/	13:30	1.25%
WoW - At Sea	0:31	/	1:01	0.09%
WoW - Alongside	4:02	/	177:09	16.40%
Standby Marine Mammal Observance	0:00	/	5:55	0.55%
Standby Marine Traffic	0:00	/	2:25	0.22%
Standby Client	0:00	/	2:44	0.25%
Standby Data QC	0:00	/	5:36	0.52%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	0:00	/	35:20	3.27%
Total	24:00	/	1080:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	10:02	04:02	WoW - Alongside	Forecasted conditions poor. Damen engineer visited vessel to inspect crack in a frame face plate. Recommended repair but said no problem with carrying out normal ops.
10:02	11:01	00:59	Transit	Transit to site
11:01	11:32	00:31	WoW - At Sea	Conditions still marginal for deployment. Waited behind breakwater
11:32	15:47	04:15	2.9 UXO with GRAD	Deployed miniwing in shelter behind breakwater. Carried out UXO ops
15:47	17:00	01:13	Transit	Transit to Scheveningen. Vessel housekeeping
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	7.7	30.8	km	53.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	4:15	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	7:45	74:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.6	0.5	0.3	-	Conditions improved throughout the day

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	400.00	600.00	4,024.00	L

Client Rep Comments

Party Chief Comments

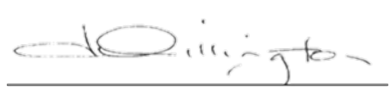
A-Frame OK for use according to Damen engineer but will arrange repair.

Fugro Representative

Roger Pewsey
Party Chief

17/08/2022

Client Representative



16/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	46	**Date:**	17/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	0	/	133
Daily Meeting	1	/	44
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2682
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	35:40	3.23%
Port Call - Overnight	12:00	/	548:40	49.70%
Transit	1:43	/	39:06	3.54%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.92%
2.9 UXO with GRAD	0:00	/	31:07	2.82%
Infill - MBES	0:00	/	1:26	0.13%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.18%
Deployment / Recovery	0:00	/	3:05	0.28%
Recce	0:00	/	2:25	0.22%
Vessel Duties	0:00	/	15:14	1.38%
SVP Dip	0:00	/	3:00	0.27%
Mobilisation Alongside	0:00	/	119:59	10.87%
Mobilisation Calibrations	0:00	/	13:08	1.19%
Mobilisation Transit	0:00	/	3:30	0.32%
WoW - Mobilisation	0:00	/	13:30	1.22%
WoW - At Sea	0:30	/	1:31	0.14%
WoW - Alongside	8:47	/	185:56	16.84%
Standby Marine Mammal Observance	0:00	/	5:55	0.54%
Standby Marine Traffic	0:00	/	2:25	0.22%
Standby Client	0:00	/	2:44	0.25%
Standby Data QC	0:00	/	5:36	0.51%
Standby Other	0:00	/	0:30	0.05%
Downtime Vessel	0:00	/	35:20	3.20%
Total	24:00	/	1104:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	11:30	05:30	WoW - Alongside	Forecast poor in morning. Improved slightly in later. Made decision to assess site condtions
11:30	12:30	01:00	Transit	Transit to site
12:30	13:00	00:30	WoW - At Sea	Conditions on site not suitable for deployment. Line running may have been ok but marginal. Checked conditions behind breakwater- upper limit for deployment and forecast wave height increasing.
13:00	13:43	00:43	Transit	Transit to Scheveningen
13:43	17:00	03:17	WoW - Alongside	Alongside in Scheveningen
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	30.8	km	53.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	86:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

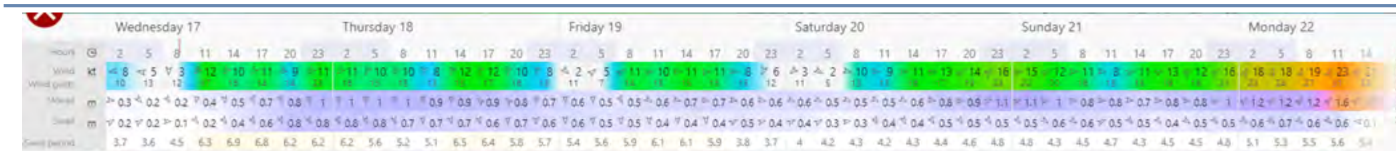
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	1	1	6
Total	6	1	1	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	0.6	-	-	Rapidly changing forecasts

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	600.00	0.00	150.00	450.00	4,174.00	L

Client Rep Comments

Party Chief Comments

A frame welding postponed to free up tomorrow if forecast improves

Bogdan Hrusov replaced Mark Shelley as skipper.

Fugro Representative

Roger Pewsey
Party Chief

18/08/2022

Client Representative

17/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	47	**Date:**	18/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	1	/	134
Daily Meeting	1	/	45
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2754
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	0
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	36:40	3.25%
Port Call - Overnight	12:00	/	560:40	49.70%
Transit	0:00	/	39:06	3.47%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.86%
2.9 UXO with GRAD	0:00	/	31:07	2.76%
Infill - MBES	0:00	/	1:26	0.13%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.18%
Deployment / Recovery	0:00	/	3:05	0.27%
Recce	0:00	/	2:25	0.21%
Vessel Duties	0:00	/	15:14	1.35%
SVP Dip	0:00	/	3:00	0.27%
Mobilisation Alongside	0:00	/	119:59	10.64%
Mobilisation Calibrations	0:00	/	13:08	1.16%
Mobilisation Transit	0:00	/	3:30	0.31%
WoW - Mobilisation	0:00	/	13:30	1.20%
WoW - At Sea	0:00	/	1:31	0.13%
WoW - Alongside	11:00	/	196:56	17.46%
Standby Marine Mammal Observance	0:00	/	5:55	0.52%
Standby Marine Traffic	0:00	/	2:25	0.21%
Standby Client	0:00	/	2:44	0.24%
Standby Data QC	0:00	/	5:36	0.50%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	35:20	3.13%
Total	24:00	/	1128:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:00	17:00	11:00	WoW - Alongside	Alongside in Scheveningen. Bunkered. Crew general duties and admin
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel to accomodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	30.8	km	53.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	98:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

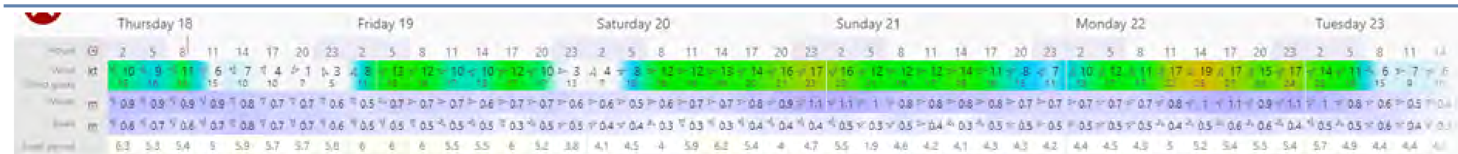
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	-	-	-	-	Vessel alongside

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	450.00	550.00	-550.00	1,550.00	3,624.00	L

Client Rep Comments

Party Chief Comments

No Additional comments

Fugro Representative

Roger Pewsey
Party Chief

19/08/2022

Client Representative

18/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	48	**Date:**	19/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	6	/	140
Daily Meeting	1	/	46
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2826
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	1	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 permit to work for hot work - welding on Vessel A-frame.

6 TBT
0 HOCs
0 Incidents and near misses.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	37:40	3.27%
Port Call - Overnight	11:50	/	572:30	49.70%
Transit	2:06	/	41:12	3.58%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.80%
2.9 UXO with GRAD	5:21	/	36:28	3.17%
Infill - MBES	0:00	/	1:26	0.12%
Infill - SSS	0:00	/	1:59	0.17%
Deployment / Recovery	0:21	/	3:26	0.30%
Recce	0:00	/	2:25	0.21%
Vessel Duties	0:00	/	15:14	1.32%
SVP Dip	0:00	/	3:00	0.26%
Mobilisation Alongside	0:00	/	119:59	10.42%
Mobilisation Calibrations	0:00	/	13:08	1.14%
Mobilisation Transit	0:00	/	3:30	0.30%
WoW - Mobilisation	0:00	/	13:30	1.17%
WoW - At Sea	0:00	/	1:31	0.13%
WoW - Alongside	0:00	/	196:56	17.09%
Standby Marine Mammal Observance	0:00	/	5:55	0.51%
Standby Marine Traffic	0:00	/	2:25	0.21%
Standby Client	0:00	/	2:44	0.24%
Standby Data QC	0:00	/	5:36	0.49%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	3:22	/	38:42	3.36%
Total	24:00	/	1152:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:30	09:52	03:22	Downtime Vessel	Welding alongside on Aframe PtW raised
09:52	10:48	00:56	Transit	Transit to site
10:48	11:09	00:21	Deployment / Recovery	Arrived on site, TBT SVP, Miniwing
11:09	16:30	05:21	2.9 UXO with GRAD	Acquisition
16:30	17:40	01:10	Transit	Finished work TBT Recovery transit to port.
17:40	18:10	00:30	Crew Travel to / from Accommodation	Travel to accommodation
18:10	24:00	05:50	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	9.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	5:21	45:23	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	2:57	101:21	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

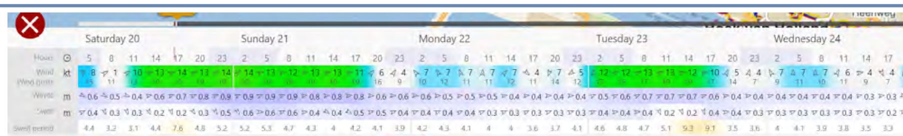
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,550.00	0.00	900.00	650.00	4,524.00	L

Client Rep Comments

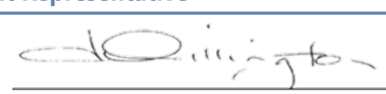
Party Chief Comments

Conducted A-frame repairs and hot work permit to work raised.
Conducted acquisition of survey lines with Miniwing.
UPS system failure, spare requested.

Fugro Representative

Roger Pewsey
Party Chief
20/08/2022

Client Representative



null
null
20/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	48	**Date:**	19/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	6	/	140
Daily Meeting	1	/	46
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	6		
Crew Hours	72	/	2826
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	1	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 permit to work for hot work - welding on Vessel A-frame.

6 TBT
0 HOCs
0 Incidents and near misses.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	37:40	3.27%
Port Call - Overnight	11:50	/	572:30	49.70%
Transit	2:06	/	41:12	3.58%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.80%
2.9 UXO with GRAD	5:21	/	36:28	3.17%
Infill - MBES	0:00	/	1:26	0.12%
Infill - SSS	0:00	/	1:59	0.17%
Deployment / Recovery	0:21	/	3:26	0.30%
Recce	0:00	/	2:25	0.21%
Vessel Duties	0:00	/	15:14	1.32%
SVP Dip	0:00	/	3:00	0.26%
Mobilisation Alongside	0:00	/	119:59	10.42%
Mobilisation Calibrations	0:00	/	13:08	1.14%
Mobilisation Transit	0:00	/	3:30	0.30%
WoW - Mobilisation	0:00	/	13:30	1.17%
WoW - At Sea	0:00	/	1:31	0.13%
WoW - Alongside	0:00	/	196:56	17.09%
Standby Marine Mammal Observance	0:00	/	5:55	0.51%
Standby Marine Traffic	0:00	/	2:25	0.21%
Standby Client	0:00	/	2:44	0.24%
Standby Data QC	0:00	/	5:36	0.49%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	3:22	/	38:42	3.36%
Total	24:00	/	1152:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel to vessel
06:30	09:52	03:22	Downtime Vessel	Welding alongside on Aframe PtW raised
09:52	10:48	00:56	Transit	Transit to site
10:48	11:09	00:21	Deployment / Recovery	Arrived on site, TBT SVP, Miniwing
11:09	16:30	05:21	2.9 UXO with GRAD	Acquisition
16:30	17:40	01:10	Transit	Finished work TBT Recovery transit to port.
17:40	18:10	00:30	Crew Travel to / from Accommodation	Travel to accommodation
18:10	24:00	05:50	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	9.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	98:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

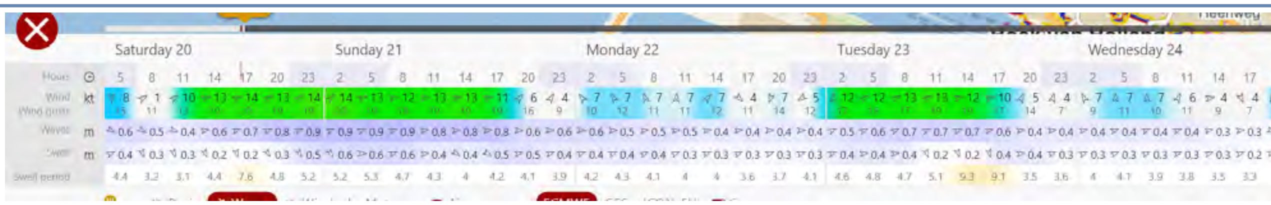
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,550.00	0.00	900.00	650.00	4,524.00	L

Client Rep Comments

Party Chief Comments

Conducted A-frame repairs and hot work permit to work raised.
Conducted acquisition of survey lines with Miniwing.
UPS system failure, spare requested.

Fugro Representative

Roger Pewsey
Party Chief
20/08/2022

Client Representative

null
null
20/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	49	**Date:**	20/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	1
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	6
Audit / Inspection	0	/	1
Toolbox Talk	0	/	140
Daily Meeting	1	/	47
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	6
Total Persons Onboard	7		
Crew Hours	84	/	2910
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Nothing to report

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	38:40	3.29%
Port Call - Overnight	12:30	/	585:00	49.74%
Transit	0:00	/	41:12	3.50%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.74%
2.9 UXO with GRAD	0:00	/	36:28	3.10%
Infill - MBES	0:00	/	1:26	0.12%

Summary of Activities

Activity	Today	/	To Date	Progress
Infill - SSS	0:00	/	1:59	0.17%
Deployment / Recovery	0:00	/	3:26	0.29%
Recce	0:00	/	2:25	0.21%
Vessel Duties	0:00	/	15:14	1.30%
SVP Dip	0:00	/	3:00	0.26%
Mobilisation Alongside	0:00	/	119:59	10.20%
Mobilisation Calibrations	0:00	/	13:08	1.12%
Mobilisation Transit	0:00	/	3:30	0.30%
WoW - Mobilisation	0:00	/	13:30	1.15%
WoW - At Sea	0:00	/	1:31	0.13%
WoW - Alongside	0:00	/	196:56	16.75%
Standby Marine Mammal Observance	0:00	/	5:55	0.50%
Standby Marine Traffic	0:00	/	2:25	0.21%
Standby Client	0:00	/	2:44	0.23%
Standby Data QC	0:00	/	5:36	0.48%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	10:30	/	49:12	4.18%
Total	24:00	/	1176:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	17:30	10:30	Downtime Vessel	Breakdown due to multiple UPS failures. The Marina power is outputting 245v may have caused a problem. Chasing spare UPS units and electrician to be confirmed.
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	98:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	1	1	6
Total	6	1	1	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

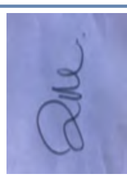
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	650.00	0.00	0.00	650.00	4,524.00	L

Client Rep Comments

Party Chief Comments

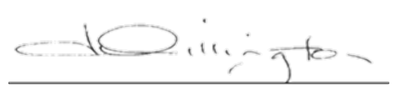
Issue with second UPS failure in two days. No spare UPS available so sourcing a spare over the weekend.
Sourced two UPS units from GeoMarine however require retermination and cable reruns to install.
Liaising with the agent to source an electrician.
PC handover started Roger Pewsey to Reuben Mace. Roger Pewsey left the vessel.

Fugro Representative



Reuben Mace
Party Chief
21/08/2022

Client Representative



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21/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	50	**Date:**	21/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	2	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	1	/	7
Audit / Inspection	0	/	1
Toolbox Talk	0	/	140
Daily Meeting	1	/	48
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	7
Total Persons Onboard	6		
Crew Hours	72	/	2982
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Held safety meeting 2 HOCs raised: bolts for centre winch don't have markers on them (markers applied and hoc closed). Double pulley blocks for the side arm to prevent cross loading of the davit pin (under discussion double pulley blocks might improve setup).

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	39:40	3.31%
Port Call - Overnight	12:00	/	597:00	49.75%
Transit	0:00	/	41:12	3.43%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.69%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	36:28	3.04%
Infill - MBES	0:00	/	1:26	0.12%
Infill - SSS	0:00	/	1:59	0.17%
Deployment / Recovery	0:00	/	3:26	0.29%
Recce	0:00	/	2:25	0.20%
Vessel Duties	0:00	/	15:14	1.27%
SVP Dip	0:00	/	3:00	0.25%
Mobilisation Alongside	0:00	/	119:59	10.00%
Mobilisation Calibrations	0:00	/	13:08	1.09%
Mobilisation Transit	0:00	/	3:30	0.29%
WoW - Mobilisation	0:00	/	13:30	1.13%
WoW - At Sea	0:00	/	1:31	0.13%
WoW - Alongside	0:00	/	196:56	16.41%
Standby Marine Mammal Observance	0:00	/	5:55	0.49%
Standby Marine Traffic	0:00	/	2:25	0.20%
Standby Client	0:00	/	2:44	0.23%
Standby Data QC	0:00	/	5:36	0.47%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	11:00	/	60:12	5.02%
Total	24:00	/	1200:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Port call Scheveningen
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	18:00	11:00	Downtime Vessel	Downtime UPS failure, chasing electrician for fault finding, finding replacement UPS as the GeoMarine UPS are not useable due to too much current being drawn for the breakers onboard the vessel.
18:00	18:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:30	24:00	05:30	Port Call - Overnight	Overnight in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	40:02	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	98:24	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

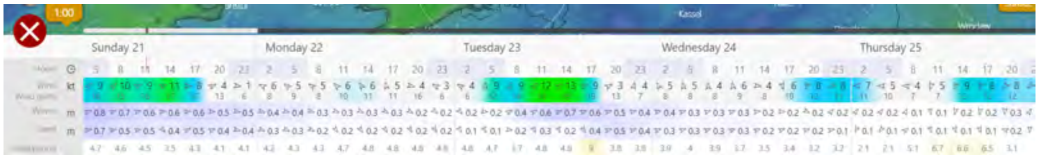
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

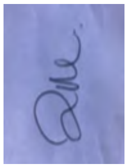
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	650.00	0.00	0.00	650.00	4,524.00	L

Client Rep Comments

Party Chief Comments

- Installed and tested GeoMarine UPS systems however current draw was too high for the vessel circuit breakers.
- Spent the day on downtime due to UPS failure, chasing UPS systems available from other sources.
- Conducted safety Sunday cross departmental tour. 2 HOCs.- Suggestion: winch bed bolt marker applied to centre winch, Suggestion: single pulley blocks on Side arm Davit were requested to be changed by engineer to double blocks.
- Talk on manual handling.
- Vessel drill for MoB.
- Demob GeoMarine UPS systems complete.

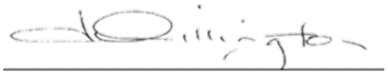
Fugro Representative



Reuben Mace
Party Chief

21/08/2022

Client Representative



21/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	51	**Date:**	22/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	2	/	142
Daily Meeting	1	/	49
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3054
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

2 TBT
0 HOCS
0 Accidents or near misses

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	40:40	3.32%
Port Call - Overnight	13:00	/	610:00	49.84%
Transit	0:00	/	41:12	3.37%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.63%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	36:28	2.98%
Infill - MBES	0:00	/	1:26	0.12%
Infill - SSS	0:00	/	1:59	0.16%
Deployment / Recovery	0:00	/	3:26	0.28%
Recce	0:00	/	2:25	0.20%
Vessel Duties	0:00	/	15:14	1.24%
SVP Dip	0:00	/	3:00	0.25%
Mobilisation Alongside	0:00	/	119:59	9.80%
Mobilisation Calibrations	0:00	/	13:08	1.07%
Mobilisation Transit	0:00	/	3:30	0.29%
WoW - Mobilisation	0:00	/	13:30	1.10%
WoW - At Sea	0:00	/	1:31	0.12%
WoW - Alongside	0:00	/	196:56	16.09%
Standby Marine Mammal Observance	0:00	/	5:55	0.48%
Standby Marine Traffic	0:00	/	2:25	0.20%
Standby Client	0:00	/	2:44	0.22%
Standby Data QC	0:00	/	5:36	0.46%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	10:00	/	70:12	5.74%
Total	24:00	/	1224:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	17:00	10:00	Downtime Vessel	Alongside in Scheveningen trouble shooting UPS, mobbed 3 UPS at 1500Va arriving from Fugro NL. We found 2 of the units were faulty, new UPS units have been ordered to replace the ones we have estimated delivery time 2-3 working days.
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	45:23	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	101:21	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

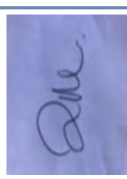
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	700.00	0.00	0.00	700.00	4,474.00	L

Client Rep Comments

Party Chief Comments

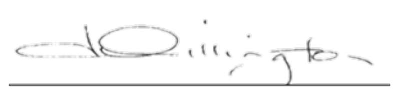
Arrived on vessel and continue to troubleshoot alongside.
2 1500va UPS delivered from Fugro NL in the morning - 1 working providing half the capacity required, 1 appears faulty points to an electrical issue.
This faulty UPS was replaced by Fugro NL however the replacement is not functioning correctly with batteries dissipating faster than it is charging. It has been removed and tested in the netherlands office and found to be functioning correctly. Again indicating that the issue could be vessel power related.
Chased agent for an electrician and Fugro NL for electrical technical support.
Test deployment was conducted in the afternoon to use grab and go hooks for deployment of the mini-wing, went smoothly and is a safer solution.

Fugro Representative



Reuben Mace
Party Chief
23/08/2022

Client Representative



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23/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	52	**Date:**	23/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	4
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	6	/	148
Daily Meeting	1	/	50
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3126
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

6 TBT
0 HOCs
0 Incidents and near misses

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:25	/	42:05	3.37%
Port Call - Overnight	12:45	/	622:45	49.90%
Transit	0:00	/	41:12	3.30%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.58%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	36:28	2.92%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.16%
Deployment / Recovery	0:00	/	3:26	0.28%
Recce	0:00	/	2:25	0.19%
Vessel Duties	0:00	/	15:14	1.22%
SVP Dip	0:00	/	3:00	0.24%
Mobilisation Alongside	0:00	/	119:59	9.61%
Mobilisation Calibrations	0:00	/	13:08	1.05%
Mobilisation Transit	0:00	/	3:30	0.28%
WoW - Mobilisation	0:00	/	13:30	1.08%
WoW - At Sea	0:00	/	1:31	0.12%
WoW - Alongside	0:00	/	196:56	15.78%
Standby Marine Mammal Observance	0:00	/	5:55	0.47%
Standby Marine Traffic	0:00	/	2:25	0.19%
Standby Client	0:00	/	2:44	0.22%
Standby Data QC	0:00	/	5:36	0.45%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	9:50	/	80:02	6.41%
Total	24:00	/	1248:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen
06:30	07:10	00:40	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:10	11:20	04:10	Downtime Vessel	Troubleshooting with electrical engineer from NL. Tested the electrics for whole vessel a few recommendations but no certain failure cause found.
11:20	12:15	00:55	Downtime Vessel	Transit to site
12:15	12:45	00:30	Downtime Vessel	TBT and depoyment of SVP, Miniwing and usbl side pole
12:45	13:00	00:15	Downtime Vessel	Troubleshooting UPS failure on approach to line. powered down equipment.
13:00	13:30	00:30	Downtime Vessel	TBT, Recovery of all equipment.
13:30	14:20	00:50	Downtime Vessel	Alongside in Scheveningen
14:20	17:00	02:40	Downtime Vessel	Troubleshooting alongside, replacing vessel batteries
17:00	17:45	00:45	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:45	24:00	06:15	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	45:23	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	101:21	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	0	270	0	0	
Wind Speed	Knots	0	12	0	0	
Sig Wave	m	0	0.4	0	0	

Weather Forecast

Liquids Status

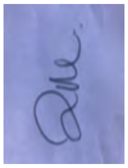
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	700.00	0.00	150.00	550.00	4,624.00	L

Client Rep Comments

Party Chief Comments

- Alongside in the morning.
- We had an electrical engineer, Remco, come onboard the vessel from Fugro Netherlands. He tested all the electrical circuits on the vessel. He recommended swapping out a console switch that isn't functioning correctly, in addition to replacing the ships batteries, and charger. No fault found with the inputs and outputs of the UPS.
- Sailed to site to work deployed the equipment to find that the unreliable UPS was switching to batteries and draining rapidly during operations with the equipment in the water. Failure started being apparent when the winch was under operation as this was having a large effect on generator voltages swinging between 205v-240v. One UPS was capable of holding its charge as expected which indicates the faulty UPS isn't capable of handling the power fluxes and doesn't have online capability. This intermittent fault was not displaying on the quayside as we were not operating the winch. The faulty UPS needs swapping out when the new ones arrive.
- we recovered the equipment and sailed back to Scheveningen, still unable to run lines as can not operate winch and PCs simultaneously.
- Contacted the local electrician to arrange for installation of equipment. Company short staffed so unlikely will be able to come to the boat on 24th.
- Ships battery's replaced and test report completed on faulty battery's.

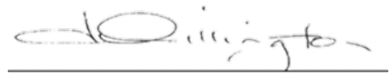
Fugro Representative



Reuben Mace
Party Chief

23/08/2022

Client Representative



23/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	53	**Date:**	24/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	5
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	3	/	151
Daily Meeting	1	/	51
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	9		
Crew Hours	96	/	3222
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 TBT
1 HOC - Used battery casing cracked
0 Incidents or near misses

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	43:05	3.39%
Port Call - Overnight	10:30	/	633:15	49.78%
Transit	0:00	/	41:12	3.24%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.53%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	36:28	2.87%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.16%
Deployment / Recovery	0:00	/	3:26	0.27%
Recce	0:00	/	2:25	0.19%
Vessel Duties	0:00	/	15:14	1.20%
SVP Dip	0:00	/	3:00	0.24%
Mobilisation Alongside	0:00	/	119:59	9.43%
Mobilisation Calibrations	0:00	/	13:08	1.03%
Mobilisation Transit	0:00	/	3:30	0.28%
WoW - Mobilisation	0:00	/	13:30	1.06%
WoW - At Sea	0:00	/	1:31	0.12%
WoW - Alongside	0:00	/	196:56	15.48%
Standby Marine Mammal Observance	0:00	/	5:55	0.47%
Standby Marine Traffic	0:00	/	2:25	0.19%
Standby Client	0:00	/	2:44	0.21%
Standby Data QC	0:00	/	5:36	0.44%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	12:30	/	92:32	7.27%
Total	24:00	/	1272:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	19:30	12:30	Downtime Vessel	Problem solving UPS, test deployment and UPS stress test, safe disposal of batteries, Electrical engineer testing generator power.
19:30	20:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
20:00	24:00	04:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	39.8	km	68.5%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	
UXO Scouting with GRAD	DR	0:00	0:00	45:23	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	101:21	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	3	3	6
Total	6	3	3	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

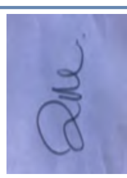
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	550.00	0.00	0.00	550.00	4,624.00	L

Client Rep Comments

Party Chief Comments

- Waiting for UPS to arrive.
- Test deployment for familiarization of the new joiners with the mini wing deployment and recovery.
- Test loading the UPS with the new batteries installed (charger still disconnected).
- ETO from Fugro Pioneer travelled to vessel to double check the winch power. Recommends generator service by the manufacturer.
- Engineer and Skipper/AB handover complete.
- Disposal of broken ships battery in hazardous waste in the port. Including TBT due to crack in casing and removal from port pod. Hoc card for broken battery.

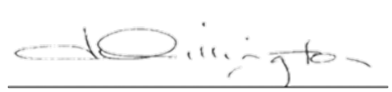
Fugro Representative



Reuben Mace
Party Chief

25/08/2022

Client Representative



24/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

TotalEnergies

Fugro Seeker

Project No.:	197217	**Report No.:**	54	**Date:**	25/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveingen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	5	/	156
Daily Meeting	1	/	52
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3294
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

5 TBT
0 HOCs
0 Incidents/near misses

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:35	/	43:40	3.37%
Port Call - Overnight	12:45	/	646:00	49.85%
Transit	1:45	/	42:57	3.31%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.49%

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	4:51	/	41:19	3.19%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.15%
Deployment / Recovery	0:48	/	4:14	0.33%
Recce	0:00	/	2:25	0.19%
Vessel Duties	0:10	/	15:24	1.19%
SVP Dip	0:00	/	3:00	0.23%
Mobilisation Alongside	0:00	/	119:59	9.26%
Mobilisation Calibrations	0:00	/	13:08	1.01%
Mobilisation Transit	0:00	/	3:30	0.27%
WoW - Mobilisation	0:00	/	13:30	1.04%
WoW - At Sea	0:00	/	1:31	0.12%
WoW - Alongside	0:00	/	196:56	15.20%
Standby Marine Mammal Observance	0:00	/	5:55	0.46%
Standby Marine Traffic	0:16	/	2:41	0.21%
Standby Client	0:00	/	2:44	0.21%
Standby Data QC	0:00	/	5:36	0.43%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	2:50	/	95:22	7.36%
Total	24:00	/	1296:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	08:50	02:50	Downtime Vessel	Electrical engineer onboard to scope the work for the fitting of the new battery charger and the replacement switch. The 3 x 3kva UPS arrived from the UK and are fitted and tested under survey load working correctly vessel ready to sail.
08:50	09:37	00:47	Transit	MMO watch started, TBT for SVP.
09:37	10:00	00:23	Deployment / Recovery	TBT, SVP, Deployment of side arm and Mini Wing.
10:00	11:23	01:23	2.9 UXO with GRAD	Acquisition
11:23	11:37	00:14	Standby Marine Traffic	Waiting for tug vessel Buzzard towing Van Oord Goliath
11:37	14:22	02:45	2.9 UXO with GRAD	Acquisition
14:22	14:24	00:02	Standby Marine Traffic	Standby for vessel Delia
14:24	15:07	00:43	2.9 UXO with GRAD	Acquisition
15:07	15:32	00:25	Deployment / Recovery	TBT, Recovery of equipment
15:32	16:30	00:58	Transit	Transit from site to Scheveningen
16:30	16:40	00:10	Vessel Duties	Tidy up and leave vessel
16:40	17:15	00:35	Crew Travel to / from Accommodation	Travel from vessel to accommodation.
17:15	24:00	06:45	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	8.5	48.3	km	83.1%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	4:53	50:16	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting	DR	0:00	0:16	101:37	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
with GRAD						
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	200	300	0		
Wind Speed	Knots	5	8	12		
Sig Wave	m	0.3	0.4	0.5		

Weather Forecast

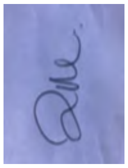
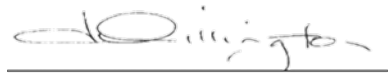
Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	550.00	0.00	278.00	272.00	4,902.00	L

Client Rep Comments

Party Chief Comments

- UPS arrived from the UK, installed successfully, 3.0kva UPS to replace 1.5kva unit that isn't compatible with the vessel power.
- Electrician scoped work for vessel battery charger and he is sourcing change over switch. These items being identified as the potential causing electrical issues on the vessel but also a requirement for replacement as part of vessel maintenance.
- Sailed to site, continued with MiniWing acquisition.

Fugro Representative		Client Representative	
			
Reuben Mace **Party Chief**	**26/08/2022**	**null** **null**	**26/08/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	54	**Date:**	25/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveingen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	5	/	156
Daily Meeting	1	/	52
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3294
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

5 TBT
0 HOCs
0 Incidents/near misses

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:35	/	43:40	3.37%
Port Call - Overnight	12:45	/	646:00	49.85%
Transit	1:45	/	42:57	3.31%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.49%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	4:51	/	41:19	3.19%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.15%
Deployment / Recovery	0:48	/	4:14	0.33%
Recce	0:00	/	2:25	0.19%
Vessel Duties	0:10	/	15:24	1.19%
SVP Dip	0:00	/	3:00	0.23%
Mobilisation Alongside	0:00	/	119:59	9.26%
Mobilisation Calibrations	0:00	/	13:08	1.01%
Mobilisation Transit	0:00	/	3:30	0.27%
WoW - Mobilisation	0:00	/	13:30	1.04%
WoW - At Sea	0:00	/	1:31	0.12%
WoW - Alongside	0:00	/	196:56	15.20%
Standby Marine Mammal Observance	0:00	/	5:55	0.46%
Standby Marine Traffic	0:16	/	2:41	0.21%
Standby Client	0:00	/	2:44	0.21%
Standby Data QC	0:00	/	5:36	0.43%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	2:50	/	95:22	7.36%
Total	24:00	/	1296:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	08:50	02:50	Downtime Vessel	Electrical engineer onboard to scope the work for the fitting of the new battery charger and the replacement switch. The 3 x 3kva UPS arrived from the UK and are fitted and tested under survey load working correctly vessel ready to sail.
08:50	09:37	00:47	Transit	MMO watch started, TBT for SVP.
09:37	10:00	00:23	Deployment / Recovery	TBT, SVP, Deployment of side arm and Mini Wing.
10:00	11:23	01:23	2.9 UXO with GRAD	Acquisition
11:23	11:37	00:14	Standby Marine Traffic	Waiting for tug vessel Buzzard towing Van Oord Goliath
11:37	14:22	02:45	2.9 UXO with GRAD	Acquisition
14:22	14:24	00:02	Standby Marine Traffic	Standby for vessel Delia
14:24	15:07	00:43	2.9 UXO with GRAD	Acquisition
15:07	15:32	00:25	Deployment / Recovery	TBT, Recovery of equipment
15:32	16:30	00:58	Transit	Transit from site to Scheveningen
16:30	16:40	00:10	Vessel Duties	Tidy up and leave vessel
16:40	17:15	00:35	Crew Travel to / from Accommodation	Travel from vessel to accommodation.
17:15	24:00	06:45	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	8.5	48.3	km	83.1%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	4:51	50:14	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting	DR	0:00	2:59	104:20	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
with GRAD						
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	200	300	0		
Wind Speed	Knots	5	8	12		
Sig Wave	m	0.3	0.4	0.5		

Weather Forecast

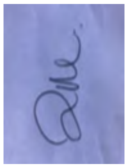
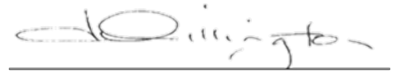
Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	550.00	0.00	278.00	272.00	4,902.00	L

Client Rep Comments

Party Chief Comments

- UPS arrived from the UK, installed successfully, 3.0kva UPS to replace 1.5kva unit that isn't compatible with the vessel power.
- Electrician fitted vessel battery charger and he is sourcing change over switch. These items being identified as the potential causing electrical issues on the vessel but also a requirement for replacement as part of vessel maintenance.
- Sailed to site, continued with MiniWing acquisition.

Fugro Representative		Client Representative	
			
Reuben Mace **Party Chief**	**26/08/2022**	**null** **null**	**26/08/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	55	**Date:**	26/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	0	/	156
Daily Meeting	1	/	53
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3366
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBTs
0 HOCs
0 Incident/Near miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	44:40	3.38%
Port Call - Overnight	12:00	/	658:00	49.85%
Transit	0:00	/	42:57	3.25%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.44%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	41:19	3.13%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.15%
Deployment / Recovery	0:00	/	4:14	0.32%
Recce	0:00	/	2:25	0.18%
Vessel Duties	0:00	/	15:24	1.17%
SVP Dip	0:00	/	3:00	0.23%
Mobilisation Alongside	0:00	/	119:59	9.09%
Mobilisation Calibrations	0:00	/	13:08	0.99%
Mobilisation Transit	0:00	/	3:30	0.27%
WoW - Mobilisation	0:00	/	13:30	1.02%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	11:00	/	207:56	15.75%
Standby Marine Mammal Observance	0:00	/	5:55	0.45%
Standby Marine Traffic	0:00	/	2:41	0.20%
Standby Client	0:00	/	2:44	0.21%
Standby Data QC	0:00	/	5:36	0.42%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	95:22	7.22%
Total	24:00	/	1320:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	07:30	07:30	Port Call - Overnight	Alongside in Scheveningen
07:30	08:00	00:30	Crew Travel to / from Accommodation	Travel accommodation to vessel
08:00	19:00	11:00	WoW - Alongside	Alongside in Scheveningen on weather, vessel duties and survey procedures.
19:00	19:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
19:30	24:00	04:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	48.3	km	83.1%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	50:14	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	116:20	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

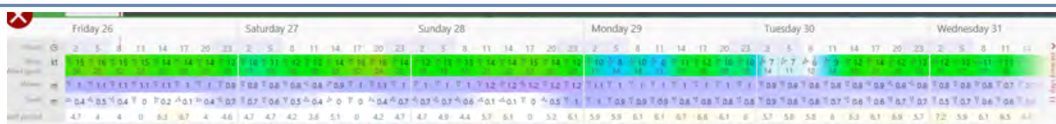
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

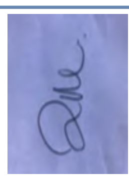
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	272.00	728.00	0.00	1,000.00	4,902.00	L

Client Rep Comments

Party Chief Comments

- WOW
- PMS checks for Eng.
- Catching up on admin and project emails.

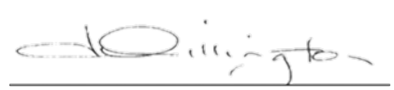
Fugro Representative



Reuben Mace
Party Chief

27/08/2022

Client Representative



26/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	56	**Date:**	27/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	3
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	7
Audit / Inspection	0	/	1
Toolbox Talk	5	/	161
Daily Meeting	1	/	54
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	7
Total Persons Onboard	6		
Crew Hours	72	/	3438
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

5 TBT
3 HOCs - Two for previous UPS failures, one for flat batterie
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	45:40	3.40%
Port Call - Overnight	12:00	/	670:00	49.85%
Transit	1:55	/	44:52	3.34%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.40%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	1:35	/	42:54	3.19%
Infill - MBES	0:00	/	1:26	0.11%
Infill - SSS	0:00	/	1:59	0.15%
Deployment / Recovery	0:50	/	5:04	0.38%
Recce	0:00	/	2:25	0.18%
Vessel Duties	0:10	/	15:34	1.16%
SVP Dip	0:00	/	3:00	0.22%
Mobilisation Alongside	0:00	/	119:59	8.93%
Mobilisation Calibrations	0:00	/	13:08	0.98%
Mobilisation Transit	0:00	/	3:30	0.26%
WoW - Mobilisation	0:00	/	13:30	1.00%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	6:30	/	214:26	15.95%
Standby Marine Mammal Observance	0:00	/	5:55	0.44%
Standby Marine Traffic	0:00	/	2:41	0.20%
Standby Client	0:00	/	2:44	0.20%
Standby Data QC	0:00	/	5:36	0.42%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	95:22	7.10%
Total	24:00	/	1344:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:00	06:10	00:10	Vessel Duties	Morning checks
06:10	07:00	00:50	Transit	Transit from port to site
07:00	07:25	00:25	Deployment / Recovery	TBT, SVP, side arm, MiniWing deployment
07:25	09:00	01:35	2.9 UXO with GRAD	Acquisition, weather marginal.
09:00	09:25	00:25	Deployment / Recovery	Recovery of equipment due to deteriorating weather.
09:25	10:30	01:05	Transit	Transit back, rough conditions.
10:30	17:00	06:30	WoW - Alongside	Admin tasks and waiting on weather alongside
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	2.5	50.8	km	87.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	1:35	51:49	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	10:25	126:45	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

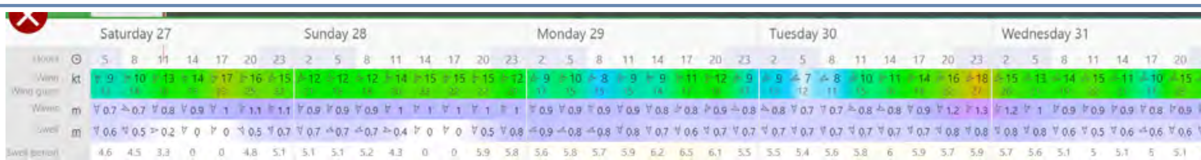
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	8	13	17		
Wind Direction	Coords	0	0	0		
Sig Wave	m	0.7	0.8	1		

Weather Forecast



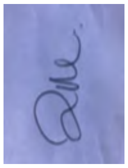
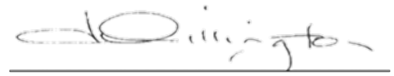
Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	250.00	750.00	5,152.00	L

Client Rep Comments

Party Chief Comments

Weather forecast improved overnight headed out to site first thing and collected 9 lines.
WOW in afternoon.
HOC cards entered into impact retrospectively for equipment failures earlier in the week.

Fugro Representative		Client Representative
		
Reuben Mace **Party Chief**	**27/08/2022**	**27/08/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	57	**Date:**	28/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	3	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	1	/	8
Audit / Inspection	0	/	1
Toolbox Talk	0	/	161
Daily Meeting	1	/	55
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	8
Total Persons Onboard	6		
Crew Hours	72	/	3510
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 HOCs - Replacement strop for side pole, crack in life buoy casing (cosmetic only), winch cover for hand winch.
0 TBT
0 Incidents/ Near Miss
1 Cross Departmental Tour

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	46:40	3.41%
Port Call - Overnight	12:00	/	682:00	49.85%
Transit	0:00	/	44:52	3.28%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.36%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	42:54	3.14%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.14%
Deployment / Recovery	0:00	/	5:04	0.37%
Recce	0:00	/	2:25	0.18%
Vessel Duties	0:00	/	15:34	1.14%
SVP Dip	0:00	/	3:00	0.22%
Mobilisation Alongside	0:00	/	119:59	8.77%
Mobilisation Calibrations	0:00	/	13:08	0.96%
Mobilisation Transit	0:00	/	3:30	0.26%
WoW - Mobilisation	0:00	/	13:30	0.99%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	11:00	/	225:26	16.48%
Standby Marine Mammal Observance	0:00	/	5:55	0.43%
Standby Marine Traffic	0:00	/	2:41	0.20%
Standby Client	0:00	/	2:44	0.20%
Standby Data QC	0:00	/	5:36	0.41%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	95:22	6.97%
Total	24:00	/	1368:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen.
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	18:00	11:00	WoW - Alongside	Waiting on weather, Safety Sunday focusing on fire, Fire and Abandon ship drill, PMS checks and general maintenance of the vessel.
18:00	18:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:30	24:00	05:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	50.8	km	87.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	51:49	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	138:45	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	13	13	13		
Wind Direction	Coords	0	0	0		
Sig Wave	m	1	1	1		

Weather Forecast

Liquids Status

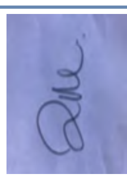
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	5,152.00	L

Client Rep Comments

Party Chief Comments

Waiting on weather,
Safety Sunday focusing on fire,
Fire and Abandon ship drill,
PMS checks and general maintenance of the vessel.

Fugro Representative



Reuben Mace
Party Chief

29/08/2022

Client Representative

null
null

29/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	58	**Date:**	29/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	5	/	166
Daily Meeting	1	/	56
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	3582
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

5 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:15	/	47:55	3.44%
Port Call - Overnight	12:40	/	694:40	49.90%
Transit	1:45	/	46:37	3.35%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.32%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	7:15	/	50:09	3.60%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.14%
Deployment / Recovery	0:40	/	5:44	0.41%
Recce	0:00	/	2:25	0.17%
Vessel Duties	0:25	/	15:59	1.15%
SVP Dip	0:00	/	3:00	0.22%
Mobilisation Alongside	0:00	/	119:59	8.62%
Mobilisation Calibrations	0:00	/	13:08	0.94%
Mobilisation Transit	0:00	/	3:30	0.25%
WoW - Mobilisation	0:00	/	13:30	0.97%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	0:00	/	225:26	16.19%
Standby Marine Mammal Observance	0:00	/	5:55	0.43%
Standby Marine Traffic	0:00	/	2:41	0.19%
Standby Client	0:00	/	2:44	0.20%
Standby Data QC	0:00	/	5:36	0.40%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	95:22	6.85%
Total	24:00	/	1392:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:15	05:15	Port Call - Overnight	Alongside in Scheveningen
05:15	05:50	00:35	Crew Travel to / from Accommodation	Travel from accommodation to vessel
05:50	06:05	00:15	Vessel Duties	Morning checks, mooring operations
06:05	07:00	00:55	Transit	Transit to site
07:00	07:20	00:20	Deployment / Recovery	TBT, Deployment of SVP, USBL pole, MiniWIng,
07:20	14:35	07:15	2.9 UXO with GRAD	Acquisition with MiniWing on the southern end of the block
14:35	14:55	00:20	Deployment / Recovery	TBT, Recovery of MiniWing and Pole
14:55	15:45	00:50	Transit	Transit to Port
15:45	15:55	00:10	Vessel Duties	Mooring and lock up
15:55	16:35	00:40	Crew Travel to / from Accommodation	Travel from vessel to accommodation
16:35	24:00	07:25	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	14.5	65.3	km	112.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	7:15	59:04	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	4:45	143:30	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	45	45	45		
Wind Speed	Knots	5	5	13		
Sig Wave	m	0.8	0.8	0.8		

Weather Forecast

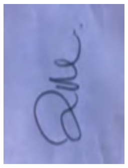
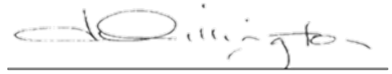
Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	250.00	500.00	5,402.00	L

Client Rep Comments

Party Chief Comments

Went to site early morning.
Swell was high but with little to no wind so was safe to deploy.
Ran lines 54 lines throughout the day, finishing virgin line acquisition.
Waiting on infill plan from the processing team.

Fugro Representative		Client Representative	
			
Reuben Mace Party Chief	29/08/2022		29/08/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	59	**Date:**	30/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	0	/	166
Daily Meeting	1	/	57
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	7		
Crew Hours	84	/	3666
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	48:55	3.45%
Port Call - Overnight	12:00	/	706:40	49.91%
Transit	0:00	/	46:37	3.29%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.28%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	50:09	3.54%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.14%
Deployment / Recovery	0:00	/	5:44	0.40%
Recce	0:00	/	2:25	0.17%
Vessel Duties	0:00	/	15:59	1.13%
SVP Dip	0:00	/	3:00	0.21%
Mobilisation Alongside	0:00	/	119:59	8.47%
Mobilisation Calibrations	0:00	/	13:08	0.93%
Mobilisation Transit	0:00	/	3:30	0.25%
WoW - Mobilisation	0:00	/	13:30	0.95%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	11:00	/	236:26	16.70%
Standby Marine Mammal Observance	0:00	/	5:55	0.42%
Standby Marine Traffic	0:00	/	2:41	0.19%
Standby Client	0:00	/	2:44	0.19%
Standby Data QC	0:00	/	5:36	0.40%
Standby Other	0:00	/	0:30	0.04%
Downtime Vessel	0:00	/	95:22	6.73%
Total	24:00	/	1416:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:30	06:30	Port Call - Overnight	Alongside in Scheveningen
06:30	07:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	18:00	11:00	WoW - Alongside	Waiting on weather alongside in port
18:00	18:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:30	24:00	05:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	65.3	km	112.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopshyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	59:04	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	155:30	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	1	1	6
Total	6	1	1	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	5,402.00	L

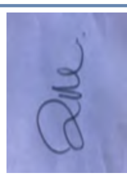
Client Rep Comments

Party Chief Comments

WOW
Planning up coming operations
UXO consultant crew change - Hendrick Hak for Mitchell Zoon

Type text here

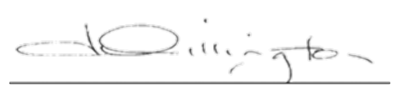
Fugro Representative



Reuben Mace
Party Chief

31/08/2022

Client Representative



30/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	60	**Date:**	31/08/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	0	/	166
Daily Meeting	1	/	58
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	7		
Crew Hours	84	/	3750
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOCs
0 Incidents/ Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:15	/	50:10	3.48%
Port Call - Overnight	12:00	/	718:40	49.91%
Transit	0:00	/	46:37	3.24%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.24%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	50:09	3.48%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.14%
Deployment / Recovery	0:00	/	5:44	0.40%
Recce	0:00	/	2:25	0.17%
Vessel Duties	0:00	/	15:59	1.11%
SVP Dip	0:00	/	3:00	0.21%
Mobilisation Alongside	0:00	/	119:59	8.33%
Mobilisation Calibrations	0:00	/	13:08	0.91%
Mobilisation Transit	0:00	/	3:30	0.24%
WoW - Mobilisation	0:00	/	13:30	0.94%
WoW - At Sea	0:00	/	1:31	0.11%
WoW - Alongside	10:45	/	247:11	17.17%
Standby Marine Mammal Observance	0:00	/	5:55	0.41%
Standby Marine Traffic	0:00	/	2:41	0.19%
Standby Client	0:00	/	2:44	0.19%
Standby Data QC	0:00	/	5:36	0.39%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	95:22	6.62%
Total	24:00	/	1440:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	07:00	01:00	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:00	17:45	10:45	WoW - Alongside	Waiting on weather
17:45	18:00	00:15	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	65.3	km	112.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	59:04	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	167:30	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

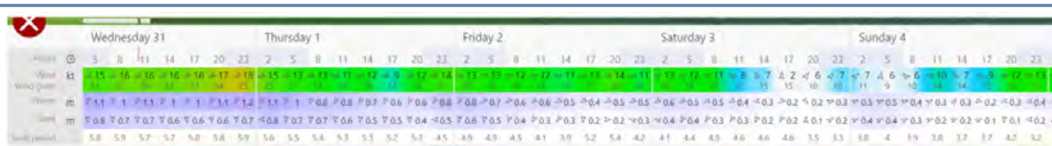
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	1	1	6
Total	6	1	1	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

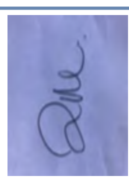
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	500.00	0.00	1,000.00	5,402.00	L

Client Rep Comments

Party Chief Comments

- Waiting on weather alongside in Scheveningen.
- Dropped off spare equipment to Fugro NL office.
- Visited GAC warehouse. Took photos of Fugro and GeoMarine UHRS equipment for mode change due 05/09/2022
- Changed drivers contract for the crew rental vehicle to split driving tasks more effectively.
- Planning meetings for mode change on Monday.
- Moved accommodation from 's-Gravenzande to the Fletcher hotel Scheveningen.
- Skipper crew change, Bogdan handed over to Ted Duff.
- Vessel maintenance tasks weather looking marginal in the morning and workable in the afternoon
- Plan to head to site and collect infills nearest opportunity

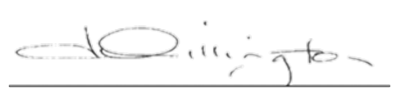
Fugro Representative



Reuben Mace
Party Chief

31/08/2022

Client Representative



31/08/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	61	**Date:**	01/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	1	/	167
Daily Meeting	1	/	59
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	3822
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	6
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOC
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:30	/	50:40	3.46%
Port Call - Overnight	12:30	/	731:10	49.94%
Transit	1:51	/	48:28	3.31%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.20%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	50:09	3.43%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.14%
Deployment / Recovery	0:00	/	5:44	0.39%
Recce	0:00	/	2:25	0.17%
Vessel Duties	0:00	/	15:59	1.09%
SVP Dip	0:00	/	3:00	0.20%
Mobilisation Alongside	0:00	/	119:59	8.20%
Mobilisation Calibrations	0:00	/	13:08	0.90%
Mobilisation Transit	0:00	/	3:30	0.24%
WoW - Mobilisation	0:00	/	13:30	0.92%
WoW - At Sea	4:04	/	5:35	0.38%
WoW - Alongside	5:05	/	252:16	17.23%
Standby Marine Mammal Observance	0:00	/	5:55	0.40%
Standby Marine Traffic	0:00	/	2:41	0.18%
Standby Client	0:00	/	2:44	0.19%
Standby Data QC	0:00	/	5:36	0.38%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	95:22	6.51%
Total	24:00	/	1464:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:45	05:45	Port Call - Overnight	Alongside in Scheveningen
05:45	06:00	00:15	Crew Travel to / from Accommodation	Arrive at vessel
06:00	06:30	00:30	Transit	Transit to site
06:30	10:34	04:04	WoW - At Sea	Swell to much for deployment of the Wing. Wave heights above predicted, 1m at 5seconds, wind speed 14knts. After waiting on site conditions didn't improve so headed back to port.
10:34	11:55	01:21	Transit	Transit back to port
11:55	17:00	05:05	WoW - Alongside	Vessel duties and admin tasks alongside.
17:00	17:15	00:15	Crew Travel to / from Accommodation	Travel from vessel to hotel
17:15	24:00	06:45	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	65.3	km	112.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopshyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	59:04	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	12:00	179:30	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	14	14	14		
Wind Direction	Coords	90	90	90		
Sig Wave	m	1	1	1		

Weather Forecast

Liquids Status

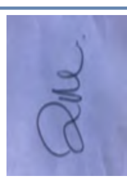
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	250.00	750.00	5,652.00	L

Client Rep Comments

Party Chief Comments

- Headed out to site to look at conditions. WOW at sea
- Returned to port. WOW

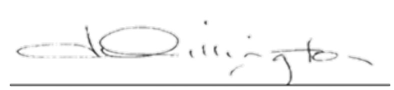
Fugro Representative



Reuben Mace
Party Chief

02/09/2022

Client Representative



01/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	62	**Date:**	02/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	7	/	174
Daily Meeting	1	/	60
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	3894
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	1	/	7
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

7 TBT
0 HOCs
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:45	/	51:25	3.46%
Port Call - Overnight	12:00	/	743:10	49.94%
Transit	2:00	/	50:28	3.39%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.17%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	6:46	/	56:55	3.83%
Infill - MBES	0:00	/	1:26	0.10%
Infill - SSS	0:00	/	1:59	0.13%
Deployment / Recovery	1:54	/	7:38	0.51%
Recce	0:00	/	2:25	0.16%
Vessel Duties	0:25	/	16:24	1.10%
SVP Dip	0:00	/	3:00	0.20%
Mobilisation Alongside	0:00	/	119:59	8.06%
Mobilisation Calibrations	0:00	/	13:08	0.88%
Mobilisation Transit	0:00	/	3:30	0.24%
WoW - Mobilisation	0:00	/	13:30	0.91%
WoW - At Sea	0:00	/	5:35	0.38%
WoW - Alongside	0:00	/	252:16	16.95%
Standby Marine Mammal Observance	0:00	/	5:55	0.40%
Standby Marine Traffic	0:10	/	2:51	0.19%
Standby Client	0:00	/	2:44	0.18%
Standby Data QC	0:00	/	5:36	0.38%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	95:22	6.41%
Total	24:00	/	1488:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:45	05:45	Port Call - Overnight	Alongside in Scheveningen
05:45	06:05	00:20	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:05	07:10	01:05	Transit	Transit from port to site
07:10	08:00	00:50	Deployment / Recovery	TBT, Deployment of SVP, Pole and MiniWing
08:00	08:30	00:30	Deployment / Recovery	TBT, MiniWing recovery to check towing configuration.
08:30	08:40	00:10	Deployment / Recovery	TBT, Deployment of Wing after checking nothing seen.
08:40	08:50	00:10	Standby Marine Traffic	Traffic standby
08:50	15:36	06:46	2.9 UXO with GRAD	Acquisition of MiniWing infills
15:36	16:00	00:24	Deployment / Recovery	TBT, Recovery of pole and MiniWing
16:00	16:55	00:55	Transit	Transit from site to port
16:55	17:20	00:25	Vessel Duties	Vessel duties alongside
17:20	17:45	00:25	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:45	24:00	06:15	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	4.2	69.5	km	119.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	6:46	65:50	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	5:14	184:44	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

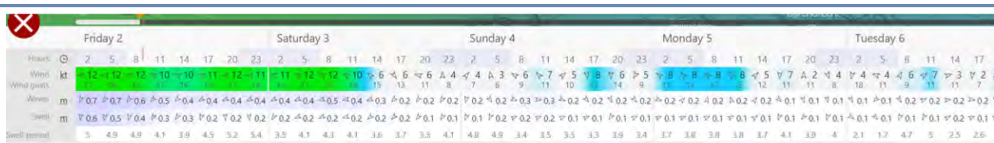
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	13	13	10		
Wind Direction	Coords	90	90	90		
Sig Wave	m	0.5	0.5	0.5		

Weather Forecast



Liquids Status

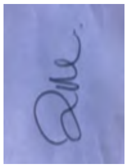
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	250.00	500.00	5,902.00	L

Client Rep Comments

Party Chief Comments

- After vessel induction for new UXO specialist Michael Wind went to site.
- Collected infill lines all day, doubling up many of the lines to ensure coverage.
- Unfortunately feedback from the data processor after operation had finished showed that we have intermittent low field signal, which means some lines were rejected and as a result we don’t yet have complete coverage. Most likely cause is combination of current, vessel speed and towing configuration being favourable in one direction rather than the other.
- 9 infill lines remaining for tomorrow

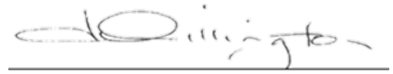
Fugro Representative



Reuben Mace
Party Chief

03/09/2022

Client Representative



02/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	63	**Date:**	03/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	5	/	179
Daily Meeting	1	/	61
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	3966
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	7
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

5 TBT
0 HOCs
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:30	/	51:55	3.43%
Port Call - Overnight	12:00	/	755:10	49.94%
Transit	2:00	/	52:28	3.47%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.13%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	3:39	/	60:34	4.01%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.13%
Deployment / Recovery	0:45	/	8:23	0.55%
Recce	0:00	/	2:25	0.16%
Vessel Duties	1:15	/	17:39	1.17%
SVP Dip	0:00	/	3:00	0.20%
Mobilisation Alongside	0:00	/	119:59	7.94%
Mobilisation Calibrations	0:00	/	13:08	0.87%
Mobilisation Transit	0:00	/	3:30	0.23%
WoW - Mobilisation	0:00	/	13:30	0.89%
WoW - At Sea	0:00	/	5:35	0.37%
WoW - Alongside	0:00	/	252:16	16.68%
Standby Marine Mammal Observance	0:00	/	5:55	0.39%
Standby Marine Traffic	0:00	/	2:51	0.19%
Standby Client	0:00	/	2:44	0.18%
Standby Data QC	3:00	/	8:36	0.57%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:51	/	96:13	6.36%
Total	24:00	/	1512:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:45	05:45	Port Call - Overnight	Alongside in Scheveningen
05:45	06:00	00:15	Crew Travel to / from Accommodation	Travel to vessel from accommodation
06:00	06:45	00:45	Vessel Duties	Morning checks, loading infill plan for days operations.
06:45	07:45	01:00	Transit	Transit from port to work site
07:45	08:15	00:30	Deployment / Recovery	TBT, SVP, Side pole, MiniWing deployment
08:15	09:06	00:51	Downtime Vessel	Autopilot functionality lost, problem with control screen of the AP70MK2 controller. reboot of all SIMRAD systems, after a hard reset the nav string in the unit required reselection.
09:06	11:00	01:54	2.9 UXO with GRAD	Acquisition of infills
11:00	14:00	03:00	Standby Data QC	Waiting for data processing
14:00	15:45	01:45	2.9 UXO with GRAD	Coverage confirmed, collection of low priority infills.
15:45	16:00	00:15	Deployment / Recovery	TBT, Recovery of MiniWing and Pole
16:00	17:00	01:00	Transit	Transit from site to port.
17:00	17:30	00:30	Vessel Duties	Mooring up alongside, data backup
17:30	17:45	00:15	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:45	24:00	06:15	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	1.4	70.9	km	122.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	3:39	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting	DR	0:00	7:30	192:14	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
with GRAD						
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	120	120	120		
Wind Speed	Knots	12	10	10		
Sig Wave	m	0.3	0.3	0.3		

Weather Forecast

Liquids Status

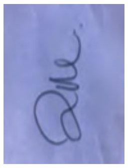
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	250.00	250.00	6,152.00	L

Client Rep Comments

Party Chief Comments

- Went to site early.
- Ran all high priority infills, waited on site for processing and coverage confirmed with the processor.
- Subsequently received low priority infills which were run before leaving site.

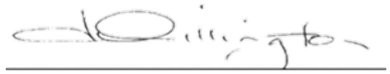
Fugro Representative



Reuben Mace
Party Chief

04/09/2022

Client Representative



03/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	64	**Date:**	04/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	0	/	179
Daily Meeting	1	/	62
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	4038
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	7
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	52:55	3.45%
Port Call - Overnight	12:00	/	767:10	49.95%
Transit	0:00	/	52:28	3.42%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.10%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.94%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.13%
Deployment / Recovery	0:00	/	8:23	0.55%
Recce	0:00	/	2:25	0.16%
Vessel Duties	0:00	/	17:39	1.15%
SVP Dip	0:00	/	3:00	0.20%
Mobilisation Alongside	0:00	/	119:59	7.81%
Mobilisation Calibrations	0:00	/	13:08	0.86%
Mobilisation Transit	0:00	/	3:30	0.23%
Demobilisation Alongside	11:00	/	11:00	0.72%
WoW - Mobilisation	0:00	/	13:30	0.88%
WoW - At Sea	0:00	/	5:35	0.36%
WoW - Alongside	0:00	/	252:16	16.42%
Standby Marine Mammal Observance	0:00	/	5:55	0.39%
Standby Marine Traffic	0:00	/	2:51	0.19%
Standby Client	0:00	/	2:44	0.18%
Standby Data QC	0:00	/	8:36	0.56%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	6.26%
Total	24:00	/	1536:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	Demobilisation Alongside	Demobalisation of the Miniwing and STR winch
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	0.0	N°	0.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

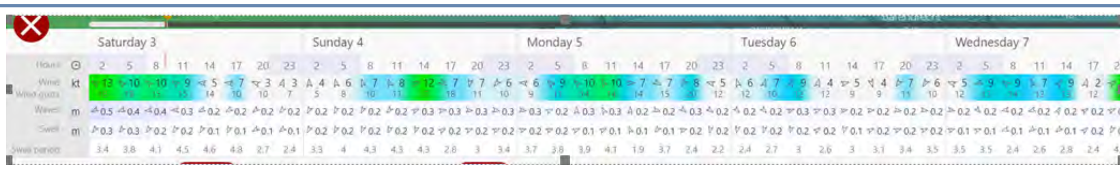
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

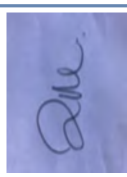
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	250.00	750.00	0.00	1,000.00	6,152.00	L

Client Rep Comments

Party Chief Comments

Bunkering alongside the fuel barge.
Demobilisation tasks alongside eg preparing Miniwing and Winch for lifting, removing DTS and TPU.
Damen sub contractor visited vessel for aft bollard pull test.

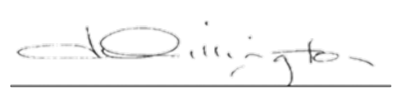
Fugro Representative



Reuben Mace
Party Chief

05/09/2022

Client Representative



04/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	65	**Date:**	05/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	1	/	180
Daily Meeting	1	/	63
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	8
Total Persons Onboard	6		
Crew Hours	72	/	4110
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	7
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
1 TBT
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	53:55	3.46%
Port Call - Overnight	12:00	/	779:10	49.95%
Transit	0:00	/	52:28	3.36%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.07%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.88%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.13%
Deployment / Recovery	0:00	/	8:23	0.54%
Recce	0:00	/	2:25	0.15%
Vessel Duties	0:00	/	17:39	1.13%
SVP Dip	0:00	/	3:00	0.19%
Mobilisation Alongside	11:00	/	130:59	8.40%
Mobilisation Calibrations	0:00	/	13:08	0.84%
Mobilisation Transit	0:00	/	3:30	0.22%
Demobilisation Alongside	0:00	/	11:00	0.71%
WoW - Mobilisation	0:00	/	13:30	0.87%
WoW - At Sea	0:00	/	5:35	0.36%
WoW - Alongside	0:00	/	252:16	16.17%
Standby Marine Mammal Observance	0:00	/	5:55	0.38%
Standby Marine Traffic	0:00	/	2:51	0.18%
Standby Client	0:00	/	2:44	0.18%
Standby Data QC	0:00	/	8:36	0.55%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	6.17%
Total	24:00	/	1560:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Alongside in Scheveningen
04:30	05:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
05:00	16:00	11:00	Mobilisation Alongside	Mobilisation of the UHRS equipment.
16:00	16:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
16:30	24:00	07:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	1.0	1.0	N°	100.0%
1.6 Port call - Geophysical	LS	1.0	0.0	0.0	N°	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.5	0.5	N°	50.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.6a Port call - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.6b - Port call - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

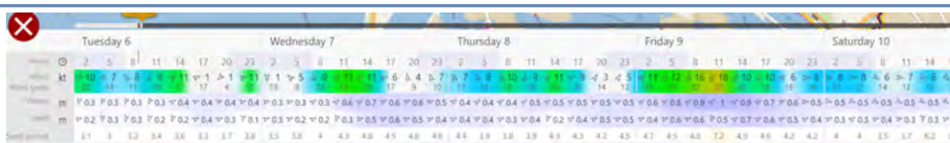
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

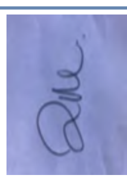
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	6,152.00	L

Client Rep Comments

Party Chief Comments

- Arrival of the crane 0830 at the first harbour Scheveningen.
- Arrival of equipment from GAC at 1130. Delayed delivery of goods from GAC. Complete.
- Lifting MiniWing and STR winch off the vessel, complete.
- Lifting UHRS equipment onboard the vessel, complete.
- GAC to collect remaining equipment for transport to their warehouse, complete.
- Physical installation of the UHRS equipment, complete.
- Interfacing of the UHRS equipment, ongoing.

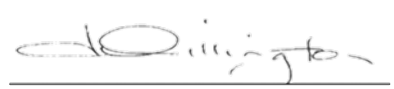
Fugro Representative



Reuben Mace
Party Chief

06/09/2022

Client Representative



05/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	66	**Date:**	06/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	1
Toolbox Talk	2	/	182
Daily Meeting	1	/	64
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	9
Total Persons Onboard	6		
Crew Hours	72	/	4182
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	7
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

2 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	54:55	3.47%
Port Call - Overnight	12:00	/	791:10	49.95%
Transit	0:00	/	52:28	3.31%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.03%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.82%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.13%
Deployment / Recovery	0:00	/	8:23	0.53%
Recce	0:00	/	2:25	0.15%
Vessel Duties	0:00	/	17:39	1.11%
SVP Dip	0:00	/	3:00	0.19%
Mobilisation Alongside	11:00	/	141:59	8.96%
Mobilisation Calibrations	0:00	/	13:08	0.83%
Mobilisation Transit	0:00	/	3:30	0.22%
Demobilisation Alongside	0:00	/	11:00	0.69%
WoW - Mobilisation	0:00	/	13:30	0.85%
WoW - At Sea	0:00	/	5:35	0.35%
WoW - Alongside	0:00	/	252:16	15.93%
Standby Marine Mammal Observance	0:00	/	5:55	0.37%
Standby Marine Traffic	0:00	/	2:51	0.18%
Standby Client	0:00	/	2:44	0.17%
Standby Data QC	0:00	/	8:36	0.54%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	6.07%
Total	24:00	/	1584:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:00	05:00	Port Call - Overnight	Alongside Scheveningen
05:00	05:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
05:30	16:30	11:00	Mobilisation Alongside	UHRS mobilisation
16:30	17:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:00	24:00	07:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.5	N°	50.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

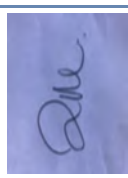
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	6,152.00	L

Client Rep Comments

Party Chief Comments

- Interfacing of the UHRS equipment. Complete.
- Ensure correct setup regarding NG outputs and triggering. Complete.
- Manual test shots (wet) for the Sparker alongside. Complete.
- Streamer function testing. Complete.
- Tidy up and deck fasten remaining UHRS kit. Complete.
- Safety walk around cross departmental tour. Safety focus on high voltage electrical equipment, introduction and roles and responsibilities.

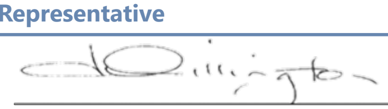
Fugro Representative



Reuben Mace
Party Chief

07/09/2022

Client Representative



06/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	67	**Date:**	07/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	1	/	2
Toolbox Talk	0	/	182
Daily Meeting	1	/	65
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	10
Total Persons Onboard	6		
Crew Hours	72	/	4254
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	1	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

TotalEnergies engineer's vessel inspection during initial geophysical mobilisation added to QHSE statistics.

0 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	55:55	3.48%
Port Call - Overnight	12:00	/	803:10	49.95%
Transit	0:00	/	52:28	3.26%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	2.00%
2.9 UXO with GRAD	0:00	/	60:34	3.77%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.12%
Deployment / Recovery	0:00	/	8:23	0.52%
Recce	0:00	/	2:25	0.15%
Vessel Duties	0:00	/	17:39	1.10%
SVP Dip	0:00	/	3:00	0.19%
Mobilisation Alongside	0:00	/	141:59	8.83%
Mobilisation Calibrations	0:00	/	13:08	0.82%
Mobilisation Transit	0:00	/	3:30	0.22%
Demobilisation Alongside	0:00	/	11:00	0.68%
WoW - Mobilisation	11:00	/	24:30	1.52%
WoW - At Sea	0:00	/	5:35	0.35%
WoW - Alongside	0:00	/	252:16	15.69%
Standby Marine Mammal Observance	0:00	/	5:55	0.37%
Standby Marine Traffic	0:00	/	2:51	0.18%
Standby Client	0:00	/	2:44	0.17%
Standby Data QC	0:00	/	8:36	0.53%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.98%
Total	24:00	/	1608:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Overnight in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	WoW - Mobilisation	Waiting on weather, admin and survey tasks completed during the day as well as handovers and vessel inductions
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Overnight in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	0:00	Hours	0.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	0.5	N°	50.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

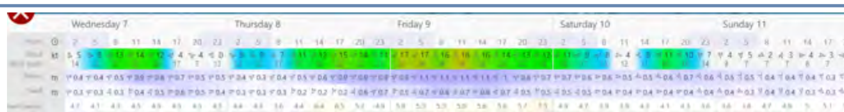
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

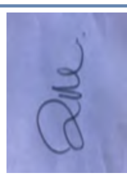
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	0.00	1,000.00	6,152.00	L

Client Rep Comments

Party Chief Comments

WOW
Vessel induction for Gil.
Crew change for skippers Mark Shelly replacing Ted Duff.
Equipment optimisation tasks alongside.

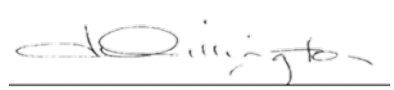
Fugro Representative



Reuben Mace
Party Chief

08/09/2022

Client Representative



07/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	68	**Date:**	08/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	2
Toolbox Talk	3	/	185
Daily Meeting	1	/	66
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	10
Total Persons Onboard	6		
Crew Hours	72	/	4326
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	56:55	3.49%
Port Call - Overnight	12:00	/	815:10	49.95%
Transit	1:55	/	54:23	3.33%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.98%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.71%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.12%
Deployment / Recovery	1:26	/	9:49	0.60%
Recce	0:00	/	2:25	0.15%
Vessel Duties	0:25	/	18:04	1.11%
SVP Dip	0:00	/	3:00	0.18%
Mobilisation Alongside	0:00	/	141:59	8.70%
Mobilisation Calibrations	1:29	/	14:37	0.90%
Mobilisation Transit	0:00	/	3:30	0.21%
Demobilisation Alongside	0:00	/	11:00	0.67%
WoW - Mobilisation	0:00	/	24:30	1.50%
WoW - At Sea	0:00	/	5:35	0.34%
WoW - Alongside	5:15	/	257:31	15.78%
Standby Marine Mammal Observance	0:30	/	6:25	0.39%
Standby Marine Traffic	0:00	/	2:51	0.17%
Standby Client	0:00	/	2:44	0.17%
Standby Data QC	0:00	/	8:36	0.53%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.90%
Total	24:00	/	1632:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:00	04:00	Port Call - Overnight	Alongside in Scheveningen
04:00	04:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
04:30	04:55	00:25	Vessel Duties	Morning checks
04:55	05:52	00:57	Transit	Transit to site
05:52	06:50	00:58	Deployment / Recovery	TBT, SVP, Streamer, Sparker deployment, Start MMO prewatch
06:50	07:20	00:30	Standby Marine Mammal Observance	Marine mammal watch and soft start completed
07:20	08:49	01:29	Mobilisation Calibrations	UHRS working and collecting useable data.
08:49	09:17	00:28	Deployment / Recovery	TBT, Recovery of UHRS
09:17	10:15	00:58	Transit	Transit from site to port
10:15	15:30	05:15	WoW - Alongside	Waiting on weather, QC and data transfer tasks, vessel visitors, GAC logistics picked up items for storage at GAC
15:30	16:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
16:00	24:00	08:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	12:00	Hours	50.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.5	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

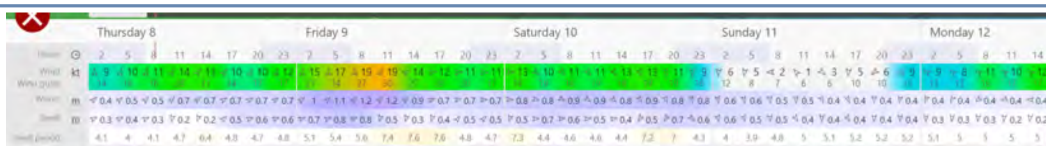
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	0	6
Total	6	0	0	6

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	SW	SW		
Wind Speed	Knots	13	15	15		
Sig Wave	m	0.5	1	1		

Weather Forecast



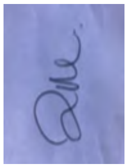
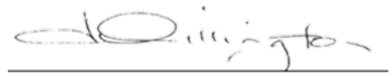
Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	1,000.00	0.00	200.00	800.00	6,352.00	L

Client Rep Comments

Party Chief Comments

Went to site early, started acquisition of UHRS good data verifying the mobilisation.
Weather conditions deteriorating so after test lines were completed recovered UHRS safely and headed to port.
Vessel visit alongside from colleagues from Fugro NL project management, Kasper Speth, David de Jong, Hughes, Chuffart, Hugues.
Admin and processing tasks alongside.

Fugro Representative		Client Representative	
			
Reuben Mace **Party Chief**	**08/09/2022**		**08/09/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	69	**Date:**	09/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	5
HOC - Suggestion	0	/	6
Vessel Drill - Specify in comments	0	/	10
Cross Department Tour	0	/	8
Audit / Inspection	0	/	2
Toolbox Talk	0	/	185
Daily Meeting	1	/	67
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	10
Total Persons Onboard	5		
Crew Hours	60	/	4386
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOCs
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	57:55	3.50%
Port Call - Overnight	12:00	/	827:10	49.95%
Transit	0:00	/	54:23	3.28%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.95%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.66%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.12%
Deployment / Recovery	0:00	/	9:49	0.59%
Recce	0:00	/	2:25	0.15%
Vessel Duties	0:00	/	18:04	1.09%
SVP Dip	0:00	/	3:00	0.18%
Mobilisation Alongside	0:00	/	141:59	8.57%
Mobilisation Calibrations	0:00	/	14:37	0.88%
Mobilisation Transit	0:00	/	3:30	0.21%
Demobilisation Alongside	0:00	/	11:00	0.66%
WoW - Mobilisation	0:00	/	24:30	1.48%
WoW - At Sea	0:00	/	5:35	0.34%
WoW - Alongside	11:00	/	268:31	16.21%
Standby Marine Mammal Observance	0:00	/	6:25	0.39%
Standby Marine Traffic	0:00	/	2:51	0.17%
Standby Client	0:00	/	2:44	0.17%
Standby Data QC	0:00	/	8:36	0.52%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.81%
Total	24:00	/	1656:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	WoW - Alongside	Waiting on weather, sorting out equipment with the agent
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	24:00	Hours	100.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

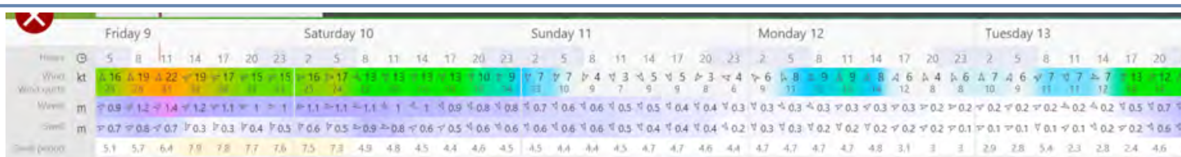
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	6	0	1	5
Total	6	0	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

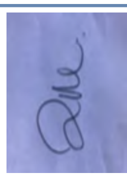
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	0.00	800.00	6,352.00	L

Client Rep Comments

Party Chief Comments

Persons onboard adjusted as Gil will remain as shore based support.
WOW
Vessel duties and equipment logistical tasks

Fugro Representative



Reuben Mace
Party Chief

10/09/2022

Client Representative

09/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	70	**Date:**	10/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	6
HOC - Suggestion	2	/	8
Vessel Drill - Specify in comments	1	/	11
Cross Department Tour	1	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	185
Daily Meeting	1	/	68
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4446
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 HOCs -
- Tugger winch cable to be stowed on A frame to prevent accidental loading,
- House keeping - general state of vessel untidy - tools need to be put away after use etc,
- Cables under survey desk are untidy and care is needed not to damage connectors with feet.

0 TBT
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	58:55	3.51%
Port Call - Overnight	12:00	/	839:10	49.95%

Summary of Activities

Activity	Today	/	To Date	Progress
Transit	0:00	/	54:23	3.24%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.92%
2.9 UXO with GRAD	0:00	/	60:34	3.61%
Infill - MBES	0:00	/	1:26	0.09%
Infill - SSS	0:00	/	1:59	0.12%
Deployment / Recovery	0:00	/	9:49	0.58%
Recce	0:00	/	2:25	0.14%
Vessel Duties	0:00	/	18:04	1.08%
SVP Dip	0:00	/	3:00	0.18%
Mobilisation Alongside	0:00	/	141:59	8.45%
Mobilisation Calibrations	0:00	/	14:37	0.87%
Mobilisation Transit	0:00	/	3:30	0.21%
Demobilisation Alongside	0:00	/	11:00	0.65%
WoW - Mobilisation	0:00	/	24:30	1.46%
WoW - At Sea	0:00	/	5:35	0.33%
WoW - Alongside	11:00	/	279:31	16.64%
Standby Marine Mammal Observance	0:00	/	6:25	0.38%
Standby Marine Traffic	0:00	/	2:51	0.17%
Standby Client	0:00	/	2:44	0.16%
Standby Data QC	0:00	/	8:36	0.51%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.73%
Total	24:00	/	1680:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	07:00	07:00	Port Call - Overnight	Alongside in Scheveningen
07:00	07:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
07:30	18:30	11:00	WoW - Alongside	Waiting on weather, weekly safety meeting, admin tasks
18:30	19:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
19:00	24:00	05:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	0:00	Hours	0.0%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	36:00	Hours	150.0%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

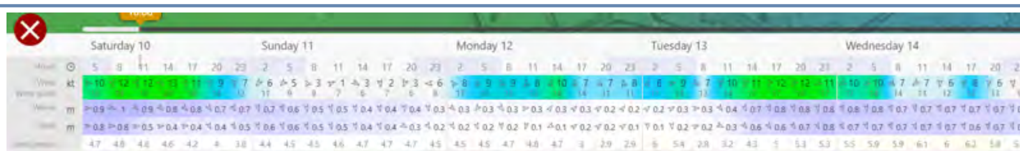
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

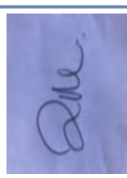
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	0.00	800.00	6,352.00	L

Client Rep Comments

Party Chief Comments

WOW
Admin tasks
Weekly safety meeting focusing on driving
Vessel drill - Medical emergency, use of a defibrillator, ERP, watch keepers inductions
Equipment stock check

Fugro Representative



Reuben Mace
Party Chief

10/09/2022

Client Representative

10/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	71	**Date:**	11/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	6
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	3	/	188
Daily Meeting	1	/	69
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4506
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 TBT
0 HOCs
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	59:55	3.52%
Port Call - Overnight	12:00	/	851:10	49.95%
Transit	1:53	/	56:16	3.30%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.89%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.55%
2.9a UXO with UHRS	6:40	/	6:40	0.39%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.12%
Deployment / Recovery	1:17	/	11:06	0.65%
Recce	0:00	/	2:25	0.14%
Vessel Duties	1:10	/	19:14	1.13%
SVP Dip	0:00	/	3:00	0.18%
Mobilisation Alongside	0:00	/	141:59	8.33%
Mobilisation Calibrations	0:00	/	14:37	0.86%
Mobilisation Transit	0:00	/	3:30	0.21%
Demobilisation Alongside	0:00	/	11:00	0.65%
WoW - Mobilisation	0:00	/	24:30	1.44%
WoW - At Sea	0:00	/	5:35	0.33%
WoW - Alongside	0:00	/	279:31	16.40%
Standby Marine Mammal Observance	0:00	/	6:25	0.38%
Standby Marine Traffic	0:00	/	2:51	0.17%
Standby Client	0:00	/	2:44	0.16%
Standby Data QC	0:00	/	8:36	0.50%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.65%
Total	24:00	/	1704:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside in Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:00	06:25	00:25	Vessel Duties	Morning checks
06:25	07:18	00:53	Transit	Transit from port to site
07:18	08:20	01:02	Deployment / Recovery	MMO watch, TBT, SVP, deployment of the sparker and streamer, soft start
08:20	15:00	06:40	2.9a UXO with UHRS	Acquisition of UHRS mainlines in and around the channel
15:00	15:15	00:15	Deployment / Recovery	TBT, Recovery of the UHRS kit
15:15	16:15	01:00	Transit	Transit from site to port
16:15	17:00	00:45	Vessel Duties	Packing up and data storage
17:00	17:30	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:30	24:00	06:30	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	16.6	16.6	km	33.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Scouting with UHRS	DR	24:00	6:40	6:40	Hours	27.8%
3.5a Sailing and Standby Rate UHRS	DR	24:00	5:20	41:20	Hours	172.2%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	SW	SW		
Wind Speed	Knots	6	7	8		
Sig Wave	m	0.7	0.6	0.5		

Weather Forecast

Liquids Status

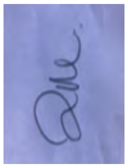
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	800.00	0.00	250.00	550.00	6,602.00	L

Client Rep Comments

Party Chief Comments

Completed lines across the site but mainly W-E lines in the channel.
Running lines in the same direction as the traffic lane orientation in order to mitigate risk and optimise survey efficiency.
Ship wash was causing problems with the UHRS navigation from the buoys of the due to large heave between the A frame and the front pods.
Ship wash was also present throughout the day with data artefacts seen consistently on the streamer as the streamer surfaces.
Feather angle tolerance of 13 degrees sometimes unachievable due to the nature of currents on site and vessel speed is limited in the river.

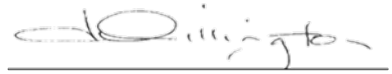
Fugro Representative



Reuben Mace
Party Chief

12/09/2022

Client Representative



11/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	72	**Date:**	12/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	3	/	191
Daily Meeting	1	/	70
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4566
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 HOC
3 TBT
0 Incidents/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	60:55	3.53%
Port Call - Overnight	11:30	/	862:40	49.92%
Transit	1:50	/	58:06	3.36%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.87%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.51%
2.9a UXO with UHRS	7:10	/	13:50	0.80%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:50	/	11:56	0.69%
Recce	0:00	/	2:25	0.14%
Vessel Duties	1:20	/	20:34	1.19%
SVP Dip	0:00	/	3:00	0.17%
Mobilisation Alongside	0:00	/	141:59	8.22%
Mobilisation Calibrations	0:00	/	14:37	0.85%
Mobilisation Transit	0:00	/	3:30	0.20%
Demobilisation Alongside	0:00	/	11:00	0.64%
WoW - Mobilisation	0:00	/	24:30	1.42%
WoW - At Sea	0:00	/	5:35	0.32%
WoW - Alongside	0:00	/	279:31	16.18%
Standby Marine Mammal Observance	0:20	/	6:45	0.39%
Standby Marine Traffic	0:00	/	2:51	0.16%
Standby Client	0:00	/	2:44	0.16%
Standby Data QC	0:00	/	8:36	0.50%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.57%
Total	24:00	/	1728:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:30	04:30	Port Call - Overnight	Alongside in Scheveningen
04:30	05:00	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
05:00	05:30	00:30	Vessel Duties	Morning checks
05:30	06:25	00:55	Transit	Transit from port to site
06:25	07:00	00:35	Deployment / Recovery	MMO, TBT, UHRS deployment,
07:00	07:20	00:20	Standby Marine Mammal Observance	Soft start UHRS
07:20	14:30	07:10	2.9a UXO with UHRS	UHRS acquisition, across whole site
14:30	14:45	00:15	Deployment / Recovery	TBT, Recovery of UHRS
14:45	15:40	00:55	Transit	Transit from site to port
15:40	16:30	00:50	Vessel Duties	Backup and restore of online log, call with PM, admin tasks, locking up
16:30	17:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
17:00	24:00	07:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	24.0	40.6	km	82.7%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	7:10	13:50	Hours	57.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	4:50	46:10	Hours	192.4%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

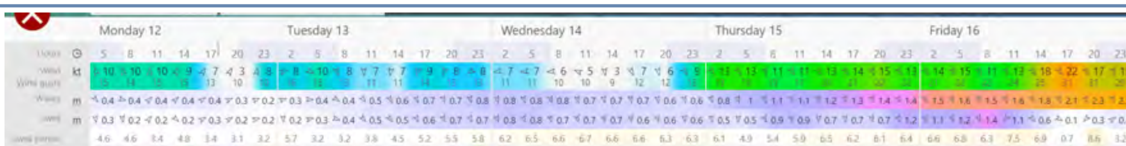
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	8	8	8		
Wind Direction	Coords	S	S	S		
Sig Wave	m	0.2	0.2	0.2		

Weather Forecast



Liquids Status

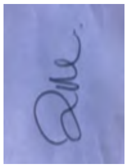
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	550.00	0.00	300.00	250.00	6,902.00	L

Client Rep Comments

Party Chief Comments

- Running lines in the same direction as the traffic lane orientation in order to mitigate risk and optimise survey efficiency.
- Ship wake was causing problems with the UHRS navigation from the buoys of the due to large heave between the A frame and the front pods.
- Ship wake was also present throughout the day, higher than 1.2m at times, with data artefacts seen consistently on the streamer as the streamer surfaces.
- Feather angle tolerance of 13 degrees unachievable due to the nature of currents on site and vessel speed is limited in the river.
- Main VHF coms channel 03 is experiencing interference. Causing increased risk to safety of navigation, channel 16 still working well.
- Experienced 1 PC crash on a line route cause was software Emily2 running on the online PC for UPS monitoring.
- Processing shows 3 reruns and 3 infills on data collected until 12th. There is an artefacts present in the data due to passing vessel noise.

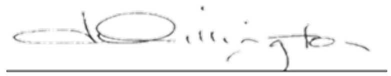
Fugro Representative



Reuben Mace
Party Chief

13/09/2022

Client Representative



12/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	73	**Date:**	13/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	3	/	194
Daily Meeting	0	/	70
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4626
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	0
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

3 TBT
0 HOCs
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:15	/	62:10	3.55%
Port Call - Overnight	12:00	/	874:40	49.92%
Transit	1:55	/	60:01	3.43%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.84%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.46%
2.9a UXO with UHRS	1:19	/	15:09	0.86%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:56	/	12:52	0.73%
Recce	0:00	/	2:25	0.14%
Vessel Duties	1:35	/	22:09	1.26%
SVP Dip	0:00	/	3:00	0.17%
Mobilisation Alongside	0:00	/	141:59	8.10%
Mobilisation Calibrations	0:00	/	14:37	0.83%
Mobilisation Transit	0:00	/	3:30	0.20%
Demobilisation Alongside	0:00	/	11:00	0.63%
WoW - Mobilisation	0:00	/	24:30	1.40%
WoW - At Sea	0:00	/	5:35	0.32%
WoW - Alongside	5:00	/	284:31	16.24%
Standby Marine Mammal Observance	0:00	/	6:45	0.39%
Standby Marine Traffic	0:00	/	2:51	0.16%
Standby Client	0:00	/	2:44	0.16%
Standby Data QC	0:00	/	8:36	0.49%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.49%
Total	24:00	/	1752:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:35	04:35	Port Call - Overnight	Alongside in Scheveningen
04:35	05:15	00:40	Crew Travel to / from Accommodation	Travel from accommodation to vessel
05:15	06:20	01:05	Vessel Duties	Vessel duties, morning checks and admin alongside.
06:20	07:25	01:05	Transit	Transit to site
07:25	08:00	00:35	Deployment / Recovery	MMO, TBT, SVP, Deployment of UHRS
08:00	09:19	01:19	2.9a UXO with UHRS	Working on two lines to the North of the channel
09:19	09:40	00:21	Deployment / Recovery	Wave heights increasing and choppy conditions. TBT, Recovery of UHRS kit
09:40	10:30	00:50	Transit	Transit from site to port
10:30	11:00	00:30	Vessel Duties	Bunkering
11:00	16:00	05:00	WoW - Alongside	Vessel duties alongside
16:00	16:35	00:35	Crew Travel to / from Accommodation	Travel from vessel to accommodation
16:35	24:00	07:25	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	2.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	1:19	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	10:41	56:51	Hours	236.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

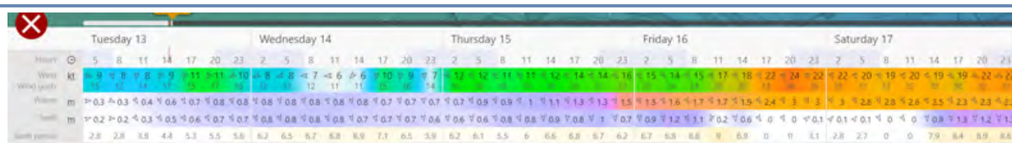
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Speed	Knots	10	10	10		
Wind Direction	Coords	NW	NW	NW		
Sig Wave	m	0.5	0.6	0.7		

Weather Forecast



Liquids Status

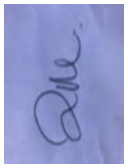
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	250.00	750.00	250.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

- Arrived on site anticipating a full day's work.
- After two lines conditions deteriorated quickly, short swell period, so recovered gear safely and returned to port.
- Main VHF coms channel 03 is experiencing interference. Causing increased risk to safety of navigation, channel 16 still working well.
- Bunkering
- Alongside WOW

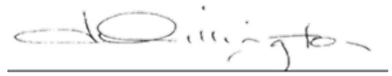
Fugro Representative



Reuben Mace
Party Chief

14/09/2022

Client Representative



13/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	74	**Date:**	14/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	70
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4686
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	1	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 TBT
0 HOCs
0 Incident/Near Miss
1 Review of the UHRS deployment and recovery work instruction

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	63:10	3.56%
Port Call - Overnight	12:00	/	886:40	49.92%
Transit	0:00	/	60:01	3.38%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.81%

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.41%
2.9a UXO with UHRS	0:00	/	15:09	0.85%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.72%
Recce	0:00	/	2:25	0.14%
Vessel Duties	0:00	/	22:09	1.25%
SVP Dip	0:00	/	3:00	0.17%
Mobilisation Alongside	0:00	/	141:59	7.99%
Mobilisation Calibrations	0:00	/	14:37	0.82%
Mobilisation Transit	0:00	/	3:30	0.20%
Demobilisation Alongside	0:00	/	11:00	0.62%
WoW - Mobilisation	0:00	/	24:30	1.38%
WoW - At Sea	0:00	/	5:35	0.31%
WoW - Alongside	11:00	/	295:31	16.64%
Standby Marine Mammal Observance	0:00	/	6:45	0.38%
Standby Marine Traffic	0:00	/	2:51	0.16%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.48%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.42%
Total	24:00	/	1776:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	WoW - Alongside	Administration tasks, vessel tasks, equipment inspection, Work instruction review for deployment and recovery.
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	68:51	Hours	286.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

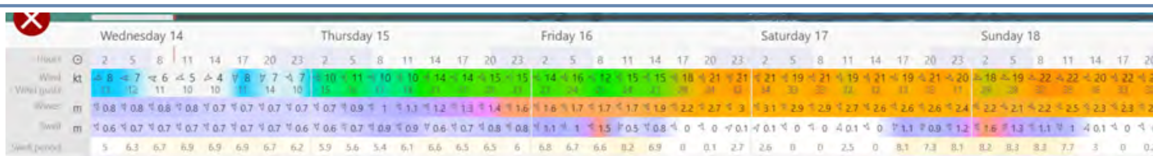
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

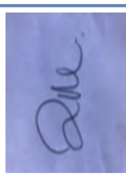
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

WOW alongside

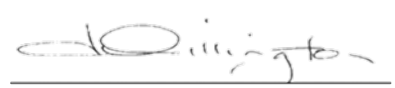
Fugro Representative



Reuben Mace
Party Chief

15/09/2022

Client Representative



14/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	75	**Date:**	15/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	70
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4746
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBT
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	64:10	3.56%
Port Call - Overnight	12:00	/	898:40	49.93%
Transit	0:00	/	60:01	3.33%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.79%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.36%
2.9a UXO with UHRS	0:00	/	15:09	0.84%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.71%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.23%
SVP Dip	0:00	/	3:00	0.17%
Mobilisation Alongside	0:00	/	141:59	7.89%
Mobilisation Calibrations	0:00	/	14:37	0.81%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.61%
WoW - Mobilisation	0:00	/	24:30	1.36%
WoW - At Sea	0:00	/	5:35	0.31%
WoW - Alongside	11:00	/	306:31	17.03%
Standby Marine Mammal Observance	0:00	/	6:45	0.38%
Standby Marine Traffic	0:00	/	2:51	0.16%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.48%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.35%
Total	24:00	/	1800:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Schevengingen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	WoW - Alongside	Admin and logistics tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Schevengingen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	80:51	Hours	336.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

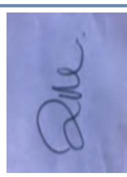
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

WOW
Moving equipment into the rental van to clear space on vessel
Organising logistics for equipment to be shipped to the UK

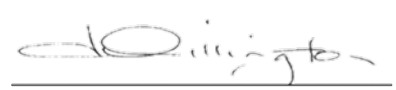
Fugro Representative



Reuben Mace
Party Chief

16/09/2022

Client Representative



15/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	76	**Date:**	16/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	1	/	71
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4806
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBTs
0 Incident/Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	65:10	3.57%
Port Call - Overnight	12:00	/	910:40	49.93%
Transit	0:00	/	60:01	3.29%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.77%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.32%
2.9a UXO with UHRS	0:00	/	15:09	0.83%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.71%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.21%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.78%
Mobilisation Calibrations	0:00	/	14:37	0.80%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.60%
WoW - Mobilisation	0:00	/	24:30	1.34%
WoW - At Sea	0:00	/	5:35	0.31%
WoW - Alongside	11:00	/	317:31	17.41%
Standby Marine Mammal Observance	0:00	/	6:45	0.37%
Standby Marine Traffic	0:00	/	2:51	0.16%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.47%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.28%
Total	24:00	/	1824:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside in Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	Travel from accommodation to vessel
06:30	17:30	11:00	WoW - Alongside	Vessel duties and admin
17:30	18:00	00:30	Crew Travel to / from Accommodation	Travel from vessel to accommodation
18:00	24:00	06:00	Port Call - Overnight	Alongside in Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	92:51	Hours	386.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

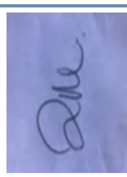
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

WOW

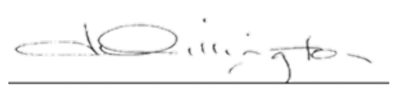
Fugro Representative



Reuben Mace
Party Chief

16/09/2022

Client Representative



16/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

TotalEnergies

Fugro Seeker

Project No.:	197217	**Report No.:**	77	**Date:**	17/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	71
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4866
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBT
0 Incidents/ Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	66:10	3.58%
Port Call - Overnight	12:00	/	922:40	49.93%
Transit	0:00	/	60:01	3.25%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.74%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.28%
2.9a UXO with UHRS	0:00	/	15:09	0.82%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.70%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.20%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.68%
Mobilisation Calibrations	0:00	/	14:37	0.79%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.60%
WoW - Mobilisation	0:00	/	24:30	1.33%
WoW - At Sea	0:00	/	5:35	0.30%
WoW - Alongside	11:00	/	328:31	17.78%
Standby Marine Mammal Observance	0:00	/	6:45	0.37%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.47%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.21%
Total	24:00	/	1848:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	PC Surveyor handover admin tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	104:51	Hours	436.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

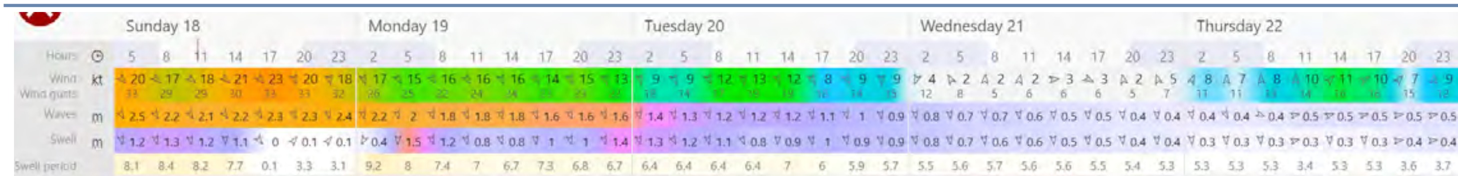
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Sunday 18		5	8	11	14	17	20	23
Wind	kt	20	17	18	21	23	20	18
Wind gusts		33	29	29	30	33	33	32
Waves	m	2.5	2.2	2.1	2.2	2.3	2.3	2.4
Swell	m	1.2	1.3	1.2	1.1	0	0.1	0.1
Swell period		8.1	8.4	8.2	7.7	0.1	3.3	3.1

Monday 19		2	5	8	11	14	17	20	23
Wind	kt	17	15	16	16	16	14	15	13
Wind gusts		26	25	22	24	24	[illegible]	23	22
Waves	m	2.2	2	1.8	1.8	1.8	1.6	1.6	1.6
Swell	m	0.4	1.5	1.2	0.8	0.8	1	1	1.4
Swell period		9.2	8	7.4	7	6.7	7.3	6.8	6.7

Tuesday 20		2	5	8	11	14	17	20	23
Wind	kt	9	9	12	13	12	8	9	9
Wind gusts		18	14	17	19	19	16	14	15
Waves	m	1.4	1.3	1.2	1.2	1.2	1.1	1	0.9
Swell	m	1.3	1.2	1.1	0.8	0.9	1	0.9	0.9
Swell period		6.4	6.4	6.4	6.4	7	6	5.9	5.7

Wednesday 21		2	5	8	11	14	17	20	23
Wind	kt	4	2	2	2	3	3	2	5
Wind gusts		12	8	5	6	6	6	5	7
Waves	m	0.8	0.7	0.7	0.6	0.5	0.5	0.4	0.4
Swell	m	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4
Swell period		5.5	5.6	5.7	5.6	5.6	5.5	5.4	5.3

Thursday 22		2	5	8	11	14	17	20	23
Wind	kt	8	7	8	10	11	10	7	9
Wind gusts		11	11	13	14	16	16	15	12
Waves	m	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
Swell	m	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Swell period		5.3	5.3	5.3	3.4	5.3	5.3	3.6	3.7

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

WoW. PC Surveyor handover and admin tasks.

Vessel not expected to sail tomorrow as poor conditions are forecast.

Fugro Representative

Peter Horobin
Party Chief

18/09/2022

Client Representative

17/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	77	**Date:**	17/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	71
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4866
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBT
0 Incidents/ Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	66:10	3.58%
Port Call - Overnight	12:00	/	922:40	49.93%
Transit	0:00	/	60:01	3.25%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.74%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.28%
2.9a UXO with UHRS	0:00	/	15:09	0.82%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.70%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.20%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.68%
Mobilisation Calibrations	0:00	/	14:37	0.79%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.60%
WoW - Mobilisation	0:00	/	24:30	1.33%
WoW - At Sea	0:00	/	5:35	0.30%
WoW - Alongside	11:00	/	328:31	17.78%
Standby Marine Mammal Observance	0:00	/	6:45	0.37%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.47%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.21%
Total	24:00	/	1848:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	PC Surveyor handover admin tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopshyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	92:51	Hours	386.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

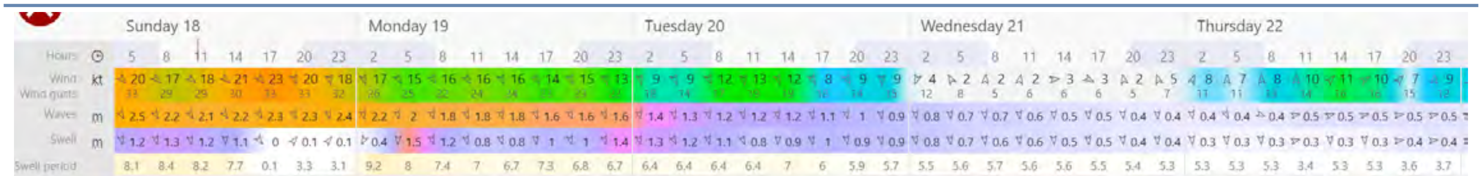
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

WoW. PC Surveyor handover and admin tasks.

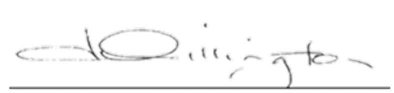
Vessel not expected to sail tomorrow as poor conditions are forecast.

Fugro Representative

Peter Horobin
Party Chief

18/09/2022

Client Representative



17/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	78	**Date:**	18/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	71
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4926
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBT
0 Incidents/ Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	67:10	3.59%
Port Call - Overnight	12:00	/	934:40	49.93%
Transit	0:00	/	60:01	3.21%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.72%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.24%
2.9a UXO with UHRS	0:00	/	15:09	0.81%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.69%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.18%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.58%
Mobilisation Calibrations	0:00	/	14:37	0.78%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.59%
WoW - Mobilisation	0:00	/	24:30	1.31%
WoW - At Sea	0:00	/	5:35	0.30%
WoW - Alongside	11:00	/	339:31	18.14%
Standby Marine Mammal Observance	0:00	/	6:45	0.36%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.46%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.14%
Total	24:00	/	1872:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Admin tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	116:51	Hours	486.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

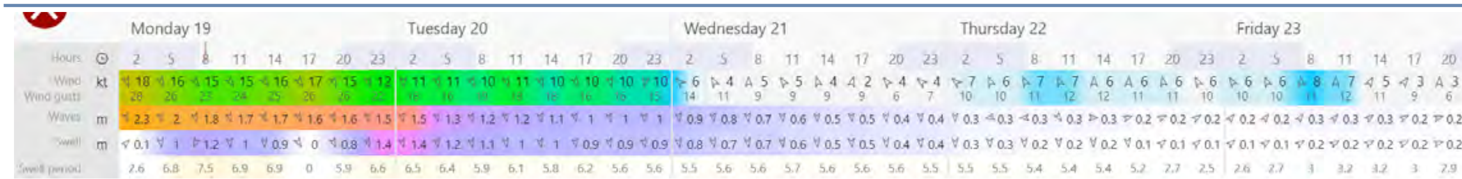
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

Vessel alongside WoW.

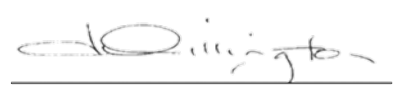
Forecast poor tomorrow, vessel not expected to sail. Weekly safety meeting, vessel drills and weekly safety walkaround to be held.

Fugro Representative

Peter Horobin
Party Chief

19/09/2022

Client Representative



18/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

TotalEnergies

Fugro Seeker

Project No.:	197217	**Report No.:**	78	**Date:**	18/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	11
Cross Department Tour	0	/	9
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	71
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	11
Total Persons Onboard	5		
Crew Hours	60	/	4926
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 HOCs
0 TBT
0 Incidents/ Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	67:10	3.59%
Port Call - Overnight	12:00	/	934:40	49.93%
Transit	0:00	/	60:01	3.21%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.72%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.24%
2.9a UXO with UHRS	0:00	/	15:09	0.81%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.11%
Deployment / Recovery	0:00	/	12:52	0.69%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.18%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.58%
Mobilisation Calibrations	0:00	/	14:37	0.78%
Mobilisation Transit	0:00	/	3:30	0.19%
Demobilisation Alongside	0:00	/	11:00	0.59%
WoW - Mobilisation	0:00	/	24:30	1.31%
WoW - At Sea	0:00	/	5:35	0.30%
WoW - Alongside	11:00	/	339:31	18.14%
Standby Marine Mammal Observance	0:00	/	6:45	0.36%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.15%
Standby Data QC	0:00	/	8:36	0.46%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.14%
Total	24:00	/	1872:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Admin tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	92:51	Hours	386.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

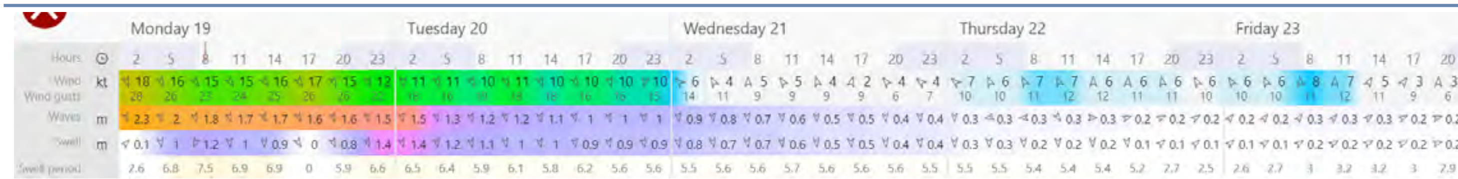
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

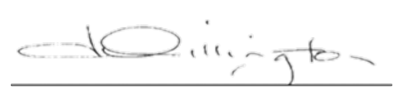
Vessel alongside WoW.

Forecast poor tomorrow, vessel not expected to sail. Weekly safety meeting, vessel drills and weekly safety walkaround to be held.

Fugro Representative

Peter Horobin
Party Chief
19/09/2022

Client Representative



18/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	79	**Date:**	19/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	1	/	12
Cross Department Tour	1	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	1	/	72
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	1	/	12
Total Persons Onboard	5		
Crew Hours	60	/	4986
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

1 x Weekly safety meeting
1 x Weekly safety walkaround
1 x Vessel drill - Fire

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	68:10	3.60%
Port Call - Overnight	12:00	/	946:40	49.93%

Summary of Activities

Activity	Today	/	To Date	Progress
Transit	0:00	/	60:01	3.17%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.70%
2.9 UXO with GRAD	0:00	/	60:34	3.19%
2.9a UXO with UHRS	0:00	/	15:09	0.80%
Infill - MBES	0:00	/	1:26	0.08%
Infill - SSS	0:00	/	1:59	0.10%
Deployment / Recovery	0:00	/	12:52	0.68%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.17%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.49%
Mobilisation Calibrations	0:00	/	14:37	0.77%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	0:00	/	11:00	0.58%
WoW - Mobilisation	0:00	/	24:30	1.29%
WoW - At Sea	0:00	/	5:35	0.29%
WoW - Alongside	11:00	/	350:31	18.49%
Standby Marine Mammal Observance	0:00	/	6:45	0.36%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	8:36	0.45%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.07%
Total	24:00	/	1896:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Weekly safety meeting, weekly safety walk around, vessel drill and admin tasks.
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	128:51	Hours	536.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

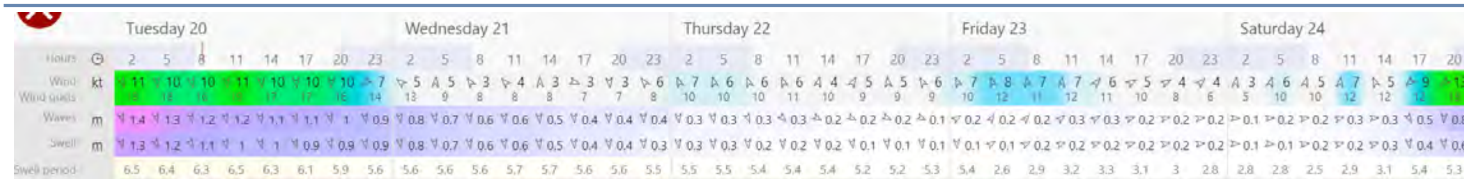
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

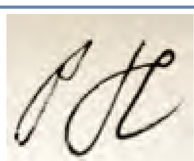
Client Rep Comments

Party Chief Comments

Vessel WoW. Weekly safety meeting, safety walk around, vessel drill and admin tasks undertaken.

Poor conditions forecast for tomorrow so vessel unlikely to sail.

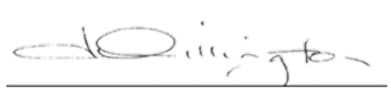
Fugro Representative



Peter Horobin
Party Chief

20/09/2022

Client Representative



19/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	80	**Date:**	20/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	194
Daily Meeting	0	/	72
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5046
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	69:10	3.60%
Port Call - Overnight	12:00	/	958:40	49.93%
Transit	0:00	/	60:01	3.13%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.68%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.15%
2.9a UXO with UHRS	0:00	/	15:09	0.79%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Deployment / Recovery	0:00	/	12:52	0.67%
Recce	0:00	/	2:25	0.13%
Vessel Duties	0:00	/	22:09	1.15%
SVP Dip	0:00	/	3:00	0.16%
Mobilisation Alongside	0:00	/	141:59	7.39%
Mobilisation Calibrations	0:00	/	14:37	0.76%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	0:00	/	11:00	0.57%
WoW - Mobilisation	0:00	/	24:30	1.28%
WoW - At Sea	0:00	/	5:35	0.29%
WoW - Alongside	11:00	/	361:31	18.83%
Standby Marine Mammal Observance	0:00	/	6:45	0.35%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	8:36	0.45%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	5.01%
Total	24:00	/	1920:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Admin and logistics tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	15:09	Hours	63.1%
3.5a Sailing and Standby Rate UHRS	DR	24:00	12:00	140:51	Hours	586.9%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

		Wednesday 21								Thursday 22							
Hours		2	5	8	11	14	17	20	23	2	5	8	11	14	17	20	23
Wind	kt	5	3	4	6	2	3	4	6	5	6	6	6	4	5	3	6
Wind gusts		11	8	7	10	10	7	8	10	9	9	10	11	10	11	9	8
Wave	m	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1
Swell	m	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1
Swell period		5.6	5.6	5.6	5.7	5.7	5.6	5.6	5.5	5.5	5.4	5.4	5.4	5.3	5.3	5.1	5.1

		Friday 23								Saturday 24								Sunday 25						
Hours		2	5	8	11	14	17	20	23	2	5	8	11	14	17	20	23	2	5	8	11	14	17	20
Wind	kt	8	9	9	9	9	9	10	10	9	11	13	15	16	16	13	10	8	8	6	7	7	7	8
Wind gusts		12	13	13	14	15	14	15	16	15	16	19	22	24	24	[illegible]	19	14	13	11	12	13	13	14
Wave	m	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.9	1.2	1.4	1.4	1.3	1.1	1	0.9	0.8	0.8	0.8	0.8	0.8	0.8
Swell	m	0.1	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.7	0.9	0.8	0.6	0.5	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.8
Swell period		2.7	3	3.4	3.7	3.9	3.7	3.7	3.7	3.5	5	5.6	3.6	5.6	5.2	5.5	5.2	5	5.1	5	5.2	5.4	5.7	5.7

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	0.00	750.00	7,152.00	L

Client Rep Comments

Party Chief Comments

Vessel did not sail. WoW. Vessel admin and logistics tasks undertaken.

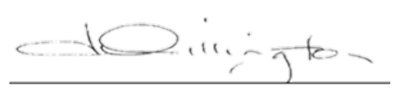
Weather conditions forecast to improve around midday. Vessel will sail in anticipation of improved conditions. When safe to deploy the vessel will resume acquisition.

Fugro Representative

Peter Horobin
Party Chief

21/09/2022

Client Representative



20/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	81	**Date:**	21/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	4	/	198
Daily Meeting	1	/	73
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5106
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

4 x TBT
SVP
SLAM procedure
Deploy streamer and sparker
Recover streamer and sparker

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	70:10	3.61%
Port Call - Overnight	11:55	/	970:35	49.93%
Transit	2:05	/	62:06	3.19%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.66%
2.9 UXO with GRAD	0:00	/	60:34	3.12%
2.9a UXO with UHRS	2:54	/	18:03	0.93%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	3:22	/	3:22	0.17%
Deployment / Recovery	0:55	/	13:47	0.71%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:50	/	22:59	1.18%
SVP Dip	0:15	/	3:15	0.17%
Mobilisation Alongside	0:00	/	141:59	7.30%
Mobilisation Calibrations	0:00	/	14:37	0.75%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	0:00	/	11:00	0.57%
WoW - Mobilisation	0:00	/	24:30	1.26%
WoW - At Sea	0:00	/	5:35	0.29%
WoW - Alongside	0:00	/	361:31	18.60%
Standby Marine Mammal Observance	0:20	/	7:05	0.36%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	8:36	0.44%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	4.95%
Downtime Survey	0:24	/	0:24	0.02%
Total	24:00	/	1944:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:50	00:30	Crew Travel to / from Accommodation	To vessel
05:50	06:30	00:40	Vessel Duties	Prep for sea
06:30	07:30	01:00	Transit	Transit to site
07:30	07:45	00:15	SVP Dip	TBT SVP
07:45	08:15	00:30	Deployment / Recovery	TBT SLAM, TBT deploy streamer and sparker
08:15	08:35	00:20	Standby Marine Mammal Observance	Soft start
08:35	11:29	02:54	2.9a UXO with UHRS	10 Lines
11:29	11:53	00:24	Downtime Survey	Re-acquired incorrect line
11:53	15:15	03:22	Infill - UHRS	2 lines
15:15	15:40	00:25	Deployment / Recovery	TBT Recover streamer and sparker
15:40	16:45	01:05	Transit	Transit to site
16:45	16:55	00:10	Vessel Duties	Vessel admin
16:55	17:25	00:30	Crew Travel to / from Accommodation	From vessel
17:25	24:00	06:35	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	42.6	km	69.0%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	6:16	21:25	Hours	89.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	5:20	146:11	Hours	609.1%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	SW	NA	NA	
Wind Speed	Knots	7-10	5-8	NA	NA	
Sig Wave	m	0.7	0.4	NA	NA	Wave height dropped throughout the morning.

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	250.00	500.00	7,402.00	L

Client Rep Comments

Party Chief Comments

Vessel sailed acquiring remaining virgin E-W and N-S lines. Optional N-S lines and infill acquired as opportunity presented.

Party Chief Comments

Expected that vessel will sail tomorrow to acquire any remaining lines and infill.

12/10/2022 - DPR updated to reflect Nearshore Concession 1 - Incorrect UHRS Line Acquired.

Fugro Representative

Peter Horobin
Party Chief

22/09/2022

Client Representative

21/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	81	**Date:**	21/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	4	/	198
Daily Meeting	1	/	73
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5106
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

4 x TBT
SVP
SLAM procedure
Deploy streamer and sparker
Recover streamer and sparker

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	70:10	3.61%
Port Call - Overnight	11:55	/	970:35	49.93%
Transit	2:05	/	62:06	3.19%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.66%
2.9 UXO with GRAD	0:00	/	60:34	3.12%
2.9a UXO with UHRS	5:53	/	21:02	1.08%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:47	/	0:47	0.04%
Deployment / Recovery	0:55	/	13:47	0.71%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:50	/	22:59	1.18%
SVP Dip	0:15	/	3:15	0.17%
Mobilisation Alongside	0:00	/	141:59	7.30%
Mobilisation Calibrations	0:00	/	14:37	0.75%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	0:00	/	11:00	0.57%
WoW - Mobilisation	0:00	/	24:30	1.26%
WoW - At Sea	0:00	/	5:35	0.29%
WoW - Alongside	0:00	/	361:31	18.60%
Standby Marine Mammal Observance	0:20	/	7:05	0.36%
Standby Marine Traffic	0:00	/	2:51	0.15%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	8:36	0.44%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	4.95%
Total	24:00	/	1944:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:50	00:30	Crew Travel to / from Accommodation	To vessel
05:50	06:30	00:40	Vessel Duties	Prep for sea
06:30	07:30	01:00	Transit	Transit to site
07:30	07:45	00:15	SVP Dip	TBT SVP
07:45	08:15	00:30	Deployment / Recovery	TBT SLAM, TBT deploy streamer and sparker
08:15	08:35	00:20	Standby Marine Mammal Observance	Soft start
08:35	14:28	05:53	2.9a UXO with UHRS	10 Lines
14:28	15:15	00:47	Infill - UHRS	2 lines
15:15	15:40	00:25	Deployment / Recovery	TBT Recover streamer and sparker
15:40	16:45	01:05	Transit	Transit to site
16:45	16:55	00:10	Vessel Duties	Vessel admin
16:55	17:25	00:30	Crew Travel to / from Accommodation	From vessel
17:25	24:00	06:35	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	49.1	0.0	42.6	km	86.8%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	6:40	21:49	Hours	90.9%
3.5a Sailing and Standby Rate UHRS	DR	24:00	5:20	146:11	Hours	609.1%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

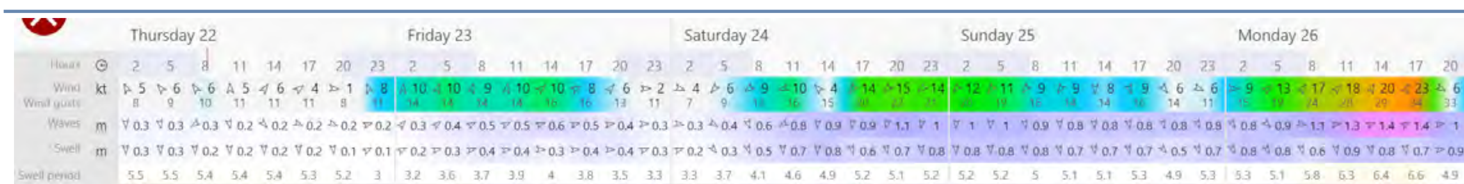
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	SW	NA	NA	
Wind Speed	Knots	7-10	5-8	NA	NA	
Sig Wave	m	0.7	0.4	NA	NA	Wave height dropped throughout the morning.

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	750.00	0.00	250.00	500.00	7,402.00	L

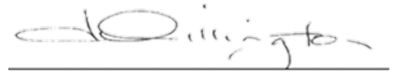
Client Rep Comments

Party Chief Comments

Vessel sailed acquiring remaining virgin E-W and N-S lines. Optional N-S lines and infill acquired as opportunity presented.

Expected that vessel will sail tomorrow to acquire any remaining lines and infill.

DOME

Fugro Representative		Client Representative
		
Peter Horobin **Party Chief**	**22/09/2022**	**21/09/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	82	**Date:**	22/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	3	/	201
Daily Meeting	1	/	74
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5166
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

3 x TBT
SVP
Deploy Sparker and Streamer
Recover Sparker and Streamer

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:10	/	71:20	3.62%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Port Call - Overnight	12:00	/	982:35	49.93%
Transit	1:52	/	63:58	3.25%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.64%
2.9 UXO with GRAD	0:00	/	60:34	3.08%
2.9a UXO with UHRS	1:20	/	22:22	1.14%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:40	/	1:27	0.07%
Deployment / Recovery	0:28	/	14:15	0.72%
Recce	0:00	/	2:25	0.12%
Vessel Duties	3:05	/	26:04	1.32%
SVP Dip	0:15	/	3:30	0.18%
Mobilisation Alongside	0:00	/	141:59	7.21%
Mobilisation Calibrations	0:00	/	14:37	0.74%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	0:00	/	11:00	0.56%
WoW - Mobilisation	0:00	/	24:30	1.24%
WoW - At Sea	0:00	/	5:35	0.28%
WoW - Alongside	0:00	/	361:31	18.37%
Standby Marine Mammal Observance	0:20	/	7:25	0.38%
Standby Marine Traffic	1:05	/	3:56	0.20%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	1:45	/	10:21	0.53%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	4.89%
Total	24:00	/	1968:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:55	00:35	Crew Travel to / from Accommodation	To vessel
05:55	06:15	00:20	Vessel Duties	Prep for sea
06:15	07:05	00:50	Transit	To site
07:05	07:20	00:15	SVP Dip	TBT SVP dip
07:20	07:35	00:15	Deployment / Recovery	TBT Deploy sparker and streamer
07:35	07:55	00:20	Standby Marine Mammal Observance	Soft start
07:55	08:24	00:29	2.9a UXO with UHRS	UHRS acquisition
08:24	08:35	00:11	Standby Marine Traffic	Lines obstructed by vessel traffic
08:35	09:26	00:51	2.9a UXO with UHRS	UHRS acquisition
09:26	10:05	00:39	Standby Marine Traffic	Lines obstructed by vessel traffic
10:05	10:23	00:18	Infill - UHRS	UHRS infill / rerun acquisition
10:23	10:38	00:15	Standby Marine Traffic	Lines obstructed by vessel traffic
10:38	11:00	00:22	Infill - UHRS	UHRS infill / rerun acquisition
11:00	12:45	01:45	Standby Data QC	Processing of data
12:45	12:58	00:13	Deployment / Recovery	TBT recovery of sparker and streamer
12:58	14:00	01:02	Transit	To port
14:00	16:45	02:45	Vessel Duties	Vessel admin

Time Summary

Begin	End	Duration	Type	Description
16:45	17:20	00:35	Crew Travel to / from Accommodation	From vessel
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	12.4	55.0	km	89.1%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	2:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	10:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	S	NA	NA	
Wind Speed	Knots	5	2	NA	NA	
Sig Wave	m	0.2	0.2	NA	NA	

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	200.00	300.00	7,602.00	L

DOME

Client Rep Comments

Party Chief Comments

Please note that the achieved UHRS line km in todays DPR is combination of lines run on 21st and 22nd September as this figure was omitted in the DPR for 21st.

Vessel sailed and acquired remaining optional and infill lines. UHRS acquisition now complete.

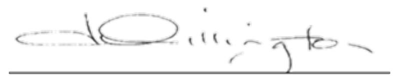
Tomorrow vessel will be alongside beginning preparation for demob of UHRS equipment.

Fugro Representative

Peter Horobin
Party Chief

23/09/2022

Client Representative



22/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	83	**Date:**	23/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	201
Daily Meeting	0	/	74
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5226
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	72:20	3.63%
Port Call - Overnight	12:00	/	994:35	49.93%
Transit	0:00	/	63:58	3.21%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.62%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	3.04%
2.9a UXO with UHRS	0:00	/	22:22	1.12%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.72%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:00	/	26:04	1.31%
SVP Dip	0:00	/	3:30	0.18%
Mobilisation Alongside	0:00	/	141:59	7.13%
Mobilisation Calibrations	0:00	/	14:37	0.73%
Mobilisation Transit	0:00	/	3:30	0.18%
Demobilisation Alongside	11:00	/	22:00	1.10%
WoW - Mobilisation	0:00	/	24:30	1.23%
WoW - At Sea	0:00	/	5:35	0.28%
WoW - Alongside	0:00	/	361:31	18.15%
Standby Marine Mammal Observance	0:00	/	7:25	0.37%
Standby Marine Traffic	0:00	/	3:56	0.20%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	10:21	0.52%
Standby Other	0:00	/	0:30	0.03%
Downtime Vessel	0:00	/	96:13	4.83%
Total	24:00	/	1992:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	Demobilisation Alongside	Begin demob of UHRS equipment
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	0.0	N°	0.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

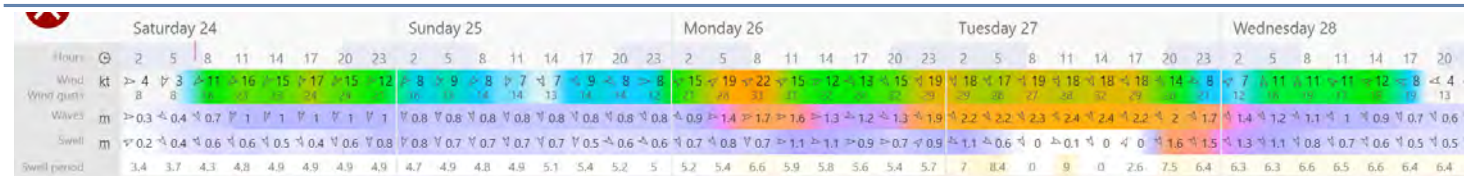
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Day	Hours	Wind (kt)	Wind gusts	Waves (m)	Swell (m)	Swell period
Saturday 24	2	4	8	0.3	0.2	3.4
	5	3	8	0.4	0.4	3.7
	8	11	16	0.7	0.6	4.3
	11	16	23	1	0.6	4.8
	14	15	33	1	0.5	4.9
	17	17	24	1	0.4	4.9
	20	15	29	1	0.6	4.9
	23	12	[illegible]	1	0.8	4.9
Sunday 25	2	8	16	0.8	0.8	4.7
	5	9	13	0.8	0.7	4.9
	8	8	14	0.8	0.7	4.8
	11	7	14	0.8	0.7	4.9
	14	7	13	0.8	0.7	5.1
	17	9	14	0.8	0.5	5.4
	20	8	14	0.8	0.6	5.2
	23	8	12	0.8	0.6	5
Monday 26	2	15	21	0.9	0.7	5.2
	5	19	28	1.4	0.8	5.4
	8	22	31	1.7	0.7	6.6
	11	15	31	1.6	1.1	5.9
	14	12	32	1.3	1.1	5.8
	17	13	30	1.2	0.9	5.6
	20	15	32	1.3	0.7	5.4
	23	19	29	1.9	0.9	5.7
Tuesday 27	2	18	29	2.2	1.1	7
	5	17	28	2.2	0.6	8.4
	8	19	27	2.3	0	0
	11	18	28	2.4	0.1	9
	14	18	32	2.4	0	0
	17	18	29	2.2	0	2.6
	20	14	20	2	1.6	7.5
	23	8	21	1.7	1.5	6.4
Wednesday 28	2	7	12	1.4	1.3	6.3
	5	11	18	1.2	1.1	6.3
	8	11	19	1.1	0.8	6.6
	11	11	17	1	0.7	6.5
	14	12	18	0.9	0.6	6.6
	17	8	19	0.7	0.5	6.4
	20	4	13	0.6	0.5	6.4

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

Client Rep Comments

Party Chief Comments

Vessel alongside beginning demobilisation of UHRS equipment.

Tomorrow UHRS equipment to be lifted from vessel and GAMBAS equipment will be lifted on to begin mobilization.

Fugro Representative

Peter Horobin
Party Chief

24/09/2022

Client Representative

23/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	84	**Date:**	24/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	1	/	202
Daily Meeting	0	/	74
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	7		
Crew Hours	84	/	5310
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	8
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

1 x TBT
Lifting operations

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	73:20	3.64%
Port Call - Overnight	12:00	/	1006:35	49.93%

Summary of Activities

Activity	Today	/	To Date	Progress
Transit	0:00	/	63:58	3.17%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.60%
2.9 UXO with GRAD	0:00	/	60:34	3.00%
2.9a UXO with UHRS	0:00	/	22:22	1.11%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.71%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:00	/	26:04	1.29%
SVP Dip	0:00	/	3:30	0.17%
Mobilisation Alongside	4:00	/	145:59	7.24%
Mobilisation Calibrations	0:00	/	14:37	0.73%
Mobilisation Transit	0:00	/	3:30	0.17%
Demobilisation Alongside	7:00	/	29:00	1.44%
WoW - Mobilisation	0:00	/	24:30	1.22%
WoW - At Sea	0:00	/	5:35	0.28%
WoW - Alongside	0:00	/	361:31	17.93%
Standby Marine Mammal Observance	0:00	/	7:25	0.37%
Standby Marine Traffic	0:00	/	3:56	0.20%
Standby Client	0:00	/	2:44	0.14%
Standby Data QC	0:00	/	10:21	0.51%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.77%
Total	24:00	/	2016:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	13:30	07:00	Demobilisation Alongside	UHRS Demobilization
13:30	17:30	04:00	Mobilisation Alongside	Mobilization of GAMBAS
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	1.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

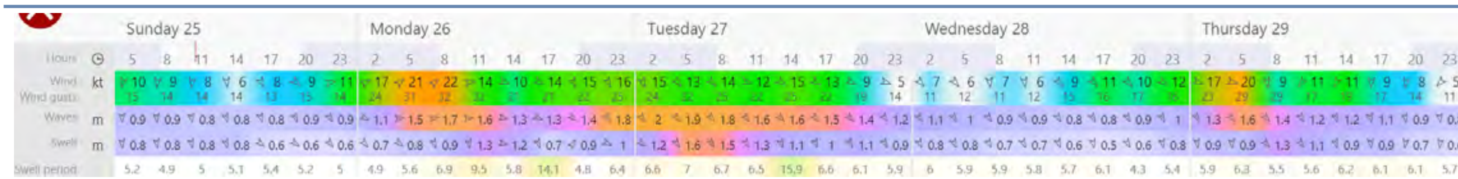
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	2	2	5
Total	5	2	2	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Sunday 25								
Hours		5	8	11	14	17	20	23
Wind	kt	10	9	8	6	8	9	11
Wind gusts		15	14	14	14	13	15	14
Waves	m	0.9	0.9	0.8	0.8	0.8	0.9	0.9
Swell	m	0.8	0.8	0.8	0.8	0.6	0.6	0.6
Swell period		5.2	4.9	5	5.1	5.4	5.2	5

Monday 26									
Hours		2	5	8	11	14	17	20	23
Wind	kt	17	21	22	14	10	14	15	16
Wind gusts		24	31	32	32	27	27	22	25
Waves	m	1.1	1.5	1.7	1.6	1.3	1.3	1.4	1.8
Swell	m	0.7	0.8	0.9	1.3	1.2	0.7	0.9	1
Swell period		4.9	5.6	6.9	9.5	5.8	14.1	4.8	6.4

Tuesday 27									
Hours		2	5	8	11	14	17	20	23
Wind	kt	15	13	14	12	15	13	9	5
Wind gusts		24	32	25	22	25	22	19	14
Waves	m	2	1.9	1.8	1.6	1.6	1.5	1.4	1.2
Swell	m	1.2	1.6	1.5	1.3	1.1	1	1.1	0.9
Swell period		6.6	7	6.7	6.5	15.9	6.6	6.1	5.9

Wednesday 28									
Hours		2	5	8	11	14	17	20	23
Wind	kt	7	6	7	6	9	11	10	12
Wind gusts		11	12	11	12	15	16	17	18
Waves	m	1.1	1	0.9	0.9	0.8	0.8	0.9	1
Swell	m	0.8	0.8	0.7	0.7	0.6	0.5	0.6	0.8
Swell period		6	5.9	5.9	5.8	5.7	6.1	4.3	5.4

Thursday 29									
Hours		2	5	8	11	14	17	20	23
Wind	kt	17	20	9	11	11	9	8	5
Wind gusts		23	29	29	17	18	17	14	11
Waves	m	1.3	1.6	1.4	1.2	1.2	1.1	0.9	0.8
Swell	m	0.9	0.9	1.3	1.1	0.9	0.9	0.7	0.6
Swell period		5.9	6.3	5.5	5.6	6.2	6.1	6.1	5.7

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

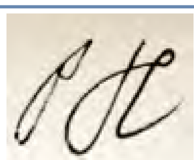
Client Rep Comments

Party Chief Comments

UHRS equipment demobilized. GAMBAS equipment delivered and loaded onto the vessel.

Mobilization of GAMBAS continuing tomorrow. Vessel inductions for new joiners.

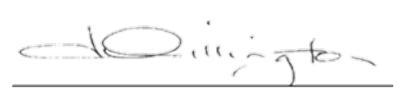
Fugro Representative



Peter Horobin
Party Chief

25/09/2022

Client Representative



24/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	85	**Date:**	25/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	5
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	202
Daily Meeting	0	/	74
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5370
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	2	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	74:20	3.64%
Port Call - Overnight	12:00	/	1018:35	49.93%
Transit	0:00	/	63:58	3.14%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.58%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.97%
2.9a UXO with UHRS	0:00	/	22:22	1.10%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.70%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:00	/	26:04	1.28%
SVP Dip	0:00	/	3:30	0.17%
Mobilisation Alongside	11:00	/	156:59	7.70%
Mobilisation Calibrations	0:00	/	14:37	0.72%
Mobilisation Transit	0:00	/	3:30	0.17%
Demobilisation Alongside	0:00	/	29:00	1.42%
WoW - Mobilisation	0:00	/	24:30	1.20%
WoW - At Sea	0:00	/	5:35	0.27%
WoW - Alongside	0:00	/	361:31	17.72%
Standby Marine Mammal Observance	0:00	/	7:25	0.36%
Standby Marine Traffic	0:00	/	3:56	0.19%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.51%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.72%
Total	24:00	/	2040:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	Mobilisation Alongside	Mobilisation of GAMBAS
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

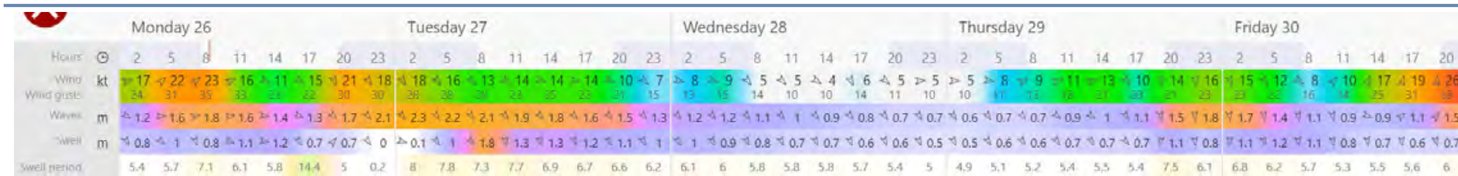
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

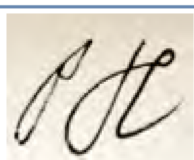
Client Rep Comments

Party Chief Comments

Vessel alongside mobilising. Fabricator required to modify frame to fit GAMBAS equipment.

Tomorrow continue mobilising alongside. Fabricator booked to attend vessel and modify frame.

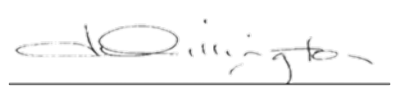
Fugro Representative



Peter Horobin
Party Chief

26/09/2022

Client Representative



25/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	86	**Date:**	26/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	202
Daily Meeting	1	/	75
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5430
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 x HOC - Suggestion - Exhaust lagging to be used as thermal protection on hydraulic power pack.
0 x TBT
0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	75:20	3.65%
Port Call - Overnight	12:00	/	1030:35	49.93%
Transit	0:00	/	63:58	3.10%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.56%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.93%
2.9a UXO with UHRS	0:00	/	22:22	1.08%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.10%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.69%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:00	/	26:04	1.26%
SVP Dip	0:00	/	3:30	0.17%
Mobilisation Alongside	11:00	/	167:59	8.14%
Mobilisation Calibrations	0:00	/	14:37	0.71%
Mobilisation Transit	0:00	/	3:30	0.17%
Demobilisation Alongside	0:00	/	29:00	1.41%
WoW - Mobilisation	0:00	/	24:30	1.19%
WoW - At Sea	0:00	/	5:35	0.27%
WoW - Alongside	0:00	/	361:31	17.52%
Standby Marine Mammal Observance	0:00	/	7:25	0.36%
Standby Marine Traffic	0:00	/	3:56	0.19%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.50%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.66%
Total	24:00	/	2064:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	Mobilisation Alongside	Mobilisation
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

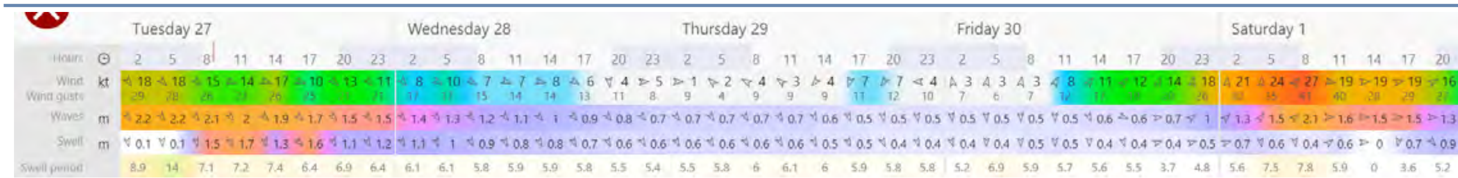
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

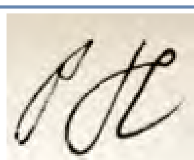
Client Rep Comments

Party Chief Comments

Vessel alongside mobilising. Fitter unable to attend vessel, rebooked for tomorrow.

Tomorrow fitter expected to modify frame. After successful modification winch, rollers and hydraulic control system to be fitted.

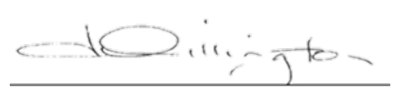
Fugro Representative



Peter Horobin
Party Chief

27/09/2022

Client Representative



26/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	87	**Date:**	27/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	202
Daily Meeting	1	/	76
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	6		
Crew Hours	72	/	5502
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	76:20	3.66%
Port Call - Overnight	12:00	/	1042:35	49.93%
Transit	0:00	/	63:58	3.06%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.54%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.90%
2.9a UXO with UHRS	0:00	/	22:22	1.07%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.68%
Recce	0:00	/	2:25	0.12%
Vessel Duties	0:00	/	26:04	1.25%
SVP Dip	0:00	/	3:30	0.17%
Mobilisation Alongside	11:00	/	178:59	8.57%
Mobilisation Calibrations	0:00	/	14:37	0.70%
Mobilisation Transit	0:00	/	3:30	0.17%
Demobilisation Alongside	0:00	/	29:00	1.39%
WoW - Mobilisation	0:00	/	24:30	1.17%
WoW - At Sea	0:00	/	5:35	0.27%
WoW - Alongside	0:00	/	361:31	17.31%
Standby Marine Mammal Observance	0:00	/	7:25	0.36%
Standby Marine Traffic	0:00	/	3:56	0.19%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.50%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.61%
Total	24:00	/	2088:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	Mobilisation Alongside	Mobilisation
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

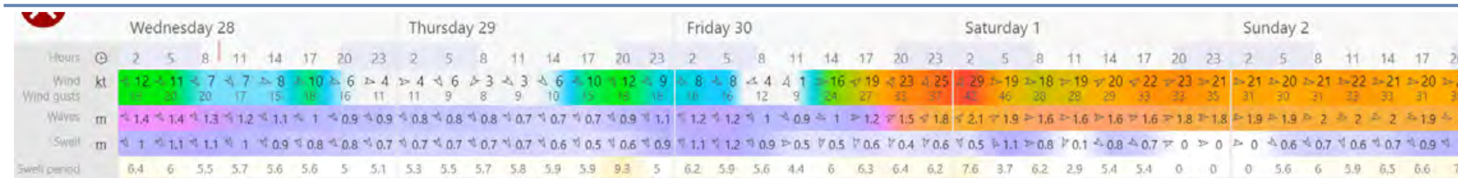
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

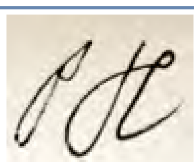
Client Rep Comments

Party Chief Comments

Vessel alongside mobilising GAMBAS. Frame fitted, winch, rollers and hydraulic control unit mounted.

Tomorrow mobilisation will continue; hydraulic and pneumatic equipment to be connected up. Load tester to attend vessel this afternoon.

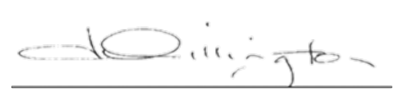
Fugro Representative



Peter Horobin
Party Chief

28/09/2022

Client Representative



27/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	88	**Date:**	28/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	202
Daily Meeting	0	/	76
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5562
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	77:20	3.66%
Port Call - Overnight	12:00	/	1054:35	49.93%
Transit	0:00	/	63:58	3.03%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.53%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.87%
2.9a UXO with UHRS	0:00	/	22:22	1.06%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.67%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:00	/	26:04	1.23%
SVP Dip	0:00	/	3:30	0.17%
Mobilisation Alongside	11:00	/	189:59	9.00%
Mobilisation Calibrations	0:00	/	14:37	0.69%
Mobilisation Transit	0:00	/	3:30	0.17%
Demobilisation Alongside	0:00	/	29:00	1.37%
WoW - Mobilisation	0:00	/	24:30	1.16%
WoW - At Sea	0:00	/	5:35	0.26%
WoW - Alongside	0:00	/	361:31	17.12%
Standby Marine Mammal Observance	0:00	/	7:25	0.35%
Standby Marine Traffic	0:00	/	3:56	0.19%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.49%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.56%
Total	24:00	/	2112:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	07:00	07:00	Port Call - Overnight	Alongside Scheveningen
07:00	07:30	00:30	Crew Travel to / from Accommodation	To vessel
07:30	18:30	11:00	Mobilisation Alongside	Mobilisation
18:30	19:00	00:30	Crew Travel to / from Accommodation	From vessel
19:00	24:00	05:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	0.0	km	0.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction	DR	36:00	0:00	0:00	Hours	0.0%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Seismic and MASW						
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

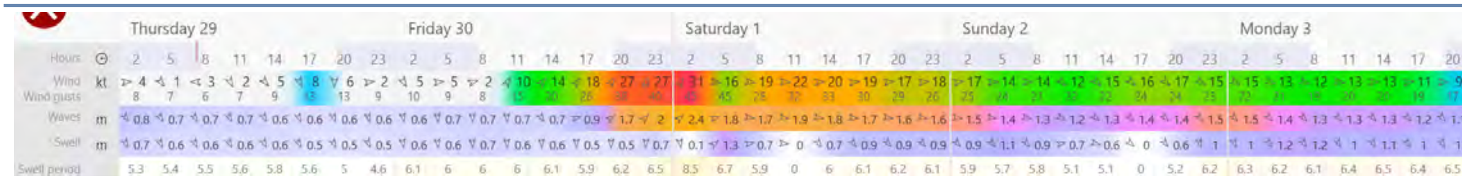
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

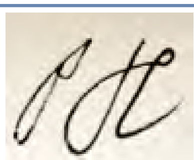
Client Rep Comments

Party Chief Comments

Vessel alongside mobilising. Lift testing and winch adjustment carried out. Hydraulic and pneumatic connection made up.

Intention for vessel to sail after completing alongside practice deployment. Weather may be marginal though, will be monitored.

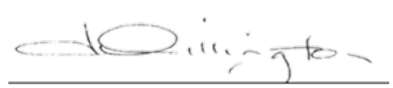
Fugro Representative



Peter Horobin
Party Chief

29/09/2022

Client Representative



28/09/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	89	**Date:**	29/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	8	/	210
Daily Meeting	0	/	76
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5622
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

8 x TBT
Practice deployment/recovery of GAMBAS
SVP
Deploy side arm
Deploy GAMBAS
Recover GAMBAS
Deploy GAMBAS
Recover GAMBAS
Recover side arm

0 x Incident and near misses

HSE Comments

3 x SLAM. During practice deployment when activities drifted too far from TBT'd procedure. Job stopped re-evaluated and resumed with verbal update to original TBT.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:10	/	78:30	3.68%
Port Call - Overnight	10:00	/	1064:35	49.84%
Transit	0:00	/	63:58	2.99%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.51%
2.9 UXO with GRAD	0:00	/	60:34	2.84%
2.9a UXO with UHRS	0:00	/	22:22	1.05%
2.9b UXO with Refraction Seismic and MASW	0:26	/	0:26	0.02%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:15	0.67%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:00	/	26:04	1.22%
SVP Dip	0:00	/	3:30	0.16%
Mobilisation Alongside	5:05	/	195:04	9.13%
Mobilisation Calibrations	4:09	/	18:46	0.88%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.36%
WoW - Mobilisation	0:00	/	24:30	1.15%
WoW - At Sea	0:00	/	5:35	0.26%
WoW - Alongside	0:00	/	361:31	16.92%
Standby Marine Mammal Observance	0:00	/	7:25	0.35%
Standby Marine Traffic	0:00	/	3:56	0.18%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.48%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.50%
Downtime Survey	3:10	/	3:10	0.15%
Total	24:00	/	2136:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:25	04:25	Port Call - Overnight	Alongside Scheveningen
04:25	05:00	00:35	Crew Travel to / from Accommodation	To vessel
05:00	10:05	05:05	Mobilisation Alongside	Click test, practice deployment
10:05	14:14	04:09	Mobilisation Calibrations	Mobilisation at sea.
14:14	14:40	00:26	2.9b UXO with Refraction Seismic and MASW	GAMBAS acquisition
14:40	17:50	03:10	Downtime Survey	Working on air gun compressors electrical supply due to them shutting down or tripping the generators.
17:50	18:25	00:35	Crew Travel to / from Accommodation	From vessel
18:25	24:00	05:35	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.8	0.8	km	2.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	0:00	Hours	0.0%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	0:00	Hours	0.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	1.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

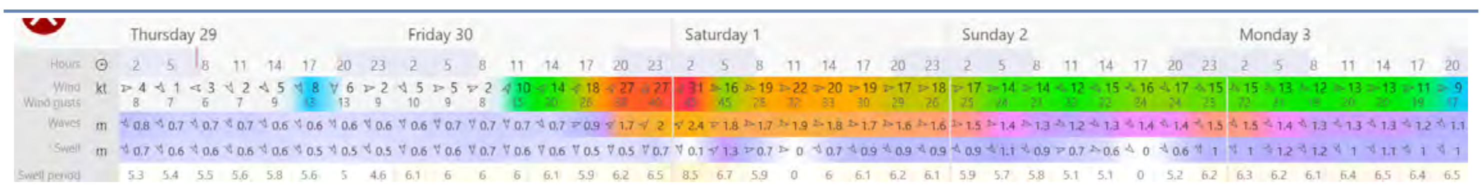
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	NA	NA	NE	NA	
Wind Speed	Knots	NA	NA	10	NA	
Sig Wave	m	NA	NA	0.6	NA	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	200.00	100.00	7,802.00	L

Client Rep Comments

TOTAL "consider the vessel to be in mobilization mode until equipment offshore tests are fully completed and spread is accepted for continuation of the execution".

Party Chief Comments

Click test successfully achieved. Practice deployment completed. Vessel sailed to attempt acquisition in the afternoon. A 0.825 km line of acquisition was achieved,

Party Chief Comments

mobilisation completion TBC.

Fugro Representative

Peter Horobin
Party Chief

30/09/2022

Client Representative

29/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	90	**Date:**	30/09/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	5	/	215
Daily Meeting	0	/	76
Crew Led Kick-Off Meeting	0	/	1
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5682
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

5 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recovery
Sidearm recovery

0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:10	/	79:40	3.69%
Port Call - Overnight	11:05	/	1075:40	49.80%
Transit	1:15	/	65:13	3.02%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.49%
2.9 UXO with GRAD	0:00	/	60:34	2.80%
2.9a UXO with UHRS	0:00	/	22:22	1.04%
2.9b UXO with Refraction Seismic and MASW	1:45	/	2:11	0.10%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:35	/	14:50	0.69%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:40	/	26:44	1.24%
SVP Dip	0:15	/	3:45	0.17%
Mobilisation Alongside	0:00	/	195:04	9.03%
Mobilisation Calibrations	0:00	/	18:46	0.87%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.34%
WoW - Mobilisation	0:00	/	24:30	1.13%
WoW - At Sea	0:00	/	5:35	0.26%
WoW - Alongside	3:30	/	365:01	16.90%
Standby Marine Mammal Observance	0:00	/	7:25	0.34%
Standby Marine Traffic	0:00	/	3:56	0.18%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.48%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.45%
Downtime Survey	3:45	/	6:55	0.32%
Total	24:00	/	2160:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:20	04:20	Port Call - Overnight	Alongside Scheveningen
04:20	04:55	00:35	Crew Travel to / from Accommodation	To vessel
04:55	05:35	00:40	Vessel Duties	Prep for sea and bunkering
05:35	06:50	01:15	Transit	To site
06:50	07:05	00:15	SVP Dip	TBT SVP
07:05	07:40	00:35	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS deploy
07:40	09:25	01:45	2.9b UXO with Refraction Seismic and MASW	GAMBAS acquisition 3 lines
09:25	13:10	03:45	Downtime Survey	HP air dropped below acceptable level for acquisition and could not be replenished
13:10	16:40	03:30	WoW - Alongside	Weather condition deteriorated beyond vessel limits such that further work could not have been done had vessel returned to site.
16:40	17:15	00:35	Crew Travel to / from Accommodation	From vessel
17:15	24:00	06:45	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	2.5	3.3	km	8.3%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	2:11	2:11	Hours	9.1%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	11:10	11:10	Hours	31.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	SW	SW	NA	NA	
Wind Speed	Knots	14	19	NA	NA	Forecast to continue rising throughout the day
Sig Wave	m	0.6	0.6	NA	NA	

Weather Forecast

Friday 30		5	8	11	14	17	20	23
Wind	kt	3	3	9	16	20	23	24
Wind gusts		7	8	14	21	29	31	35
Waves	m	0.6	0.6	0.6	0.8	1.1	1.5	1.7
Swell	m	0.5	0.5	0.5	0.5	0.5	0.6	0.9
Swell period		5.5	5.5	5.5	5.7	5.9	6.2	6.4

Saturday 1		2	5	8	11	14	17	20	23
Wind	kt	27	17	18	20	19	18	14	18
Wind gusts		40	41	26	30	31	28	26	25
Waves	m	2	1.8	1.4	1.6	1.7	1.5	1.4	1.4
Swell	m	0.6	1	0.7	0.5	0.6	0.9	1.2	0.8
Swell period		7.9	8.1	8.2	5.5	5.6	5.8	5.7	5.7

Sunday 2		2	5	8	11	14	17	20	23
Wind	kt	17	17	13	12	9	8	9	9
Wind gusts		26	26	34	20	17	14	14	11
Waves	m	1.5	1.6	1.4	1.3	1.1	1	0.9	0.9
Swell	m	0.8	0.8	1.2	0.9	0.9	0.9	0.8	0.8
Swell period		5.7	5.7	5.8	6	5.8	5.8	5.7	5.3

Monday 3		2	5	8	11	14	17	20	23
Wind	kt	6	6	3	3	5	7	3	5
Wind gusts		13	10	9	7	8	10	10	8
Waves	m	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.5
Swell	m	0.8	0.7	0.7	0.6	0.5	0.5	0.5	0.5
Swell period		5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.2

Tuesday 4		2	5	8	11	14	17	20	23
Wind	kt	8	8	10	11	13	12	9	12
Wind gusts		12	12	14	16	20	19	17	16
Waves	m	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8
Swell	m	0.4	0.4	0.4	0.3	0.3	0.4	0.6	0.7
Swell period		5.4	5.6	5.7	5.7	5.8	4.1	4.4	4.9

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	100.00	0.00	-250.00	350.00	7,552.00	L

Client Rep Comments

Party Chief Comments

Vessel sailed to acquire GAMBAS data. Three lines achieved. HP air ran out before vessel left site due to compressors overloading the back deck generator. Please note that "Refraction and MASW using GAMBAS" production hours includes 26 minutes from a single line from the 29/09/2022 which were not included in that DPR.

DOME

Party Chief Comments

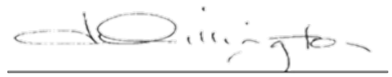
Vessel expected to WoW tomorrow. Additional petrol generator to be sourced.

Fugro Representative

Peter Horobin
Party Chief

01/10/2022

Client Representative



30/09/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	91	**Date:**	01/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	6
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	7
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	12
Cross Department Tour	0	/	10
Audit / Inspection	0	/	2
Toolbox Talk	0	/	215
Daily Meeting	0	/	76
Crew Led Kick-Off Meeting	1	/	2
Safety meeting	0	/	12
Total Persons Onboard	5		
Crew Hours	60	/	5742
Two Part HIRA (Held Onboard)	0	/	1
Soundbite Training	0	/	2
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss
1 x Crew led Kick Off Meeting for GAMBAS scope

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	80:40	3.69%
Port Call - Overnight	12:00	/	1087:40	49.80%
Transit	0:00	/	65:13	2.99%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.48%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.77%
2.9a UXO with UHRS	0:00	/	22:22	1.02%
2.9b UXO with Refraction Seismic and MASW	0:00	/	2:11	0.10%
Infill - MBES	0:00	/	1:26	0.07%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:50	0.68%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:00	/	26:44	1.22%
SVP Dip	0:00	/	3:45	0.17%
Mobilisation Alongside	0:00	/	195:04	8.93%
Mobilisation Calibrations	0:00	/	18:46	0.86%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.33%
WoW - Mobilisation	0:00	/	24:30	1.12%
WoW - At Sea	0:00	/	5:35	0.26%
WoW - Alongside	8:00	/	373:01	17.08%
Standby Marine Mammal Observance	0:00	/	7:25	0.34%
Standby Marine Traffic	0:00	/	3:56	0.18%
Standby Client	0:00	/	2:44	0.13%
Standby Data QC	0:00	/	10:21	0.47%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.41%
Downtime Survey	3:00	/	9:55	0.45%
Total	24:00	/	2184:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	09:30	03:00	Downtime Survey	Unable to run two compressors to maintain HP air pressure on current generator setup. Extra petrol generator brought to vessel to provide dedicated generator for each compressor to eliminate this problem
09:30	17:30	08:00	WoW - Alongside	Vessel alongside WoW
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	3.3	km	8.3%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting	DR	0:00	0:00	192:14	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
with GRAD						
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	2:11	Hours	9.1%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	23:10	Hours	64.4%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

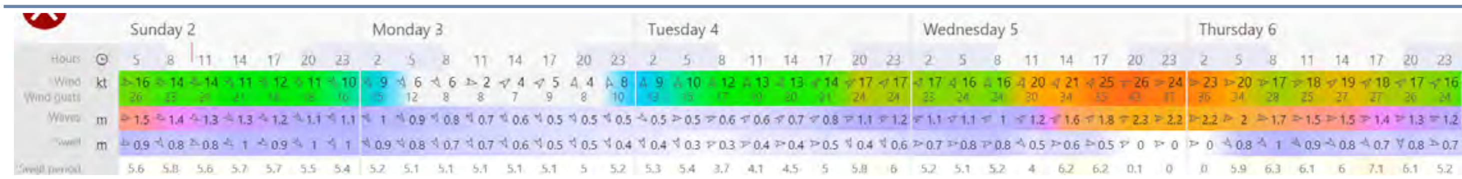
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Sunday 2								
Hours		5	8	11	14	17	20	23
Wind	kt	16	14	14	11	12	11	10
Wind gusts		26	23	20	21	18	18	16
Waves	m	1.5	1.4	1.3	1.3	1.2	1.1	1.1
Swell	m	0.9	0.8	0.8	1	0.9	1	1
Swell period		5.6	5.8	5.6	5.7	5.7	5.5	5.4

Monday 3									
Hours		2	5	8	11	14	17	20	23
Wind	kt	9	6	6	2	4	5	4	8
Wind gusts		15	12	8	8	7	9	8	10
Waves	m	1	0.9	0.8	0.7	0.6	0.5	0.5	0.5
Swell	m	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.4
Swell period		5.2	5.1	5.1	5.1	5.1	5.1	5	5.2

Tuesday 4									
Hours		2	5	8	11	14	17	20	23
Wind	kt	9	10	12	13	13	14	17	17
Wind gusts		13	15	17	19	20	21	24	24
Waves	m	0.5	0.5	0.6	0.6	0.7	0.8	1.1	1.2
Swell	m	0.4	0.3	0.3	0.4	0.4	0.5	0.4	0.6
Swell period		5.3	5.4	3.7	4.1	4.5	5	5.8	6

Wednesday 5									
Hours		2	5	8	11	14	17	20	23
Wind	kt	17	16	16	20	21	25	26	24
Wind gusts		23	24	24	30	34	35	43	37
Waves	m	1.1	1.1	1	1.2	1.6	1.8	2.3	2.2
Swell	m	0.7	0.8	0.8	0.5	0.6	0.5	0	0
Swell period		5.2	5.1	5.2	4	6.2	6.2	0.1	0

Thursday 6									
Hours		2	5	8	11	14	17	20	23
Wind	kt	23	20	17	18	19	18	17	16
Wind gusts		36	34	28	25	27	27	26	24
Waves	m	2.2	2	1.7	1.5	1.5	1.4	1.3	1.2
Swell	m	0	0.8	1	0.9	0.8	0.7	0.8	0.7
Swell period		0	5.9	6.3	6.1	6	7.1	6.1	5.2

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	350.00	0.00	0.00	350.00	7,552.00	L

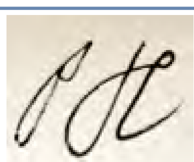
Client Rep Comments

Party Chief Comments

Vessel alongside yesterday WoW. Generator overload by compressor in HP air system problem resolved with addition of petrol generator to provide a dedicated electrical supply to each compressor. Crew led kick off meeting held onboard for the GAMBAS scope.

Vessel WoW tomorrow based on current forecast. Weekly safety meeting and vessel walkaround and inspection to be held.

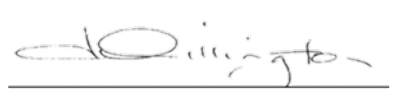
Fugro Representative



Peter Horobin
Party Chief

02/10/2022

Client Representative



01/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	Report No.:	92	Date:	02/10/2022
Client:	TotalEnergies EP Nederland BV			Timezone:	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	1	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	1	/	13
Cross Department Tour	1	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	215
Daily Meeting	0	/	76
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	1	/	13
Total Persons Onboard	5		
Crew Hours	60	/	5802
Two Part HIRA (Held Onboard)	1	/	2
Soundbite Training	1	/	3
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

2 x HOC
Unsafe condition - Positions of some personnel during streamer recovery and organisation on back makes them more susceptible to vessel and could cause falls. This has been reviewed and positions for personnel have been amended to remedy this.
Safe act - Plastic petrol bottles have been stored in a closed metal box to protect then from damage or sources of ignition.

0 x TBT
0 x Incident or Near Miss

1 x Safety Meeting
1 x Vessel Safety Walk around / Inspection
1 x Vessel drill - Abandonment
1 x Soundbite training - Seeker geophysical survey systems

Review of HIRA by vessel crew.

HSE Comments

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	81:40	3.70%
Port Call - Overnight	12:00	/	1099:40	49.80%
Transit	0:00	/	65:13	2.95%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.46%
2.9 UXO with GRAD	0:00	/	60:34	2.74%
2.9a UXO with UHRS	0:00	/	22:22	1.01%
2.9b UXO with Refraction Seismic and MASW	0:00	/	2:11	0.10%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.07%
Deployment / Recovery	0:00	/	14:50	0.67%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:00	/	26:44	1.21%
SVP Dip	0:00	/	3:45	0.17%
Mobilisation Alongside	0:00	/	195:04	8.83%
Mobilisation Calibrations	0:00	/	18:46	0.85%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.31%
WoW - Mobilisation	0:00	/	24:30	1.11%
WoW - At Sea	0:00	/	5:35	0.25%
WoW - Alongside	11:00	/	384:01	17.39%
Standby Marine Mammal Observance	0:00	/	7:25	0.34%
Standby Marine Traffic	0:00	/	3:56	0.18%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.47%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.36%
Downtime Survey	0:00	/	9:55	0.45%
Total	24:00	/	2208:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Vessel alongside WoW. Wave height forecast over 1m throughout. Safety meeting, safety walkaround/inspection, vessel drill, HIRA review.
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Refraction Seismic Line KM Completion	DR	39.8	0.0	3.3	km	8.3%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	2:11	Hours	9.1%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	35:10	Hours	97.7%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

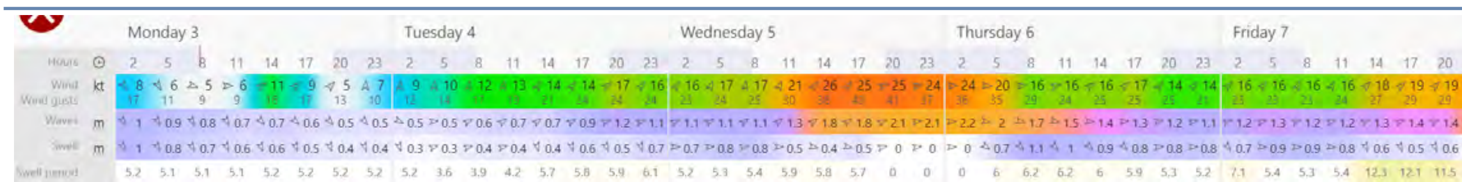
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Monday 3		2	5	8	11	14	17	20	23
Wind	kt	8	6	5	6	11	9	5	7
Wind gusts		17	11	9	9	16	17	13	10
Waves	m	1	0.9	0.8	0.7	0.7	0.6	0.5	0.5
Swell	m	1	0.8	0.7	0.6	0.6	0.5	0.4	0.4
Swell period		5.2	5.1	5.1	5.1	5.2	5.2	5.2	5.2

Tuesday 4		2	5	8	11	14	17	20	23
Wind	kt	9	10	12	13	14	14	17	16
Wind gusts		12	14	17	19	21	24	24	24
Waves	m	0.5	0.5	0.6	0.7	0.7	0.9	1.2	1.1
Swell	m	0.3	0.3	0.4	0.4	0.4	0.6	0.5	0.7
Swell period		5.2	3.6	3.9	4.2	5.7	5.8	5.9	6.1

Wednesday 5		2	5	8	11	14	17	20	23
Wind	kt	16	17	17	21	26	25	25	24
Wind gusts		23	24	25	30	38	40	41	37
Waves	m	1.1	1.1	1.1	1.3	1.8	1.8	2.1	2.1
Swell	m	0.7	0.8	0.8	0.5	0.4	0.5	0	0
Swell period		5.2	5.3	5.4	5.9	5.8	5.7	0	0

Thursday 6		2	5	8	11	14	17	20	23
Wind	kt	24	20	16	16	16	17	14	14
Wind gusts		36	35	29	24	25	25	25	21
Waves	m	2.2	2	1.7	1.5	1.4	1.3	1.2	1.1
Swell	m	0	0.7	1.1	1	0.9	0.8	0.8	0.8
Swell period		0	6	6.2	6.2	6	5.9	5.3	5.2

Friday 7		2	5	8	11	14	17	20
Wind	kt	16	16	16	16	18	19	19
Wind gusts		23	23	23	24	27	29	29
Waves	m	1.2	1.3	1.2	1.2	1.3	1.4	1.4
Swell	m	0.7	0.9	0.9	0.8	0.6	0.5	0.6
Swell period		7.1	5.4	5.3	5.4	12.3	12.1	11.5

Liquids Status

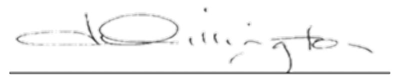
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	350.00	0.00	0.00	350.00	7,552.00	L

Client Rep Comments

Party Chief Comments

Vessel alongside WoW. Weekly safety meeting held, weekly safety walkaround/inspection and vessel drill was conducted. HIRA reviewed.

Vessel expected to sail tomorrow. Weather conditions forecast as marginal and improving slightly during the day.

Fugro Representative		Client Representative	
			
Peter Horobin **Party Chief**	**03/10/2022**		**02/10/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	93	**Date:**	03/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	221
Daily Meeting	1	/	77
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	5862
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	1	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

6 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recover / deploy
GAMBAS recover
Sidearm recover

0 x Incidents or Near Miss

1 x Soundbite training - Petrol generator

HSE Comments

Review by whole crew of TRA for use of petrol generator onboard.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	82:40	3.70%
Port Call - Overnight	11:25	/	1111:05	49.78%
Transit	2:25	/	67:38	3.03%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.44%
2.9 UXO with GRAD	0:00	/	60:34	2.71%
2.9a UXO with UHRS	0:00	/	22:22	1.00%
2.9b UXO with Refraction Seismic and MASW	3:45	/	5:56	0.27%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	1:06	/	15:56	0.71%
Recce	0:00	/	2:25	0.11%
Vessel Duties	1:00	/	27:44	1.24%
SVP Dip	0:15	/	4:00	0.18%
Mobilisation Alongside	0:00	/	195:04	8.74%
Mobilisation Calibrations	0:00	/	18:46	0.84%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.30%
WoW - Mobilisation	0:00	/	24:30	1.10%
WoW - At Sea	1:10	/	6:45	0.30%
WoW - Alongside	0:00	/	384:01	17.21%
Standby Marine Mammal Observance	0:00	/	7:25	0.33%
Standby Marine Traffic	0:00	/	3:56	0.18%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.46%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.31%
Downtime Survey	1:54	/	11:49	0.53%
Total	24:00	/	2232:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	07:15	00:45	Vessel Duties	Prep for sea
07:15	08:40	01:25	Transit	Transit to site
08:40	09:50	01:10	WoW - At Sea	Conditions to severe to deploy. 0.8m wave height
09:50	10:05	00:15	SVP Dip	TBT SVP
10:05	10:46	00:41	Deployment / Recovery	TBT Sidearm deploy TBT GAMBAS deploy
10:46	12:40	01:54	Downtime Survey	Downtime from problems with GAMBAS auto lift system due to water ingress on connector and loose fabric on the streamer catching on another part of the streamer causing a loop. TBT recover and deploy GAMBAS.
12:40	16:25	03:45	2.9b UXO with Refraction Seismic and MASW	Acquisition on North side of channel
16:25	16:50	00:25	Deployment / Recovery	TBT Recover GAMBAS TBT recover sidearm
16:50	17:50	01:00	Transit	To port

Time Summary

Begin	End	Duration	Type	Description
17:50	18:05	00:15	Vessel Duties	Backups
18:05	18:35	00:30	Crew Travel to / from Accommodation	From vessel
18:35	24:00	05:25	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	5.2	8.5	km	21.4%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	3:45	5:56	Hours	24.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	8:15	43:25	Hours	120.6%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

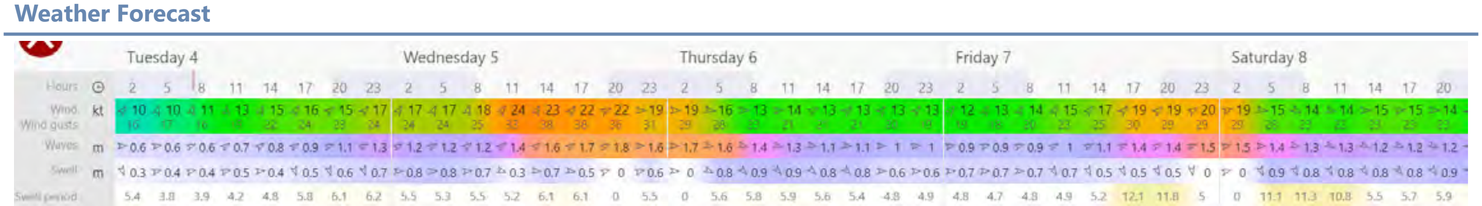
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.7	0.6	0.5	NA	
Wind Speed	Knots	12	11	14	NA	
Wind Direction	Coords	w	sw	sw	NA	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit

DOME

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	350.00	0.00	250.00	100.00	7,802.00	L

Client Rep Comments

Party Chief Comments

Vessel sailed to acquire. Downtime experienced due to technical problems. Afterward acquired data on remaining lines North of the channel.

Weather forecast marginal. Vessel will sail to Southern side of channel.

Fugro Representative

Peter Horobin
Party Chief

04/10/2022

Client Representative

03/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	94	**Date:**	04/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	5	/	226
Daily Meeting	1	/	78
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	5922
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	83:40	3.71%
Port Call - Overnight	12:00	/	1123:05	49.78%
Transit	2:55	/	70:33	3.13%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.43%
2.9 UXO with GRAD	0:00	/	60:34	2.68%
2.9a UXO with UHRS	0:00	/	22:22	0.99%

Summary of Activities

Activity	Today	/	To Date	Progress
2.9b UXO with Refraction Seismic and MASW	1:47	/	7:43	0.34%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:58	/	16:54	0.75%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:25	/	28:09	1.25%
SVP Dip	0:20	/	4:20	0.19%
Mobilisation Alongside	0:00	/	195:04	8.65%
Mobilisation Calibrations	0:00	/	18:46	0.83%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.29%
WoW - Mobilisation	0:00	/	24:30	1.09%
WoW - At Sea	0:00	/	6:45	0.30%
WoW - Alongside	3:55	/	387:56	17.20%
Standby Marine Mammal Observance	0:00	/	7:25	0.33%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:40	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.46%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.26%
Downtime Survey	0:00	/	11:49	0.52%
Total	24:00	/	2256:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:15	04:15	Port Call - Overnight	Alongside Scheveningen
04:15	04:45	00:30	Crew Travel to / from Accommodation	To vessel
04:45	05:10	00:25	Vessel Duties	Prep for sea and bunkering
05:10	06:50	01:40	Transit	Transit to site
06:50	07:10	00:20	SVP Dip	TBT SVP
07:10	07:38	00:28	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS recover
07:38	08:00	00:22	2.9b UXO with Refraction Seismic and MASW	Acquisition 1 line 1.138km
08:00	08:40	00:40	Standby Tide / Currents	Vessel not able to maintain survey speed / steerage due to current conditions on site.
08:40	10:05	01:25	2.9b UXO with Refraction Seismic and MASW	Acquisition 2 lines 2.145km
10:05	10:35	00:30	Deployment / Recovery	TBT Recover GAMBAS, TBT recover sidearm
10:35	11:50	01:15	Transit	To port
11:50	15:45	03:55	WoW - Alongside	Vessel recovered due to rising weather conditions. Rijkswaterstaat wave buoy reading 0.85m on site at recovery.
15:45	16:15	00:30	Crew Travel to / from Accommodation	From vessel
16:15	24:00	07:45	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	3.3	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	10:13	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	1:47	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	43:25	Hours	120.6%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

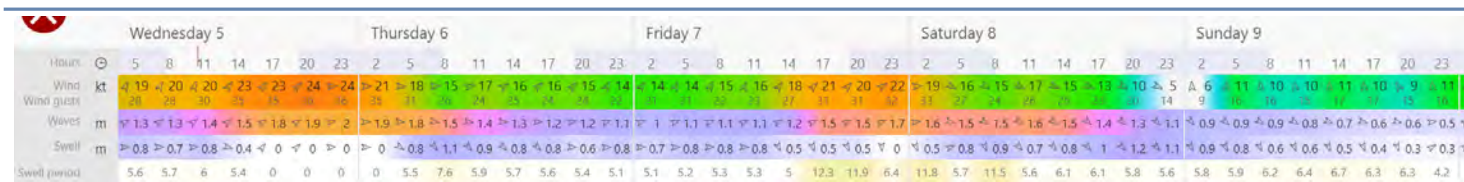
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.6	0.8	NA	NA	0.85m measured on Rijkswaterstraat wave buoy on site.
Wind Speed	Knots	17	20	NA	NA	
Wind Direction	Coords	sw	sw	NA	NA	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	100.00	0.00	-200.00	300.00	7,602.00	L

Client Rep Comments

Party Chief Comments

Vessel bunkered. Vessel sailed acquiring GAMBAS lines South of the channel. Equipment was recovered due to rising weather conditions. Vessel returned to port, WoW

Party Chief Comments

afterward.

Vessel WoW based on forecast. Admin and logistical tasks undertaken.

Fugro Representative		Client Representative	
			
Peter Horobin Party Chief	05/10/2022		04/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	94	**Date:**	04/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	5	/	226
Daily Meeting	1	/	78
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	5922
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	83:40	3.71%
Port Call - Overnight	12:00	/	1123:05	49.78%
Transit	2:55	/	70:33	3.13%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.43%
2.9 UXO with GRAD	0:00	/	60:34	2.68%
2.9a UXO with UHRS	0:00	/	19:23	0.86%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9b UXO with Refraction Seismic and MASW	1:47	/	7:43	0.34%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	4:02	0.18%
Deployment / Recovery	0:58	/	16:54	0.75%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:25	/	28:09	1.25%
SVP Dip	0:20	/	4:20	0.19%
Mobilisation Alongside	0:00	/	195:04	8.65%
Mobilisation Calibrations	0:00	/	18:46	0.83%
Mobilisation Transit	0:00	/	3:30	0.16%
Demobilisation Alongside	0:00	/	29:00	1.29%
WoW - Mobilisation	0:00	/	24:30	1.09%
WoW - At Sea	0:00	/	6:45	0.30%
WoW - Alongside	3:55	/	387:56	17.20%
Standby Marine Mammal Observance	0:00	/	7:25	0.33%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:40	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.46%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.26%
Downtime Survey	0:00	/	12:13	0.54%
Total	24:00	/	2256:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:15	04:15	Port Call - Overnight	Alongside Scheveningen
04:15	04:45	00:30	Crew Travel to / from Accommodation	To vessel
04:45	05:10	00:25	Vessel Duties	Prep for sea and bunkering
05:10	06:50	01:40	Transit	Transit to site
06:50	07:10	00:20	SVP Dip	TBT SVP
07:10	07:38	00:28	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS recover
07:38	08:00	00:22	2.9b UXO with Refraction Seismic and MASW	Acquisition 1 line 1.138km
08:00	08:40	00:40	Standby Tide / Currents	Vessel not able to maintain survey speed / steerage due to current conditions on site.
08:40	10:05	01:25	2.9b UXO with Refraction Seismic and MASW	Acquisition 2 lines 2.145km
10:05	10:35	00:30	Deployment / Recovery	TBT Recover GAMBAS, TBT recover sidearm
10:35	11:50	01:15	Transit	To port
11:50	15:45	03:55	WoW - Alongside	Vessel recovered due to rising weather conditions. Rijkswaterstaat wave buoy reading 0.85m on site at recovery.
15:45	16:15	00:30	Crew Travel to / from Accommodation	From vessel
16:15	24:00	07:45	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	3.3	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	1:47	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	10:13	53:38	Hours	149.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

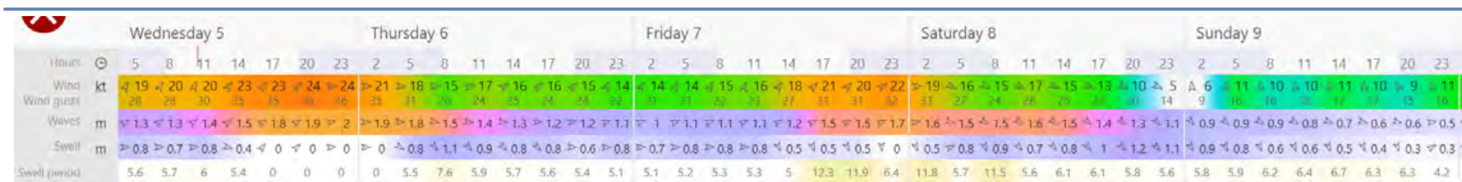
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	sw	sw	NA	NA	
Wind Speed	Knots	17	20	NA	NA	
Sig Wave	m	0.6	0.8	NA	NA	0.85m measured on Rijkswaterstraat wave buoy on site.

Weather Forecast



Wednesday 5		5	8	11	14	17	20	23
Wind	kt	19	20	20	23	23	24	24
Wind gusts		28	28	30	35	35	36	36
Waves	m	1.3	1.3	1.4	1.5	1.8	1.9	2
Swell	m	0.8	0.7	0.8	0.4	0	0	0
Swell period		5.6	5.7	6	5.4	0	0	0

Thursday 6		2	5	8	11	14	17	20	23
Wind	kt	21	18	15	17	16	16	15	14
Wind gusts		35	31	26	24	25	24	24	22
Waves	m	1.9	1.8	1.5	1.4	1.3	1.2	1.2	1.1
Swell	m	0	0.8	1.1	0.9	0.8	0.8	0.6	0.8
Swell period		0	5.5	7.6	5.9	5.7	5.6	5.4	5.1

Friday 7		2	5	8	11	14	17	20	23
Wind	kt	14	14	15	16	18	21	20	22
Wind gusts		31	31	22	23	27	31	31	32
Waves	m	1	1.1	1.1	1.1	1.2	1.5	1.5	1.7
Swell	m	0.7	0.8	0.8	0.8	0.5	0.5	0.5	0
Swell period		5.1	5.2	5.3	5.3	5	12.3	11.9	6.4

Saturday 8		2	5	8	11	14	17	20	23
Wind	kt	19	16	15	17	15	13	10	5
Wind gusts		33	27	24	26	25	[illegible]	20	14
Waves	m	1.6	1.5	1.5	1.6	1.5	1.4	1.3	1.1
Swell	m	0.5	0.8	0.9	0.7	0.8	1	1.2	1.1
Swell period		11.8	5.7	11.5	5.6	6.1	6.1	5.8	5.6

Sunday 9		2	5	8	11	14	17	20	23
Wind	kt	6	11	10	10	11	10	9	11
Wind gusts		9	16	16	15	17	17	15	16
Waves	m	0.9	0.9	0.9	0.8	0.7	0.6	0.6	0.5
Swell	m	0.9	0.8	0.6	0.6	0.5	0.4	0.3	0.3
Swell period		5.8	5.9	6.2	6.4	6.7	6.3	6.3	4.2

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	100.00	0.00	-200.00	300.00	7,602.00	L

Client Rep Comments

Party Chief Comments

Vessel bunkered. Vessel sailed acquiring GAMBAS lines South of the channel. Equipment was recovered due to rising weather conditions. Vessel returned to port, WoW

DOME

Party Chief Comments

afterward.

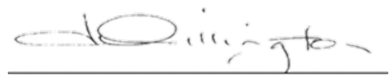
Vessel WoW based on forecast. Admin and logistical tasks undertaken.

Fugro Representative

Peter Horobin
Party Chief

05/10/2022

Client Representative



04/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	95	**Date:**	05/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	226
Daily Meeting	1	/	79
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	5982
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	84:40	3.71%
Port Call - Overnight	12:00	/	1135:05	49.78%
Transit	0:00	/	70:33	3.09%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.41%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.66%
2.9a UXO with UHRS	0:00	/	22:22	0.98%
2.9b UXO with Refraction Seismic and MASW	0:00	/	7:43	0.34%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:00	/	16:54	0.74%
Recce	0:00	/	2:25	0.11%
Vessel Duties	0:00	/	28:09	1.23%
SVP Dip	0:00	/	4:20	0.19%
Mobilisation Alongside	0:00	/	195:04	8.56%
Mobilisation Calibrations	0:00	/	18:46	0.82%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.27%
WoW - Mobilisation	0:00	/	24:30	1.07%
WoW - At Sea	0:00	/	6:45	0.30%
WoW - Alongside	11:00	/	398:56	17.50%
Standby Marine Mammal Observance	0:00	/	7:25	0.33%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.45%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.22%
Downtime Survey	0:00	/	11:49	0.52%
Total	24:00	/	2280:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	WoW alongside. Worked on streamer recovery technique and admin and maintenance.
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	55:25	Hours	153.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

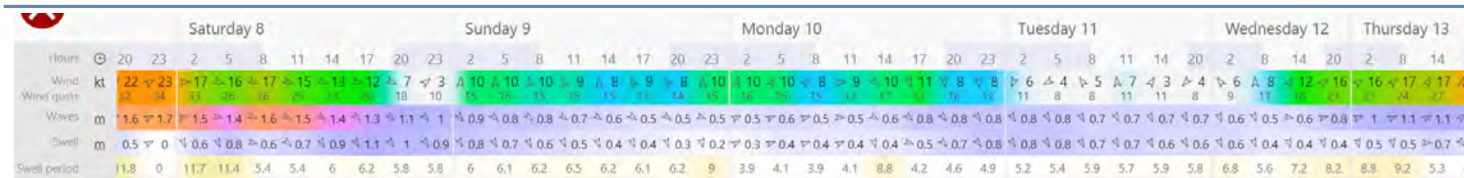
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

Client Rep Comments

Party Chief Comments

WoW alongside. Worked on streamer recovery technique, admin and maintenance.

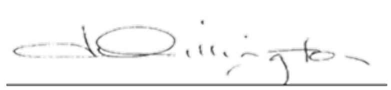
WoW expected tomorrow. Logistics tasks and admin.

Fugro Representative

Peter Horobin
Party Chief

06/10/2022

Client Representative



05/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

TotalEnergies

Fugro Seeker

Project No.:	197217	**Report No.:**	96	**Date:**	06/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	226
Daily Meeting	1	/	80
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6042
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incidents

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	85:40	3.72%
Port Call - Overnight	12:00	/	1147:05	49.79%
Transit	0:00	/	70:33	3.06%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.40%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.63%
2.9a UXO with UHRS	0:00	/	22:22	0.97%
2.9b UXO with Refraction Seismic and MASW	0:00	/	7:43	0.33%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:00	/	16:54	0.73%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	28:09	1.22%
SVP Dip	0:00	/	4:20	0.19%
Mobilisation Alongside	0:00	/	195:04	8.47%
Mobilisation Calibrations	0:00	/	18:46	0.81%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.26%
WoW - Mobilisation	0:00	/	24:30	1.06%
WoW - At Sea	0:00	/	6:45	0.29%
WoW - Alongside	11:00	/	409:56	17.79%
Standby Marine Mammal Observance	0:00	/	7:25	0.32%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.45%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.18%
Downtime Survey	0:00	/	11:49	0.51%
Total	24:00	/	2304:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	WoW alongside. Logistics and admin tasks
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	67:25	Hours	187.3%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

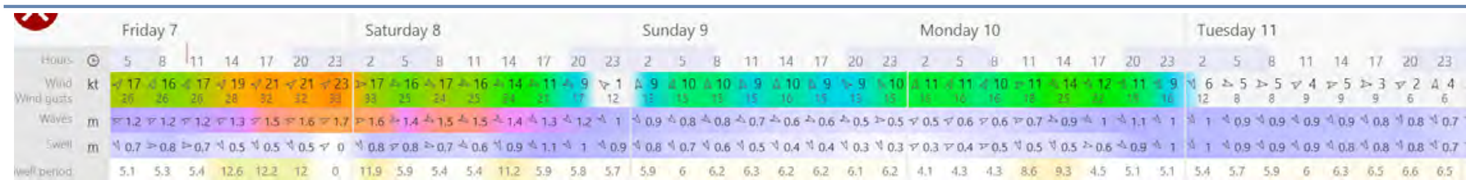
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

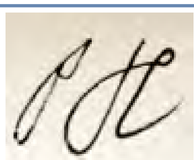
Client Rep Comments

Party Chief Comments

Vessel WoW alongside. Admin and logistics tasks. Visit to agents warehouse.

Vessel expected to WoW alongside. Admin tasks and bunkering.

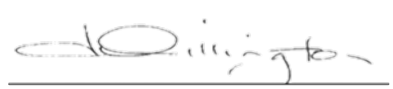
Fugro Representative



Peter Horobin
Party Chief

07/10/2022

Client Representative



06/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	97	**Date:**	07/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	226
Daily Meeting	0	/	80
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6102
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	10
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	86:40	3.72%
Port Call - Overnight	12:00	/	1159:05	49.79%
Transit	0:00	/	70:33	3.03%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.38%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.60%
2.9a UXO with UHRS	0:00	/	22:22	0.96%
2.9b UXO with Refraction Seismic and MASW	0:00	/	7:43	0.33%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.09%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:00	/	16:54	0.73%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	28:09	1.21%
SVP Dip	0:00	/	4:20	0.19%
Mobilisation Alongside	0:00	/	195:04	8.38%
Mobilisation Calibrations	0:00	/	18:46	0.81%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.25%
WoW - Mobilisation	0:00	/	24:30	1.05%
WoW - At Sea	0:00	/	6:45	0.29%
WoW - Alongside	11:00	/	420:56	18.08%
Standby Marine Mammal Observance	0:00	/	7:25	0.32%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.44%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.13%
Downtime Survey	0:00	/	11:49	0.51%
Total	24:00	/	2328:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Alongside WoW. Admin and logistics
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	79:25	Hours	220.6%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

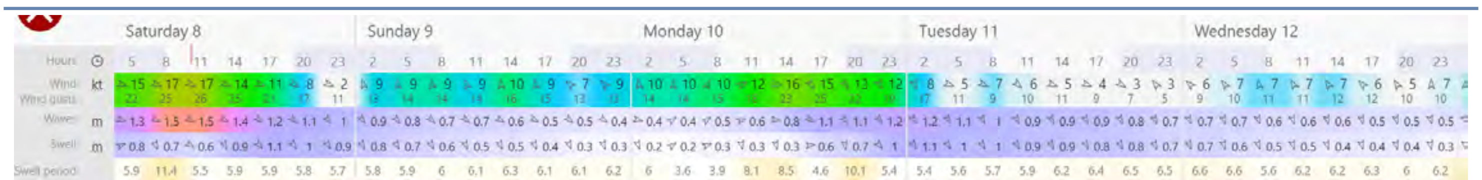
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	-200.00	500.00	7,402.00	L

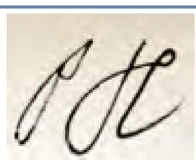
Client Rep Comments

Party Chief Comments

Vessel WoW alongside. Vessel bunkered. Admin and logistics tasks undertaken.

Vessel expected to be WoW alongside.

Fugro Representative



Peter Horobin
Party Chief

08/10/2022

Client Representative

07/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	98	**Date:**	08/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:					

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	7
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	226
Daily Meeting	1	/	81
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	6		
Crew Hours	72	/	6174
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	1	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

1 x Vessel induction - Onsigning AB

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	87:40	3.73%
Port Call - Overnight	12:00	/	1171:05	49.79%
Transit	0:00	/	70:33	3.00%

Summary of Activities

Activity	Today	/	To Date	Progress
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.37%
2.9 UXO with GRAD	0:00	/	60:34	2.58%
2.9a UXO with UHRS	0:00	/	22:22	0.95%
2.9b UXO with Refraction Seismic and MASW	0:00	/	7:43	0.33%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:00	/	16:54	0.72%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	28:09	1.20%
SVP Dip	0:00	/	4:20	0.18%
Mobilisation Alongside	0:00	/	195:04	8.29%
Mobilisation Calibrations	0:00	/	18:46	0.80%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.23%
WoW - Mobilisation	0:00	/	24:30	1.04%
WoW - At Sea	0:00	/	6:45	0.29%
WoW - Alongside	11:00	/	431:56	18.36%
Standby Marine Mammal Observance	0:00	/	7:25	0.32%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.44%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.09%
Downtime Survey	0:00	/	11:49	0.50%
Total	24:00	/	2352:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	WoW - Alongside	Alongside WoW. AB handover, admin and logistics tasks.
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	11.8	km	29.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	7:43	Hours	32.2%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	91:25	Hours	253.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

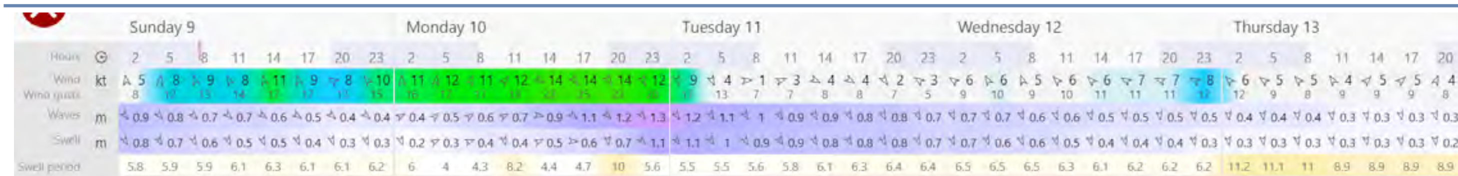
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	7,402.00	L

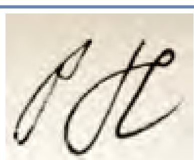
Client Rep Comments

Party Chief Comments

Vessel alongside WoW. Handover between offsigning and onsigning AB. Admin and logistics tasks.

Vessel expected to sail tomorrow to acquire remaining priority lines South of the channel. After completion the streamer will need to be swapped in preparation for the lines in the channel.

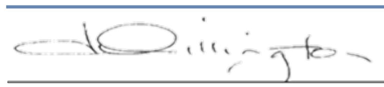
Fugro Representative



Peter Horobin
Party Chief

09/10/2022

Client Representative



08/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	99	**Date:**	09/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	1	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	5	/	231
Daily Meeting	1	/	82
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6234
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	4
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 x HOC - Safe Act - Good teamwork by crew during a difficult recovery of equipment.

5 x TBT
SVP
Sidearm deployment
GAMBAS deployment
GAMBAS recovery
Sidearm deployment

0 x Incident or Near Miss

Multiple SLAM during recovery.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	88:40	3.73%
Port Call - Overnight	11:25	/	1182:30	49.77%
Transit	2:18	/	72:51	3.07%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.36%
2.9 UXO with GRAD	0:00	/	60:34	2.55%
2.9a UXO with UHRS	0:00	/	22:22	0.94%
2.9b UXO with Refraction Seismic and MASW	4:55	/	12:38	0.53%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	2:20	/	19:14	0.81%
Recce	0:00	/	2:25	0.10%
Vessel Duties	1:40	/	29:49	1.25%
SVP Dip	0:22	/	4:42	0.20%
Mobilisation Alongside	0:00	/	195:04	8.21%
Mobilisation Calibrations	0:00	/	18:46	0.79%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.22%
WoW - Mobilisation	0:00	/	24:30	1.03%
WoW - At Sea	0:00	/	6:45	0.28%
WoW - Alongside	0:00	/	431:56	18.18%
Standby Marine Mammal Observance	0:00	/	7:25	0.31%
Standby Marine Traffic	0:00	/	3:56	0.17%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.12%
Standby Data QC	0:00	/	10:21	0.44%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.05%
Downtime Survey	0:00	/	11:49	0.50%
Total	24:00	/	2376:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	04:25	04:25	Port Call - Overnight	Alongside Scheveningen
04:25	04:55	00:30	Crew Travel to / from Accommodation	To vessel
04:55	05:05	00:10	Vessel Duties	Prep for sea
05:05	06:23	01:18	Transit	To site
06:23	06:45	00:22	SVP Dip	TBT SVP
06:45	07:15	00:30	Deployment / Recovery	TBT deploy sidearm, TBT deploy GAMBAS
07:15	12:10	04:55	2.9b UXO with Refraction Seismic and MASW	9 lines 6.15km acquired South of the channel
12:10	14:00	01:50	Deployment / Recovery	TBT GAMBAS recovery, TBT Sidearm recovery. Recovery of streamer was difficult because the protective hose around it absorbed sand in places.
14:00	15:00	01:00	Transit	From site
15:00	16:30	01:30	Vessel Duties	Started work on swapping streamer to MASW for the channel
16:30	17:00	00:30	Crew Travel to / from Accommodation	From vessel
17:00	24:00	07:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	6.2	18.0	km	45.2%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	4:55	12:38	Hours	52.6%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	7:05	98:30	Hours	273.6%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

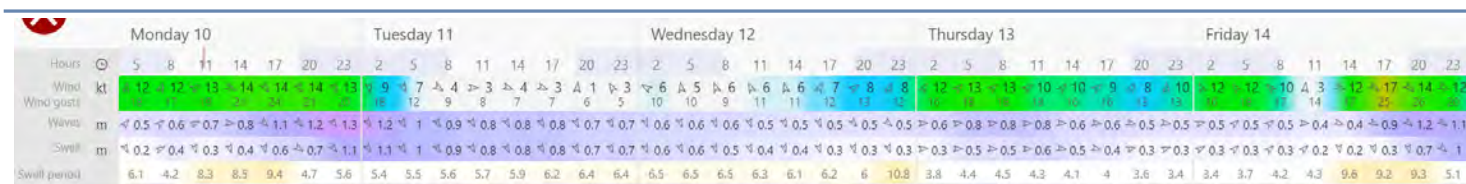
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	sw	sw	NA	NA	
Wind Speed	Knots	14	14	NA	NA	
Sig Wave	m	0.7	0.6	NA	NA	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	250.00	250.00	7,652.00	L

Client Rep Comments

Party Chief Comments

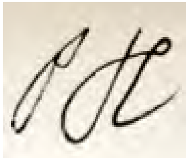
Vessel sailed acquiring data completing the acquisition in the area South of the channel. Streamer recovery afterward difficult due to ingress of sand/silt into the streamer.

DOME

Party Chief Comments

Vessel not expected to sail as completing connection of the streamer. Weather forecast the weather becoming unworkable before midday.

Fugro Representative



Peter Horobin
Party Chief

10/10/2022

Client Representative

09/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	100	**Date:**	10/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	231
Daily Meeting	0	/	82
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6294
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	1	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near Miss

1 x Soundbite training - Proper use of bolt cutters for all the crew

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	89:40	3.74%
Port Call - Overnight	12:00	/	1194:30	49.77%
Transit	0:00	/	72:51	3.04%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.34%
2.9 UXO with GRAD	0:00	/	60:34	2.52%
2.9a UXO with UHRS	0:00	/	22:22	0.93%
2.9b UXO with Refraction Seismic and MASW	0:00	/	12:38	0.53%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	0:00	/	19:14	0.80%
Recce	0:00	/	2:25	0.10%
Vessel Duties	5:00	/	34:49	1.45%
SVP Dip	0:00	/	4:42	0.20%
Mobilisation Alongside	0:00	/	195:04	8.13%
Mobilisation Calibrations	0:00	/	18:46	0.78%
Mobilisation Transit	0:00	/	3:30	0.15%
Demobilisation Alongside	0:00	/	29:00	1.21%
WoW - Mobilisation	0:00	/	24:30	1.02%
WoW - At Sea	0:00	/	6:45	0.28%
WoW - Alongside	6:00	/	437:56	18.25%
Standby Marine Mammal Observance	0:00	/	7:25	0.31%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	0:00	/	10:21	0.43%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	4.01%
Downtime Survey	0:00	/	11:49	0.49%
Total	24:00	/	2400:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	07:00	07:00	Port Call - Overnight	Alongside Scheveningen
07:00	07:30	00:30	Crew Travel to / from Accommodation	To vessel
07:30	12:30	05:00	Vessel Duties	Completion of swap to MASW streamer, vessel bunkered
12:30	18:30	06:00	WoW - Alongside	Alongside WoW.
18:30	19:00	00:30	Crew Travel to / from Accommodation	From vessel
19:00	24:00	05:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	18.0	km	45.2%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	166:24	Hours	693.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	12:38	Hours	52.6%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	110:30	Hours	306.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	250.00	0.00	-250.00	500.00	7,402.00	L

Client Rep Comments

Party Chief Comments

Vessel alongside completing swap to MASW streamer. Vessel bunkered. Due to rising forecast vessel WoW for remainder of the day. Logistics tasks undertaken and discussions on the strategy for streamer recoveries during subsequent operations.

Vessel expected to sail prospectively tomorrow to assess conditions on site and, if possible deploy equipment to acquire priority lines in the main channel.

Client Representative

10/10/2022

DOME

Fugro Representative

Peter Horobin **Party Chief**	**11/10/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	101	**Date:**	11/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	237
Daily Meeting	1	/	83
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6354
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

6 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recovery and redeploy
GAMBAS recovery and redeploy (GAMBAS was not redeployed due to adverse sea conditions)
Sidearm recovery

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	90:40	3.74%
Port Call - Overnight	12:00	/	1206:30	49.77%
Transit	2:25	/	75:16	3.11%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.33%
2.9 UXO with GRAD	0:00	/	60:34	2.50%
2.9a UXO with UHRS	0:00	/	22:22	0.92%
2.9b UXO with Refraction Seismic and MASW	2:40	/	15:18	0.63%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	1:27	0.06%
Deployment / Recovery	1:35	/	20:49	0.86%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:20	/	35:09	1.45%
SVP Dip	0:25	/	5:07	0.21%
Mobilisation Alongside	0:00	/	195:04	8.05%
Mobilisation Calibrations	0:00	/	18:46	0.77%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.20%
WoW - Mobilisation	0:00	/	24:30	1.01%
WoW - At Sea	0:45	/	7:30	0.31%
WoW - Alongside	2:50	/	440:46	18.18%
Standby Marine Mammal Observance	0:00	/	7:25	0.31%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	0:00	/	10:21	0.43%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.97%
Downtime Survey	0:00	/	11:49	0.49%
Total	24:00	/	2424:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:50	00:30	Crew Travel to / from Accommodation	To vessel
05:50	06:10	00:20	Vessel Duties	Prep for sea
06:10	07:35	01:25	Transit	To site
07:35	08:00	00:25	SVP Dip	TBT SVP
08:00	08:45	00:45	WoW - At Sea	Conditions unsuitable for safe deployment. 1m wave height initially.
08:45	09:15	00:30	Deployment / Recovery	TBT Side arm deploy, TBT GAMBAS deploy
09:15	09:45	00:30	2.9b UXO with Refraction Seismic and MASW	1 line
09:45	10:20	00:35	Deployment / Recovery	TBT Recovery and deployment of GAMBAS. To check for sand/silt in streamer.
10:20	12:30	02:10	2.9b UXO with Refraction Seismic and MASW	3 lines acquired
12:30	13:00	00:30	Deployment / Recovery	TBT GAMBAS recovery (also covered redeployment but did not redeploy), TBT Sidearm recovery
13:00	14:00	01:00	Transit	Transit back to port as deteriorating weather conditions prevented further deployment of GAMBAS equipment.
14:00	16:50	02:50	WoW - Alongside	WoW alongside.

Time Summary

Begin	End	Duration	Type	Description
16:50	17:20	00:30	Crew Travel to / from Accommodation	From vessel
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	5.5	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:49	Hours	99.2%
3.5a Sailing and Standby Rate UHRS	DR	24:00	9:20	175:44	Hours	732.2%
Refraction and MASW using GAMBAS	DR	24:00	2:40	15:18	Hours	63.8%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	110:30	Hours	306.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	1	0.8	NA	NA	
Wind Speed	Knots	10	10	NA	NA	
Wind Direction	Coords	nw	w	NA	NA	

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	200.00	300.00	7,602.00	L

Client Rep Comments

Party Chief Comments

Sailed acquiring 4 priority lines in the channel. GAMBAS recovered and redeployed during acquisition to check for sand/silt build up.

Vessel to sail to acquire a comparison rerun line to the North of the channel then the remaining 4 priority lines in the channel.

Fugro Representative

Peter Horobin
Party Chief

12/10/2022

Client Representative

11/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	101	**Date:**	11/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	237
Daily Meeting	1	/	83
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6354
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

6 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recovery and redeploy
GAMBAS recovery and redeploy (GAMBAS was not redeployed due to adverse sea conditions)
Sidearm recovery

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	90:40	3.74%
Port Call - Overnight	12:00	/	1206:30	49.77%
Transit	2:25	/	75:16	3.11%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.33%
2.9 UXO with GRAD	0:00	/	60:34	2.50%
2.9a UXO with UHRS	0:00	/	19:23	0.80%
2.9b UXO with Refraction Seismic and MASW	2:40	/	15:18	0.63%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.17%
Deployment / Recovery	1:35	/	20:49	0.86%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:20	/	35:09	1.45%
SVP Dip	0:25	/	5:07	0.21%
Mobilisation Alongside	0:00	/	195:04	8.05%
Mobilisation Calibrations	0:00	/	18:46	0.77%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.20%
WoW - Mobilisation	0:00	/	24:30	1.01%
WoW - At Sea	0:45	/	7:30	0.31%
WoW - Alongside	2:50	/	440:46	18.18%
Standby Marine Mammal Observance	0:00	/	7:25	0.31%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	0:00	/	10:21	0.43%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.97%
Downtime Survey	0:00	/	12:13	0.50%
Total	24:00	/	2424:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:50	00:30	Crew Travel to / from Accommodation	To vessel
05:50	06:10	00:20	Vessel Duties	Prep for sea
06:10	07:35	01:25	Transit	To site
07:35	08:00	00:25	SVP Dip	TBT SVP
08:00	08:45	00:45	WoW - At Sea	Conditions unsuitable for safe deployment. 1m wave height initially.
08:45	09:15	00:30	Deployment / Recovery	TBT Side arm deploy, TBT GAMBAS deploy
09:15	09:45	00:30	2.9b UXO with Refraction Seismic and MASW	1 line
09:45	10:20	00:35	Deployment / Recovery	TBT Recovery and deployment of GAMBAS. To check for sand/silt in streamer.
10:20	12:30	02:10	2.9b UXO with Refraction Seismic and MASW	3 lines acquired
12:30	13:00	00:30	Deployment / Recovery	TBT GAMBAS recovery (also covered redeployment but did not redeploy), TBT Sidearm recovery
13:00	14:00	01:00	Transit	Transit back to port as deteriorating weather conditions prevented further deployment of GAMBAS equipment.
14:00	16:50	02:50	WoW - Alongside	WoW alongside.

Time Summary

Begin	End	Duration	Type	Description
16:50	17:20	00:30	Crew Travel to / from Accommodation	From vessel
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	5.5	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopsyhical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	2:40	15:18	Hours	63.8%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	9:20	130:03	Hours	361.2%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

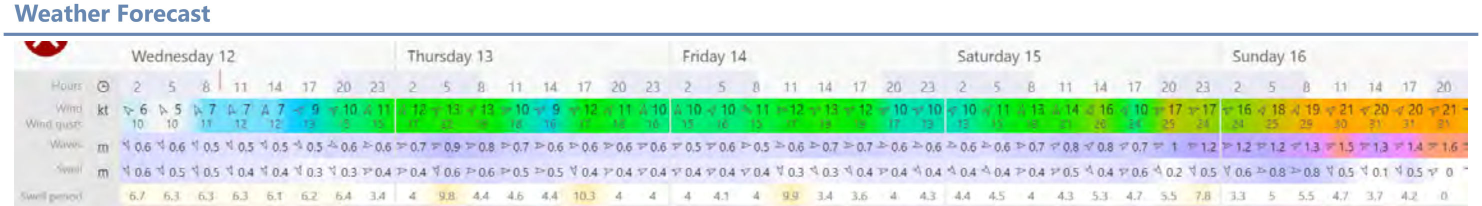
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	nw	w	NA	NA	
Wind Speed	Knots	10	10	NA	NA	
Sig Wave	m	1	0.8	NA	NA	

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	200.00	300.00	7,602.00	L

DOME

Client Rep Comments

Party Chief Comments

Sailed acquiring 4 priority lines in the channel. GAMBAS recovered and redeployed during acquisition to check for sand/silt build up.

Vessel to sail to acquire a comparison rerun line to the North of the channel then the remaining 4 priority lines in the channel.

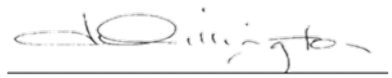
DPR81 (21/9/22) has been updated retrospectively to reflect Nearshore Concession 1. Within the Time Summary, acquisition of incorrect UHRS line (24 minutes) has been changed to Downtime-Survey. Production summary was also updated to remove 24 minutes of UHRS Acquisition.

Fugro Representative

Peter Horobin
Party Chief

12/10/2022

Client Representative



11/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	102	**Date:**	12/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	243
Daily Meeting	1	/	84
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6414
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

6 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recovery and redeploy
GAMBAS recovery
Sidearm recovery

0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:35	/	91:15	3.73%
Port Call - Overnight	12:00	/	1218:30	49.78%
Transit	2:14	/	77:30	3.17%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.32%
2.9 UXO with GRAD	0:00	/	60:34	2.47%
2.9a UXO with UHRS	0:00	/	19:23	0.79%
2.9b UXO with Refraction Seismic and MASW	5:16	/	20:34	0.84%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	1:34	/	22:23	0.91%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:05	/	35:14	1.44%
SVP Dip	0:16	/	5:23	0.22%
Mobilisation Alongside	0:00	/	195:04	7.97%
Mobilisation Calibrations	0:00	/	18:46	0.77%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.18%
WoW - Mobilisation	0:00	/	24:30	1.00%
WoW - At Sea	0:00	/	7:30	0.31%
WoW - Alongside	0:00	/	440:46	18.01%
Standby Marine Mammal Observance	0:00	/	7:25	0.30%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	2:00	/	12:21	0.50%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.93%
Downtime Survey	0:00	/	12:13	0.50%
Total	24:00	/	2448:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:55	00:35	Crew Travel to / from Accommodation	To vessel
05:55	06:00	00:05	Vessel Duties	Prep for sea
06:00	07:14	01:14	Transit	To site
07:14	07:30	00:16	SVP Dip	TBT SVP
07:30	07:50	00:20	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS deploy
07:50	11:45	03:55	2.9b UXO with Refraction Seismic and MASW	5 lines; 1 rerun and 4 priority lines
11:45	12:35	00:50	Deployment / Recovery	TBT GAMBAS recovery and redeployment (to check the streamer for sand build up)
12:35	13:56	01:21	2.9b UXO with Refraction Seismic and MASW	2 none priority lines in the channel
13:56	14:20	00:24	Deployment / Recovery	TBT recover GAMBAS, TBT recover sidearm
14:20	15:20	01:00	Transit	From site
15:20	17:20	02:00	Standby Data QC	Standby data QC
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	6:44	182:28	Hours	760.3%
Refraction and MASW using GAMBAS	DR	24:00	5:16	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	110:30	Hours	306.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.7	0.7	NA	NA	
Wind Speed	Knots	11	11	NA	NA	
Wind Direction	Coords	s	s	NA	NA	

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	200.00	100.00	7,802.00	L

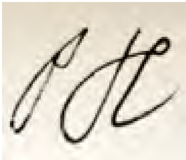
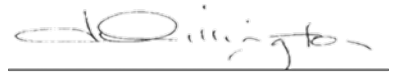
Client Rep Comments

Party Chief Comments

Vessel sailed acquiring remaining priority lines in the main channel. Afterward two extra lines acquired also in the main channel.

Party Chief Comments

Vessel alongside on standby QC with processing of data. Logistics tasks and bunkering to be undertaken.

Fugro Representative		Client Representative	
			
Peter Horobin **Party Chief**	**13/10/2022**		**12/10/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	102	**Date:**	12/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	243
Daily Meeting	1	/	84
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6414
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

6 x TBT
SVP
Sidearm deploy
GAMBAS deploy
GAMBAS recovery and redeploy
GAMBAS recovery
Sidearm recovery

0 x Incident or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:35	/	91:15	3.73%
Port Call - Overnight	12:00	/	1218:30	49.78%
Transit	2:14	/	77:30	3.17%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.32%
2.9 UXO with GRAD	0:00	/	60:34	2.47%
2.9a UXO with UHRS	0:00	/	19:23	0.79%
2.9b UXO with Refraction Seismic and MASW	5:16	/	20:34	0.84%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	1:34	/	22:23	0.91%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:05	/	35:14	1.44%
SVP Dip	0:16	/	5:23	0.22%
Mobilisation Alongside	0:00	/	195:04	7.97%
Mobilisation Calibrations	0:00	/	18:46	0.77%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.18%
WoW - Mobilisation	0:00	/	24:30	1.00%
WoW - At Sea	0:00	/	7:30	0.31%
WoW - Alongside	0:00	/	440:46	18.01%
Standby Marine Mammal Observance	0:00	/	7:25	0.30%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	2:00	/	12:21	0.50%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.93%
Downtime Survey	0:00	/	12:13	0.50%
Total	24:00	/	2448:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:55	00:35	Crew Travel to / from Accommodation	To vessel
05:55	06:00	00:05	Vessel Duties	Prep for sea
06:00	07:14	01:14	Transit	To site
07:14	07:30	00:16	SVP Dip	TBT SVP
07:30	07:50	00:20	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS deploy
07:50	11:45	03:55	2.9b UXO with Refraction Seismic and MASW	5 lines; 1 rerun and 4 priority lines
11:45	12:35	00:50	Deployment / Recovery	TBT GAMBAS recovery and redeployment (to check the streamer for sand build up)
12:35	13:56	01:21	2.9b UXO with Refraction Seismic and MASW	2 none priority lines in the channel
13:56	14:20	00:24	Deployment / Recovery	TBT recover GAMBAS, TBT recover sidearm
14:20	15:20	01:00	Transit	From site
15:20	17:20	02:00	Standby Data QC	Standby data QC
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	6:44	182:28	Hours	760.3%
Refraction and MASW using GAMBAS	DR	24:00	5:16	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	110:30	Hours	306.9%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Sig Wave	m	0.7	0.7	NA	NA	
Wind Speed	Knots	11	11	NA	NA	
Wind Direction	Coords	s	s	NA	NA	

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	200.00	100.00	7,802.00	L

Client Rep Comments

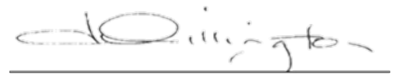
Party Chief Comments

Vessel sailed acquiring remaining priority lines in the main channel. Afterward two extra lines acquired also in the main channel.

Party Chief Comments

Vessel alongside on standby QC with processing of data. Logistics tasks and bunkering to be undertaken.

Please note that DDPR 81 has been reissued due a client concession for a UHRS line which was not acquired. This has reduced the time spend on UHRS data acquisition.

Fugro Representative		Client Representative
		
Peter Horobin **Party Chief**	**13/10/2022**	**12/10/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route
Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	102	**Date:**	12/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	6	/	243
Daily Meeting	1	/	84
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6414
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:35	/	91:15	3.73%
Port Call - Overnight	12:00	/	1218:30	49.78%
Transit	2:14	/	77:30	3.17%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.32%
2.9 UXO with GRAD	0:00	/	60:34	2.47%
2.9a UXO with UHRS	0:00	/	19:23	0.79%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9b UXO with Refraction Seismic and MASW	5:16	/	20:34	0.84%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	1:34	/	22:23	0.91%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:05	/	35:14	1.44%
SVP Dip	0:16	/	5:23	0.22%
Mobilisation Alongside	0:00	/	195:04	7.97%
Mobilisation Calibrations	0:00	/	18:46	0.77%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.18%
WoW - Mobilisation	0:00	/	24:30	1.00%
WoW - At Sea	0:00	/	7:30	0.31%
WoW - Alongside	0:00	/	440:46	18.01%
Standby Marine Mammal Observance	0:00	/	7:25	0.30%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	2:00	/	12:21	0.50%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.93%
Downtime Survey	0:00	/	12:13	0.50%
Total	24:00	/	2448:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:20	05:20	Port Call - Overnight	Alongside Scheveningen
05:20	05:55	00:35	Crew Travel to / from Accommodation	To vessel
05:55	06:00	00:05	Vessel Duties	Prep for sea
06:00	07:14	01:14	Transit	To site
07:14	07:30	00:16	SVP Dip	TBT SVP
07:30	07:50	00:20	Deployment / Recovery	TBT Sidearm deploy, TBT GAMBAS deploy
07:50	11:45	03:55	2.9b UXO with Refraction Seismic and MASW	5 lines; 1 rerun and 4 priority lines
11:45	12:35	00:50	Deployment / Recovery	TBT GAMBAS recovery and redeployment (to check the streamer for sand build up)
12:35	13:56	01:21	2.9b UXO with Refraction Seismic and MASW	2 none priority lines in the channel
13:56	14:20	00:24	Deployment / Recovery	TBT recover GAMBAS, TBT recover sidearm
14:20	15:20	01:00	Transit	From site
15:20	17:20	02:00	Standby Data QC	Standby data QC
17:20	24:00	06:40	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Refraction Seismic Line KM Completion	DR	39.8	0.0	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	5:16	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	6:44	136:47	Hours	380.0%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	s	s	NA	NA	
Wind Speed	Knots	11	11	NA	NA	
Sig Wave	m	0.7	0.7	NA	NA	

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	0.00	300.00	7,602.00	L

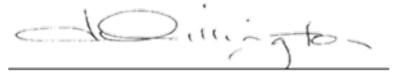
Client Rep Comments

Party Chief Comments

Vessel sailed acquiring remaining priority lines in the main channel. Afterward two extra lines acquired also in the main channel.

Vessel alongside on standby QC with processing of data. Logistics tasks and bunkering to be undertaken.

Please note that DDPR 81 has been reissued due a client concession for a UHRS line which was not acquired. This has reduced the time spend on UHRS data acquisition.

Fugro Representative		Client Representative	
			
Peter Horobin Party Chief	13/10/2022		12/10/2022

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	103	**Date:**	13/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	243
Daily Meeting	0	/	84
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6474
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC
0 x TBT
0 x Incident or Near MIss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	92:15	3.73%
Port Call - Overnight	12:00	/	1230:30	49.78%
Transit	0:00	/	77:30	3.14%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.30%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9 UXO with GRAD	0:00	/	60:34	2.45%
2.9a UXO with UHRS	0:00	/	19:23	0.78%
2.9b UXO with Refraction Seismic and MASW	0:00	/	20:34	0.83%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	0:00	/	22:23	0.91%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	35:14	1.43%
SVP Dip	0:00	/	5:23	0.22%
Mobilisation Alongside	0:00	/	195:04	7.89%
Mobilisation Calibrations	0:00	/	18:46	0.76%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	0:00	/	29:00	1.17%
WoW - Mobilisation	0:00	/	24:30	0.99%
WoW - At Sea	0:00	/	7:30	0.30%
WoW - Alongside	0:00	/	440:46	17.83%
Standby Marine Mammal Observance	0:00	/	7:25	0.30%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	11:00	/	23:21	0.94%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.89%
Downtime Survey	0:00	/	12:13	0.49%
Total	24:00	/	2472:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	06:00	06:00	Port Call - Overnight	Alongside Scheveningen
06:00	06:30	00:30	Crew Travel to / from Accommodation	To vessel
06:30	17:30	11:00	Standby Data QC	Data processing and presentation, logistics tasks, bunkering
17:30	18:00	00:30	Crew Travel to / from Accommodation	From vessel
18:00	24:00	06:00	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	23.5	km	59.0%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	182:28	Hours	760.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	12:00	122:30	Hours	340.3%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

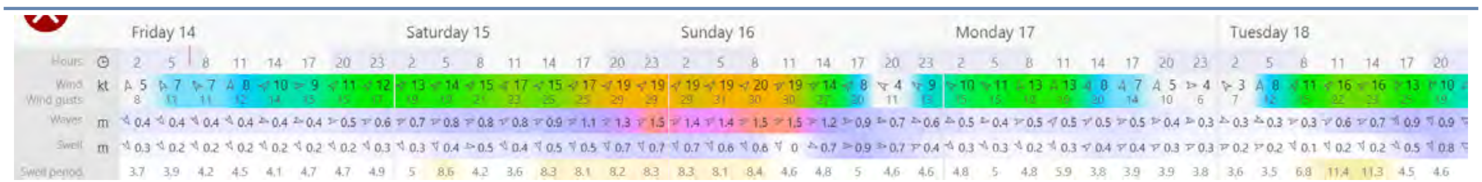
POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast



Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	300.00	0.00	-200.00	500.00	7,402.00	L

Client Rep Comments

Party Chief Comments

Vessel on standby data QC. Data processing, presentation and logistics tasks undertaken. Vessel bunkered.

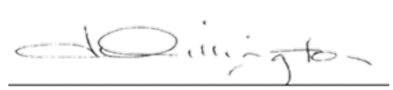
Data to be presented to client rep today for evaluation.

Fugro Representative

Peter Horobin
Party Chief

14/10/2022

Client Representative



13/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	104	**Date:**	14/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	0	/	243
Daily Meeting	0	/	84
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	0	/	6474
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

0 x HOC

1 x TBT
Removal of side arm

0 x Incidents or Near Miss

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	1:00	/	93:15	3.74%
Port Call - Overnight	12:00	/	1242:30	49.78%

Summary of Activities

Activity	Today	/	To Date	Progress
Transit	0:00	/	77:30	3.10%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.29%
2.9 UXO with GRAD	0:00	/	60:34	2.43%
2.9a UXO with UHRS	0:00	/	19:23	0.78%
2.9b UXO with Refraction Seismic and MASW	0:00	/	20:34	0.82%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	0:00	/	22:23	0.90%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	35:14	1.41%
SVP Dip	0:00	/	5:23	0.22%
Mobilisation Alongside	0:00	/	195:04	7.82%
Mobilisation Calibrations	0:00	/	18:46	0.75%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	10:00	/	39:00	1.56%
WoW - Mobilisation	0:00	/	24:30	0.98%
WoW - At Sea	0:00	/	7:30	0.30%
WoW - Alongside	0:00	/	440:46	17.66%
Standby Marine Mammal Observance	0:00	/	7:25	0.30%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	1:00	/	24:21	0.98%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.85%
Downtime Survey	0:00	/	12:13	0.49%
Total	24:00	/	2496:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:30	05:30	Port Call - Overnight	Alongside Scheveningen
05:30	06:00	00:30	Crew Travel to / from Accommodation	To vessel
06:00	07:00	01:00	Standby Data QC	Standby data QC until completion certificate signed at 0700
07:00	17:00	10:00	Demobilisation Alongside	Demobilisation.
17:00	17:30	00:30	Crew Travel to / from Accommodation	From vessel
17:30	24:00	06:30	Port Call - Overnight	Alongside Scheveningen

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	8.2	31.7	km	79.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophysical	DR	51:00	0:00	200:02	Hours	392.2%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	182:28	Hours	760.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	1:30	123:60	Hours	344.4%
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	0.0	0.0	N°	0.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	0	0	5
Total	5	0	0	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments

Weather Forecast

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	7,402.00	L

Client Rep Comments

Party Chief Comments

Vessel on standby data QC until project completion certificate signed off. Demobilisation commenced.

Tomorrow lift off of GAMBAS equipment to take place and handover to new Party Chief.

Please note that the line km from the 12 October did not record properly in the DPR. This has been added to todays DPR to reflect the total line km run during the Refraction Seismic and MASW scope.

Fugro Representative		Client Representative	
			
Peter Horobin **Party Chief**	**15/10/2022**		**14/10/2022**

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	105	**Date:**	15/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	1	/	244
Daily Meeting	1	/	85
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6534
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 x TBT - Lifting operations using a shore side crane.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:00	/	93:15	3.70%
Port Call - Overnight	18:15	/	1260:45	50.03%
Transit	0:30	/	78:00	3.10%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.28%
2.9 UXO with GRAD	0:00	/	60:34	2.40%
2.9a UXO with UHRS	0:00	/	19:23	0.77%

Summary of Activities

Activity	Today	/	To Date	Progress
2.9b UXO with Refraction Seismic and MASW	0:00	/	20:34	0.82%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	0:00	/	22:23	0.89%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	35:14	1.40%
SVP Dip	0:00	/	5:23	0.21%
Mobilisation Alongside	0:00	/	195:04	7.74%
Mobilisation Calibrations	0:00	/	18:46	0.74%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	5:15	/	44:15	1.76%
WoW - Mobilisation	0:00	/	24:30	0.97%
WoW - At Sea	0:00	/	7:30	0.30%
WoW - Alongside	0:00	/	440:46	17.49%
Standby Marine Mammal Observance	0:00	/	7:25	0.29%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	0:00	/	24:21	0.97%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.82%
Downtime Survey	0:00	/	12:13	0.48%
Total	24:00	/	2520:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:00	05:00	Port Call - Overnight	Alongside Scheveningen
05:00	05:30	00:30	Transit	Transit to vessel
05:30	10:45	05:15	Demobilisation Alongside	Lifting off the Gambas survey equipment from the vessel and preparing vessel for transit
10:45	24:00	13:15	Port Call - Overnight	Vessel alongside in Scheveningen overnight

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	31.7	km	79.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geopshyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	182:28	Hours	760.3%
Refraction and MASW using GAMBAS	DR	24:00	0:00	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	123:60	Hours	344.4%

DOME

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	1.0	1.0	N°	100.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	-	-	-	-	
Wind Speed	Knots	-	-	-	-	
Sig Wave	m	-	-	-	-	

Weather Forecast

N/A

Liquids Status

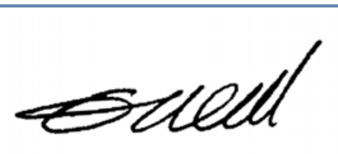
Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	7,402.00	L

Client Rep Comments

Party Chief Comments

All GAMBAS equipment was demobilised from the vessel using a shoreside crane in Scheveningen. Peter Horobin departed the vessel and was replaced by Oli Neill for the final day of demobilisation.

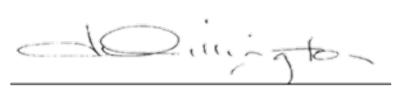
Fugro Representative



Oli Neill
Party Chief

16/10/2022

Client Representative



15/10/2022

DOME

DAILY PROGRESS REPORT

TOTAL NL Aramis Pipeline Route Survey

Fugro Seeker

Project No.:	197217	**Report No.:**	105	**Date:**	15/10/2022
Client:	TotalEnergies EP Nederland BV			**Timezone:**	UTC
Location:	Scheveningen, NL				

Quality, Health, Safety and Environment

Safety Information	Today	/	To Date
HOC - Safe Act	0	/	8
HOC - Unsafe Act	0	/	0
HOC - Unsafe Condition	0	/	8
HOC - Suggestion	0	/	8
Vessel Drill - Specify in comments	0	/	13
Cross Department Tour	0	/	11
Audit / Inspection	0	/	2
Toolbox Talk	1	/	244
Daily Meeting	1	/	85
Crew Led Kick-Off Meeting	0	/	2
Safety meeting	0	/	13
Total Persons Onboard	5		
Crew Hours	60	/	6534
Two Part HIRA (Held Onboard)	0	/	2
Soundbite Training	0	/	5
Vessel Induction (No. of persons)	0	/	11
Workpack Review	0	/	1
Permit to Work	0	/	1
Quality - Lessons Learned	0	/	0
Security Incidents	0	/	0
Environmental Incidents	0	/	0
Health & Safety Incidents	0	/	0
Incident - Specify in Comments	0	/	0
Near Miss - Specify in Comments	0	/	1

HSE Comments

1 x TBT - Lifting operations using a shore side crane.

Summary of Activities

Activity	Today	/	To Date	Progress
Crew Travel to / from Accommodation	0:00	/	93:15	3.70%
Port Call - Overnight	18:15	/	1260:45	50.03%
Transit	0:30	/	78:00	3.10%
2.8 Geophysical acquisition (MBES, SSS, SBP and MAG)	0:00	/	32:14	1.28%
2.9 UXO with GRAD	0:00	/	60:34	2.40%
2.9a UXO with UHRS	0:00	/	19:23	0.77%

DOME

Summary of Activities

Activity	Today	/	To Date	Progress
2.9b UXO with Refraction Seismic and MASW	0:00	/	20:34	0.82%
Infill - MBES	0:00	/	1:26	0.06%
Infill - SSS	0:00	/	1:59	0.08%
Infill - UHRS	0:00	/	4:02	0.16%
Deployment / Recovery	0:00	/	22:23	0.89%
Recce	0:00	/	2:25	0.10%
Vessel Duties	0:00	/	35:14	1.40%
SVP Dip	0:00	/	5:23	0.21%
Mobilisation Alongside	0:00	/	195:04	7.74%
Mobilisation Calibrations	0:00	/	18:46	0.74%
Mobilisation Transit	0:00	/	3:30	0.14%
Demobilisation Alongside	5:15	/	44:15	1.76%
WoW - Mobilisation	0:00	/	24:30	0.97%
WoW - At Sea	0:00	/	7:30	0.30%
WoW - Alongside	0:00	/	440:46	17.49%
Standby Marine Mammal Observance	0:00	/	7:25	0.29%
Standby Marine Traffic	0:00	/	3:56	0.16%
Standby Tide / Currents	0:00	/	0:40	0.03%
Standby Client	0:00	/	2:44	0.11%
Standby Data QC	0:00	/	24:21	0.97%
Standby Other	0:00	/	0:30	0.02%
Downtime Vessel	0:00	/	96:13	3.82%
Downtime Survey	0:00	/	12:13	0.48%
Total	24:00	/	2520:00	

Time Summary

Begin	End	Duration	Type	Description
00:00	05:00	05:00	Port Call - Overnight	Alongside Scheveningen
05:00	05:30	00:30	Transit	Transit to vessel
05:30	10:45	05:15	Demobilisation Alongside	Lifting off the Gambas survey equipment from the vessel and preparing vessel for transit
10:45	24:00	13:15	Port Call - Overnight	Vessel alongside in Scheveningen overnight

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
Geophysical Line KM completion	DR	133.0	0.0	133.0	km	100.0%
UXO Line KM completion	DR	58.1	0.0	70.9	km	122.0%
UHRS Line KM Completion	DR	61.7	0.0	55.0	km	89.1%
Refraction Seismic Line KM Completion	DR	39.8	0.0	31.7	km	79.6%
2.8 Geophysical	DR	64:00	0:00	67:39	Hours	105.7%
3.4 Sailing and Standby Rate Geophsyical	DR	51:00	0:00	200:02	Hours	392.2%
UXO Scouting with GRAD	DR	0:00	0:00	69:29	Hours	0.0%
3.5 Sailing and Standby Rate UXO Scouting with GRAD	DR	0:00	0:00	192:14	Hours	0.0%
Scouting with UHRS	DR	24:00	0:00	23:25	Hours	97.6%
3.5a Sailing and Standby Rate UHRS	DR	24:00	0:00	156:11	Hours	650.8%
Refraction and MASW using GAMBAS	DR	24:00	0:00	20:34	Hours	85.7%
3.5b Sailing and Standby Rate Refraction Seismic and MASW	DR	36:00	0:00	150:17	Hours	417.5%

Production Summary

Product	DR/ LS	Estimated	Produced	To Date	Unit	Progress
1.4 Mobilisation - Geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.5 Demobilisation - geophysical	LS	1.0	0.0	1.0	N°	100.0%
1.4a Mobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.5a Demobilisation - UHRS	LS	1.0	0.0	1.0	N°	100.0%
1.4b Mobilisation - Refraction Seismic and MASW	LS	1.0	0.0	1.0	N°	100.0%
1.5b Demobilisation - Refraction Seismic and MASW	LS	1.0	1.0	1.0	N°	100.0%

POB Status

	Yesterday	Arrived	Departed	Onboard
Master, Party Chief, Surveyor Etc.	5	1	1	5
Total	5	1	1	5

Weather and Sea State Status

Weather and Sea State	Unit	06:00	12:00	18:00	24:00	Comments
Wind Direction	Coords	-	-	-	-	
Wind Speed	Knots	-	-	-	-	
Sig Wave	m	-	-	-	-	

Weather Forecast

N/A

Liquids Status

Item	Amount at start	Added today	Used Today	Amount at End	Used to Date	Unit
Fuel - Litres	500.00	0.00	0.00	500.00	7,402.00	L

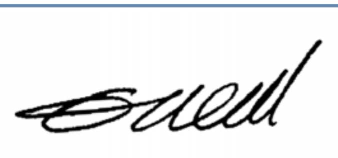
Client Rep Comments

Party Chief Comments

All GAMBAS equipment was demobilised from the vessel using a shoreside crane in Scheveningen. Peter Horobin departed the vessel and was replaced by Oli Neill for the final day of demobilisation.

PM Comment: DPR has been reissued to reflect changes to retrospective changes to DDPRs 94, 101 and 102. Sailing and Standby for these days was incorrectly recorded as UHRS Sailing/Standby on these days.

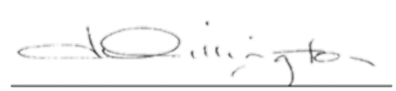
Fugro Representative



Oli Neill
Party Chief

16/10/2022

Client Representative



15/10/2022

DOME

ARAMIS DEVELOPMENT

BB03 FLOW ASSURANCE STUDY REPORT

ARM-PFE-BB3-PRO-REP-0242 / Rev. 3 October 2023

Identification page

Title: Aramis development – Flow Assurance study

Entity: **OT/TL/PROC/PF&FA/FA** Location – Date: Paris - 12/10/2023

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R. KHIARI Electronic signature	C. CANDELIER Electronic signature	C. CANDELIER Electronic signature

Keywords (10 max.- other than title): Netherlands, Aramis, Offshore, CO_2 injection, CO_2 with impurities, complex network

Geographical references: Netherlands, Rotterdam, Dutch Continental Shelf, Aramis

Abstract:

The Aramis project is a cooperation between Shell, TotalEnergies, EBN and GasUnie. It aims to develop a CO_2 transportation infrastructure that can bring captured CO_2 from emitters to offshore storage sites on the Dutch Continental Shelf.
The first phase of the project is estimated to bring just over 5 MTPA transport capacity with a full growth case estimated at some 22 MTPA. The design life of the transport infrastructure will be 30 years for end-of-life activities.
A number of impurities are included in the CO_2 specification which could be of a great challenge when defining operating philosophies.

This document presents the steady state and transient thermo-hydraulic analysis performed for the injection of CO_2 with impurities through Aramis injection system and more specifically its trunkline.

The objectives of this report are:

- Determine steady state conditions to confirm the operability of the network while ensuring that the CO_2 remains in the dense phase.
- Support the preparation of an operating philosophy and relevant procedures and equipment for transient operations (first filling, depressurization, Etc.).

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1 GENERAL

1.1 Project presentation

The Aramis project is a cooperation between Shell, TotalEnergies, EBN and GasUnie. Aramis aims to develop a CO_2 transportation infrastructure (together with CO2next and Porthos) that can bring captured CO_2 from emitter to offshore storage sites on the Dutch Continental Shelf.

Where efficient and applicable, the infrastructure will be developed in a phased manner to match the supply of CO_2 (scalable approach). The first phase is estimated to bring just over 5 MTPA transport capacity with a full growth case estimated at some 22 MTPA. The design life of the transport infrastructure will be 30 years for end-of-life activities.

Once the Aramis system is established, it would unlock the majority of offshore storage capacities in the Dutch sector of the North Sea, allowing incremental emitter by emitter decarbonization through incremental storage development.

Aramis Transport Launching phase is targeting to inject a minimum of 5 MTPA average of CO_2 with an aspirational RFSU in Q1 2028 (first pick up of CO_2 at emitters) and first injection in reservoir in Q1 2027. Of the 5 MTPA about 2 MTPA will be transported by barges to the CO2next Terminal. Another 3 MTPA will tie into the yet to be constructed Porthos onshore pipeline (vapor phase) and the existing OCAP pipeline. These volumes will arrive at the Porthos compressor station and will be compressed into the offshore trunkline transporting the CO_2 to the storage sites. The compressors are assumed to be located at the premises of the Porthos compressor station. The injection split for the Launch phase is assumed to be 50/50% between the Shell and TotalEnergies storage fields.

Aramis, a cooperation between TotalEnergies, Shell, EBN and Gasunie, is incorporating, from the onset, a cross-border approach, providing a decarbonization solution for North-West Europe. Aramis will deliver through studies and through establishing agreements with other operators in the transport infrastructure such as Co2next and Porthos an end-to-end transport solution for CO_2 molecules from emitter to store.

The Aramis Transport CCS network, contains the following:

- **Shipping solution - studied by Aramis** - that will collect liquified CO_2 from new export terminals located in the North Sea Port area on both sides of the Westerschelde estuary.
- **A new receiving shipping terminal at Maasvlakte - studied by CO2next** (to be built and operated by CO2next)**:** Liquid CO_2 will be transported by coasters/barges from different industrial clusters located in the Northwest Europe region to a new receiving terminal and temporary storage in an onshore hub located at the Maasvlakte near Rotterdam.
- **Adding compressor capacity to the Porthos compressors station – studied jointly between Aramis and Porthos.** Compressed (gas phase) CO_2 volumes coming by onshore pipeline from Rotterdam and its hinterlands will be further compressed in a compressor station and combined with liquid CO_2 for transport through a new high-pressure, ambient-temperature offshore trunkline to the receiving offshore platforms.
- **A trunkline – studied by Aramis:** Aramis envisages a ~200 km oversized trunkline (dense phase) to the offshore platforms / blocks with tie-in points to cater for future growth and enable third-party access.

The scope for the ARAMIS common infrastructure is divided into Building Blocks (BB). Aramis partners have agreed to develop Building Blocks jointly or individually, see figure below (Ref. [1]).

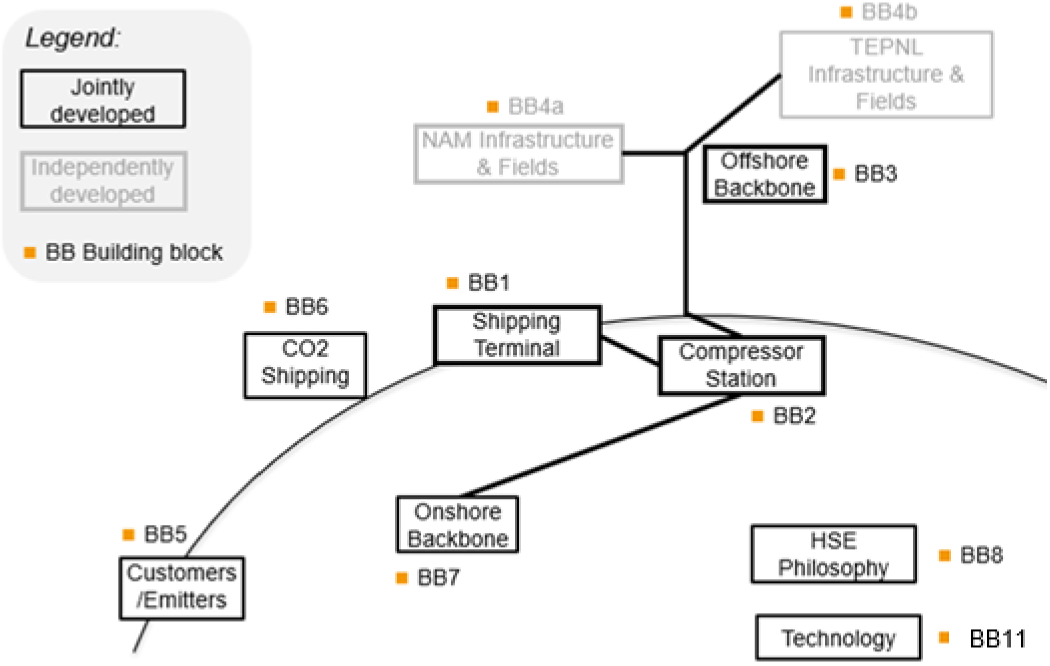

Figure 1-1: Aramis Transport Scope of Work

For the next phase (technical work until start of FEED) the technical work will be led by integrated ARAMIS teams with one company leading each block, as per below table:

	Description	Key focal point/Lead
BB01	Terminal	TotalEnergies
BB02	Compressor	Shell
BB03	Backbone	TotalEnergies
BB06	Shipping	Shell
BB08 A	Operations	Shell
BB08 B	HSSE	Shell / TotalEnergies combined
BB11	ICCS/Telecom	Shell / TotalEnergies combined

Table 1-1: Key focal point for each building block

1.2 Purpose of the document

This document presents the steady state and transient thermo-hydraulic analysis performed for the injection of CO_2 through Aramis trunkline.

The objectives of this report are:

- Determine steady state conditions to confirm the operability of the network while ensuring that the CO_2 remains in the dense phase
- Support the preliminary definition of an operating philosophy and procedures based on transient scenario analyses of key operations expected on field.

1.3 Reference documents

1.3.1 Company documents

The following COMPANY documents are referenced in this document

Ref. [X]	Title	Issuer
Ref. [1]	Aramis Transport: Project premises Document	OT/CL/CO2/CCS-DEV
Ref. [2]	Aramis Project – Aramis BB03 Process Report	OT/TL/PROC

Table 1-2: COMPANY documents

2 EXECUTIVE SUMMARY

2.1 Introduction

Aramis project aims to develop a CO_2 transportation infrastructure that can bring captured CO_2 from emitters to offshore storage sites on the Dutch Continental Shelf. The infrastructure will be developed in a phased manner to match the supply of CO_2. The first phase is estimated to bring just over 5 MTPA transport capacity with a full growth case estimated at some 22 MTPA. The design life of the transport infrastructure will be 30 years for end-of-life activities.
A number of impurities are included in the CO_2 specification. The impurity level of several components, including H_2O, are directly linked to maintaining design integrity.

The injection system starts onshore at the Rotterdam port, goes through a 32'' OD trunkline subsea all the way to the K14 ILT/PLET where the take-off for SHELL wells occurs, before getting to the central platform D-HUBN (Also referred to as DHUB) at about 196 km from the inlet and 33 km from K14 ILT/PLET.

At the DHUB, a second take-off for Neptune wells (Platform L10) occurs. The remaining volume is injected in TotalEnergies area at about 26 km from the DHUB through a 24'' OD spurline. The TotalEnergies area, starts at the level of the PLEM and reaches first L4A platform. Only the trunkline and this part of the injected system are covered in this report.

This document presents the steady state and transient thermo-hydraulic analysis performed for the injection of CO_2 with impurities through Aramis injection system and more specifically its trunkline.

The objectives of this report are:

- Determine steady state conditions to confirm the operability of the integrated network while ensuring that the CO_2 remains in the dense phase. The number of steady state simulations has been optimized by selecting critical sizing years along the injection profiles and the inlet conditions. Only the base cases are presented in this section:

- **Base Case 1**: Max Flowrate of 22 MTPA – discharge pressure 180 barg – Inlet temperature 50°C, and considering subsequent reservoir pressure build-up,
- **Base Case 2**: Startup flowrate of 5 MTPA – discharge pressure 150 barg – Inlet temperature 50°C, with no pressure build-up at reservoir level.

- Support the preliminary definition of an operating philosophy and procedures based on transient scenario analyses of key operations expected on field. The injection case selected to perform transient analysis is 22 MTPA. The conducted transient simulations are listed here below:

- **Shutdown – Packing case 1:** Spurious closure of wells while the pumps are still in operation – 22 MTPA steady state as base case (Base Case 1)
- **Shutdown – Packing case 2**: Spurious closure of the Riser Isolation Valve (RIV) at the DHUB while the pumps are still in operation – 22 MTPA all the way to DHUB steady state as base case (Sensitivity Case 1).
- **Shutdown – Depacking**: Spurious shutdown of pumps while the wells are still open – 22 MTPA steady state as base case (Base Case 1).
- **Planned depressurization:** Shutdown of pumps while the wells are still open, then blowdown through the wells until the pressure in the transport line reaches 10 – 20 bar above highest WHSIP or 10 bar above pressure triggering two-phase flow, the wells are then closed, and

depressurization continues through the Restricted orifices (RO) topside – 22 MTPA steady state as base case (Base Case 1).

- **Depressurization after unplanned abnormal shutdown – wells available:** Spurious closure of wells while the pumps are still in operation which would pack the line at highest pressure, then blowdown through one well, the furthest and having the lowest WHSIP (controlled depressurization) until the pressure in the transport line reaches 10 – 20 bar above this lowest WHSIP or 10 bar above pressure triggering two-phase flow – 22 MTPA steady state as base case (Base Case 1).
- **Depressurization after unplanned abnormal shutdown – wells not available:** Spurious closure of wells while the pumps are still in operation which would pack the line at highest pressure, then blowdown through the RO topsides – 22 MTPA steady state as base case (Base Case 1).

2.2 Results & Recommendations

The main outcomes of the present Flow Assurance study for BB03 are summarized here after:

2.2.1 Steady state results

- **22 MTPA peak rate**

Here after are presented the arrival conditions at each platform along with the flowrates for the 22 MTPA peak rate:

Platform	K14	DHUB	L10	TTE PLEM (3)
Arrival flowrate (MTPA)	8	14	6	8
Arrival flowrate (kg/s)	253.68	443.94	190.26	253.68
Arrival pressure (bara) (1)	137.96	135.18	133.79	136.43
Arrival pressure + topside pressure drop margin (2)	132.96	135.18	128.79	136.43
Temperature (°C)	19.2	17.06	16	16.33

Note:

1. The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

2. The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

3. For the peak rate only indicative results of the subsea manifold at 1.9 km from L4A platform and -39 m of water depth are presented

Table 2-1: Arrival conditions at key points of the injection system for 22 MTPA base case

From the present Flow Assurance study, it appears that the injection of 22 MTPA might be highly challenging at the end of life, therefore highlighting the strong effect of the pressure build-up observed in the reservoir during field life.

This is a major uncertainty that is difficult to unlock at this stage.

- **5 MTPA start-up rate**

Here after are presented the arrival conditions at each platform along with the flowrates for the 5 MTPA start-up rate:

Platform	K14	DHUB	L4A
Arrival flowrate (MTPA)	2.5	2.5	2.5
Arrival flowrate (kg/s)	79.27	79.27	79.27
Arrival pressure (bara) (1)	146.49	146.47	146.26
Arrival pressure + topside pressure drop margin (2)	141.49	146.47	141.26
Temperature (°C)	16.96	16.62	15.5
Note: **1.** The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL, **2.** The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL.			

Table 2-2: Arrival conditions at platforms for 5 MTPA base case

2.2.2 Transient simulations results

- **Shutdown – Packing Case 1**

This scenario consists in spurious closure of injection sites (Christmas Tree closure) while onshore pumps are still running.

Pressure build-up anticipated in transport pipeline for this shutdown scenario is presented here after. It is worth mentioning that a Pressure Protection System for the trunkline is supposed to be triggered at 200 barg.

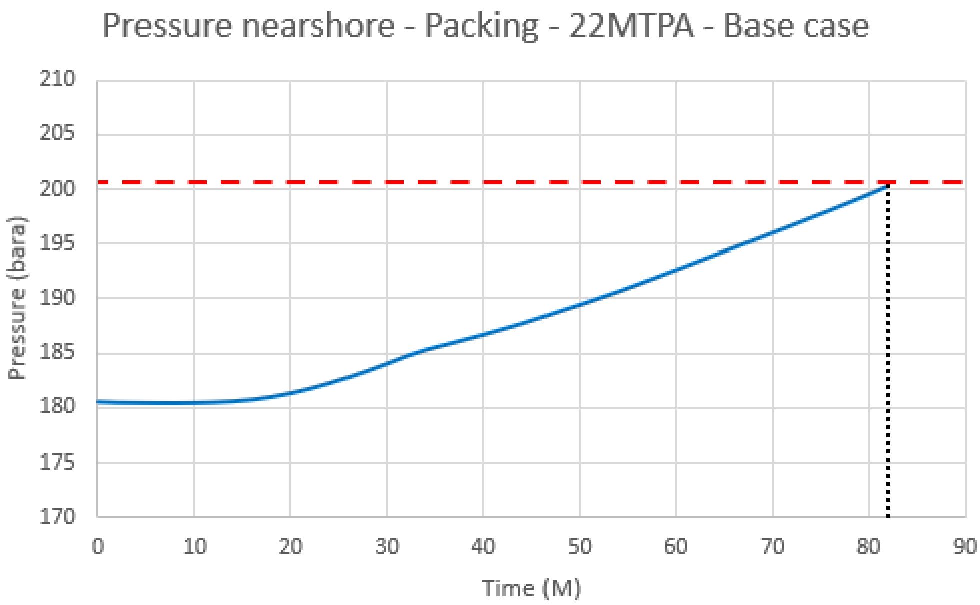

Figure 2-1: Pressure build-up in pipeline with shutdown at injection sites and no shutdown onshore – Base Case

The pressure build-up in the transport pipeline is relatively rapid because of the high initial steady state operating pressure. The higher is the pressure build-up in the reservoir due to CO_2 injection, then the faster is the packing of the transport pipeline. This means that at late life, packing of the trunkline will be faster than at early life conditions.

For the worst scenario (late life, 22 MTPA injection with reservoir pressure build-up), the Pressure Protection System alarm is triggered after 82 min of the unplanned shutdown, leaving enough time for the operators, the pipeline control or pipeline safety system to respond and to avoid a high pipeline shut-in pressure.

- **Shutdown – Packing Case 2**

This scenario consists in spurious closure of Riser Head valve at the central platform DHUB while onshore pumps are still running. This scenario is looked at as faster pressurization is anticipated due to the smaller volume of the pipeline.

Pressure build-up anticipated in transport pipeline for this shutdown scenario is presented here after.

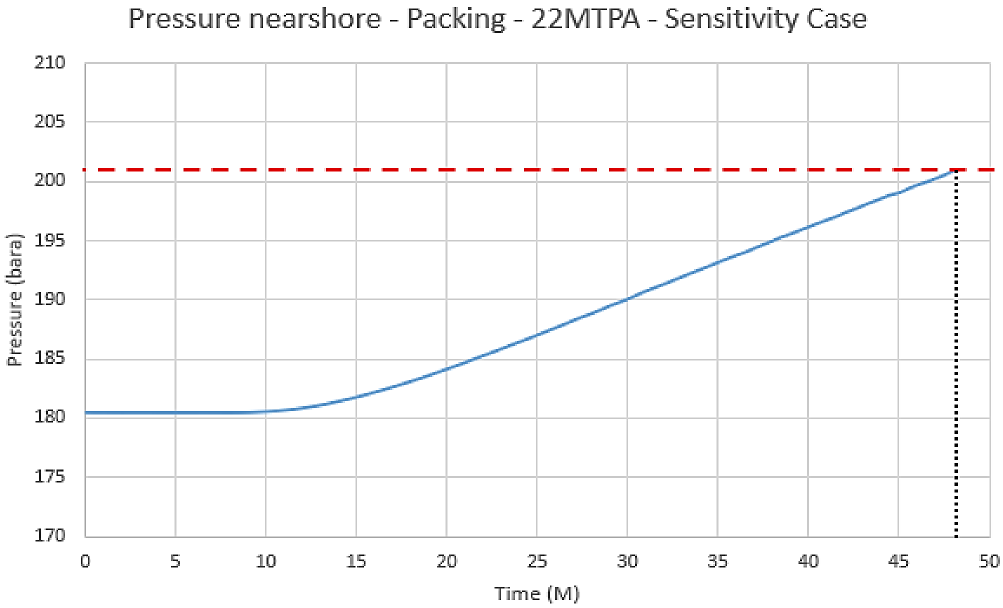

Figure 2-2: Pressure build-up in pipeline with RIV shutdown and no shutdown onshore – Sensitivity Case

As for packing case 1, worst conditions have been considered to define the shortest pressurization time for this sensitivity study, namely, late life conditions with pressurized reservoir and injection at 22 MTPA. For this scenario, the Pressure Protection System alarm is triggered after 48 min of the unplanned shutdown. Even though this case is most likely not to occur, the operators, the pipeline control or pipeline safety system should still have enough time to respond and to avoid a high pipeline shut-in pressure.

- **Shutdown – Depacking**

Transport pipeline blowdown into wells for such shutdown scenario is presented here after:

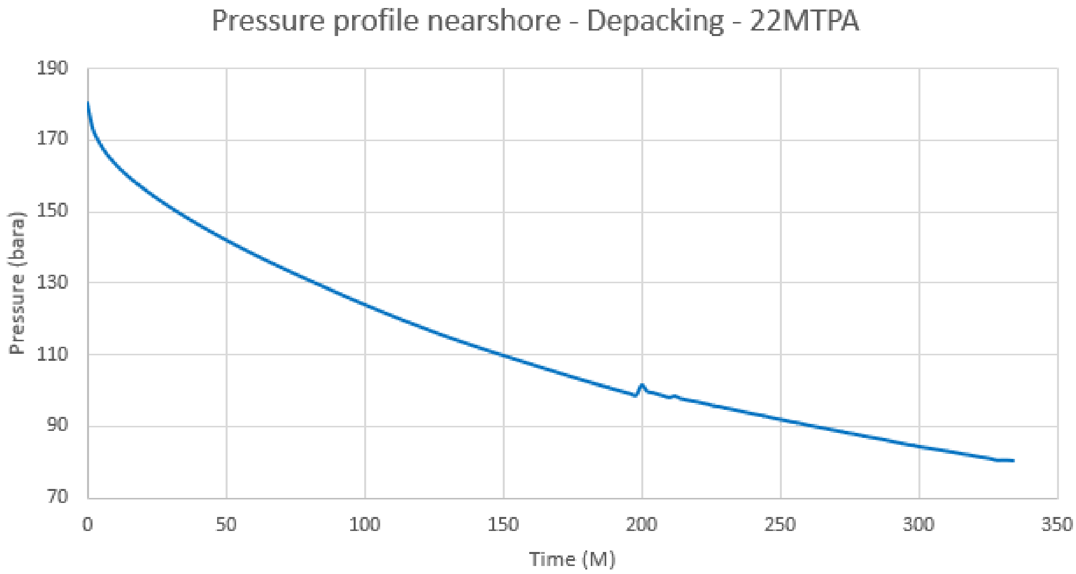

Figure 2-3: Transport pipeline blowdown into wells with shutdown onshore and no shutdown at injection sites

As presented on figure above, the pressure in the transport pipeline decreases by approximately 0.3 bar / min. The present study also highlights that gas flashing is experienced after about 5 hours (300 min) following unplanned shutdown in the beginning of the transport pipeline between the Onshore and the Micro-Tunnel sections.

Those two-phases conditions in the transport pipeline are observed as soon as the Pressure @ Maasvlakte goes below 82 barg. Even with such conditions, operators and control system should have enough time to respond and avoid the appearance of gas pockets within transport pipeline. A pressure set point of 90 barg including a 10 bar margin over the critical point for Low Pressure Alarm should be respected at Maasvlakte terminal, after which the risks of two-phase flow become unavoidable.

Another outcome of the present study is that no crossflow phenomena between the different injection wells will be observed, at least, in the first 5 hours following unplanned shutdown event. The potential risk of cross flow between the different wells has not been further assessed as the injection network should already be in two-phase flow conditions, what should be avoided and can be considered as driving parameter in case of blowdown events.

- **Depressurization**

There is no specific operational requirement for depressurization of the subsea network in normal situation / shutdown. The potential scenarios that may impose a depressurization of the subsea system could be:

- Damage of the transport pipeline requiring repair and then blow-down of subsea system prior any intervention,
- Formation of a plug requiring blow-down to attempt remediating,
- Pipeline decommissioning,
- Operational issues at onshore plant requiring blow-down of the subsea system to control CO_2 release if any.

In the frame of this study, 3 main scenarios have been considered. They are summarized here below. All cases have been covered and deeply assessed. Nevertheless, in order to ease the reading of this report, it has been decided not to present all the cases as all the results are almost similar and proposed design complies with all requirements.

➢ Normal / Planned shutdown:

- Shutdown of the export pumps while the wells are still open in order to empty the pipeline as much as possible,
- When the pressure reaches 90 barg at Maasvlakte terminal and before triggering the two-phase flow, the blowdown through the wells is stopped,
- 1 hour waiting time for the preparation of venting operations,
- Vent through restricted orifice(s),

➢ Abnormal / Unplanned shutdown:

- Spurious closure of wells while the export pumps are still in operation,
- Packing of the transport pipeline at the highest pressure,

- Blowdown operation into the furthest well having the lowest WHSIP (for better control of the depressurization activity, nevertheless number and location of wells still to be defined by Field Operations team – Single well or multi wells operation, acceptance of two-phase flow in well during blowdown, Etc.) until reaching the pressure set point of 90 barg at Maasvlakte terminal, or 10 bar above the lowest WHSIP
- After settle-out pressure in network is about 90 barg or 10 bar above the lowest WHSIP, well is shutdown, and vent through restricted orifice(s) initiated,

Because this case is similar to the planned shutdown with minor differences, only relative results will be presented.

- Abnormal / Unplanned shutdown with line packed and wells are not available,

- Representative scenario in case of hydrates plug before reaching the platforms,
- The export pumps are still in operation and the line is packed,
- 1 hour waiting time for the preparation of venting operations,
- Vent through restricted orifice(s).

This case has a very low probability of occurrence as wells should always be available, at least one, which means that blowdown and pressure reduction into transport pipeline should always be possible through the wells at first. Because this case is similar to the planned shutdown with minor differences, only relative results will be presented.

It is worth mentioning that when depressurizing the CO_2 to atmospheric conditions, extremely low temperatures are anticipated whatever the scenarios considered. Therefore, it is important to control the pressure in the transport pipeline during depressurization operations in order to comply with design temperatures of the transport pipeline. The control of the pressure during blow-down has been achieved by considering staggered depressurization sequence and by adjusting the diameter of the Restriction Orifices over depressurization sequence.

Since there is a high risk of ice formation around the pipe at very low temperatures and in order to take into account enough margin to cover the uncertainties related to *OLGA* software, the minimum considered temperature is 0°C. It is also worth mentioning that the depressurization simulations are very slow, and the temperature does not fall rapidly which means that the margin over the temperature could be relaxed as these calculations are not considered as fast transient.

The back pressure downstream Restriction Orifice should be also defined to avoid ice formation in the depressurization system. In the present study, and considering the phase diagram of CO_2, the pressure has been fixed at 7 bara (above triple point) to avoid ice formation and risk of plugging of depressurization lines. The transition from 7 bara to atmospheric conditions at vent and associated equipment should be developed by Process in accordance with Flow Assurance outcomes / recommendations presented in this report and to mitigate the risks of plugging of the depressurization network.

After completion of the different analyses, proposed design of depressurization system consists in implementing 4 Restriction Orifices. This arrangement has been identified as the best compromise in order to avoid too low temperatures in transport pipeline with regard to design temperature and water icing risks, but also to shorten the duration of the depressurization sequence.

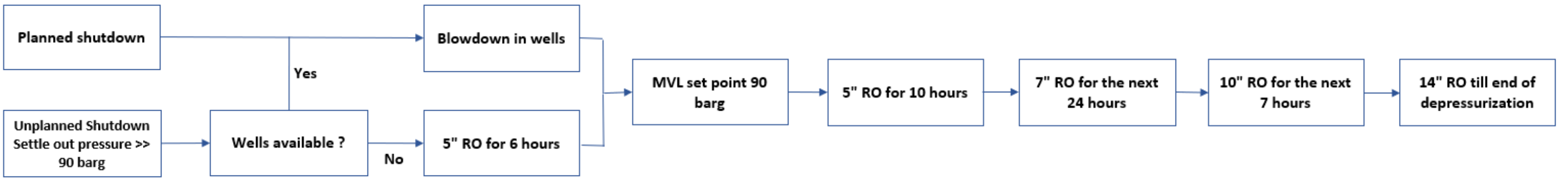

Figure 2-4: Depressurization sequence – Staggered Restriction Orifices

Proposed diameters of the Restriction Orifice are 5, 7, 10 and 14 inches for the depressurization of the BB03 trunkline. Those Restriction Orifices are used in sequence (the one after the other). The switch between the first and second Restriction Orifices occurs 10 hours after depressurization of first RO. 24 hours later, occurs the second switch. The third switch occurs 7 hours after depressurization of third RO. The minimum achieved bulk temperature is 1°C (for a few minutes) to which a 5°C margin should be applied to define the minimum design temperature of the pipeline.

The duration of the depressurization starting from a pressure set point of 90 barg at MVL lasts approximately 2 days and a half (58 hours).

Concerning the unplanned shutdown with wells available post packing of the line, the blowdown through the furthest well with the lowest WHSIP lasts a little more than 10 days until reaching the pressure set point of 90 barg. In the present study, the WHSIP of the considered well for blowdown operations being lower than 90 barg, the two-phase flow condition is driving the switch to Restriction Orifice to complete the depressurization of the injection network. Once the pressure set point is reached at MVL terminal, the proposed operating philosophy detailed above can be applied.

On the other hand, for the unplanned shutdown with line packing and wells not available, the procedure of the depressurization can start directly with a 5" RO (approximately 6 hours until reaching 90 barg at MVL then continue with 10 hours before switching to a bigger RO) and the steps detailed above can still be valid and applicable as the temperature can still be controlled and does not drop to very low values, respecting the 0°C threshold. The only possible difference with the planned shutdown sequence is that the first step of 5" RO can be longer than expected. Nevertheless, there is no risk of dropping to very low temperatures and ice formation around the pipe can be avoided.

Because of the isenthalpic phenomena during the liquid blow-down, the minimum expected temperature downstream the different Restriction Orifices is about -56°C. Those low temperatures should be experienced as long as liquid CO_2 will be observed downstream Restriction Orifice. A 20°C margin is then added to the minimum temperature leading to a design temperature of the topside piping of - 76°C.

3 BASIS OF DESIGN

3.1 Software and margins

3.1.1 Thermodynamic software

Because of the relatively new topics in the industry dealing with pure CO_2 injection, it is admitted that the accuracy of the different available thermodynamic packages might be questionable. This is mainly due to the presence of the various impurities that affect the phase envelope of the CO_2.

For compatibility reasons between the thermodynamic and multiphase flow software, *Multiflash – commercial version - 7.1* was used to generate the fluids. The following models and adjustments were used:

- Thermodynamic model: SRK Advanced (RKSA in *Multiflash*) with CO_2 volume shift (VSRK=$6.2\text{x}10^{-6}m^3$/mol)
- Viscosity: Super TRAPP
- Thermal conductivity: Super TRAPP

3.1.2 Multiphase flow software

OLGA 2021.2.0 has been used as a reference for all thermo-hydraulic analyses (steady state and transient).

Due to the nature of the fluid and the presence of the impurities, a compositional tracking approach has been considered as base case for all Flow Assurance studies.

3.2 Environmental data

The ambient conditions are presented in the following table (Ref. [1]):

Ambient temperature (°C)		
Depth (m)	**Cold case (winter)**	**Warm case (summer)**
Air	-4.7	21.7
0	-0.5	21.1
1	4.0	16.0
30	4.0	16.0
50	4.0	16.0

Table 3-1: Ambient conditions

In a conservative approach, the warm case set of data is considered for thermo-hydraulic calculations since it maximizes the pressure losses.

No current has been accounted for on the external surface of the production pipe in the frame of this study (faster cooling effect during transient operations, almost no impact on trenched / buried sections in the steady state, slightly under conservative for exposed sections in the steady state but impact negligible on the final results).

3.3 Injection system description

The injection system starts onshore at the Rotterdam port, goes through a 32'' OD trunkline subsea all the way to the K14 ILT/PLET where the take-off for SHELL wells occurs, before getting to the central platform D-HUBN (Also referred to as DHUB) at about 196 km from the inlet and 33 km from K14 ILT/PLET. At the DHUB, a second take-off for Neptune wells (Platform L10) occurs. The remaining volume is injected in TotalEnergies area at about 26 km from the DHUB through a 24'' OD spurline. The TotalEnergies area starts at the level of the PLEM. The L4A platform is located at 1.9 km from the PLEM. The trunkline is also referred to as BB03.

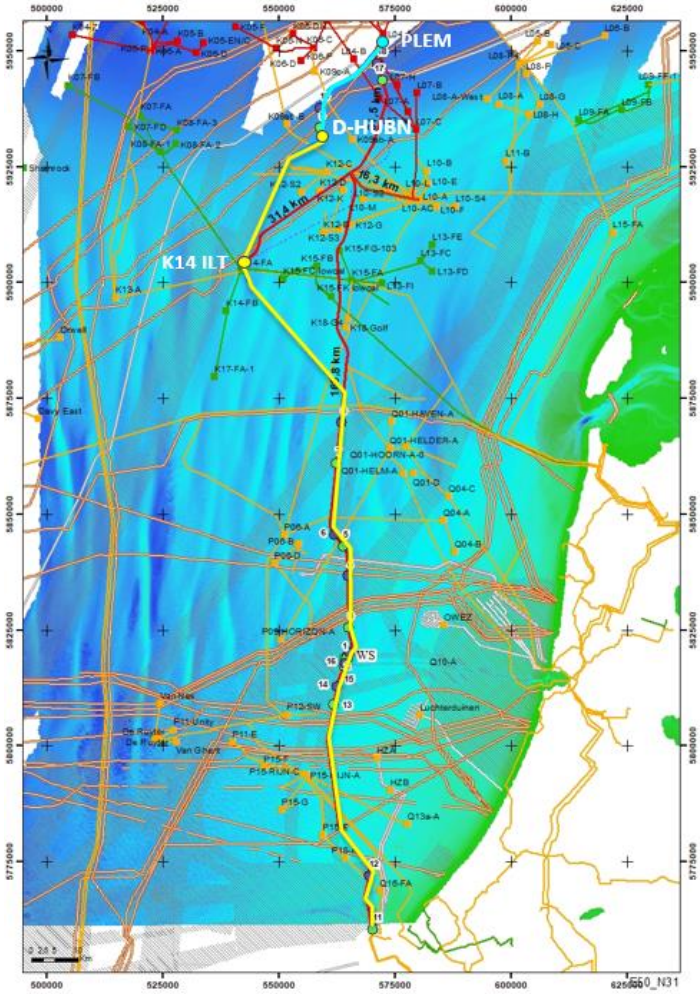

Figure 3-1: Aramis injection system

3.3.1 Injection system description

The following tables detail the characteristics of Aramis injection system (Ref. [1])

Flowline	Length (km)	Outer diameter (in)	Internal diameter (mm)	Roughness (mm) (1)
Onshore to Maasvlakte terminal	1.92	32	755.6	0.045
Maasvlakte terminal to K14 ILT	160.95	32	755.6	0.045
K14 ILT to DHUB	33.5	32	755.6	0.045
DHUB to PLEM	26.2	24	565.1	0.045
K14 ILT to K14 platform	2	24	565.1	0.045
DHUB to L10 platform	20	24	565.1	0.045
PLEM to L04-A	1.88	24	565.1	0.045
Note: **1.** The considered roughness is conservative and representative of the roughness after a few years in operation of the transport pipeline				

Table 3-2: Injection system characteristics

3.3.2 Bathymetries

The figures here below present the elevation profile of each section of the main trunkline and the spurlines provided by the geospatial team.

The status of the transport pipeline at seabed (exposed, trenched, Etc.) has been added to the different figures. When there is no available information, the pipe is considered exposed. Should the transport pipeline be fully or partially buried on short sections, then no impact is anticipated on the results of the Flow Assurance study summarized in the present report.

3.3.2.1 Main trunkline

The coating of the transport pipeline at seabed is very different from a section to another due to several external constraints (shipping lanes, platform zone, micro-tunnel nearshore...). The length and position of each section are shared by pipeline specialists (Onshore and nearshore flowlines) and geospatial team (Shipping lanes). The platform zone is an extended area 500 m from platforms as defined in pipeline design code / standards.

At shore approach, the transport pipeline connection to onshore facilities is achieved through a drilled micro-tunnel.

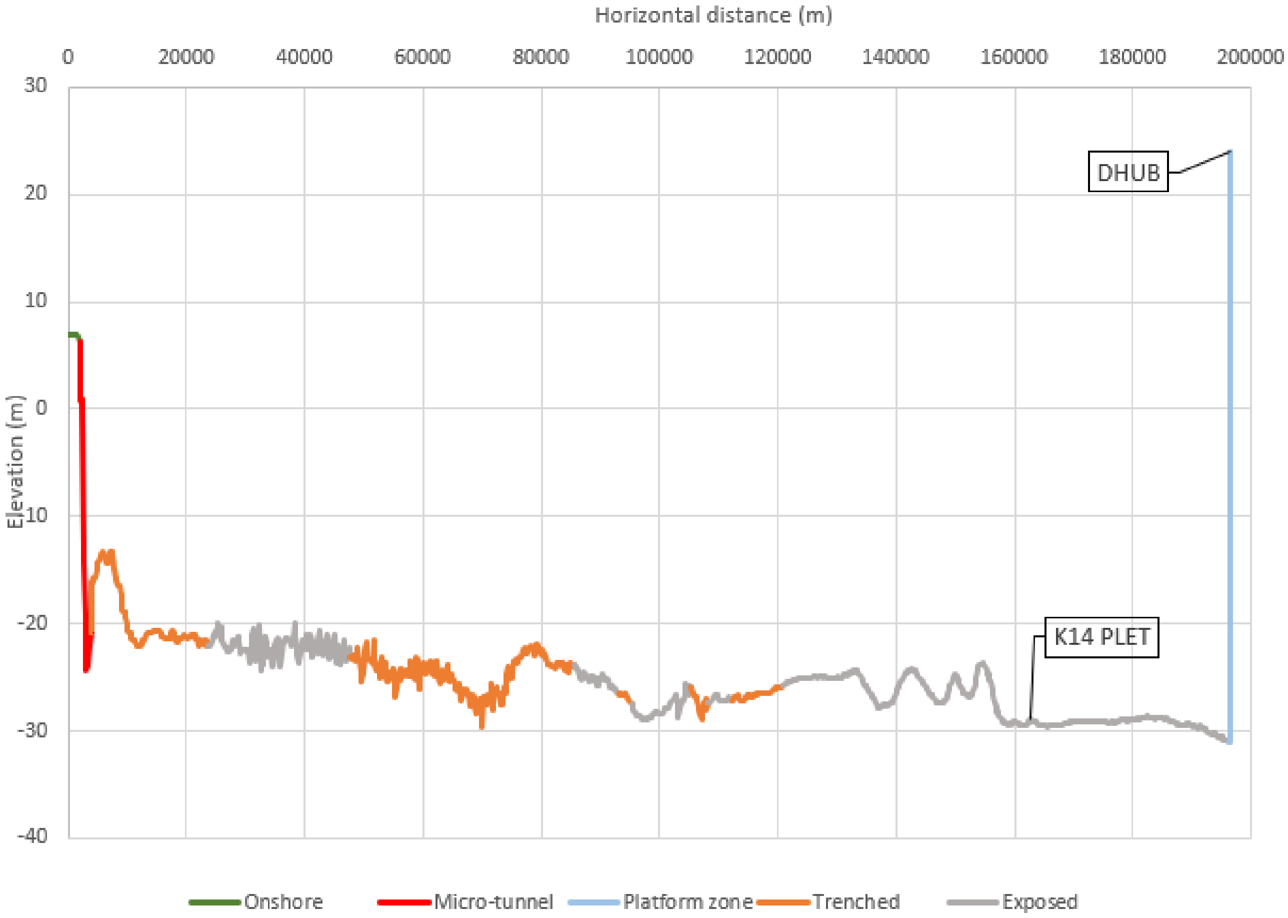

Figure 3-2: Trunkline - Onshore to DHUB pipeline bathymetries

The total measured length of the trunkline is about 198.3 km.

3.3.2.2 Main Spurlines

The main spurlines are part of the injection system. The pipe diameter is the main difference with the trunkline. The spurlines are listed here after:

- DHUB to L4A PLEM: Total measured length is about 26.2 km.
- L4A PLEM to L4A platform: Total measured length is about 1.9 km.
- K14 PLET to K14 platform: Total measured length is about 2 km.
- DHUB to L10 platform: Total measured length is about 20 km.

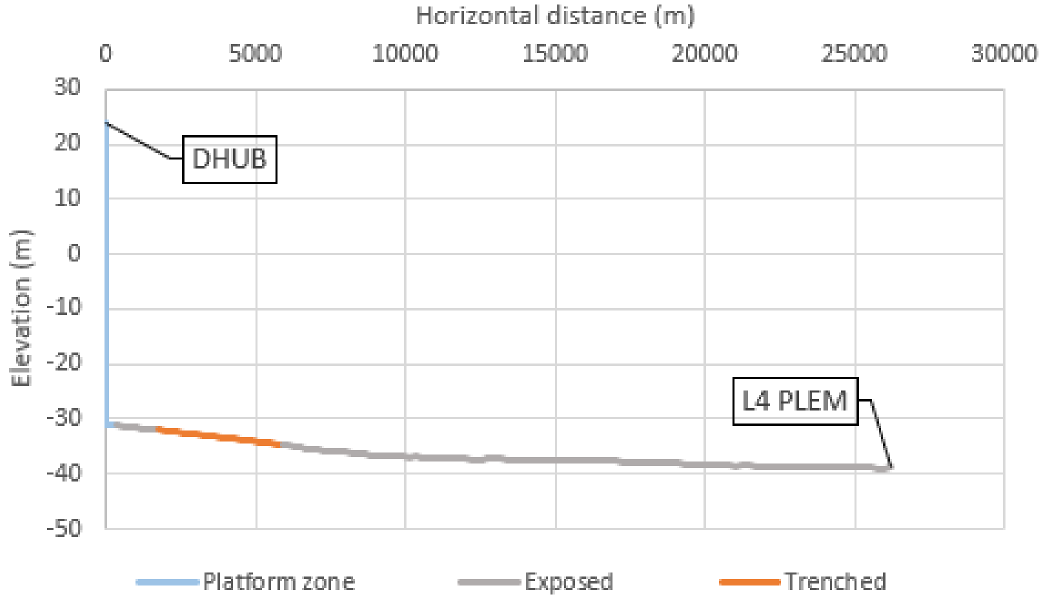

Figure 3-3: Section C (DHUB to L4A PLEM) pipeline bathymetries

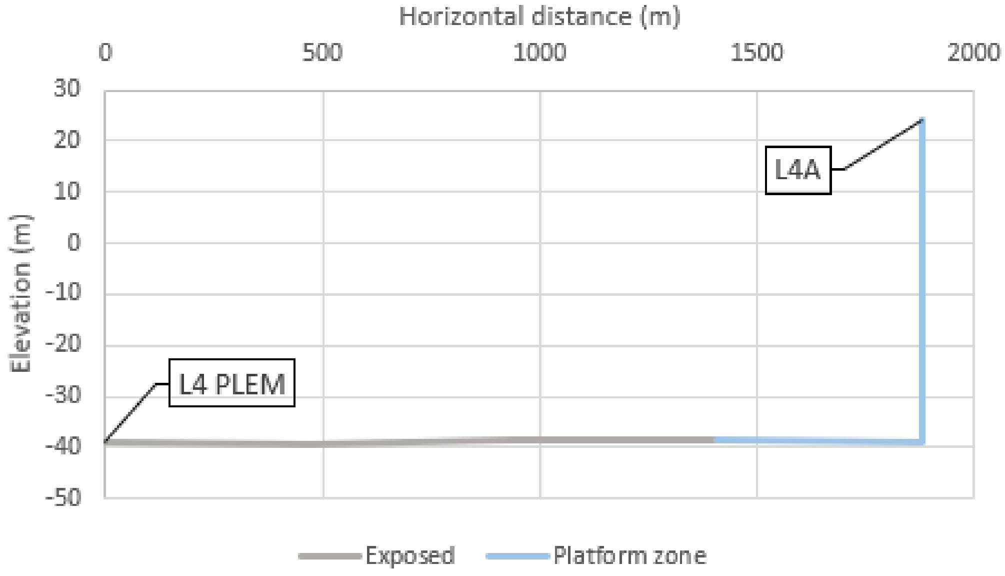

Figure 3-4: L4 PLEM to L4A platform pipeline bathymetries

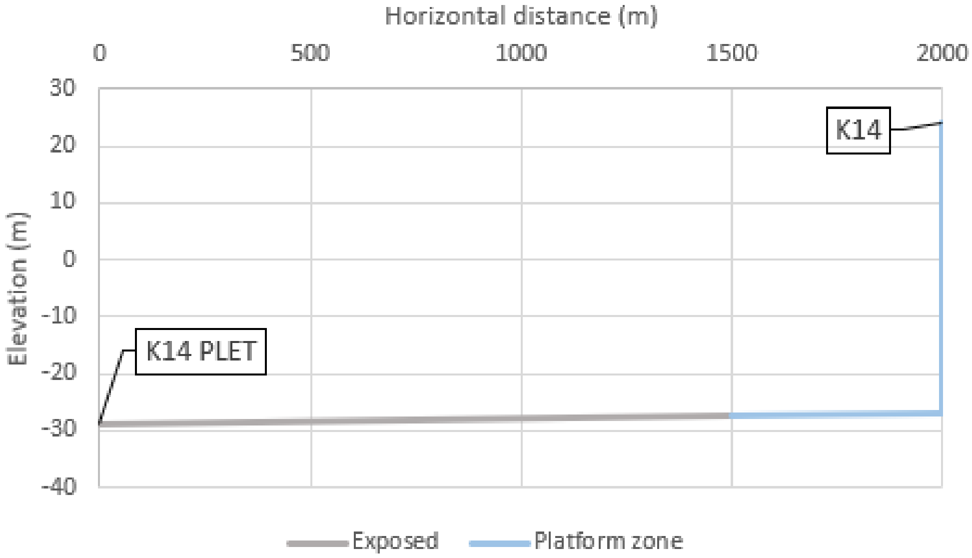

Figure 3-5: K14 PLET to K14 platform pipeline bathymetries

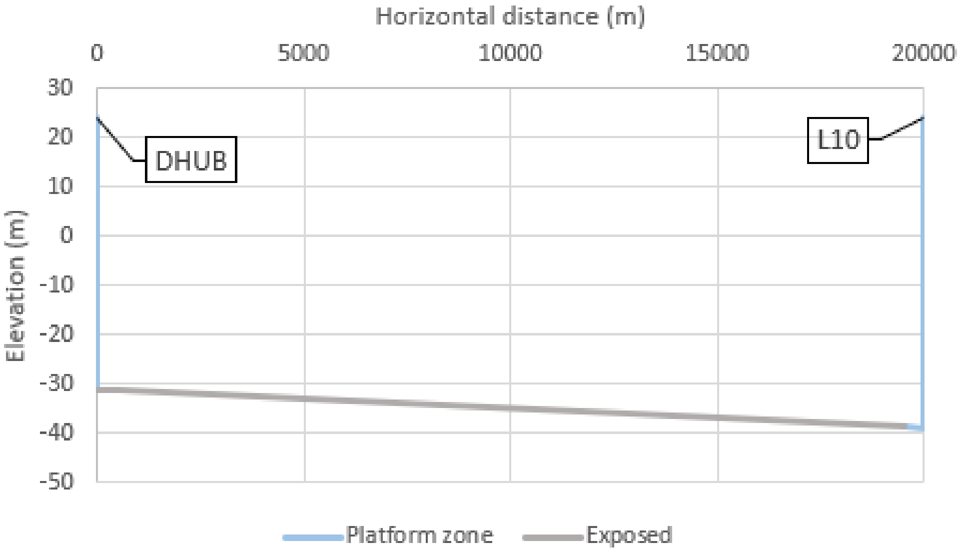

Figure 3-6: DHUB to L10 platform pipeline bathymetries

3.3.3 Cross sections of the flowlines

3.3.3.1 Main trunkline

The following table gives the cross section of the pipeline and risers considered for the study and the thermal properties of the different materials used in the analysis and as modelled in *OLGA*. These thermal properties are based on conservative values. Typically, the thermal conductivity is based on wet, aged values, while the density and heat capacity are based on initial conditions.

Different cross-sections for the transport pipeline will be observed along the pipe route due to the nature of soil, the presence of the micro-tunnel and several shipping lanes. In order to capture any potential impact of those different cross-sections during transient operations of the pipeline on the flowing temperature, a detailed modeling of the transport pipeline has been therefore developed in the *OLGA* model by implementing all the different cross sections.

Most of pipeline characteristics have been shared by the pipeline specialists. Should any information be missing, an assumption in then taken and discussed with the pipeline specialist.

It is worth mentioning that all burial depths have been recalculated by an internal tool (methodology almost similar to recommendation implemented in *OLGA User Manual*) that has been developed to estimate an equivalent thickness taking into account upper and lower layers of soil around the pipe. Because of the thickness of the equivalent layer, the density and heat capacity of the soil have been slightly modified to adjust the thermal inertia of the soil according to burial depth as per TotalEnergies internal practises in order not to over-estimate the Cool-Down time performance of the buried section. This should be revisited at next phase depending on the modelling approach considered for buried section modelling.

All pressure requirement calculations in the present Flow Assurance study are considering a transport pipeline roughness of 45 µm, which is conservative and representative of the roughness after few years in operations of the transport pipeline.

All the cross-sections included in the model are summarized in the different tables here below.

Buried – Onshore – 32'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	755.64	28.6	812.8	45	7850	470
3LPP	812.8	3.0	818.8	0.22	900	1750
Concrete	818.8	150	1118.8	3	2500	960
Buried Sand	1118.8	2510.0 (1)	6138.72	1.8	1780	907.2
Note: **1**. The pipe has a burial depth of 1 m. The presented value is an equivalent thickness taking into account lower layer as well.						

Table 3-3: Cross sections & thermal properties of the Onshore section

Micro-tunnel – 32'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	755.64	36.7	829.04	45	7850	470
3LPP	829.04	10	849.04	0.22	900	1750
Sea Water	849.04	3.7 (2)	856.36	0.6	1000	4180
Onshore rock	856.36	31174.5 (1)	63205.3	2.25	2300	850
Note: **1**. The pipe has a burial depth of 15 m. The presented value is an equivalent thickness taking into account lower layer as well. **2**. The thickness of the water layer has been calculated based on the volume of the drilled section						

Table 3-4: Cross sections & thermal properties of the micro-tunnel

Shipping channels - trenched – 32'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	755.64	28.6	812.8	45	7850	470
3LPP	812.8	3.0	818.8	0.22	900	1750
Concrete	818.8	130	1078.8	3	2500	960
Buried Sand	1078.8	1679.5 (1)	4437.85	1.8	1780	907.2
Note: **1**. The pipe has a burial depth of 0.6 m. The presented value is an equivalent thickness taking into account lower layer as well.						

Table 3-5: Cross sections & thermal properties of the shipping channels (trenched) – trunkline

Platform zones – 32'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	755.64	30.2	816	45	7850	470
3LPP	816	3.0	822	0.22	900	1750
Concrete	822	150	1122	3	2500	960

Table 3-6: Cross sections & thermal properties of the platform zones – trunkline

Exposed pipes – 32'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	755.64	28.6	812.8	45	7850	470
3LPP	812.8	3.0	818.8	0.22	900	1750
Concrete	818.8	150	1118.8	3	2500	960

Table 3-7: Cross sections & thermal properties of the exposed pipes – trunkline

3.3.3.1 Main Spurlines

Shipping channels - trenched – 24'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	565.14	22.2	609.6	45	7850	470
3LPP	609.6	3.0	615.6	0.22	900	1750
Concrete	615.6	110	835.6	3	2500	960
Buried Sand	835.6	1147.6	3130.7	1.8	1780	907.2
Note: **1**. The pipe has a burial depth of 0.6 m. The presented value is an equivalent thickness taking into account lower layer as well.						

Table 3-8: Cross sections & thermal properties of the shipping channels (trenched) – Main spurlines

Platform zones – 24'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	565.14	23.8	612.8	45	7850	470
3LPP	612.8	3.0	618.8	0.22	900	1750
Concrete	618.8	100	818.8	3	2500	960

Table 3-9: Cross sections & thermal properties of the platform zones – Main spurlines

Exposed pipes – 24'' OD						
Layer / Material	**ID**	**Thickness**	**OD**	**Conductivity**	**Density**	**Specific heat**
	mm	**mm**	**mm**	**(W/m.K)**	**(kg/m³)**	**(J/kg.C)**
Carbon steel	565.14	22.2	609.6	45	7850	470
3LPP	609.6	3.0	615.6	0.22	900	1750
Concrete	615.6	110	835.6	3	2500	960

Table 3-10: Cross sections & thermal properties of the exposed pipes – Main spurlines

3.4 CO_2 specifications – key assumptions

Two entry specifications are considered, one for CO_2 arriving by ship (liquid CO_2) and one for CO_2 arriving by vapor phase pipeline (gaseous CO_2). This section outlines entry specifications and design compositions for the respective building blocks.

The following limits on impurities are carried (Ref. [1]):

Class	Component	Constraint	unit	value
	CO_2	larger than	mol%	balance
	H_2O	less than	ppmmol	30
inerts	N_2	less than	mol%	-
	O_2	less than	ppmmol	10
	H_2	less than	ppmmol	500
	Ar	less than	mol%	-
	CH_4	less than	mol%	-
	CO	less than	ppmmol	1200
	$O_2+N_2+H_2+Ar+CH_4+CO$	sum less than	ppmmol	2000
	NO_x	sum less than	ppmmol	10
sulphur	SO_x	sum less than	ppmmol	10
	H_2S	less than	ppmmol	5
	CarbonylSulphide	less than	ppmmol	-
	DimethylSulphide	less than	ppmmol	-
	H_2S + COS + SO_x + DMS	sum less than	ppmmol	-
Volatile organic components	Amine	less than	ppmmol	10
	Formaldehyde	less than	ppmmol	20
	Acetaldehyde	less than	ppmmol	20
	Aldehydes	sum less than	ppmmol	-
	carbolylic acids & amides	sum less than	ppmmol	-
	phosphorus-containing compounds	sum less than	ppmmol	-
	NH_3	less than	ppmmol	10
	Ethylene (C_2H_4)	sum less than	ppmmol	-
	H-Cyanide (HCN)	less than	ppmmol	-
	Total volatile organic compounds (excl. MeOH, EtOH, aldehydes)	sum less than	ppmmol	10
	Methanol	less than	ppmmol	40
	Ethanol	less than	ppmmol	20
Heavies	glycols (TEG)	sum less than		-
	C_{2+} (aliphatic hydrocarbons)	sum less than	ppmmol	-
	Aromatic Hydrocarbons	sum less than	ppmmol	-
Metals	Hg	less than	ppbmol	30
	Cadmium + Thalium	sum less than	ppbmol	30

Table 3-11: Aramis Liquid CO_2 - Specifications for CO_2 loaded in the CO_2 ships/barges

Class	Component	Constraint	unit	value
	CO_2	larger than	mol%	95
	H_2O	less than	ppmmol	70(1)
inerts	N_2	less than	mol%	2.4
	O_2	less than	ppmmol	40
	H_2	less than	ppmmol	7500
	Ar	less than	mol%	0.4
	CH_4	less than	mol%	1
	CO	less than	ppmmol	750
	$O_2+N_2+H_2+Ar+CH_4+CO$	sum less than	ppmmol	40000
	NO_x	sum less than	ppmmol	5
sulphur	SO_x	sum less than	ppmmol	-
	H_2S	less than	ppmmol	5
	CarbonylSulphide	less than	ppmmol	0.1(2)
	DimethylSulphide	less than	ppmmol	1.1(2)
	H_2S + COS + SO_x + DMS	sum less than	ppmmol	20
Volatile organic components	Amine	less than	ppmmol	1
	Formaldehyde	less than	ppmmol	-
	Acetaldehyde	less than	ppmmol	0.2 (2)
	Aldehydes	sum less than	ppmmol	10
	carbolylic acids & amides	sum less than	ppmmol	1
	phosphorus-containing compounds	sum less than	ppmmol	1
	NH_3	less than	ppmmol	3
	Ethylene (C_2H_4)	sum less than	ppmmol	1(2)
	H-Cyanide (HCN)	less than	ppmmol	2
	Total volatile organic compounds (excl. MeOH, EtOH, aldehydes)	sum less than	ppmmol	10
	Methanol	less than	ppmmol	620
	Ethanol	less than	ppmmol	20
Heavies	glycols (TEG)	sum less than		Follow dew-point specs
	C_{2+} (aliphatic hydrocarbons)	sum less than	ppmmol	1200
	Aromatic Hydrocarbons	sum less than	ppmmol	0.1
Metals	Hg	less than	ppbmol	-
	Cadmium + Thalium	sum less than	ppbmol	-
Dew-point	Dew point (any liquid phase)	sum less than	°C (@ 20 bar)	-10 (3)

Table 3-12: Aramis Gaseous CO_2 - Specification for CO_2 loaded in the CO_2 pipeline

Notes

1. Specification maintained at 40 ppmmol as per OCAP spec. CO2 spec v 3.1 for Porthos infrastructure is 70 ppm.

2. Specification as per OCAP specification (OCAP-ME-20180307-JLi) and only applicable for emitters that will also flow via OCAP infrastructure.

3. Measured or predicted using CPA equation of state.

A number of impurities are included in the overview without a specific limit to their content. Emitters agree to inform Aramis in case these components are expected in the CO_2 product at levels above 1 ppmmol. Aramis will then conduct a risk assessment study to understand the maximum amount that can be tolerated (Ref. [1]).

The Aramis design does not contain facilities to remove impurities above agreed values. The impurity level of several components, including H_2O, are directly linked to maintaining design integrity.

The design composition for phase behavior and thermophysical properties is derived as follows:

- Volatile organic components are modelled as Methanol
- C2+ is modelled as Ethane
- Components <= 1 ppmmol are ignored
- For pipeline, the nitrogen content is adjusted to meet the total inert spec. All other inert components are at their maximum allowable individual level.
- Sulphur oxides are modelled as SO_2.

Component	Amount (mol)
CO_2	95
H_2O	0.004
N_2	2.4
O2	0.004
H_2	0.75
AR	0.4
CH_4	1
CO	0.075
NO	0.003
NO_2	0.002
SO_2	0
H_2S	0.00511
NH_3	0.0003
HCN	0.0002
METHANOL	0.064
ETHANOL	0.002
ETHANE	0.12

Table 3-13: Final CO_2 specification

Due to the introduction of the impurities, the phase envelope is subject to be modified compared to initial specifications. The higher will be the impurities content in the specifications, the larger will be the phase envelope, therefore potentially triggering the risks to observe two-phases flow conditions in the transport system in case of low pressure. The effect of impurities may also impact the accuracy of the Flow Assurance outcomes in two phase operational area if any.

The figures here below summarize the phase envelope associated to the different specifications along with the Water Dew curve:

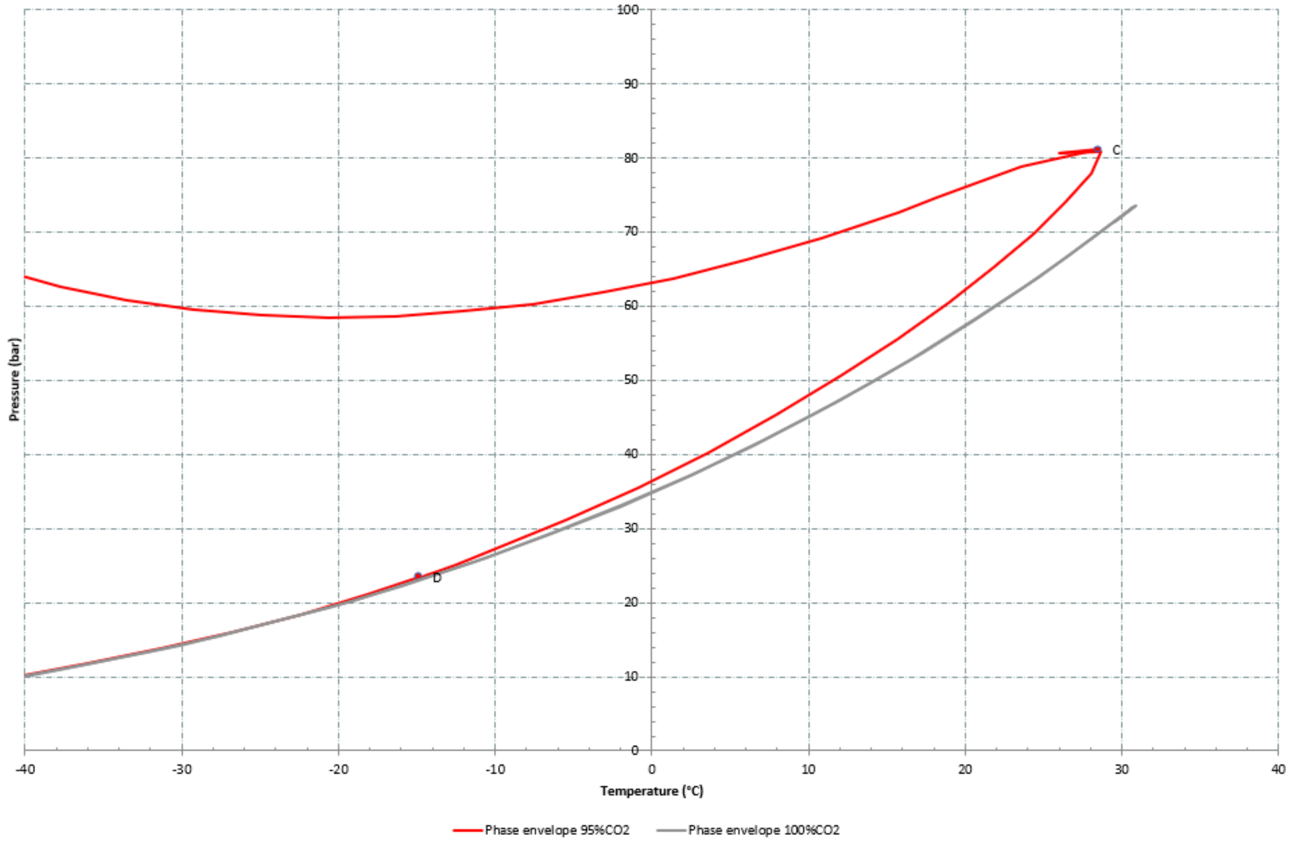

Figure 3-7: Comparisons of phase envelope between pure CO_2 & 95% CO_2 composition

As observed on the phase envelopes of pure CO_2 in comparison with CO_2 with impurities, the critical point of CO_2 fluid with impurities is higher than the one of pure CO_2 fluid (81.2 bar vs. 73.6 bar), making the fluid containing the impurities more conservative.

It is also worth mentioning that the introduction of impurities in the CO_2 specification affects the water solubility and therefore the water dew curve as those impurities will interact with water. This might increase the risks of appearance of free water and therefore the risks of corrosion.

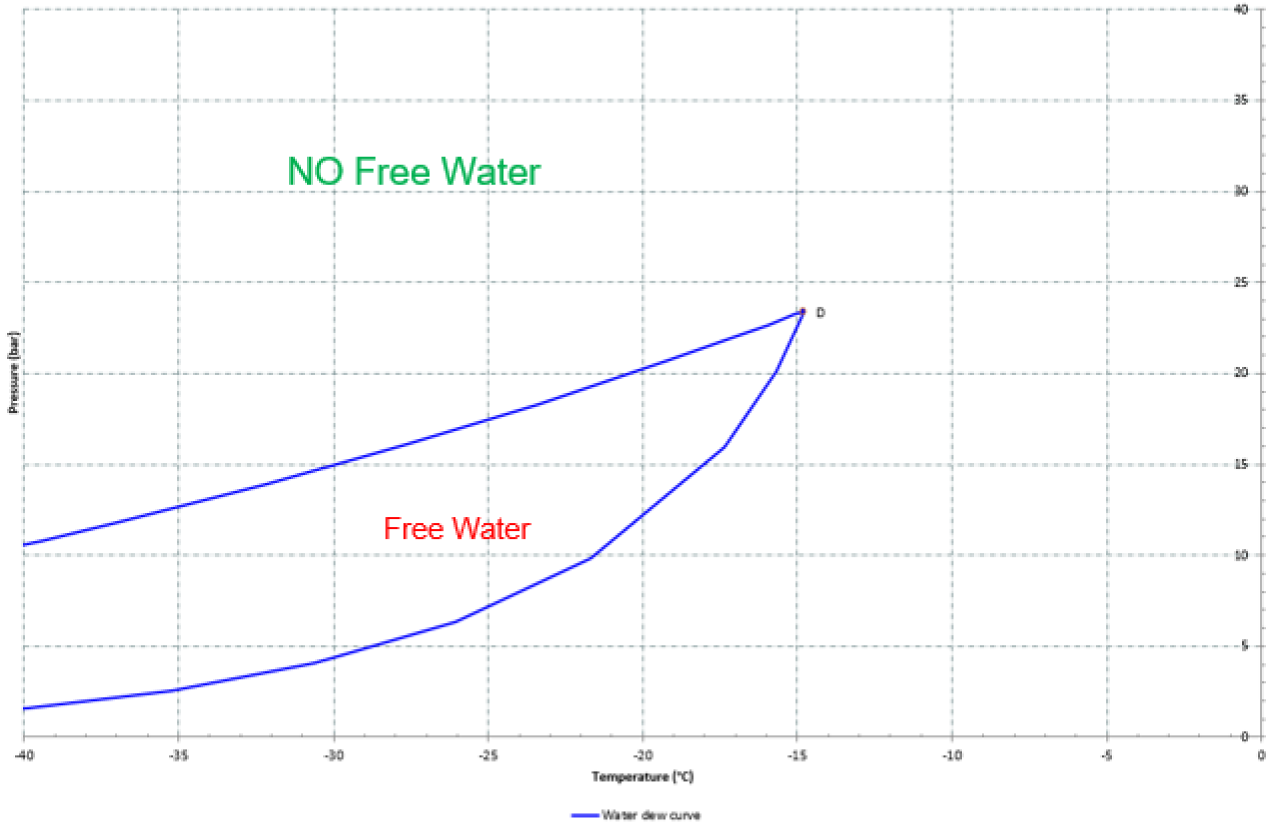

Figure 3-8: Water dew curve considering 95% CO_2 composition

According to liquid CO_2 specification and anticipated operating conditions in the injection system, there is no risk to observe free water, therefore mitigating the hydrates risks and the risks of corrosion in the system. Should the liquid CO_2 specification be revisited, then the risks to observe free water in the system should be updated accordingly.

Specific attention should be nevertheless paid during first filling operations of the trunkline with CO_2 as low pressure and low temperature might be observed during this specific operation, making operating conditions not so far from water dew curve with the latest proposed sequence by EBN (Appendix **Erreur ! Source du renvoi introuvable.**). This should be further evaluated at next phase of the project.

Due to CO_2 injection in an aquifer, hydrates risks could be triggered in the injection wells after “long” shutdown as the CO_2 stream should be saturated with higher water content than what is mentioned in the liquid CO_2 specification. The time for the CO_2 contained in the tubing to be saturated with water during shutdown is difficult to evaluate but risks cannot be neglected at this stage.

Such negative outcome imposes the implementation of specific operating procedure prior restarting wells as for instance bullheading of MEG within injection tubing before the opening of the Injection Choke valve in order to “dry” the fluid located at top part of the tubing.

In steady state operations, no hydrates risks are anticipated in the transport pipeline because of the low water content. Extremely low temperatures and low pressures have to be observed in the system before triggering any hydrates crystals formation, and those conditions are far from expected operating conditions of the transport system.

3.5 Injection profile and inlet conditions

3.5.1 Injection profile

For this phase of the project, a peak injection rate of 22 MTPA is defined. Two take-offs of 8 MTPA at K14 PLET and 6 MTPA at the DHUB towards L10 platform should be taken into account. The rest is injected into TotalEnrgies area.

In addition to the 22 MTPA peak rate, a 5 MTPA flowrate is simulated as it gives more insights on early life injection with lower reservoir pressure. The following table indicates the flowrates associated to each platform:

		Rate	
Inlet	MTPA	**5**	**22**
	Kg/s	158.55	697.62
K14	MTPA	**2.5**	**8**
	Kg/s	79.27	253.68
DHUB	MTPA	**2.5**	**14**
	Kg/s	79.27	443.94
L10	MTPA		**6**
	Kg/s		190.26
TTE PLEM	MTPA	**2.5**	**8**
	Kg/s	79.27	253.68
L4A	MTPA	**2.5**	**-**
	Kg/s	79.27	-
Note: For the peak rate, the flowrate for L4A platform is not mentioned. In this case, indicative results of the subsea manifold at 1.9 km from L4A platform and -39 m of water depth will be presented			

Table 3-14: Injection profile for the sizing years

3.5.2 Inlet conditions

The different discharge pressure requirements for both sizing years along with the discharge temperature are presented in the following table:

	5 MTPA case	22 MTPA case
Pressure (barg)	150	180
Temperature (°C)	50	50

Table 3-15: Trunkline inlet conditions

It is worth to mention that these values are input data from CCS development team working on Aramis project and are representative of future operations on Aramis. It has also been decided to consider the warmest inlet temperature as a conservative approach for thermo-hydraulic calculations since it maximizes the pressure losses. Several sensitivities are conducted regarding the inlet conditions mostly for the design temperature determination explicated in the next sections.

4 METHODOLOGY

4.1 Steady state

Steady state simulations have been performed for both peak rate and startup / early life flowrates with several inlet conditions using *OLGA 2021* for the base cases and an internal CO_2 spreadsheet developed by the Flow Assurance team in TotalEnergies and based on analytical model for pressure drop calculation for the sensitivity cases. This was possible thanks to the monophasic behavior of CO_2 transport in the network.

Concerning the *OLGA* simulations, it is worth mentioning that throughout the simulations, several parameters are assessed:

- Pressure and temperature at key points of the injection system including platforms and other focal arrival points,
- Flowrates throughout the injection system and target rates for each well,
- Injection wells chokes openings,
- The erosion velocity ratio as well as fluid velocities and flow regime inside the pipelines and riser.

For the calculations performed for this study using *OLGA*, and in order to capture the dynamic of the whole system, the entire injection system is modeled including the injection wells of TotalEnergies area. Only BB03 related information and results are presented in this report.

The number of thermo-hydraulic simulations has been optimized, mainly covering the following cases:

- Base Case 1: Max Flowrate of 22 MTPA – discharge pressure 180 barg – Inlet temperature 50°C
- Base Case 2: Startup / early life flowrate of 5 MTPA – discharge pressure 150 barg – Inlet temperature 50°C
- Sensitivity Case 1: Max Flowrate of 22 MTPA all the way to DHUB without any take-off at K14 PLET – discharge pressure 180 barg – Inlet temperature 50°C – Most likely not to occur but it was studied to evaluate the packing time.
- Sensitivity Case 2: Max Flowrate of 22 MTPA – discharge pressure 180 barg – Inlet temperature 65°C – Most likely not to occur but it was studied to define the design temperature of the trunkline.
- Sensitivity Case 3: Max Flowrate of 22 MTPA – discharge pressure 180 barg – Inlet temperature 56°C – This case was studied to further refine the design temperature of the trunkline, being less stringent.
- Sensitivity Case 4: Max Flowrate of 11 MTPA coming from Porthos – discharge pressure 180 barg vs 120 barg – Inlet temperature 65°C – This case was studied to further refine the design temperature of the trunkline being less stringent.

4.2 Transient calculations

The injection case selected to perform transient analysis is 22 MTPA, which is the injection case with maximum flowrate, maximum operating pressure, maximum settle-out pressure, high reservoir pressurization, Etc. This injection scenario is used to determine the operating philosophies and key equipment for all transient operations while ensuring pipeline integrity with regards to design conditions, risks of ice formation, hydrates risks, Etc.

The following table lists the transient simulation cases and provides further details on each case:

<table>
<tr><th>Transient operation</th><th>Sequence of operation</th><th>Verifications</th><th>Steady state initial case</th></tr>
<tr><td>Shutdown – Packing 1</td><td>1. Spurious closure of wells
2. Pumps still in operation</td><td rowspan="2">- Definition of the safe shutdown operation to avoid two-phases
- Evaluation of the time for operators to react
- Estimation of the hydrate and ice risk
- Pressure, temperature & density profile evolution over time</td><td>22 MTPA base case</td></tr>
<tr><td>Shutdown – Packing 2</td><td>1. Closure of Riser Isolation Valve (RIV) upstream DHUB
2. Pumps still in operation</td><td>22 MTPA to DHUB with no take-off at K14 (sensitivity case 1)</td></tr>
<tr><td>Shutdown - Depacking</td><td>1. Spurious shutdown of pumps
2. Wells still open</td><td>- Determination of the minimum pressure and time required after shutdown to reach the vapor phase threshold pressure or crossflow between the injection wells</td><td>22 MTPA base case</td></tr>
<tr><td>Planned depressurization</td><td>1. Shutdown of pumps
2. Wells kept open
3. Blowdown through wells till reaching pressure in transport line 10 - 20 bar above highest WHSIP or 10 bar above pressure that triggers two phase flow.
4. Wells closed
5. Depressurization continued through RO topsides</td><td rowspan="3">- Procedure for planned depressurization offshore
- Sequence in case of unplanned or emergency depressurization due to pipe blockage, collapse, Etc.
- Restriction Orifice (RO) sizing
- Depressurization flowrates to vent
- Assess position of the depressurization system (onshore or offshore)
- Accurate dynamic heat flow transfer modelling of the flowlines
- Depressurization duration
- Pressure and temperature profile vs time
- Evaluation of hydrates and ice risks, high pressure drop / line blockage, free water & two-phase zone
- Minimum temperature over the line</td><td>22 MTPA base case</td></tr>
<tr><td>Depressurization after unplanned abnormal shutdown - Wells available</td><td>1. Spurious closure of wells
2. Pumps still in operation
3. Packing of the transport pipeline at the highest pressure
4. Blowdown through furthest well presenting lowest WHSIP till reaching pressure in transport pipeline 10 - 20 bar above WHSIP or 10 bar above pressure that triggers two phase flow</td><td>22 MTPA base case</td></tr>
<tr><td>Depressurization after unplanned abnormal shutdown - Wells not available (Plug, Etc.)</td><td>1. Spurious closure of wells
2. Pumps still in operation
3. Packing of the transport pipeline at the highest pressure
4. Blowdown through RO topsides</td><td>22 MTPA base case</td></tr>
</table>

Table 4-1: Conducted transient simulations

5 STEADY STATE RESULTS

In this section are presented the main results of the steady state simulations for the base case of Aramis project along with a number of sensitivity studies changing the inlet conditions in order to analyze the impact over the temperature and pressure profiles over the trunkline.

5.1 Base case

Pressure results considered for the validation of the production profile are based on simulations for warm conditions maximizing pressure drop along the pipeline.

Two different flowrates have been studied:

- Peak flowrate: 22 MTPA with 180 barg as inlet pressure
- Early life flowrate: 5 MTPA with 150 barg as inlet pressure

5.1.1 22MTPA scenario

5.1.1.1 Operating conditions against phase envelope

The pressure and temperature profiles along the transport pipeline route have been compared to phase envelope in order to identify any risk of two-phases flow conditions anywhere in the injection system.

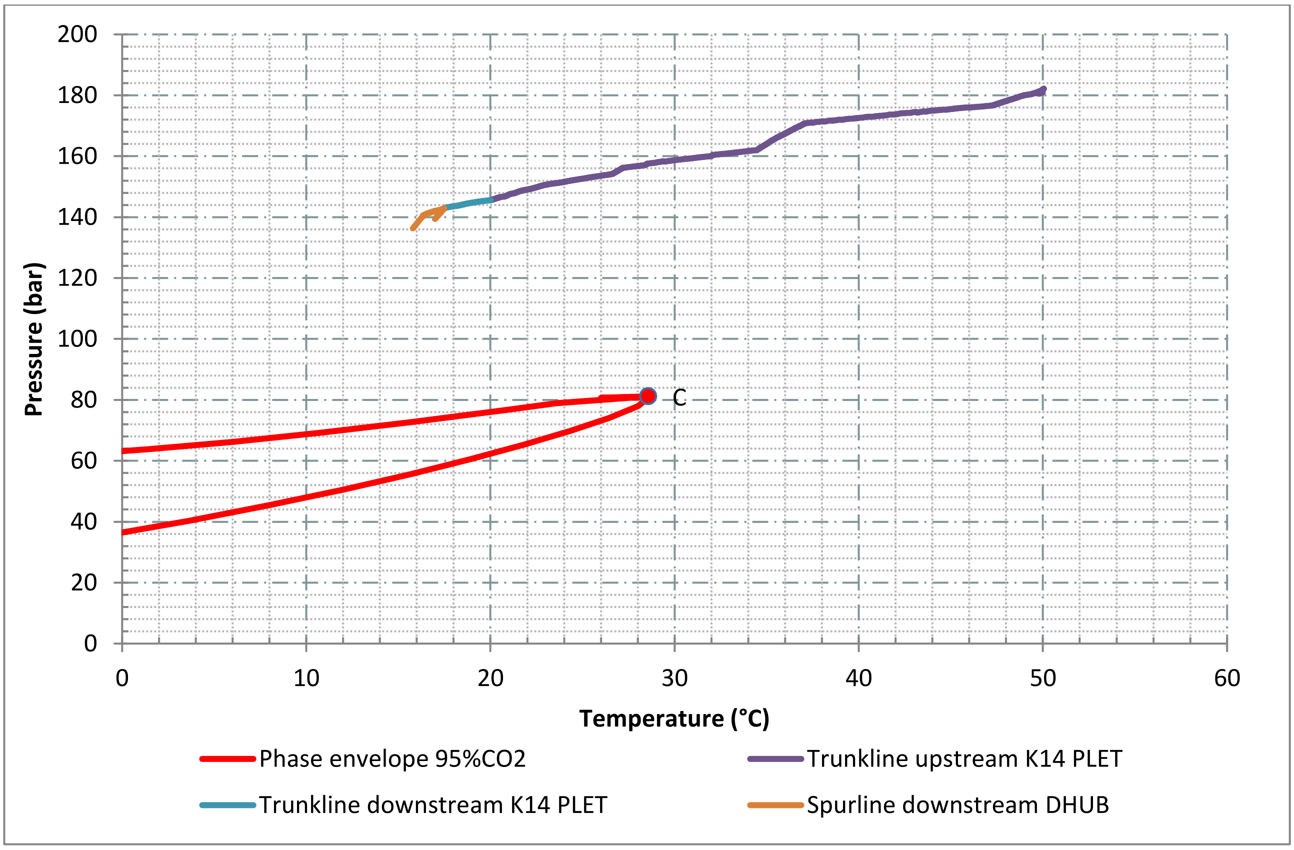

Figure 5-1: Operating conditions of transport pipeline at 22 MTPA against phase envelope

As observed on previous figure, there is no risk to operate the transport pipeline in two-phase flow conditions at 22 MTPA. The operating conditions are always far from the phase envelope with more than 60 bar from the critical point including a 10 bar margin when applied.

5.1.1.2 Pressure Profile

Here after is presented the pressure profile (more details are presented in the appendix 9.1.1.1) along the trunkline of 32 in OD for 22 MTPA with a take-off of 8 MTPA at K14 PLET and the spurline of 24 in OD after take-off of 6 MTPA at DHUB for L10 platform. The results include a 10% margin on total pressure drop.

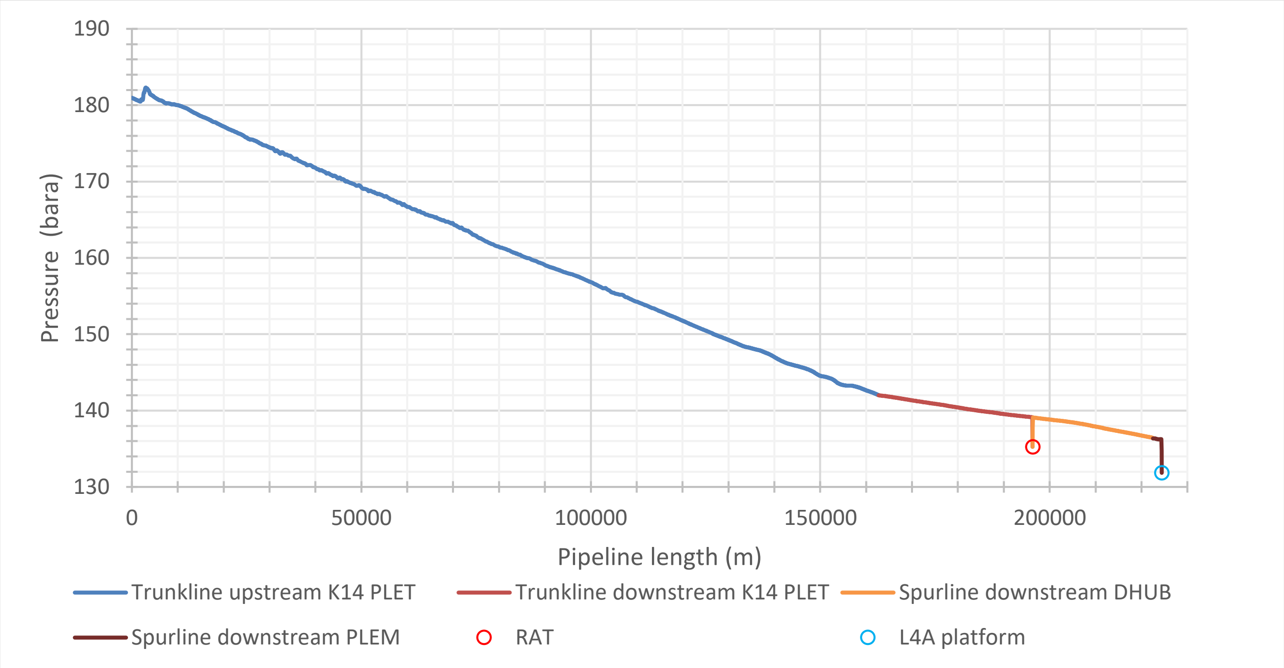

Figure 5-2: Pressure profile for the 22 MTPA case

As the figure indicates, with a 180 barg discharge pressure, the arrival pressure at K14 PLET is approximatively 141 barg and at top of DHUB 134.2 barg including the 10% margin on pressure drop. The arrival pressure at L4A platform is about 131 barg. Further indications on arrival pressures at platforms are presented in the following sections.

5.1.1.3 Temperature Profile

Here after is presented the temperature profile (more details are presented in the appendix 9.1.1.2) along the trunkline of 32 in OD for 22 MTPA with a take-off of 8 MTPA at K14 PLET and the spurline of 24 in OD after take-off of 6 MTPA at DHUB for L10 platform. The given results are for the warm case (summer conditions for ambient temperature and warmest temperature at inlet for a 22 MTPA flowrate).

As observed on the temperature profile, the arrival temperature at DHUB is about 17°C while the arrival temperature at top of L4A platform is about 15.8°C. It is worth mentioning that the fluid takes longer time than expected to be in thermal equilibrium with the seabed ambient temperature and that is due to the large flowrate, minimizing heat exchange with the ambient environment and the huge thermal inertia of the CO_2.

From this temperature profile, it appears that the range of temperature expected at the different injection sites should follow the sea water seasonal temperatures, meaning that the arrival temperature should range between 4°C and 16°C, whatever the injection temperature at onshore terminal.

It is worth mentioning that with reduced flowrate, the thermal equilibrium with surrounding sea water will be reached sooner in the trunkline, not modifying the conclusion above with regards to arrival temperature at different offshore platforms.

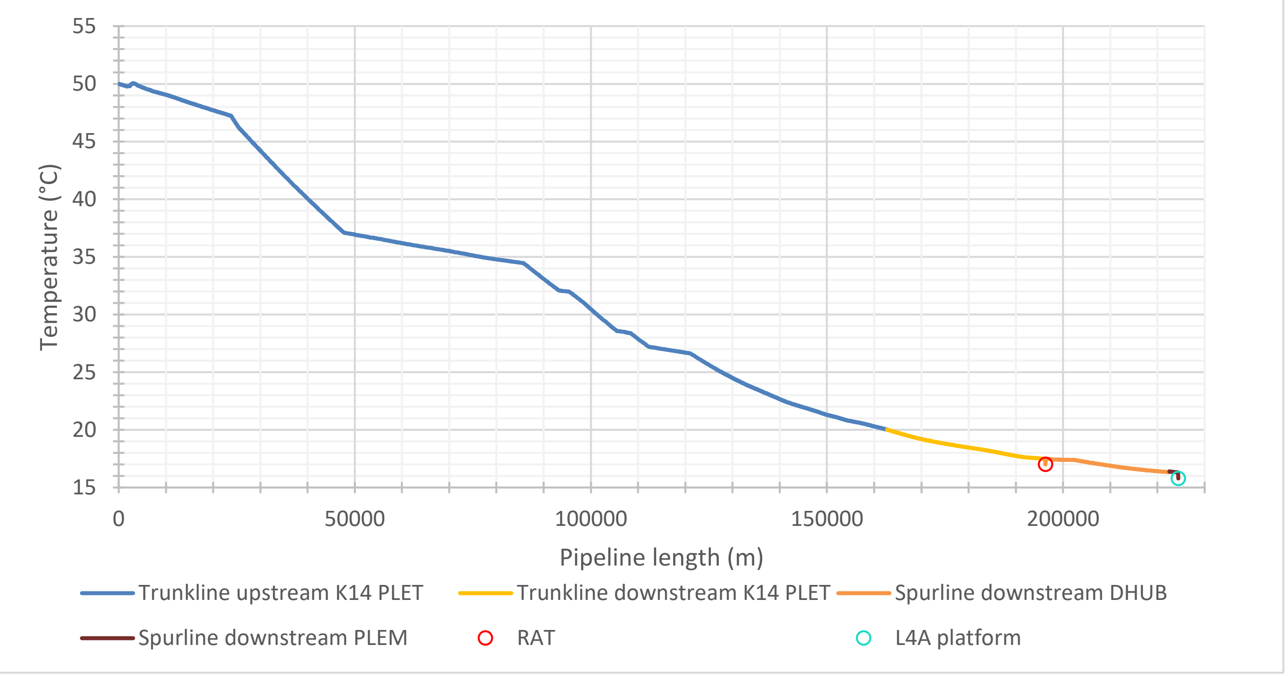

Figure 5-3: Temperature profile for the 22 MTPA warm case

5.1.1.4 Arrival conditions at platforms

Here after are presented the arrival conditions at each platform along with the reached flowrate.

From the present Flow Assurance study, it appears that the injection of 22 MTPA might be highly challenging at the end of life, therefore highlighting the strong effect of the pressure build-up observed in the reservoir during field life.

This is a major uncertainty that is difficult to unlock at this stage.

Platform	K14	DHUB	L10	TTE PLEM (3)
Arrival flowrate (MTPA)	8	14	6	8
Arrival flowrate (kg/s)	253.68	443.94	190.26	253.68
Arrival pressure (bara) (1)	137.96	135.18	133.79	136.43
Arrival pressure + topside pressure drop margin (2)	132.96	135.18	128.79	136.43
Temperature (°C)	19.2	17.06	16	16.33

Note:

1. The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

2. The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

3. For the peak rate only indicative results of the subsea manifold at 1.9 km from L4A platform and -39 m of water depth are presented

Table 5-1: Arrival conditions at platforms for 22 MTPA base case

5.1.1.5 Fluid velocity and Erosional Velocity Ratio

The fluid velocity and the Erosional velocity ratio (EVR) over transport pipeline route at peak injection rate (22 MTPA) ranges:

- Trunkline upstream DHUB:
  - Minimum Fluid velocity ranges from 1.15 to 2.34 m/s,
  - Maximum EVR ranges from 0.28 to 0.49.

- Spurlines downstream DHUB & from K14 PLET to K14 platform:
  - Minimum Fluid velocity ranges from 0.77 to 1.21 m/s,
  - Maximum EVR ranges from 0.18 to 0.29.

No erosion neither deposition (if any precipitates, particles, solids, Etc.) issues are anticipated in the mentioned flowlines as both EVR and fluid velocities are within an acceptable limit.

5.1.2 5 MTPA scenario

5.1.2.1 Operating conditions against phase envelope

The pressure and temperature profiles along transport pipeline route and within injection wells have been compared to phase envelope in order to identify any risk of two-phases flow conditions anywhere in injection system.

As observed on the following figure, there is no risk to operate the transport pipeline in two-phase flow conditions at 5 MTPA. The operating conditions are always far from phase envelope with more than 60 bar from the critical point including a 10 bar margin when applied.

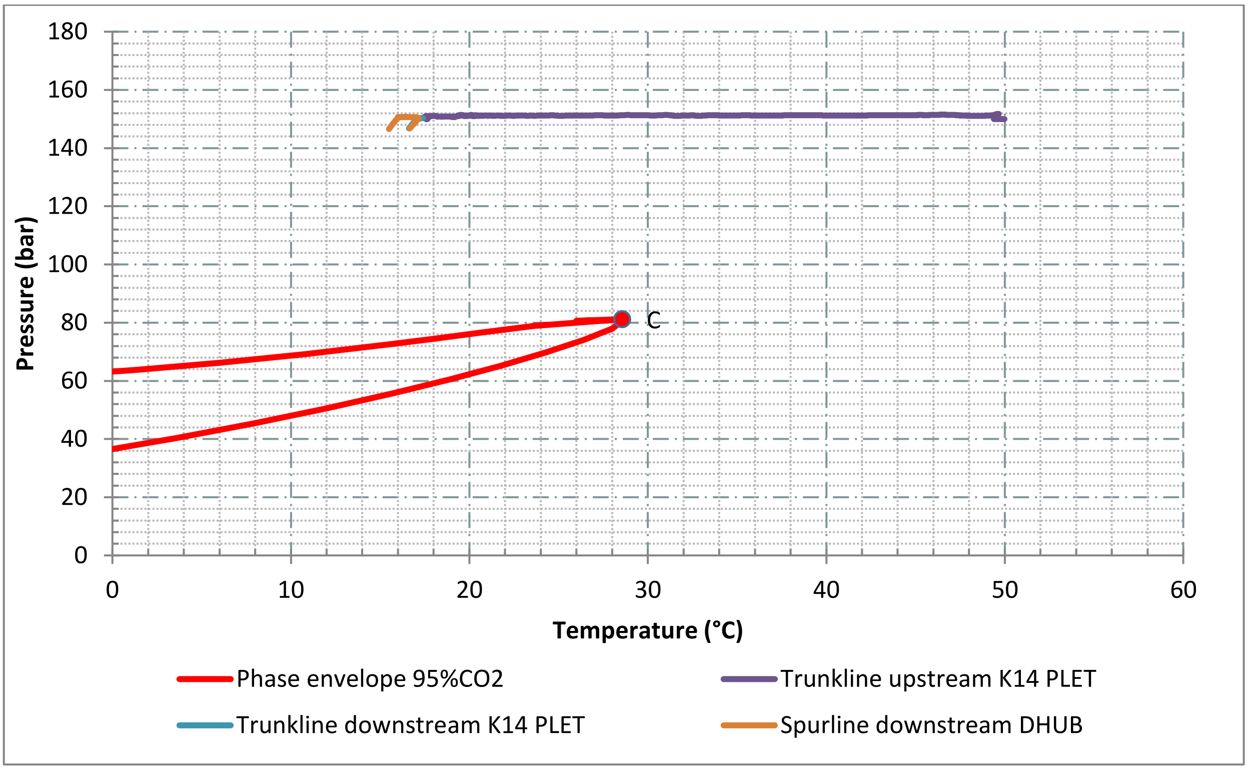

Figure 5-4: Operating conditions of transport pipeline at 5 MTPA against phase envelope

5.1.2.2 Pressure Profile

Here after is presented the pressure profile (More details are presented in the appendix 9.1.2.1) along the trunkline of 32 in OD for 5 MTPA with a take-off of 2.5 MTPA at K14 PLET and the spurline of 24 in OD downstream DHUB. The results include a 10% margin on total pressure drop.

As presented in the following figure, with a 150 barg discharge pressure, the arrival pressure at K14 PLET is approximatively 149.2 barg and at top of DHUB 145.4 barg including a 10% margin on pressure drop. The arrival pressure at L4A platform is about 145.1 barg. Further indications on arrival pressures at platforms are presented in the following sections.

Because of the low injection rate, there is almost no pressure drop into the injection system allowing reaching at injection platforms high delivery pressures. Those results are consistent.

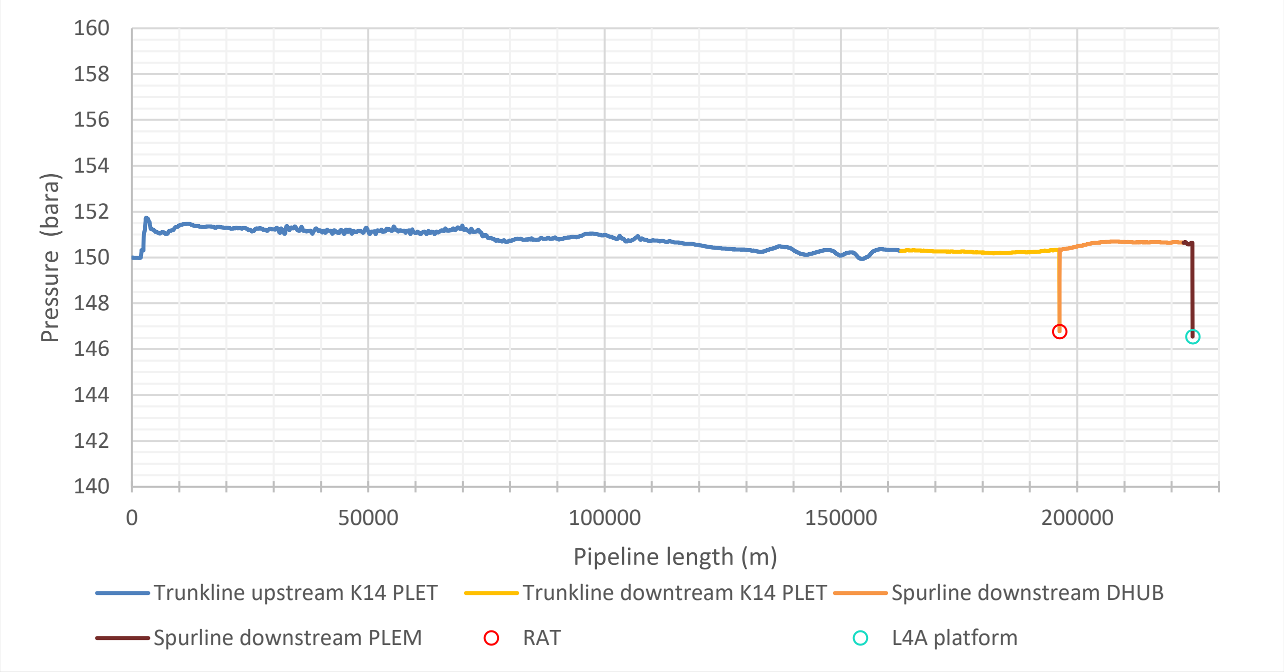

Figure 5-5: Pressure profile for the 5 MTPA case

5.1.2.3 Temperature Profile

Here after is presented the temperature profile (More details are presented in the appendix 9.1.2.2) along the trunkline of 32 in OD for 5 MTPA with a take-off of 2.5 MTPA at K14 PLET and the spurline of 24 in OD downstream DHUB. The given results are for the warm case (summer conditions for ambient temperature).

As observed on the temperature profile below, the arrival temperature at DHUB is about 16.7°C while the arrival temperature at top of L4A platform is about 15.5°C. Further indications on arrival temperatures at platforms are presented in the following sections.

As observed on the following figure, a fast thermal equilibrium with surrounding sea water is reached as soon as the CO_2 is reaching the first “exposed” section.

From this temperature profile, it appears that the range of temperature expected at the different injection platforms is unchanged compared to scenario of 22 MTPA and will follow the sea water seasonal temperatures, meaning that the arrival temperature should range between 4°C and 16°C, whatever the injection temperature at onshore terminal.

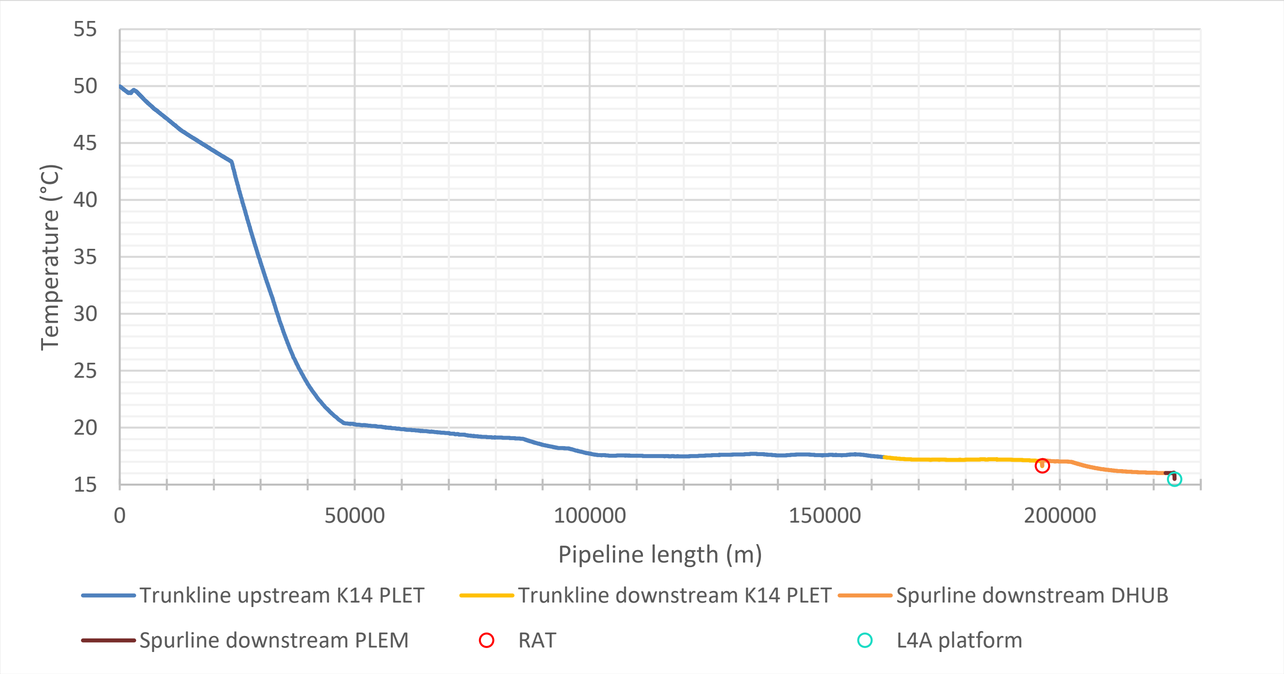

Figure 5-6: Temperature profile for the 5 MTPA warm case

5.1.2.4 Arrival pressures at platforms

Here after are presented the arrival conditions at each platform along with the reached flowrate:

Platform	K14	DHUB	L4A
Arrival flowrate (MTPA)	2.5	2.5	2.5
Arrival flowrate (kg/s)	79.27	79.27	79.27
Arrival pressure (bara) (1)	146.49	146.47	146.26
Arrival pressure + topside pressure drop margin (2)	141.49	146.47	141.26
Temperature (°C)	16.96	16.62	15.5
1. The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL, **2**. The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL.			

Table 5-2: Arrival conditions at platforms for 5 MTPA base case

5.1.2.5 Fluid velocity and Erosional Velocity Ratio

The fluid velocity and the Erosional Velocity Ratio (EVR) over transport pipeline route at 5 MTPA ranges:

- Trunkline upstream DHUB:
  - Minimum Fluid velocity ranges from 0.22 to 0.62 m/s,
  - Maximum EVR ranges from 0.05 to 0.12.

- Spurlines downstream DHUB & from K14 PLET to K14 platform:
  - Minimum Fluid velocity ranges from 0.37 to 0.39 m/s,
  - Maximum EVR ranges around 0.09.

For the 5 MTPA case, all fluid velocities are expected to be low. This could induce deposition of particles, solids, etc. if any and enhanced Corrosion Under Deposits Phenomena. For early life conditions, it is recommended to further investigate those issues in the upcoming phases of the project, more specifically the presence of any particles, solids that may settle / accumulate into the injection lines because of the low velocities.

On the other hand, the EVR limit is respected in all the mentioned injection flowlines.

5.2 Sensitivity studies

Several steady state sensitivities studying the impact of the initial conditions were conducted using the CO_2 spreadsheet or *OLGA* model. The main reasons are:

- The evaluation of the required packing time of the trunkline with comparison to the base case (Sensitivity study 1)
- The definition and refining of the trunkline's design temperature (Sensitivity study 2, 3 and 4)

The list and the description of the sensitivity studies is as follows:

Case	Flowrate (MTPA)	Discharge pressure (barg)	Inlet temperature (°C)	Details
Sensitivity study 1 *OLGA model*	22 MTPA all the way to DHUB without any take-off at K14 PLET	180	50	22 MTPA all the way to DHUB without any take-off at K14 PLET
Sensitivity study 2 *CO_2 spreadsheet*	22	180	65 (1)	Most likely not to occur but it was studied to evaluate the design temperature of the trunkline
Sensitivity study 3 *CO_2 spreadsheet*	22	180	56 (2)	This case was studied in order to further refine the design temperature of the trunkline.
Sensitivity study 4 *CO_2 spreadsheet*	11 (3)	180 vs. 120	65	This case was studied in order to further refine the design temperature of the trunkline.

Note:

1. 65°C is the maximum temperature outlet of Porthos, also considered as the Maximum Operating Temperature (MOT) for Porthos flowrate (Ref. [2]).

2. 56°C is the maximum temperature of the mix of all fluids corresponding to a flowrate of 22 MTPA at the inlet of the trunkline (Ref. [2]).

3. 11 MTPA is the maximum flowrate coming from Porthos (Ref. [2]).

Table 5-3: List of conducted steady state sensitivity cases

5.2.1 Sensitivity study 1

5.2.1.1 Pressure Profile

Here after is presented the pressure profile (More details are presented in the appendix 9.1.3.1) along the trunkline of 32 in OD for 22 MTPA with no take-off at K14 PLET. The results include a 10% margin on total pressure drop.

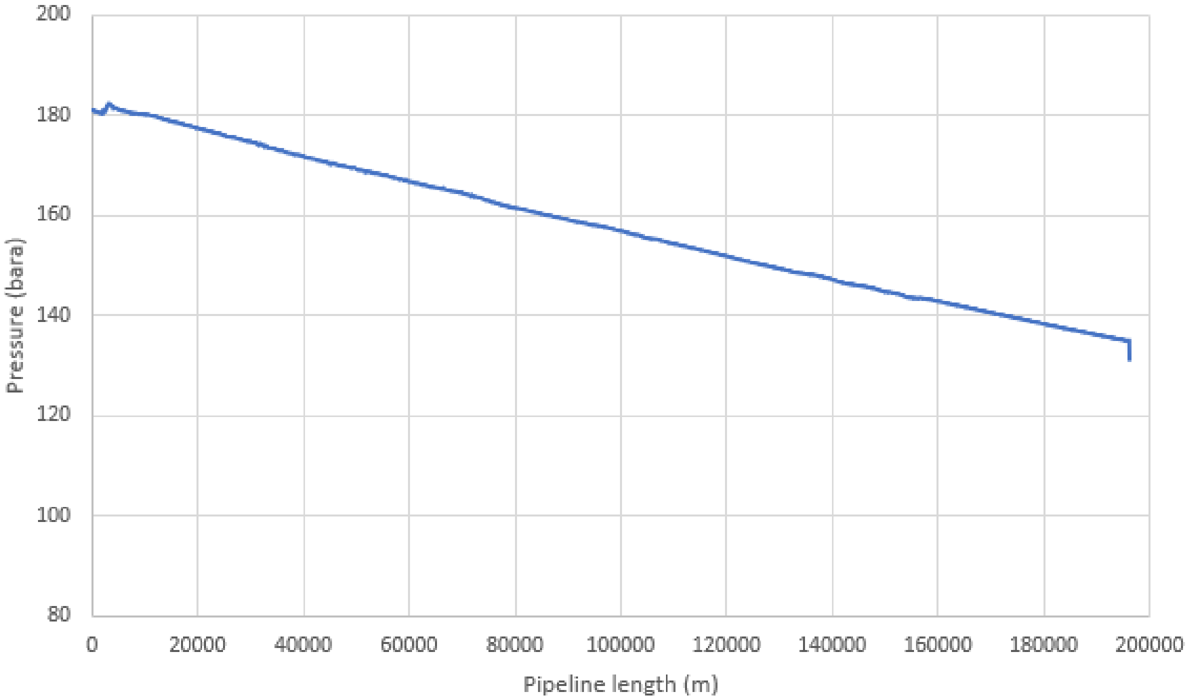

Figure 5-7: Pressure profile for the sensitivity study 1

As the figure indicates, with a 180 barg discharge pressure, the arrival pressure at top of DHUB is approximatively 130.1 barg including the 10% margin on pressure drop.

5.2.1.2 Temperature Profile

Here after is presented the temperature profile (More details are presented in the appendix 9.1.3.2) along the trunkline of 32 in OD for 22 MTPA with no take-off at K14 PLET.

As observed on the temperature profile, the arrival temperature at DHUB is about 17.3°C. It is worth reminding that the fluid takes longer time than expected to be in thermal equilibrium with the seabed ambient temperature and that is potentially due to the large flowrate minimizing the exchanges with the ambient environment and the huge thermal inertia of the CO_2.

From this sensitivity study, the expected range of arrival temperature at injection platforms remains unchanged compared to previous conclusions of the present report profile, namely this range will follow the sea water seasonal temperatures, meaning that the arrival temperature should oscillate between 4°C and 16°C, whatever the injection temperature at onshore terminal.

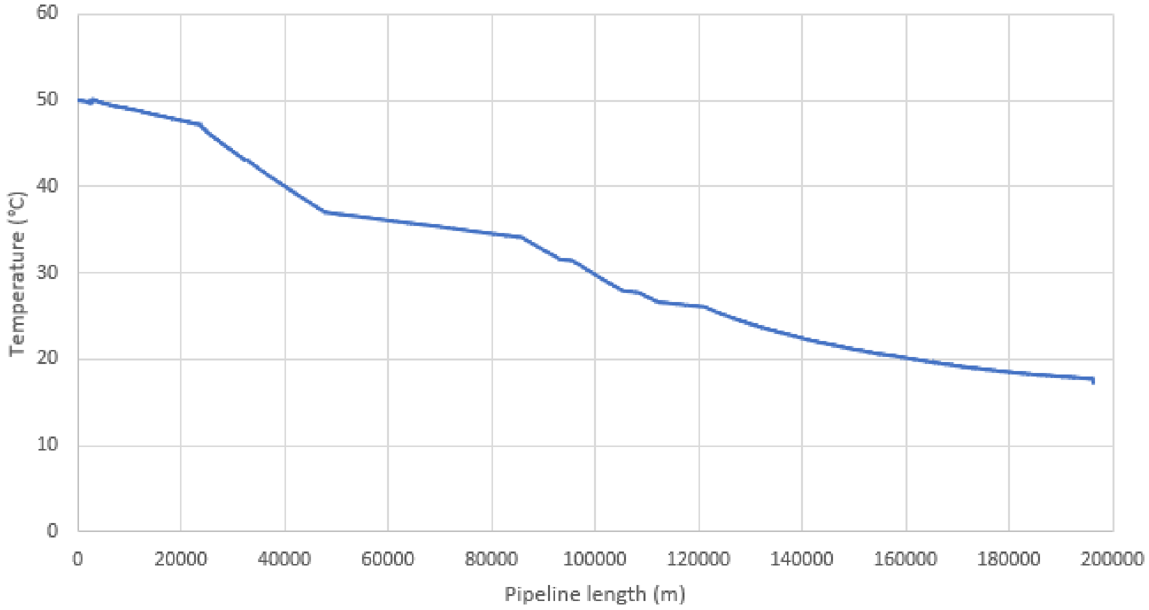

Figure 5-8: Temperature profile for the sensitivity study 1

5.2.2 Sensitivity study 2

5.2.2.1 Pressure Profile

Here after is presented the pressure profile (More details are presented in the appendix 9.1.4.1) along the trunkline of 32 in OD for 22 MTPA with a take-off of 8 MTPA at K14 PLET. The results include a 10% margin on total pressure drop.

Figure 5-9: Pressure profile for the sensitivity study 2

As the figure indicates, with a 180 barg discharge pressure, the arrival pressure at K14 PLET is approximatively 130.2 barg and at top of DHUB 121.6 barg including the 10% margin on pressure drop.

5.2.2.1 Temperature Profile

Here after is presented the temperature profile (More details are presented in the appendix 9.1.4.2) along the trunkline of 32 in OD for 22 MTPA with a take-off of 8 MTPA at K14 PLET. The given results are for the warm case (summer conditions for ambient temperature and 65°C at inlet for a 22 MTPA flowrate).

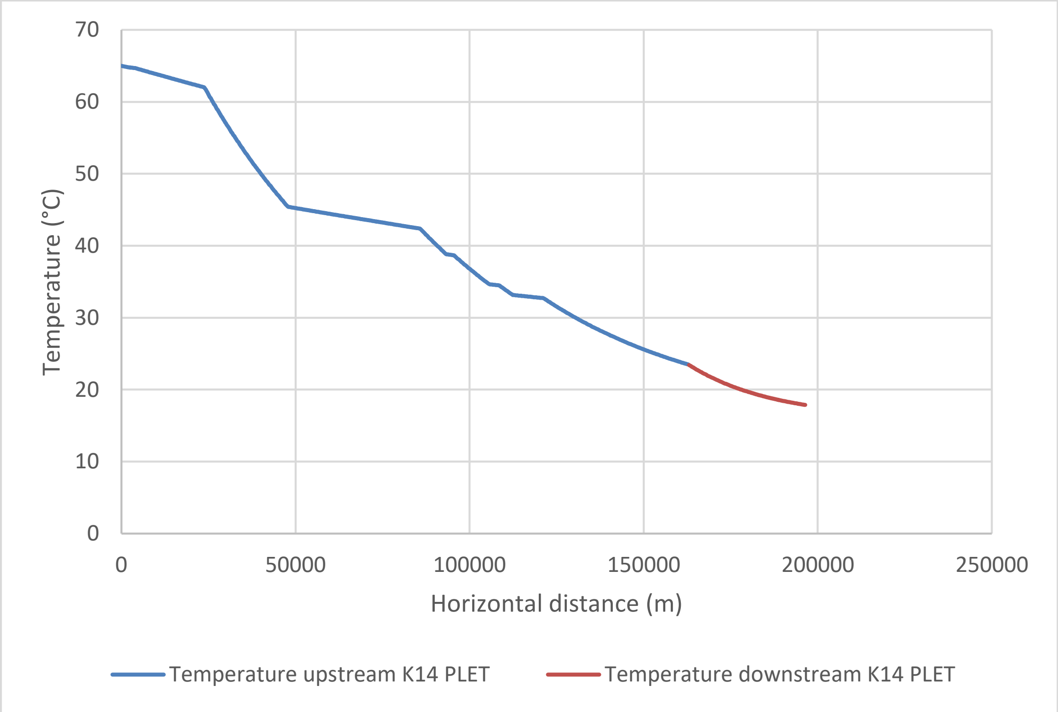

Figure 5-10: Temperature profile for the sensitivity study 2

As observed on the temperature profile, the arrival temperature at DHUB is about 17.9°C. It is worth reminding that the fluid takes longer time than expected to be in thermal equilibrium with the seabed ambient temperature and that is potentially due to the large flowrate minimizing the exchanges with the ambient environment and the huge thermal inertia of the CO_2.

5.2.3 Sensitivity study 3

This study has been conducted for the evaluation of the design temperature of the trunkline. All details are in the next section.

5.2.4 Sensitivity study 4

This study has been conducted for the evaluation of the design temperature of the trunkline. All details are in the next section.

5.3 Trunkline design temperature

Since CO2next Liquid CO_2 (LCO_2) Terminal (BB01) and Porthos Compression Station (BB02) have different conditions in terms of flowrate, temperature and pressure, in this section several sensitivities regarding the inlet conditions of the trunkline are lead.

Other sensitivities related to the length of the sections presenting different pipe characteristics (burial, coating…) are also conducted in order to cover all uncertainties related to the installation, any change of pipeline configuration following seabed surveys, Etc. and to account for marine growth or any small layers of soils that could have been transported by the sea current and laid over the pipe, affecting therefore the thermal exchange with surrounding sea water temperature.

The aim being to minimize the heat transfer conditions in order to determine the maximum design temperature of the trunkline and define a spec break location after which the design temperature could be decreased.

The base cases covering the maximum flowrates in accordance with the maximum operating temperatures (MOT) were provided by process team (Ref. [2]) and are as follow:

- **Case 1**: 11 MTPA as maximum flowrate with a MOT of 65°C
- **Case 2**: 22 MTPA as maximum flowrate with a MOT of 56°C

5.3.1 Case 1

The sensitivities conducted over this case are listed below:

- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / No additional lengths over buried sections.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / +540 m over Onshore section.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / +600 m over Micro-Tunnel section.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / + 580 m over trenched section at the exit of the Micro-Tunnel.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / + 980 m over trenched section at the exit of the Micro-Tunnel.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 180 barg / + 1580 m over trenched section at the exit of the Micro-Tunnel covering three additional lengths over the previously mentioned three buried sections.

Considering the most stringent temperature profiles, a sensitivity over the discharge pressure at the inlet has also been conducted. Giving that the lowest pressure switch (PSLL) is at 95 barg, and that any pressure lower that 120 barg at the inlet could trigger two-phase flow in the injection system, a pressure of 120 barg has been considered for this sensitivity.

- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 120 barg / + 1580 m over trenched section at the exit of the Micro-Tunnel.
- Flowrate: 11 MTPA / MOT: 65°C / Discharge pressure 120 barg / + 980 m over trenched section at the exit of the Micro-Tunnel.

5.3.2 Case 2

Considering the most stringent temperature profiles over case 1, the following sensitivities have been conducted over case 2:

- Flowrate: 22 MTPA / MOT: 56°C / Discharge pressure 180 barg / No additional lengths over buried sections.
- Flowrate: 22 MTPA / MOT: 56°C / Discharge pressure 180 barg / + 1580 m over trenched section at the exit of the Micro-Tunnel.
- Flowrate: 22 MTPA / MOT: 56°C / Discharge pressure 180 barg / + 980 m over trenched section at the exit of the Micro-Tunnel.

5.3.3 Trunkline design temperature study results

The following graph presents a comparison over all previously listed cases and sensitivities, including a 5°C margin:

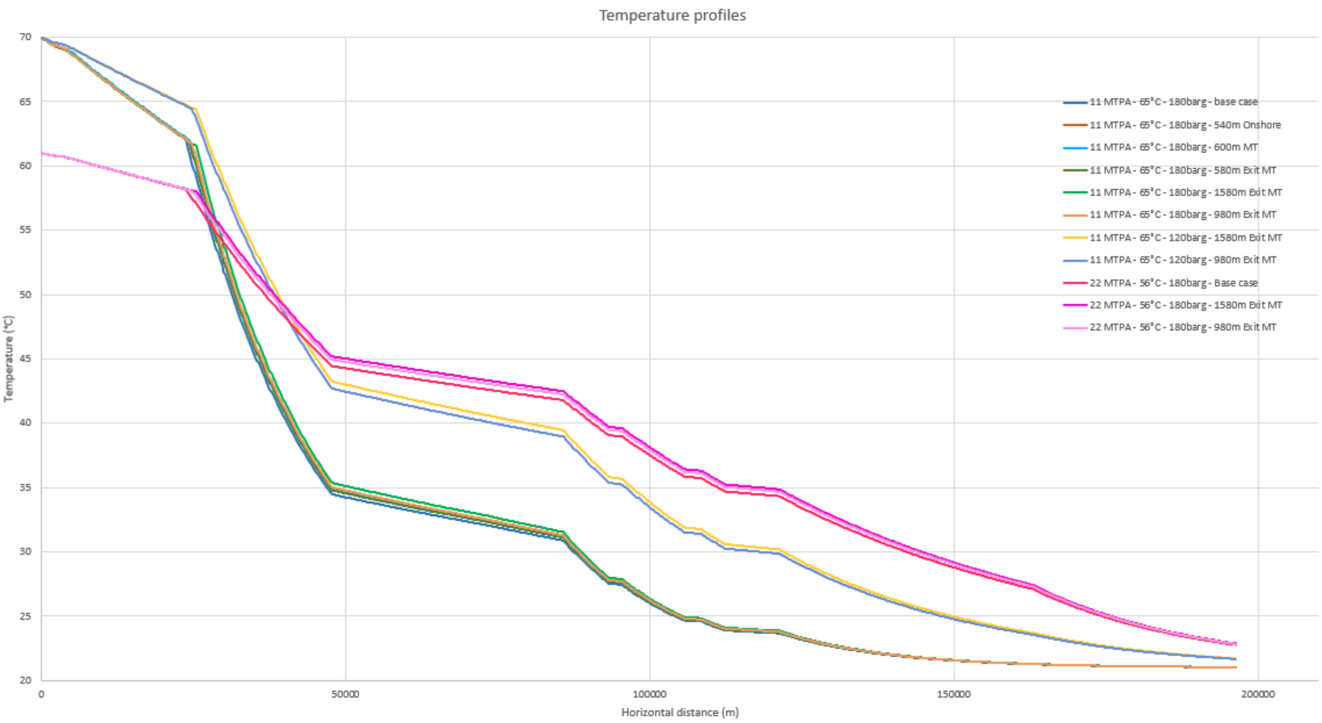

Figure 5-11: Temperature profiles for trunkline design temperature determination

As observed on the graph, the case where an 11 MTPA flowrate, a MOT of 65°C and a discharge pressure of 120 barg with a 1580 m of additional length over the buried sections all together presents the most stringent temperature profile for the first approximately 45 kilometers. The difference in the temperature profile over these first kilometers in both cases where a 980 m and 1580 m length of buried sections are added is very negligeable, meaning that any local adjustments of the pipeline configuration on the seabed will not affect the definition of the design temperature and the proposed spec break here after.

Over the rest of the trunkline, the case where a 22 MTPA flowrate, a MOT of 56°C and a discharge pressure of 180 barg with a 1580 m or 980 m of additional length over the buried sections all together presents the most stringent temperature profile.

As a conservative approach, and considering a 5°C margin, it is recommended to set a design temperature of

- 70°C over the first 50 kilometers and
- 50°C for the rest of the trunkline up to the distribution hub (DHUB).

6 TRANSIENT CALCULATION RESULTS

In this section are presented the main results of the transient calculations performed for Aramis phase 1 project.

6.1 Unplanned Shutdown – Packing & depacking phenomena

Shutdown simulations were performed for warm ambient conditions and for peak flowrate to assess the pressure and temperature profiles during the shutdown in order to define a safe shutdown operation to avoid 2-phases flow or crossflow between the injection wells and to evaluate the time needed by the operators to react following an unplanned shutdown.

6.1.1 Shutdown of injection wells & no shutdown onshore

Simulations have been performed to assess the pressure build-up in the trunkline in case of spurious shutdown of injection wells while the feed source from onshore facilities are still in operation. The packing of the transport pipeline has been assessed considering peak rate (22 MTPA) as it is considered as the most stringent. Should the injection rate be at plateau, then no major difference savings are anticipated compared to what is summarized here after.

Initial transport pipeline pressure for these considered scenarios are based on steady state operations at 22 MTPA. Both cases are listed here after:

- **Base case**: Steady state of 22 MTPA including a take-off of 8 MTPA at K14 PLET and remaining 14 MTPA flowrate to DHUB, followed by a well shutdown occurrence. The injection rate at shore is maintained constant, what is conservative considering anticipated export pump technology.
- **Sensitivity case – RIV closure**: Steady state of 22 MTPA all the way to the DHUB, followed by the RIV closure sequence. The injection rate at shore is maintained constant as well.

6.1.1.1 Base case

Pressure build-up anticipated in transport pipeline for this shutdown scenario is presented here after. It is worth mentioning that a Pressure Protection System for the trunkline is supposed to be triggered at 200 barg.

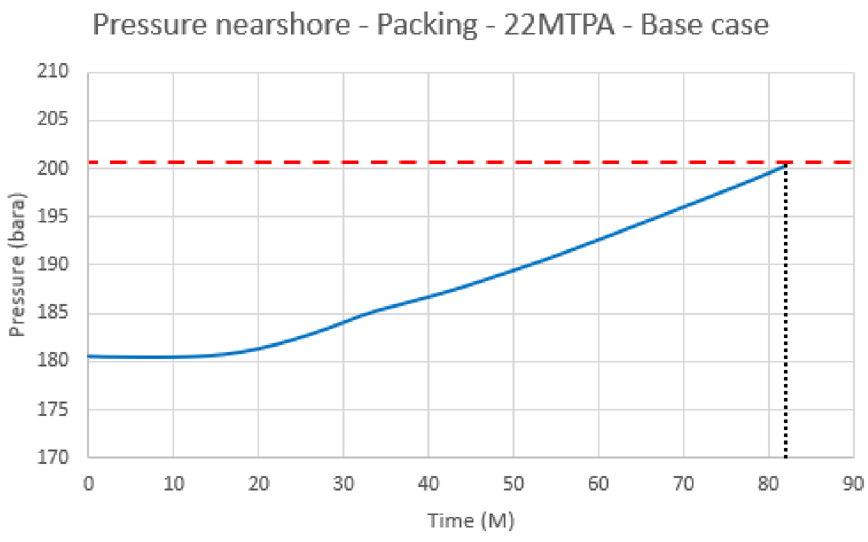

Figure 6-1: Pressure build-up in pipeline with shutdown of injection wells and no shutdown onshore – Base Case

As presented on figure above, the pressure build-up in the transport pipeline is relatively rapid because of the high initial steady state operating pressure. The higher is the pressure build-up in the reservoir due to CO_2 injection, then the faster is the packing of the transport pipeline.

During the first 12 min of the unplanned shutdown, due to the "small" compressibility of the CO_2, the pressure in the subsea system is almost constant and then increases by approximately 0.3 bar / min. The Pressure Protection System alarm is triggered after 82 min of the unplanned shutdown.

Even though the pressure build-up in the system could be relatively fast, consequence of the high initial steady state pressure in the system, the large volume of the trunkline and the low compressibility of the CO_2 (behaving as a liquid filled system), the operators, the pipeline control or pipeline safety system should have time to respond and to avoid a high pipeline shut-in pressure.

6.1.1.2 Sensitivity Case - RIV closure

Pressure build-up anticipated in transport pipeline for this shutdown scenario is presented here after. It is worth mentioning that a Pressure Protection System of the trunkline is supposed to be triggered at 200 barg.

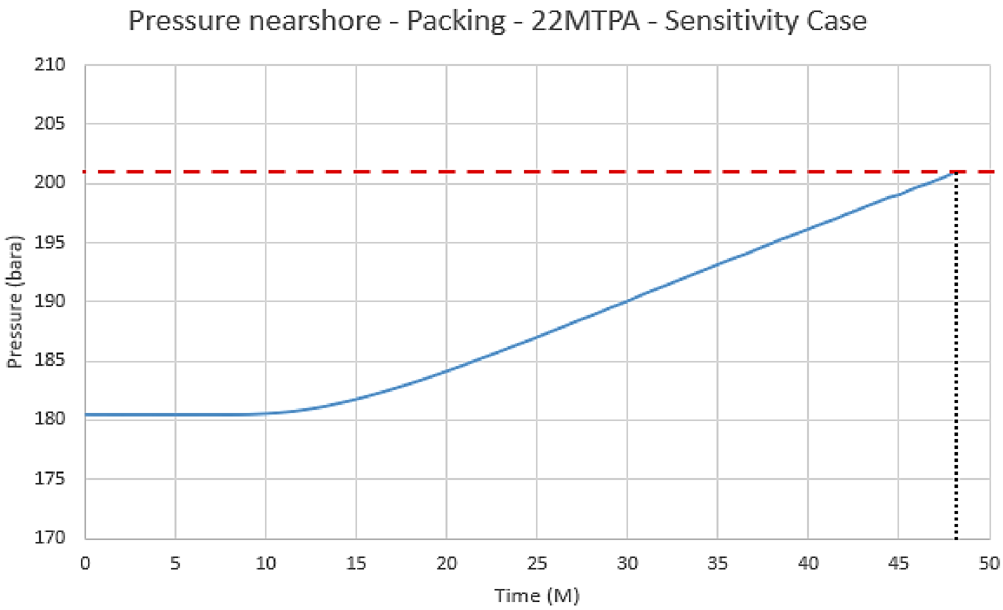

Figure 6-2: Pressure build-up in pipeline with RIV shutdown and no shutdown onshore – Sensitivity Case

During the first 10 min of the unplanned shutdown, the pressure in the subsea system is almost constant and then increases by approximately 0.6 bar / min. The Pressure Protection System alarm is triggered after 48 min of the unplanned shutdown.

Even though this case is most likely not to occur, the operators, the pipeline control or pipeline safety system should still have enough time to respond and to avoid a high pipeline shut-in pressure.

6.1.2 Shutdown onshore & no shutdown of the injection wells

A sudden shutdown onshore without shutdown of the injection wells may potentially result in low pipeline pressure and two-phases conditions in the transport pipeline. Transient shutdown simulations have been therefore performed in order to evaluate the time required before observing the minimum acceptable settle-out pressure in the transport pipeline before triggering the two-phases flow region envelope or any crossflow between the injection wells and therefore to evaluate the time for the operators to respond in case of such unplanned shutdown.

Initial transport pipeline pressure for this considered scenario is based on steady state operations at 22 MTPA. After onshore plant shutdown event, then the opening of the Injection Choke Valves is kept constant, what is relevant considering control philosophy of wells. No closure of Downhole safety valve is also considered in present study to evaluate the time between the shutdown event and the occurrence of back-flow from reservoir and crossflow between wells, if any.

Transport pipeline blowdown into wells for such shutdown scenario is presented here after.

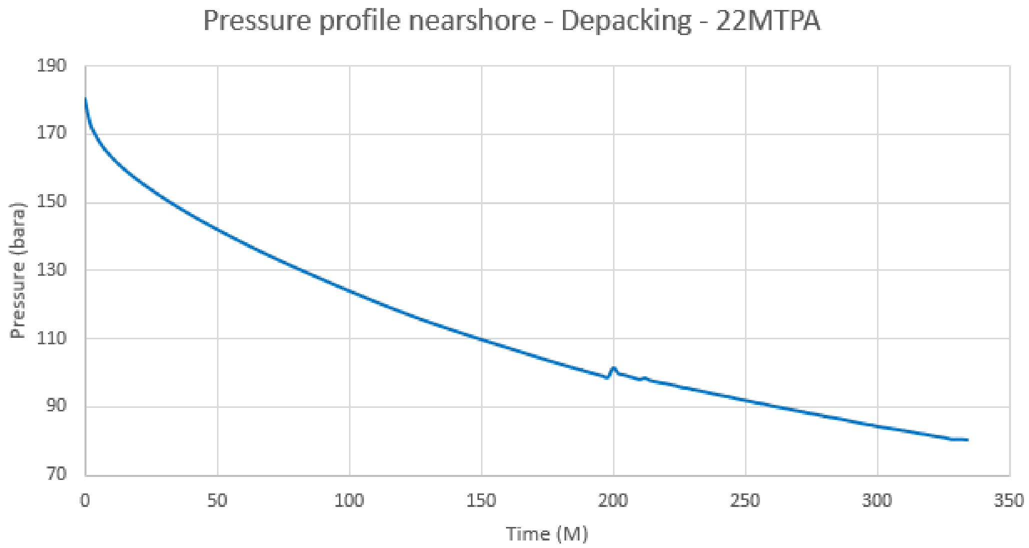

Figure 6-3: Transport pipeline blowdown into wells with shutdown onshore and no shutdown of injection wells

As presented on figure above, the pressure in the transport pipeline decreases by approximately 0.3 bar / min. The present study also highlights that gas flashing is experienced after about 5 hours following unplanned shutdown in the beginning of the transport pipeline between the Onshore and the Micro-Tunnel sections. The figure below illustrates the gas flashing through the liquid hold-up measurements near the Maasvlakte terminal just before entering the Micro-Tunnel.

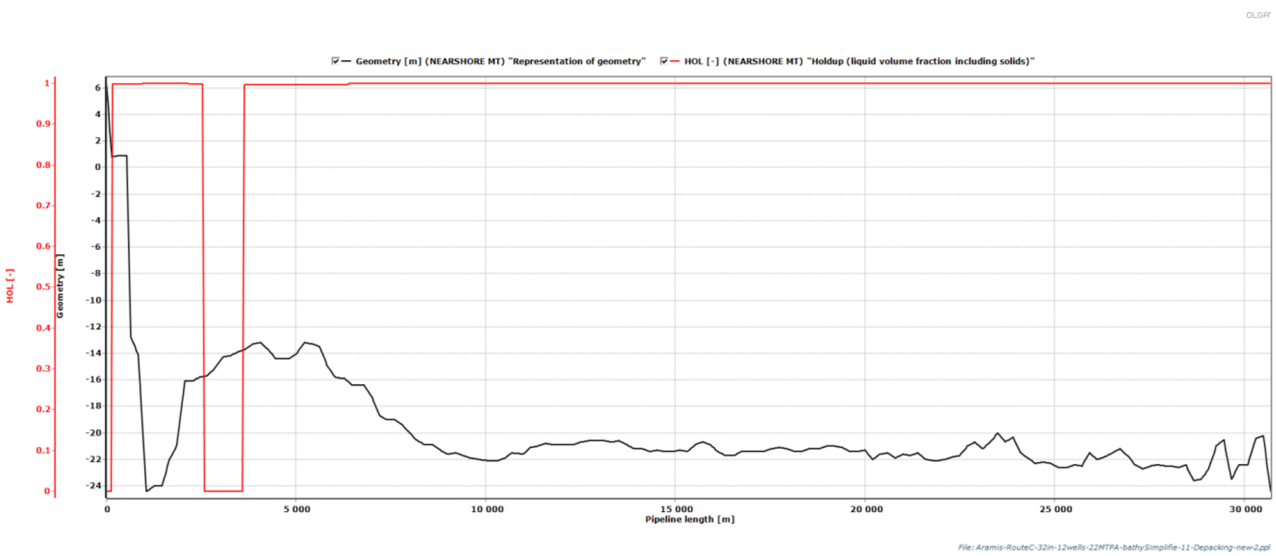

Figure 6-4: Liquid hold-up – Two-phase flow conditions in the Micro-Tunnel following unplanned shutdown of onshore facilities

Those two-phase conditions in the transport pipeline are observed as soon as the Pressure @ Maasvlakte goes below 82 barg considering the most stringent sea water ambient conditions and the CO_2 specification with impurities. It is worth mentioning that, with reservoir pressure build-up, the gas flashing should be delayed.

Even with such conditions, operators and control system should have enough time to respond and avoid the appearance of gas pockets within transport pipeline. A pressure set point of 90 barg including a 10 bar margin over the critical point should be respected at Maasvlakte terminal, after which the risks of two-phase flow become unavoidable. Should this situation occur, the Injection Choke Valves (or any other valves – Master Etc.) should be closed, and refilling operations of the transport pipeline should be carefully carried out from shore to go back in liquid filled conditions. The operating philosophy associated to those refilling operations should be developed in the upcoming phases of the project.

Another outcome of the present study is that no crossflow phenomena between the different injection wells will be observed, at least, in the first 5 hours following unplanned shutdown event as the appearance of two-phase flow conditions seems to be the driving parameter.

From the previous figure and blowdown analysis, it can be also extrapolated and estimated that at early life conditions, when injecting 5 MTPA, the time for the trunkline to blowdown into the injection wells if this scenario will be encountered will be also large enough for the operators to react before triggering the two-phase flow conditions. Indeed, a minimum 3.5 hours should be required before observing gas flashing into subsea network.

6.2 Trunkline depressurization

There is no specific operational requirement for depressurization of the subsea network in normal situation / shutdown. The potential scenarios that may impose a depressurization of the subsea system could be:

- Damage of the transport pipeline requiring repair and then blow-down of subsea system prior any intervention,
- Formation of a plug requiring blow-down to attempt remediating,
- Pipeline decommissioning,
- Operational issues at onshore plant requiring blow-down of the subsea system to control CO_2 release if any.

Depressurization of the transport pipeline should be avoided as much as possible because this operation will take time (more than 3 days) and refilling operations might be complex and will present non-negligible risks (gas pocket collapse, slack flow, low temperature, heater requirements, Etc.).

Nevertheless, even if infrequent operations, relevant facilities (Restriction Orifices, boot, Etc.) have to be integrated in the network.

When depressurizing the CO_2 to atmospheric conditions, extremely low temperatures are anticipated whatever the considered scenario. As the design temperature of the transport pipeline is supposed to be -25°C as per previous phase of the project (concept select), it is important to control the pressure in the transport pipeline during depressurization operations in order to comply with design temperatures of the transport pipeline. The control of the pressure during blow-down has been achieved by considering staggered depressurization sequence and by adjusting the diameter of the Restriction Orifices over depressurization sequence.

Since there is a high risk of ice formation around the pipe and in its layers at very low temperatures and in order to take into account enough margin to cover the uncertainties related to *OLGA* software, the minimum considered temperature is 0°C. It is also worth mentioning that the depressurization simulations are very slow, and the temperature does not fall rapidly with proposed sequence which means that the margin over the temperature could be relaxed as these calculations are not considered as fast transient.

Special attention should be also paid to the partially and totally buried sections of the transport pipeline that will not take benefits of the potential heating brought by the surrounding sea water.

The back pressure downstream Restriction Orifice should be also defined to avoid ice formation in the depressurization system. In the present study, and considering the phase diagram of CO_2, the pressure has been fixed at 7 bara (above triple point) to avoid ice formation and risk of plugging of depressurization lines. The transition from 7 bara to atmospheric conditions at vent and associated equipment should be developed by Process team in accordance with Flow Assurance outcomes / recommendations presented in this report and to mitigate the risks of plugging of the depressurization network.

In the frame of this study, 3 main scenarios have been considered. They are summarized here below. All cases have been covered and deeply assessed. Nevertheless, in order to ease the reading of this report, it has been decided not to present all the cases as all the results are almost similar and proposed design complies with all requirements.

- Normal / Planned shutdown:

- Shutdown of the export pumps while the wells are still open in order to empty the pipeline as much as possible,
- When the pressure reaches 90 barg at Maasvlakte terminal and before triggering the two-phase flow, the blowdown through the wells is stopped,
- 1 hour waiting time for the preparation of venting operations,
- Vent through restricted orifice(s),

- Abnormal / Unplanned shutdown:

- Spurious closure of wells while the export pumps are still in operation,
- Packing of the transport pipeline at the highest pressure,
- Blowdown operation into the furthest well having the lowest WHSIP (for better control of the depressurization activity, nevertheless number and location of wells still to be defined by Field Operations team– Single well or multi wells operation, acceptance of two-phase flow in well during blowdown, Etc.) until reaching the pressure set point of 90 barg at Maasvlakte terminal, or 10 bar above the lowest WHSIP
- After settle-out pressure in network is about 90 barg or 10 bar above the lowest WHSIP, well is shutdown, and vent through restricted orifice(s),

Because this case is similar to the planned shutdown with minor differences, only relative results will be presented.

➢ Abnormal / Unplanned shutdown with line packed and wells are not available,

- Representative scenario in case of hydrates plug before reaching the platforms,
- The export pumps are still in operation and the line is packed,
- 1 hour waiting time for the preparation of venting operations,
- Vent through restricted orifice(s).

This case has a very low probability of occurrence as wells should always be available, at least one, which means that blowdown and pressure reduction into transport pipeline should always be possible through the wells at first. Because this case is similar to the planned shutdown with minor differences, only relative results will be presented.

After completion of the different analyses, proposed design of depressurization system consists in implementing 4 Restriction Orifices. This arrangement has been identified as the best compromise in order to avoid too low temperatures in transport pipeline with regard to design temperature and water icing risks, but also to shorten the duration of the depressurization sequence.

Proposed diameters of the Restriction Orifice are 5, 7, 10 and 14 inches for the depressurization of the BB03 trunkline. Those Restriction Orifices are used in sequence (the one after the other). The switch between the first and second Restriction Orifices occurs 10 hours after depressurization of first RO. 24 hours later, occurs the second switch. The third switch occurs 7 hours after depressurization of third RO. The minimum achieved bulk temperature is 1°C (for a few minutes).

It is worth mentioning that the Restriction Orifice is modeled as a Leak in *OLGA*, which means it has a fixed diameter.

The following operating philosophy, which has been developed based on the different analyses carried out during the depressurization study, is proposed.

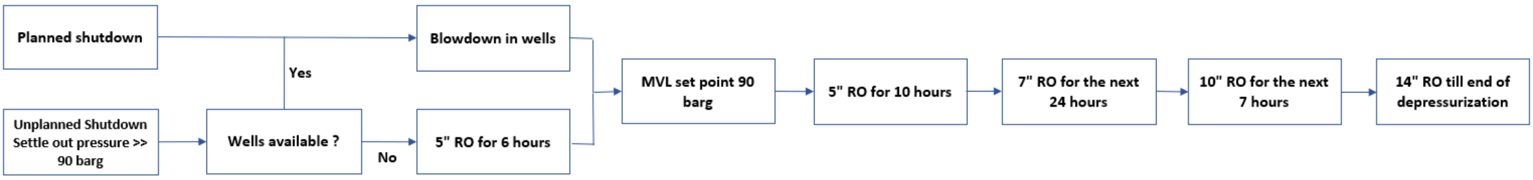

Figure 6-5: Operating philosophy of the depressurization post planned and unplanned shutdowns

The figures here below present the evolution of the pressure during depressurization at key positions of the trunkline in the case of a planned shutdown and unplanned shutdown with previous operating guidelines.

As illustrated on the sequence above, the duration of the depressurization starting from a pressure set point of 90 barg at MVL lasts approximately 2 days and a half (58 hours).

As illustrated on next figure, there is some delay / extended pressure gradient over the trunkline length. Indeed, the pressure decrease close to the DHUB appears to be faster than at onshore terminal as illustrated above. This gradient of pressure over the distance can be explained by the large volume of the trunkline and the pressure drop induced into the system due to fluid displacement.

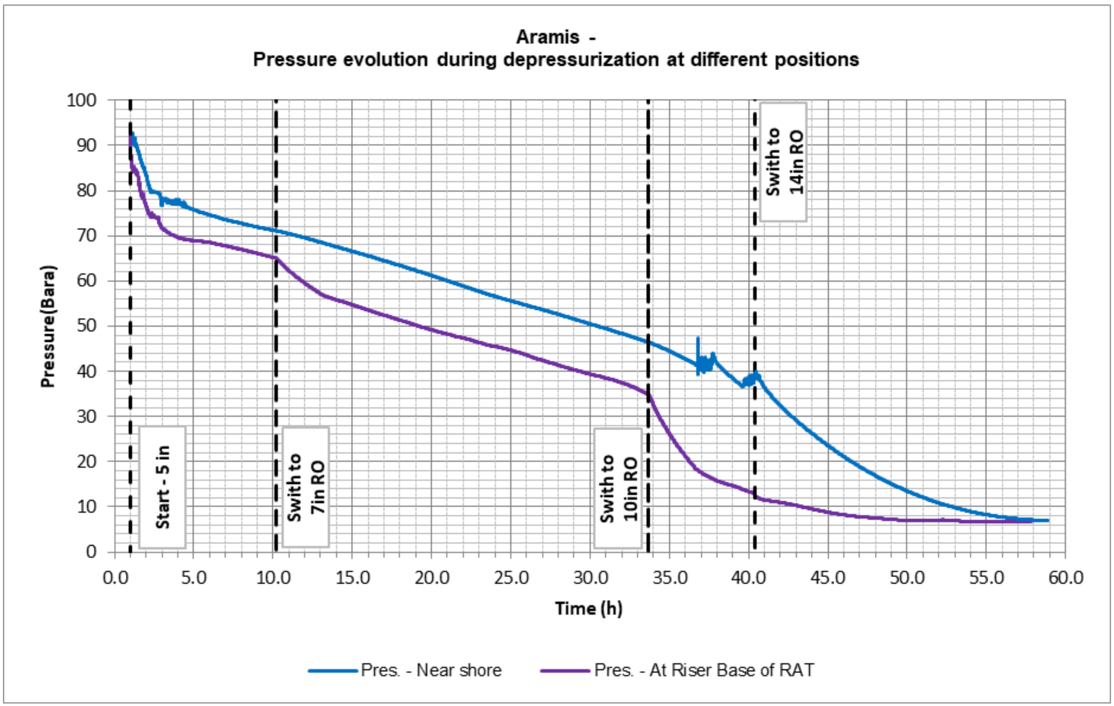

Figure 6-6: Pressure evolution in pipeline during depressurization after 90 barg set point is reached at MVL

It is worth reminding that for planned depressurization, the blowdown in wells before reaching the pressure set point at MVL terminal lasts about 5 hours after the shutdown.

Concerning the unplanned shutdown with wells available post packing of the line, the blowdown through the well with the lowest WHSIP lasts a little more than 10 days as illustrated in the figure below presenting the pressure at MVL terminal from shutdown until reaching the pressure set point of 90 barg. In the present study, the WHSIP of the considered well for blowdown operations being lower than 90 barg, the two-phase flow condition is driving the switch to Restriction Orifice to complete the depressurization of the injection network. Once the pressure set point is reached at MVL terminal, the proposed operating philosophy detailed above can be applied.

Applying the previous sequence of staggered Restriction Orifices as presented just before following the blowdown into the wells, then the results / behavior obtained will be almost similar to the case presenting here after in the report and referring to planned shutdown. This conclusion can be extrapolated from the different figures and behavior observed during the planned shutdown and by advanced analysis of the results.

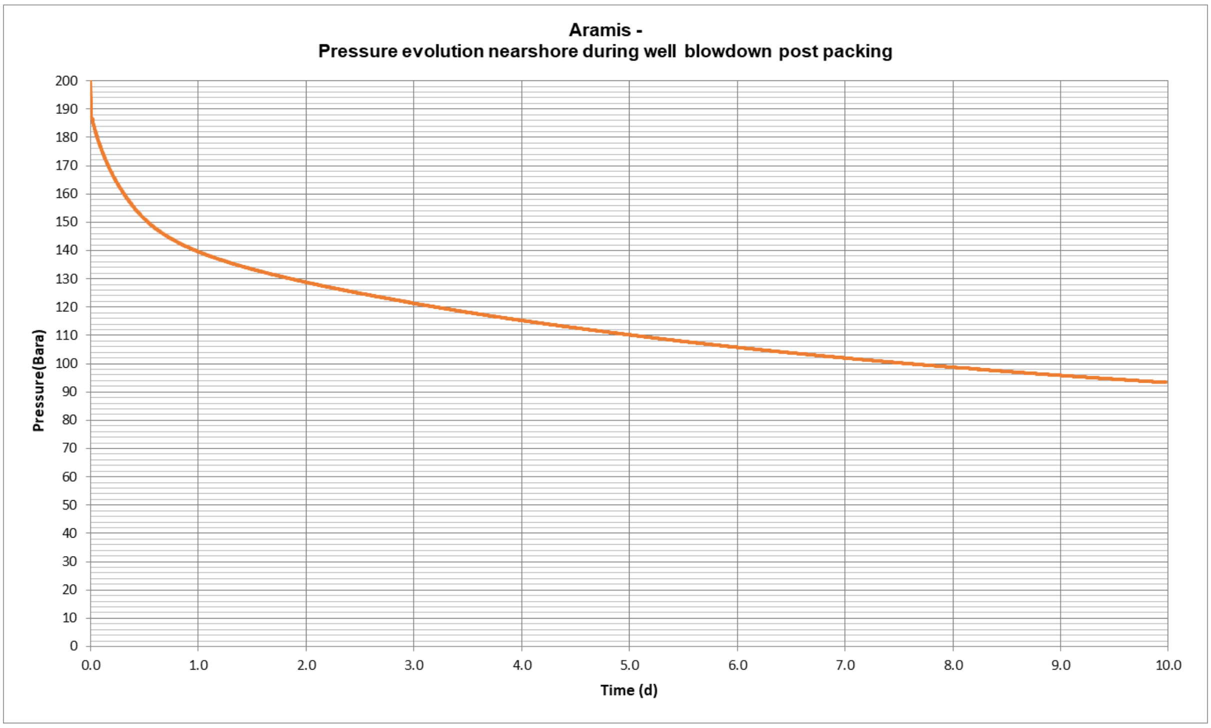

Figure 6-7: Pressure evolution in pipeline during well blowdown post unplanned shutdown - packing and prior reaching 90 barg set point at MVL

Once the pressure set point is reached at MVL terminal, the proposed operating philosophy detailed above can be applied.

On the other hand, for the unplanned shutdown with line packing and wells not available, the procedure of the depressurization can start directly with a 5" RO and the steps detailed above can still be valid and applicable as the temperature can still be controlled and does not drop to very low values, respecting the 0°C threshold. The temperature at Riser Base (coldest spot) is presented in the following figure.

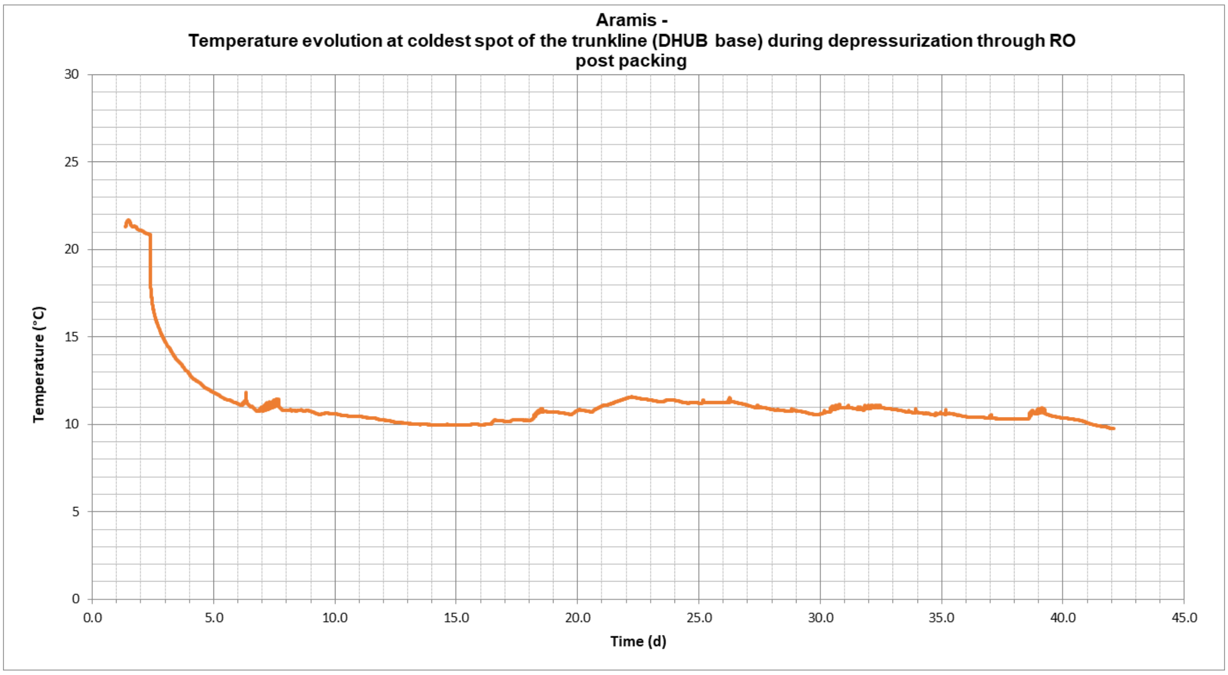

Figure 6-8: Temperature evolution at coldest spot of the trunkline (DHUB base) during depressurization through RO following unplanned shutdown - post packing

It is worth mentioning that the set point of 90 barg at MVL is reached after about 6 hours (357.9 min) of depressurization through the 5" RO in addition to the previously mentioned 10 hours. The rest of the proposed sequence for the depressurization remains unchanged with no risk of dropping to very low temperatures and ice formation around the pipe can be avoided.

As for the other unplanned shutdown, applying the previous sequence of staggered Restriction Orifices to this scenario after the blowdown through the 5" RO has been completed, then the results / behavior obtained will be almost similar to the case presenting here after in the report and referring to planned shutdown. This conclusion can be extrapolated from the different figures and behavior observed during the planned shutdown and by advanced analysis of the results.

Because of the isenthalpic phenomena during the liquid blow-down, the minimum expected temperature downstream the different Restriction Orifices is about -56°C whatever the shutdown scenario considered. Those low temperatures should be experienced as long as liquid CO_2 will be observed downstream Restriction Orifice. To cover the uncertainties related to modeling with *OLGA*, and because of the fast transient phenomena observed across Restriction Orifice, then a 20°C margin is added to the minimum temperature leading to a design temperature of the topside piping of - 76°C.

The figure below presents the evolution of the temperature downstream Restriction Orifice during the depressurization sequence. The liquid and gas mass rates are also presented downstream Restriction Orifice.

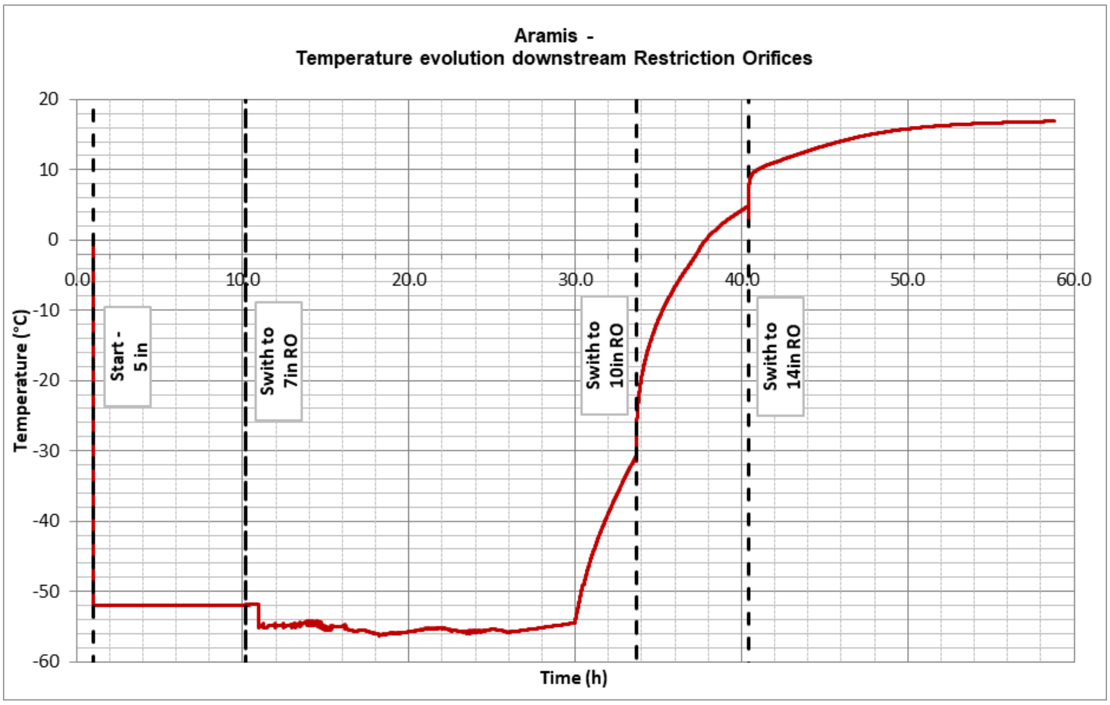

Figure 6-9: Temperature evolution downstream Restriction Orifices during depressurization

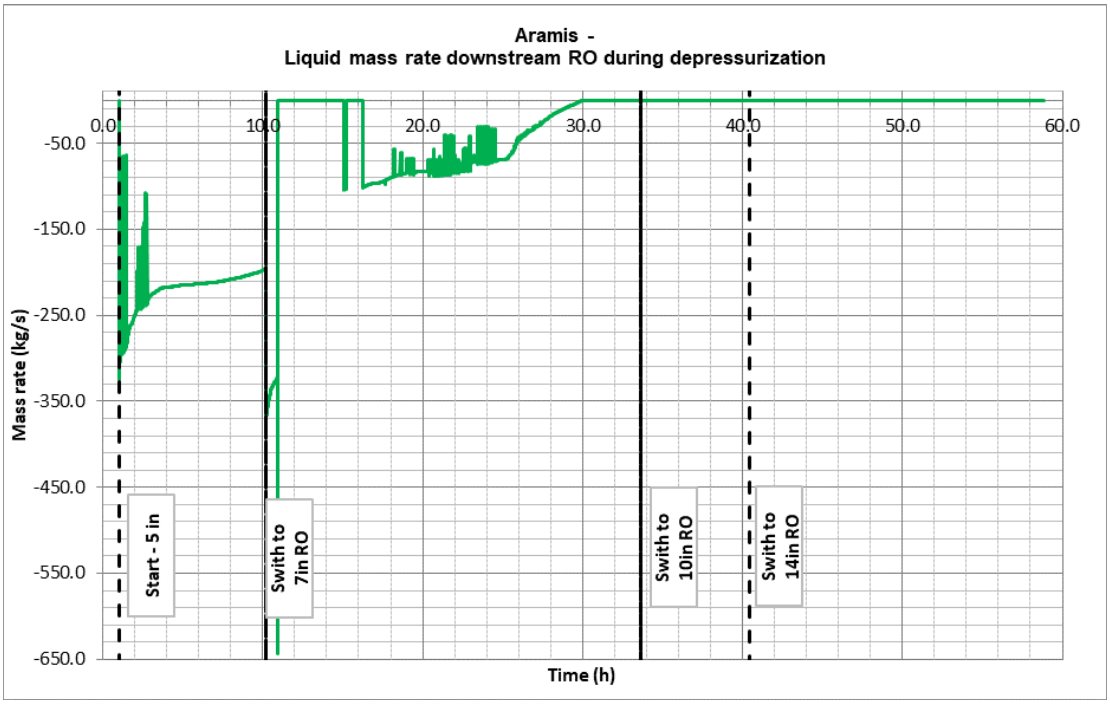

Figure 6-10: Liquid mass rates downstream Restriction Orifices during depressurization

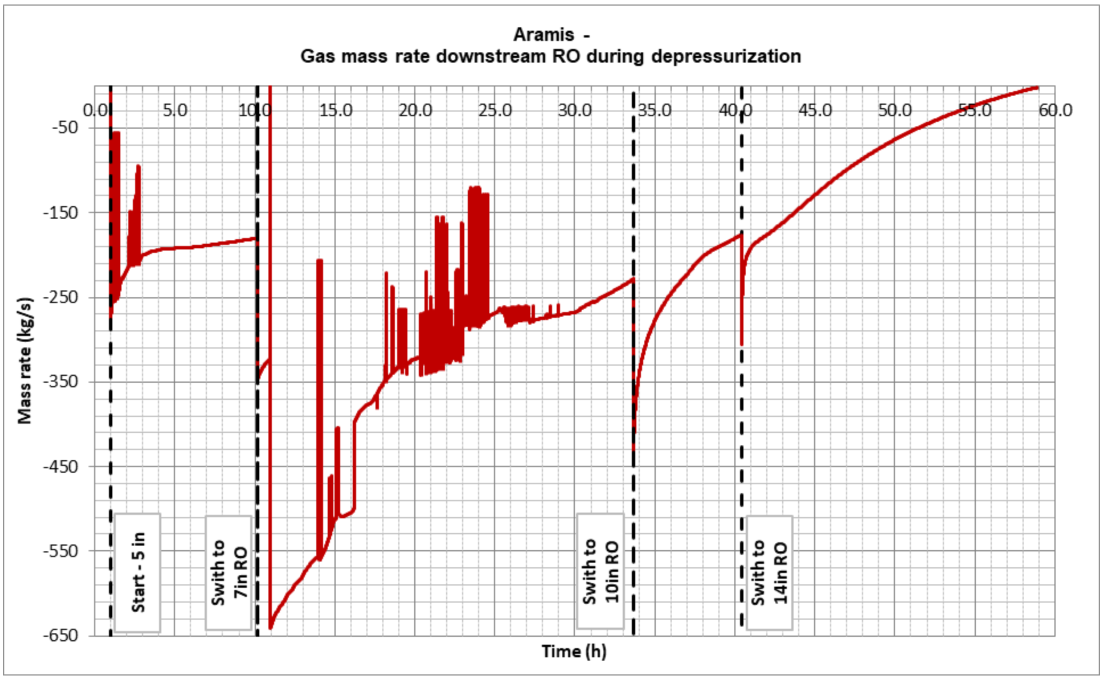

Figure 6-11: Gas mass rates downstream Restriction Orifices during depressurization

From the figures above, it is worth to mention that as soon as no more liquid CO_2 is expected downstream Restriction Orifice, then an increase of the temperature is also observed. Based on the different simulations performed, it appears that the increase of the temperature associated to the stop of liquid CO_2 flowing downstream could be used as the decision to switch to the third Restriction Orifice (10” RO) during the depressurization sequence.

Implementing TT sensors downstream Restriction Orifice is therefore recommended in order to support depressurization operations and the decision to activate the third Restriction Orifice. The last Restriction Orifice is used in order to vent faster the CO_2, once the risk of very low temperatures is over.

The following figure presents the minimum temperatures expected in the transport pipeline during the depressurization sequence for planned and unplanned shutdowns.

For all the scenarios considered in the present study, the critical location always corresponds to the section of the transport pipeline in front of the Restriction Orifice at least during the first 32 hours of the depressurization. After which, the coldest temperature can be seen close to the K14 PLET for a few hours until switching to a 10” RO, where the coldest temperatures are experienced in front of the RO again. After switching to a 14” RO all temperatures start converging to the same value.

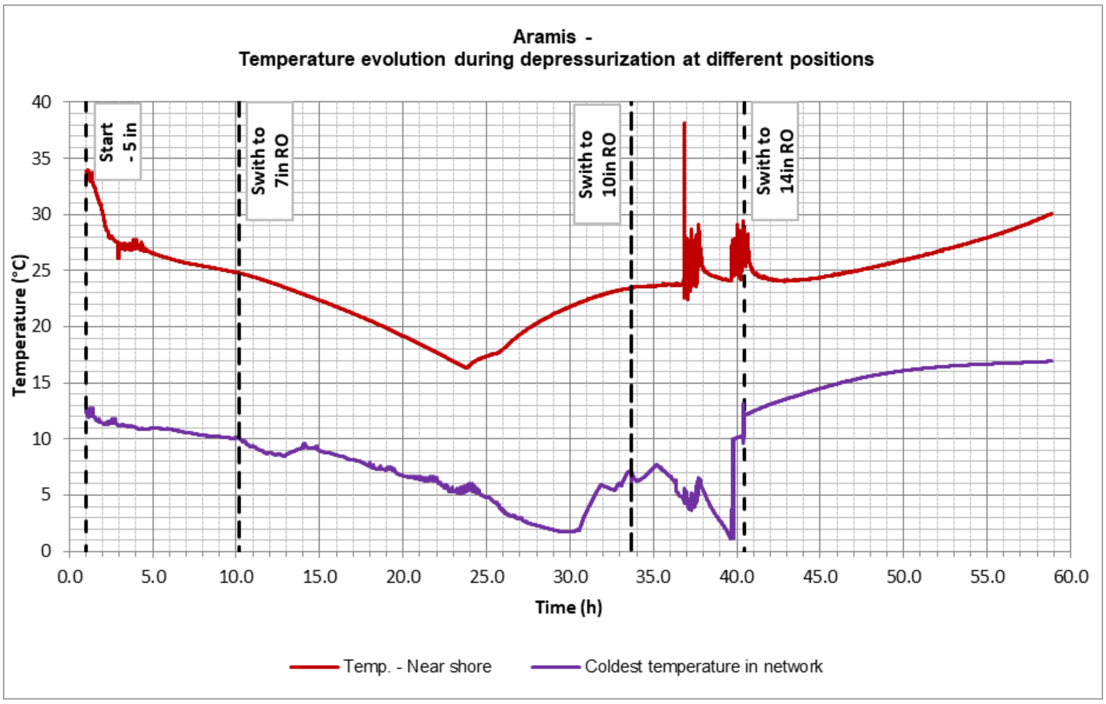

Figure 6-12: Temperature evolution at different positions upstream Restriction Orifices during depressurization

As presented on previous figures, proposed design keeps the temperatures high enough in order to avoid free water appearance and ice formation risks at 0°C and to avoid exceeding the design temperature of the trunkline. The minimum achieved temperature is 1°C for a few minutes to which a 5°C margin should be applied. A minimum temperature of -4°C should be considered at design.

The following table summarizes the peak rates of liquid and gas CO_2 expected downstream Restriction Orifice during the depressurization sequence. Both peak rates coincide at the same time, and they should be considered for the boot design and the dispersion study.

Peak liquid CO_2 (kg/s) ***10 % margin included***	**Peak gas CO_2 (kg/s)** ***10 % margin included***
708	705

Table 6-1: Peak quantity of CO_2 expected downstream Restriction Orifices during depressurization

It is worth reminding that the presented results of the depressurization are based on steady state warm conditions (warm inlet and summer ambient temperatures). In fact, it is more favorable to start the planned depressurization in warmer conditions as demonstrated in the Mollier diagram below where two starting points are presented one being colder than the other.

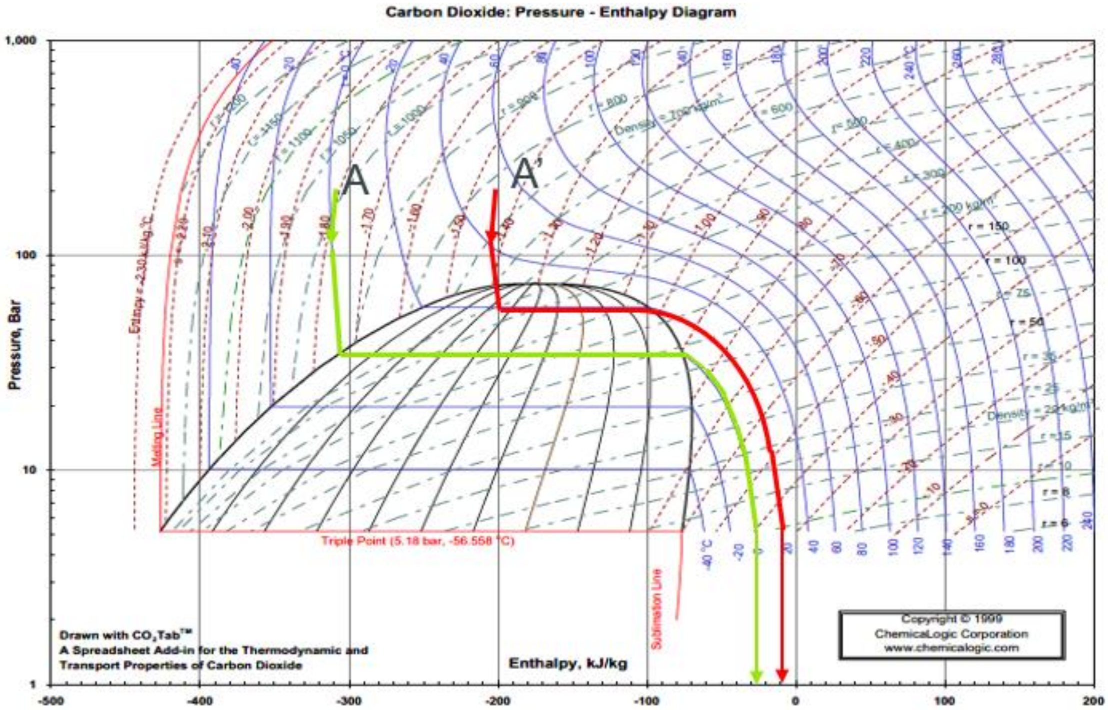

Figure 6-13: Comparison of cold and warm start of depressurization on the Mollier diagram

As observed on the figure above, the depressurization of relatively cold liquid phase CO_2 may lead to unacceptable low temperatures which could exceed the minimum design temperatures unless the conditions are controlled. When the start is at warmer conditions, the pipe is still warm thanks to the inertia and could help heat the vapor CO_2 which is also a way of controlling the minimum temperature in the system. When the system is in cold thermal equilibrium the depressurization could take longer time because it should be further sequenced with more intermediate RO sizes in order to control the temperature.

It is also worth mentioning that the probability of occurrence of such scenario where the system is in full thermal equilibrium with the ambient is very unlikely. The system is highly pressurized with liquid CO_2 and taking into account the thermal inertia even with a bare pipe and the thermal capacity of CO_2, which is very favourable, it would take days in order to be in the full thermal equilibrium which gives more flexibility in terms of operations.

Depressurization at cold temperatures with the system being in full equilibrium with the surroundings cold conditions is very unlikely to occur, and the results should not be significantly different compared to the ones presented in the present report, as illustrated on the diagram of Mollier for the CO_2, that is why it was not considered as the basis of the depressurisation design at least not at this phase of the study. As part of the Flow Assurance dossier to be developed at the next phase, the depressurization during winter conditions should be covered, what will allow verifying that the current design is still applicable even for colder temperatures.

7 UNCERTAINTIES & RISKS OF FLOW ASSURANCE STUDY

Main uncertainties & risks associated to present Flow Assurance study are listed and detailed here below:

- Reservoir Pressure:
  - The present study is considering an average reservoir pressure per year and not minimum reservoir pressure for start-up flowrates. This uncertainty also applies for late life conditions,
  - Flow Assurance study should be updated as soon as relevant information about expected reservoir pressures for the different panels will be better known,
- Well injectivity:
  - Should the injectivity not be equal to the target injection rate, then there is no guarantee to achieve the 22 MTPA injection rate through transport pipeline,
  - Flow Assurance study should be updated as soon as relevant information on well models and injectivities will be available for the different injection panels,
  - Range of injectivity (low injectivity, high injectivity, mid injectivity) should be considered as for other CCS projects to cover uncertainties at reservoir level,
- Inlet conditions & injection profile:
  - The inlet conditions to the transport pipeline (Pressure and Temperature) were provided at early stages of the project. Should any of these conditions be updated and/or modified, then a sensitivity study should be conducted in order to make sure of the feasibility of the selected concept,
  - Design temperature is based on combinations of different flowing conditions at terminal (22 MTPA – 56°C / 11 MTPA – 65°C). This design temperature assumes that Porthos premise will never deliver more than 11 MTPA. Should any upgrade of the Porthos facilities be considered in the future to get more emitters, then the design temperature of the pipeline might be a major bottleneck,
- CO_2 specifications and modelling:
  - CO_2 with impurities has been used as base case for all steady state and transient operations as there is at least 95% of CO_2 in the injected fluid. The considered fluid composition was based the Aramis Premises (Ref. [1]) and includes several assumptions (components ignored, others replaced with alike components...),
  - There are also some limitations in current commercial thermodynamic software, some impurities being not supported as Nox & Sox, while it is known today those impurities have strong impact on phase envelope of CO_2. Nox & Sox should not have a great impact on pressure drop (low impact on density and viscosity) but do have an impact on phase envelope and thus the risk of appearance of Two-phase flow and free water,
  - Since, the choice of the fluid could induce uncertainties on pressure drop calculations and depressurization key figures and although the different applied margins should cover these uncertainties, further sensitivity studies regarding CO_2 specifications should be conducted. Should the fluid composition be updated and/or modified, a feasibility study should be done in order to validate the selected concept,
- Depressurization operating philosophy,

- Scenario of depressurization to be considered are unclear because of the lack of consolidated Basis of Design. Some scenario was discarded unanimity by project at the beginning and scenario came back at the end of the Flow Assurance study,

- Pipeline characteristics,
    - In the present study, most of the pipeline characteristics were provided by the pipeline specialists. Some of the cross-section details were based on assumptions, although validated by pipeline specialists could still induce uncertainties on the temperature profile of the transport system. Even though, the applied margins should cover these uncertainties, should there be any modifications in the pipeline characteristics, a feasibility study of the selected concept should be conducted.
- *Multiflash* and *OLGA* used versions,
    - Flow Assurance study has been carried out using *Multiflash 7.1* and *OLGA 2021.2*, the latest versions adequate with CO_2 fluids,
    - The version of *OLGA* used in present study may not capture all improvements related to CO_2 modeling and it is difficult to state if results are conservative or not.

8 CONCLUSIONS & WAY FORWARD

Based on the Flow Assurance study carried out in the frame of the pre-project study of the phase 1 of the Aramis project, no major showstoppers have been identified with the proposed pipe diameter. However, it appears that the injection of 22 MTPA might be highly challenging at the end of life, therefore highlighting the strong effect of the pressure build-up observed in the reservoir during field life. It is nevertheless important to keep in mind that depending on the pressure build-up in the reservoir, this plateau might be severely affected.

It is also worth mentioning that no concern is anticipated with regards to the transport pipeline operability.

The following way forward are nevertheless proposed to complete the Flow Assurance scope of work and further refine the design and the operating philosophy / strategy:

- The selected concept needs to be further studied and validated with updated Basis of Design (CO_2 specifications, Pipeline characteristics, Injection profile, Inlet conditions, Reservoir pressure evolution, Well models…),
- Further investigate the spurlines and BB04 pipelines diameters against updated injection profiles,
- Further develop the start-up sequence and associated operating philosophy (risks of hydrates, drying philosophy, Etc.),
- Further develop the hydrates mitigation strategy to cover well restart operations and initial start-up,
- Cover wells restart operating philosophy and procedures after both planned shutdown and abnormal shutdown followed by blowdown sequence in wells, especially the way Well Performance team intend to operate the different injection wells (respect of a certain drawdown for wellbore integrity management, full Injection Choke Valve opening instantaneously, well by well or all wells together, Etc.). Once this sequence of operations will be defined, then overall impact of the well restart sequence on the dynamic of the subsea network could be addressed,
- Develop hydrates remediation strategy considering the risks of hydrates formation in the transport and injection system during operating life,
- Further clarify the scenario of design of the pipeline with regards to the probability of occurrence. At this stage, a subsea trunkline at thermal equilibrium with surrounding sea water has been discarded by project unanimity and has not been considered by Flow Assurance team,
- Redevelop same scope considering pure CO_2, even if, from literatures, present assumptions are the most stringent,
- Develop the Flow Assurance dossier for the trunkline capturing the impact of the BB04 scope,
- Further develop the integrated model mimicking the different injection sites of all partners to fully capture the dynamic of the system and the impact of the different injection sites on each other.

9 APPENDIX

9.1 Steady state results

9.1.1 22 MTPA scenario

9.1.1.1 Pressure Profile

	Pipeline length (m)	Pressure (bara)	Pressure including margin (bara)
Onshore to MVL	0	180.97	180.97
	1894.00	180.52	180.47
Nearshore (including Micro-Tunnel part)	1917.20	180.54	180.49
	32569.63	174.51	173.86
A-ALT	32618.41	174.51	173.86
	126474.15	152.94	150.13
Section F ends with K14 PLET	126499.15	152.89	150.08
	162706.17	145.56	142.02
Section D ends with DHUB	162731.17	145.54	142.00
	196259.45	139.42	135.26
Section C ends with the PLEM	196272.28	139.40	135.25
	222489.78	140.48	136.43
PLEM to L4A ends with L4A platform	222515.83	140.39	136.33
	224417.70	136.31	131.84

9.1.1.2 Temperature Profile

	Pipeline length (m)	Temperature (C)
Onshore to MVL	0	49.99
	1894.00	49.77
Nearshore (including Micro-Tunnel part)	1917.20	49.77
	32569.63	43.12
A-ALT	32618.41	43.08
	126474.15	25.29
Section F ends with K14 PLET	126499.15	25.27
	162706.17	20.02
Section D ends with DHUB	162731.17	20.02
	196259.45	16.99
Section C ends with the PLEM	196272.28	17.00
	222489.78	16.33

PLEM to L4A ends with L4A platform	222515.83	16.38
	224417.70	15.78

9.1.2 5 MTPA scenario

9.1.2.1 Pressure Profile

	Pipeline length (m)	Pressure (bara)	Pressure including margin (bara)
Onshore to MVL	0	150.00	149.90
	1894.00	150.00	149.90
Nearshore (including Micro-Tunnel part)	1917.20	150.05	149.96
	32569.63	151.30	151.32
A-ALT	32618.41	151.35	151.38
	126474.15	150.37	150.31
Section F ends with K14 PLET	126499.15	150.37	150.31
	162706.17	150.28	150.21
Section D ends with DHUB	162731.17	150.28	150.21
	196259.45	146.78	146.36
Section C ends with the PLEM	196272.28	146.78	146.36
	222489.78	150.64	150.61
PLEM to L4A ends with L4A platform	222515.83	150.64	150.61
	224417.70	146.55	146.10

9.1.2.2 Temperature Profile

	Pipeline length (m)	Temperature (C)
Onshore to MVL	0	49.98
	1894.00	49.39
Nearshore (including Micro-Tunnel part)	1917.20	49.40
	32569.63	31.32
A-ALT	32618.41	31.20
	126474.15	17.59
Section F ends with K14 PLET	126499.15	17.59
	162706.17	17.41
Section D ends with DHUB	162731.17	17.41
	196259.45	16.62
Section C ends with the PLEM	196272.28	16.66
	222489.78	16.02
PLEM to L4A ends with L4A platform	222515.83	16.02
	224417.70	15.50

9.1.3 Sensitivity study 1

9.1.3.1 Pressure Profile

	Pipeline length (m)	Pressure (bara)	Pressure including margin (bara)
Onshore to MVL	0	180.97	180.97
	1894.00	180.53	180.48
Nearshore (including Micro-Tunnel part)	1917.20	180.54	180.49
	32569.63	174.59	173.94
A-ALT	32618.41	174.58	173.94
	126474.15	153.20	150.42
Section F ends with K14 PLET	126499.15	153.16	150.38
	162706.17	145.87	142.36
Section D ends with DHUB	162731.17	145.83	142.31
	196259.45	135.61	131.07

9.1.3.2 Temperature Profile

	Pipeline length (m)	Temperature (C)
Onshore to MVL	0	49.99
	1894.00	49.77
Nearshore (including Micro-Tunnel part)	1917.20	49.77
	32569.63	43.10
A-ALT	32618.41	43.06
	126474.15	24.90
Section F ends with K14 PLET	126499.15	24.88
	162706.17	19.86
Section D ends with DHUB	162731.17	19.85
	196259.45	17.32

9.1.4 Sensitivity study 2

9.1.4.1 Pressure Profile

	Pipeline length (m)	Pressure (bara)	Pressure including margin (bara)
Onshore to MVL	0	181.00	181.00
	1919.00	180.43	180.38

Nearshore (including Micro-Tunnel part)	1919.91	180.43	180.37
	32620.51	172.63	171.79
A-ALT	32621.81	172.55	171.70
	126576.34	145.30	141.73
Section F ends with DHUB	126576.36	145.30	141.74
	196399.47	127.92	122.62

9.1.4.2 Temperature Profile

	Pipeline length (m)	Temperature (C)
Onshore to MVL	0	65.00
	1919.00	64.80
Nearshore (including Micro-Tunnel part)	1919.91	64.80
	32620.51	55.06
A-ALT	32621.81	55.06
	126576.34	31.08
Section F ends with DHUB	126576.36	31.08
	196399.47	17.89

ARAMIS DEVELOPMENT

BB03 FLOW ASSURANCE STUDY REPORT

Managementsamenvatting

Nederlandstalige versie

1 Introductie

Het Aramisproject heeft als doel een CO_2-transportinfrastructuur te ontwikkelen die afgevangen CO_2 van emitters naar offshore opslaglocaties op het Nederlands continentaal plat brengt. De infrastructuur wordt gefaseerd ontwikkeld om gelijke tred te houden met de aanvoer van CO_2. De eerste fase zal naar schatting iets meer dan 5 MTPA transportcapaciteit opleveren die wordt opgeschaald tot ongeveer 22 MTPA. De ontwerplevensduur van de transportinfrastructuur is ongeveer 30 jaar. Conform de CO_2-specificatie kan in de aangeleverde CO2-stroom een aantal onzuiverheden voorkomen. Het toelaatbare onzuiverheidsniveau van de verschillende componenten, waaronder water, is direct gekoppeld aan het behoud van de integriteit van de infrastructuur.

Het injectiesysteem begint onshore in de Rotterdamse haven, gaat via een 32''-OD onderzeese transportleiding naar K14 ILT/PLET[1] van Shell waar de afname voor Shell-putten plaatsvindt, voordat deze op het centraal platform D-HUBN (ook DHUB genoemd) aankomt op ongeveer 196 km van de inlaat en 33 km van K14 ILT/PLET. Bij de DHUB vindt een tweede afname plaats voor Neptuneputten (platform L10). Het resterende volume wordt geïnjecteerd in de reservoirs van TotalEnergies op ongeveer 26 km van de DHUB via een 24''-OD-leiding. Het TotalEnergies-gebied begint bij het PLEM en bereikt eerst het L4A-platform. Alleen de hoofdleiding en dit deel van het injectiesysteem worden in dit rapport behandeld. Het systeem is getoond in Figuur 1.

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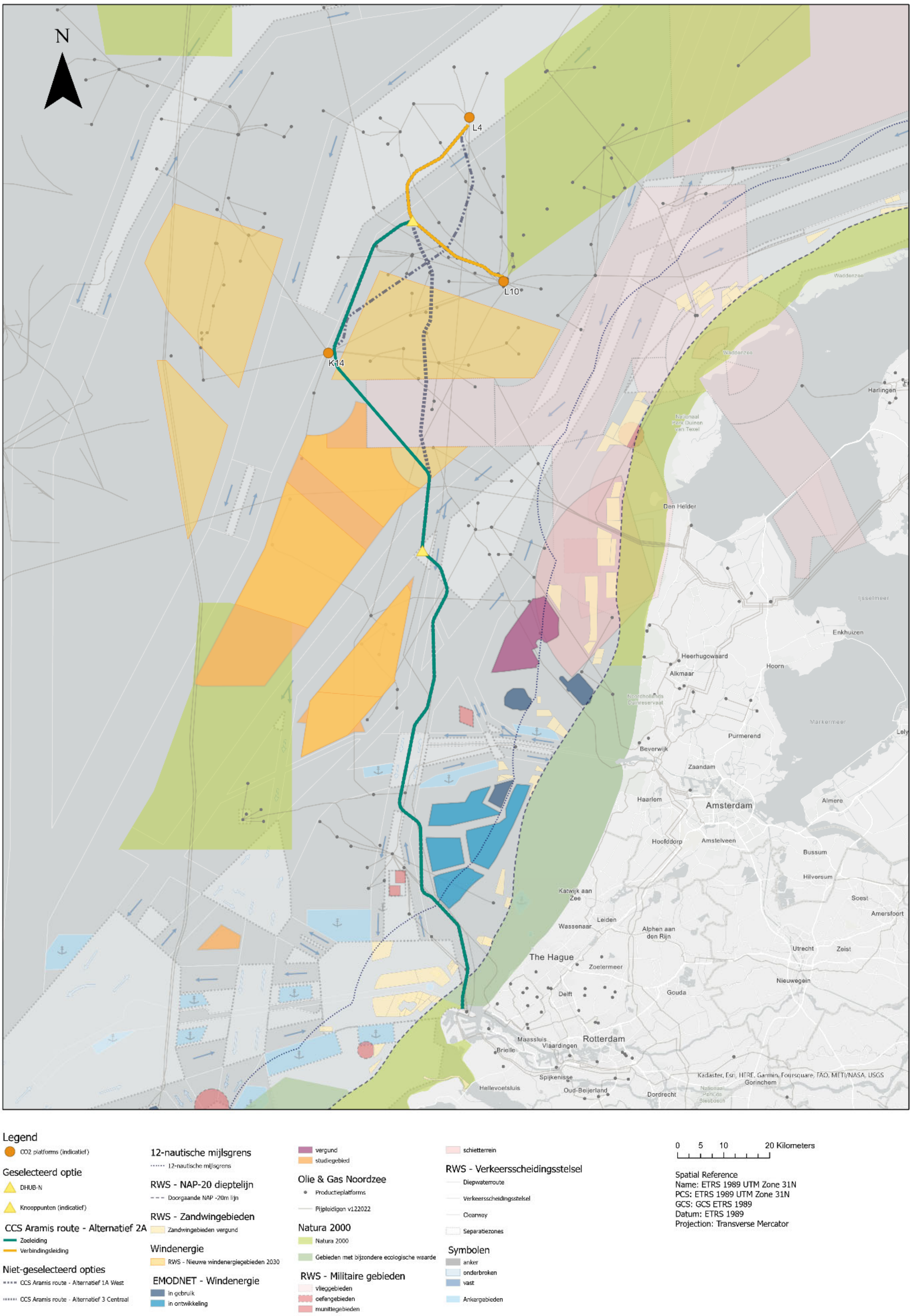
[1] PLET (pipeline end termination) en PLEM (pipeline end manifold) zijn subsea-voorzieningen voor de aansluiting van een zeeleiding op platforms en subseaputten.



Figuur 1. Kaart met het tracé van de zeeleiding inclusief overige functies op de Noordzee.

Dit document presenteert de stabiele en dynamische thermo-hydraulische analyse die is uitgevoerd voor de injectie van CO_2 met onzuiverheden via het Aramis-injectiesysteem en meer specifiek de transportleiding. De doelstellingen van dit rapport zijn:

- Bepalen van stabiele omstandigheden om de operabiliteit van het geïntegreerde netwerk te bevestigen en er tegelijkertijd voor te zorgen dat de CO_2 in de dichte fase blijft. Het aantal stabiele stromingssimulaties (steady-state) is geoptimaliseerd door kritieke punten van de injectieprofielen en de inlaatcondities te selecteren. In dit hoofdstuk worden alleen de basisscenario's gepresenteerd:

Basisscenario 1: maximale debiet van 22 MTPA - inlaatdruk 180 barg - inlaattemperatuur 50°C, en rekening houdend met de daaropvolgende drukopbouw in het reservoir;

Basisscenario 2: Opstartdebiet van 5 MTPA - inlaatdruk 150 barg - inlaattemperatuur 50°C, zonder drukopbouw in het reservoir.

- Ondersteunen van de voorlopige operationele filosofie en procedures middels scenario's van de verwachte belangrijke operaties. Het geselecteerde scenario om de dynamische analyse uit te voeren is 22 MTPA. De uitgevoerde dynamische simulaties zijn hieronder opgesomd:
  - Insluiten – Drukverhoging 1: Ongewenste sluiting van putten terwijl de pompen nog in bedrijf zijn. Stabiele stroming van 22 MTPA als startsituatie (basisscenario 1)
  - Insluiten – Drukverhoging 2: Ongewenste sluiting van de isolatieafsluiter in de stijgbuis bij de DHUB terwijl de pompen nog in bedrijf zijn – Stabiele stroming van 22 MTPA tot aan DHUB als startsituatie (gevoeligheidsscenario 1).
  - Insluiten - Drukverlaging: Ongewenste uitschakeling van pompen terwijl de putten nog open zijn – Stabiele stroming van 22 MTPA als startsituatie (basisscenario 1).
  - Gepland van druk aflaten: Uitschakelen van de pompen terwijl de putten nog open zijn, dan drukverlaging naar de putten totdat de druk in de transportleiding 10 - 20 bar boven de hoogste WHSIP (wellhead shut-in pressure) komt, of tot 10 bar boven de druk die tweefase-stroming initieert. De putten worden dan gesloten en de drukverlaging wordt voortgezet via de afblaas van de DHUB met restrictieopening (RO) – Stabiele stroming van 22 MTPA als startsituatie (basisscenario 1).
  - Van druk aflaten na ongeplande abnormale insluiting - putten beschikbaar: Ongewenste sluiting van putten terwijl de pompen nog in bedrijf zijn, waardoor de druk in de leiding tot het hoogste niveau oploopt. Druk aflaten door één put, met de laagste WHSIP (gecontroleerde drukverlaging) totdat de druk in de transportleiding 10 - 20 bar boven deze laagste WHSIP komt, of tot 10 bar boven de druk die twee-fase stroming initieert – stabiele stroming van 22 MTPA als startsituatie (Basisscenario 1).
  - Van druk aflaten na ongeplande abnormale insluiting – putten niet beschikbaar: Ongewenste sluiting van putten terwijl de pompen nog in bedrijf zijn, waardoor de druk in de leiding tot het hoogste niveau oploopt, en vervolgens van druk aflaten door de afblaas van de DHUB met RO – Stabiele stroming van 22 MTPA als startsituatie (Basisscenario 1).

2 Resultaten & aanbevelingen

De belangrijkste uitkomsten van dit Flow Assurance onderzoek zijn hieronder samengevat.

2.1 Resultaten voor stabiele stromingscondities

2.1.1 22 MTPA maximale debiet

Tabel 1 toont de aankomstcondities en -debieten op de platforms voor het 22 MTPA-scenario:

Platform	K14	DHUB	L10	TTE PLEM (3)
Arrival flowrate (MTPA)	8	14	6	8
Arrival flowrate (kg/s)	253.68	443.94	190.26	253.68
Arrival pressure (bara) (1)	137.96	135.18	133.79	136.43
Arrival pressure + topside pressure drop margin (2)	132.96	135.18	128.79	136.43
Temperature (°C)	19.2	17.06	16	16.33

Note:

1. The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

2. The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL except for TTE PLEM which is at -39 m / MSL,

3. For the peak rate only indicative results of the subsea manifold at 1.9 km from L4A platform and -39 m of water depth are presented

Tabel 1: Aankomstcondities op kenmerkende locaties van het injectiesysteem voor de 22 MPTA base case

Uit dit Flow Assurance-onderzoek blijkt dat de injectie van 22 MTPA moeilijk haalbaar zou kunnen zijn aan het einde van de projectlevensduur, als gevolg van het effect van de drukopbouw in het reservoir door de voortschrijdende vulling van het reservoir tijdens de levensduur. Dit is een grote onzekerheid die in dit stadium moeilijk te bepalen is.

2.1.2 5 MTPA opstartdebiet

Tabel 2 geeft de aankomstcondities en -debieten op de platforms voor het 5 MTPA-scenario:

Platform	K14	DHUB	L4A
Arrival flowrate (MTPA)	2.5	2.5	2.5
Arrival flowrate (kg/s)	79.27	79.27	79.27
Arrival pressure (bara) (1)	146.49	146.47	146.26
Arrival pressure + topside pressure drop margin (2)	141.49	146.47	141.26
Temperature (°C)	16.96	16.62	15.5

Note:

1. The indicated arrival pressure includes a 10% margin on the pressure drop. Reference height +24 m / MSL,

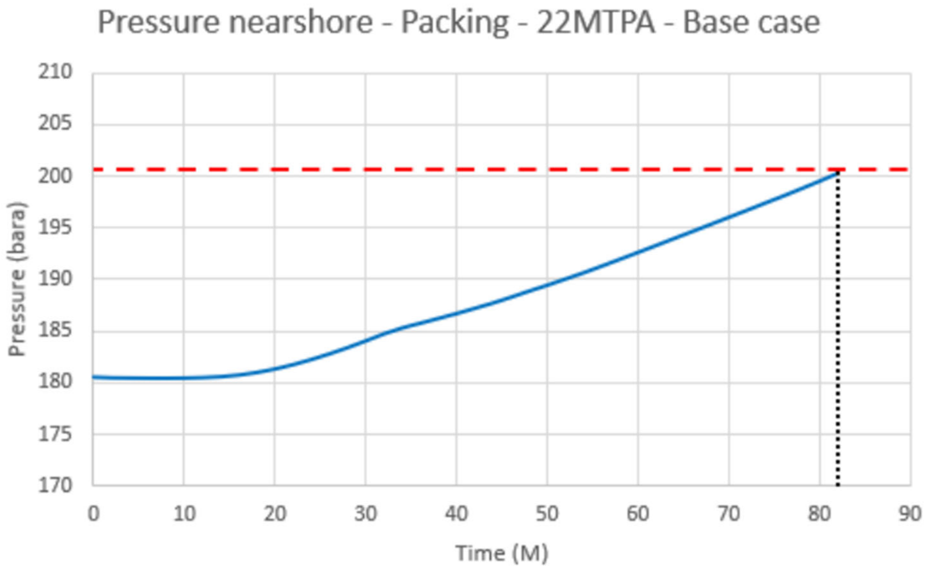
2. The indicated arrival pressure includes both 10% margin on pressure drop and a 5 bar margin representative of topside pressure drop related to piping and chokes. Reference height +24 m / MSL.

Tabel 2: Aankomstcondities op de platforms voor de 5 MPTA base case

2.2 Resultaten voor dynamische stromingscondities

2.2.1 Insluiten – drukverhoging 1

Dit scenario bestaat uit het ongewenst sluiten van injectielocaties (putsluiting) terwijl de pompen aan land nog draaien. Hieronder wordt de verwachte drukopbouw in de transportleiding voor dit insluit-scenario weergegeven. Vermeldenswaardig is dat het drukbeveiligingssysteem voor de transportleiding moet worden geactiveerd bij 200 barg.



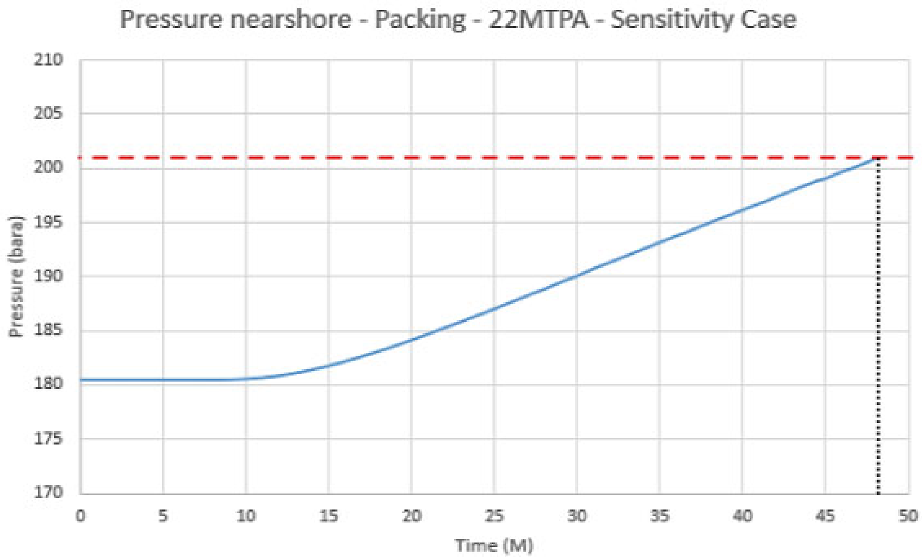
Figuur 2. Drukopbouw in de pijpleiding bij een shutdown op de injectieplatforms en geen shutdown onshore – Base Case.

De drukopbouw in de transportleiding is relatief snel vanwege de hoge initiële bedrijfsdruk. Hoe hoger de initiële druk door drukopbouw in het reservoir als gevolg van CO_2-injectie is, hoe sneller de druk in de transportleiding oploopt. Dit betekent dat later in de levensduur de druktoename in de transportleiding sneller zal verlopen dan in het begin van de levensduur.

Voor het slechtste scenario (eindperiode levensduur, injectie van 22 MTPA met drukopbouw in het reservoir) wordt het drukbeveiligingssysteem geactiveerd na 82 minuten van de ongeplande insluiting. Dit geeft voldoende tijd voor de operators en het leidingbeheersysteem om te reageren en een (te) hoge druk in de pijpleiding te voorkomen.

2.2.2 Insluiten – Drukverhoging 2

Dit scenario bestaat uit het ongewenst sluiten van de isolatieafsluiter in de stijgbuis bij de DHUB terwijl de pompen aan land nog draaien. Dit scenario wordt bekeken omdat een snellere drukopbouw wordt verwacht vanwege het kleinere volume van de pijpleiding. De drukopbouw in de transportleiding voor dit insluitscenario wordt hierna gepresenteerd.

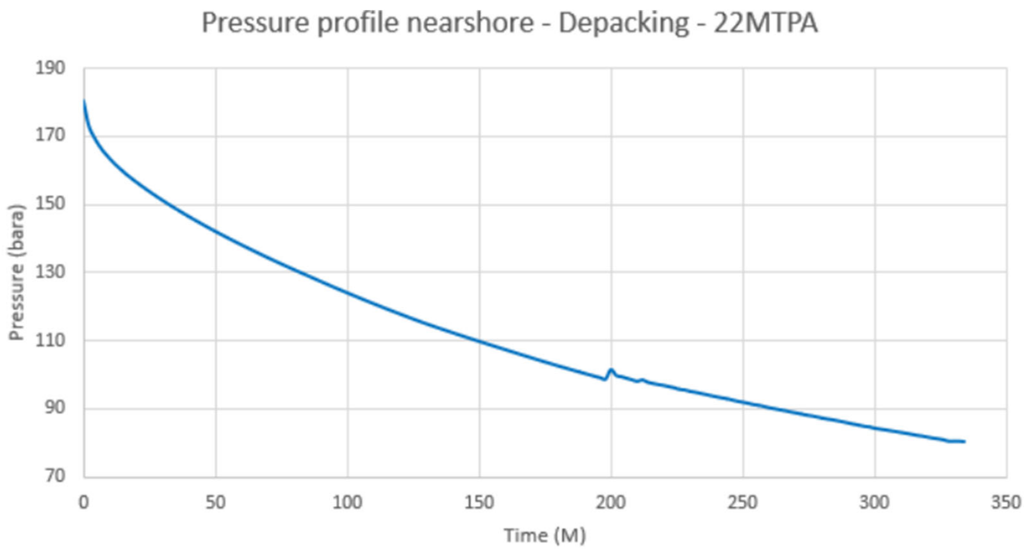


Figuur 3. Drukopbouw in de pijpleiding bij een shutdown van de riserkleppen op de injectieplatforms en geen shutdown onshore – gevoeligheidsscenario.

Net als voor insluitscenario 1 zijn de ongunstigste omstandigheden beschouwd om de kortste drukopbouwtijd te definiëren voor dit gevoeligheidsscenario, namelijk einde levensduuromstandigheden met reservoirdrukopbouw en injectie van 22 MTPA. Voor dit scenario wordt het drukbeveiligingssysteem na 48 minuten van de ongewenste insluiting geactiveerd. Hoewel het zeer waarschijnlijk is dat dit geval zich niet zal voordoen, moeten de operators en het leidingbeheersysteem voldoende tijd hebben om te reageren en een (te) hoge afsluitdruk in de pijpleiding voorkomen.

2.2.3 Insluiten – Drukverlaging

Hierna wordt het van druk laten van de transportleidingen naar putten voor het insluitscenario met drukverlaging gepresenteerd.



Figuur 4. Afblazen van de pijpleiding in de putten met een onshore shutdown en geen shutdown op de injectieplatforms.

Zoals te zien is in bovenstaande figuur, neemt de druk in de transportleiding met ongeveer 0,3 bar/min af. Uit deze studie blijkt ook dat gasvorming na ongeveer 5 uur (300 min) na een ongewenste insluiting aan het begin van de transportleiding tussen de onshore en de microtunnelsecties.

Deze tweefasecondities in de transportleiding worden waargenomen zodra de druk bij de Maasvlakte onder de 82 barg komt. Zelfs onder dergelijke omstandigheden moeten operators en regelsystemen voldoende tijd hebben om te reageren en het ontstaan van gasbellen in de transportleiding te voorkomen. Een druk van 90 barg inclusief een marge van 10 bar boven het kritische punt waaronder twee fasen kunnen voorkomen, moet worden aangehouden voor het lagedrukalarm op de Maasvlakte. Bij nog lagere druk wordt het risico van tweefasestroming onvermijdelijk.

Een ander resultaat van deze studie is dat er geen kruisstroomverschijnselen tussen de verschillende injectieputten worden waargenomen (dit is stroming van een put met een hogere druk naar een put met een lagere druk), tenminste niet in de eerste vijf uur na een ongeplande stillegging. Het potentiële risico van kruisstroming tussen de verschillende putten is niet verder (bij nog lagere druk) beoordeeld omdat het injectienetwerk zich dan al in tweefasestromingsomstandigheden zou moeten bevinden, wat moet worden vermeden en kan worden beschouwd als sturende parameter in het geval van drukverlaging.

2.2.4 Drukaflaten

Er is geen specifieke operationele eis voor het van druk laten van het onderzeese netwerk in een normale situatie of bij insluiting. De mogelijke scenario's die kunnen leiden tot het van druk laten van het onderzeese systeem zijn:

- Schade aan de transportleiding die moet worden gerepareerd waarbij de leiding van druk af moet voordat er kan worden ingegrepen,
- Vorming van een (hydraat)plug die van druk afgelaten moet worden om de situatie te herstellen,
- Ontmanteling van de pijpleiding,
- Operationele problemen op de onshore installatie waarvoor het onderzeese systeem van druk af moet om het vrijkomen van CO_2 onder controle te houden.

In het kader van deze studie zijn drie hoofdscenario’s bekeken die hieronder zijn samengevat. Alle gevallen zijn behandeld en grondig beoordeeld. Omwille van de leesbaarheid van dit rapport is besloten niet alle gevallen te presenteren, aangezien alle resultaten vrijwel gelijk zijn en het voorgestelde ontwerp aan alle eisen voldoet.

1. Druk aflaten na normale/geplande insluiting:
   - Uitschakelen van de exportpompen terwijl de putten nog open zijn om de pijpleiding zoveel mogelijk te legen,
   - Wanneer een druk van 90 barg wordt bereikt op de terminal op de Maasvlakte en voordat de tweefasestroming kan plaatsvinden, wordt het afblazen door de putten gestopt,
   - 1 uur wachttijd voor de voorbereiding van het afblazen,
   - Afblazen via een RO.
2. Druk aflaten na abnormale/ongewenste insluiting terwijl de putten beschikbaar zijn:
   - Ongewenste sluiting van putten terwijl de exportpompen nog in bedrijf zijn,
   - Drukverhoging in de transportleiding tot de hoogste druk,
   - Drukverlaging via de put met de laagste WHSIP (voor een betere controle van de drukverlagingsactiviteit). Het aantal en de locatie van de putten zijn nog te bepalen door het Field Operations-team: Operatie met één put of met meerdere putten, acceptatie van tweefasestroming in de put tijdens afblazen, enzovoort) tot het bereiken van de ingestelde druk van 90 barg op de Maasvlakte-terminal, of 10 bar boven de laagste WHSIP.
   - Nadat de druk in het netwerk is gestabiliseerd tot ongeveer 90 barg of 10 bar boven de laagste WHSIP, wordt de put afgesloten en afblazen via de RO geïnitieerd.

Omdat dit geval vergelijkbaar is met de geplande insluiting met kleine verschillen, worden alleen relatieve resultaten gepresenteerd.

3. Drukaflaten na abnormale/ ongewenste insluiting en putten niet beschikbaar: Representatief scenario in geval van een hydratenplug voor het DHUB-platform.

   - De exportpompen zijn nog in werking wat leidt tot drukverhoging in de leiding tot de hoogste druk,
   - Een uur wachttijd voor de voorbereiding van het afblazen,
   - Afblazen via een RO.

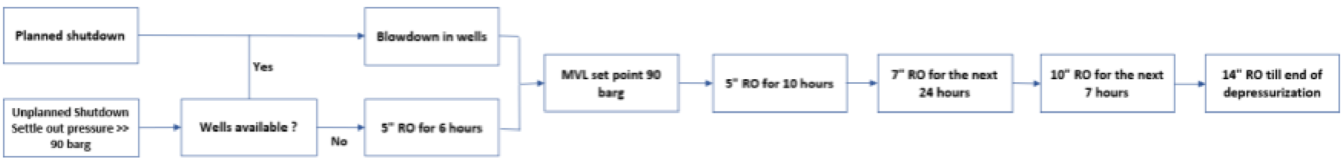
   De kans dat dit scenario zich voordoet is zeer klein, omdat er altijd minstens één put beschikbaar moet zijn, wat betekent dat drukverlaging van de transportleiding altijd mogelijk zou moeten zijn via de putten. Omdat dit geval vergelijkbaar is met de geplande stillegging met kleine verschillen, worden alleen relatieve resultaten gepresenteerd.

Het is vermeldenswaard dat bij het verlagen van de druk van CO_2 naar atmosferische omstandigheden, zeer lage temperaturen worden verwacht, ongeacht de beschouwde scenario's. Daarom is het belangrijk om de druk in de transportleiding tijdens het afblazen te beheersen en binnen de ontwerptemperatuur van de transportleiding te blijven. De drukbeheersing tijdens het afblazen wordt bereikt door een stapsgewijze drukverlaging waarbij de diameter van de RO per stap wordt aangepast.

Aangezien er een groot risico is op ijsvorming rond de leiding bij zeer lage temperaturen en om rekening te houden met voldoende marge om de onzekerheden met betrekking tot de OLGA-software af te dekken, is een minimumtemperatuur van 0°C gebruikt in de evaluatie. Het is ook vermeldenswaard dat de drukverlagingssimulaties zeer langzaam verlopen en de temperatuur niet snel daalt, wat betekent dat de marge over de temperatuur kan worden versoepeld, omdat deze berekeningen niet als snelle transities worden beschouwd.

De tegendruk stroomafwaarts van de RO moet ook worden gedefinieerd om droogijsvorming te voorkomen in het drukverlagingssysteem. In het huidige onderzoek is, gezien het fasediagram van CO_2, de druk vastgesteld op 7 bara (boven het tripelpunt) om droogijsvorming en het risico van verstopping van het afblaassysteem te voorkomen. De overgang van 7 bara naar atmosferische omstandigheden bij de afblaas en bijbehorende apparatuur moeten worden ontwikkeld door Process in overeenstemming met de resultaten van Flow Assurance Study en aanbevelingen in dit rapport en om de risico's van verstopping van het afblaassysteem te beperken.

Na voltooiing van de verschillende analyses, bestaat het voorgestelde ontwerp van het afblaassysteem uit vier restrictie openingen. Deze opstelling bleek het beste compromis te zijn om te lage temperaturen in de transportleiding te vermijden met betrekking tot de ontwerptemperatuur en de (water)ijs risico's, maar ook om de duur van de afblaasprocedure te verkorten.



Figuur 5: Volgorde van druk aflaten bij getrapte Restriction Orifices

De voorgestelde diameters van de RO's zijn 5, 7, 10 en 14 inch voor het drukloos maken van de transportleiding. Deze restrictieopeningen worden na elkaar gebruikt. De wissel tussen de eerste en tweede restrictieopening vindt 10 uur na de start van afblazen met de eerste RO plaats. 24 uur later vindt de tweede omschakeling plaats. De derde omschakeling komt 7 uur na afblazen met de derde RO. De minimaal bereikte CO_2 temperatuur is 1°C (gedurende een paar minuten) waarop een marge van 5°C is aanbevolen om de minimale ontwerptemperatuur van de leiding te bepalen. De duur van het afblazen vanaf een instelpunt van 90 barg op de Maasvlakte duurt ongeveer 2,5 dag (58 uur).

Wat betreft het scenario 'druk aflaten na ongewenst insluiten met putten die beschikbaar zijn', na het oplopen van de druk tot het hoogste niveau, duurt het van druk laten via de put met de laagste WHSIP iets meer dan 10 dagen tot het bereiken van het ingestelde druk van 90 barg. In het huidige onderzoek is de WHSIP van de put die in aanmerking komt voor van druk laten lager dan 90 barg, daarom wordt de druk voor het switchen naar de afblaas bepaald door het voorkomen van 2-fase condities in de leiding. Zodra deze druk is bereikt bij de terminal op de Maasvlakte, kan de hierboven beschreven afblaasmethode worden toegepast.

Wat betreft het scenario 'druk aflaten na ongewenst insluiten en putten niet beschikbaar', na oplopen van de druk tot het hoogste niveau, kan de procedure van de drukverlaging direct beginnen met een 5"-RO (het duurt ongeveer 6 uur tot het bereiken van 90 barg bij de Maasvlakte en dan nog 10 uur doorgaan voordat wordt overgeschakeld op een grotere RO). De hierboven beschreven stappen zijn nog steeds geldig en toepasbaar aangezien de temperatuur nog steeds gecontroleerd kan worden en niet daalt tot zeer lage waarden onder 0°C. Het enige mogelijke verschil met de geplande drukaflaatscenario is dat de eerste stap met 5"-doorstoomplaat RO langer zal duren. Desondanks is er geen risico op een daling naar zeer lage temperaturen en kan ijsvorming rond de buis worden vermeden.

Vanwege de isenthalpische verschijnselen tijdens het afblazen van de vloeistof is de minimaal te verwachten temperatuur stroomafwaarts van de verschillende restrictieopeningen ongeveer -56 °C. Deze lage temperaturen treden op zolang er vloeibare CO_2 wordt waargenomen stroomafwaarts van de restrictieopening. Een marge van 20°C wordt aangehouden, wat leidt tot een minimumontwerptemperatuur van de afblaasleidingen van - 76°C.

3 Conclusies en vervolgstappen

Op basis van deze Flow Assurance studie die is uitgevoerd in het kader van fase 1 van het Aramis-project, zijn geen grote problemen geïdentificeerd met de voorgestelde leidingdiameter. Het lijkt er echter op dat de injectie van 22 MTPA aan het einde van de levensduur moeilijk haalbaar kan zijn, als gevolg van het sterke effect van de drukopbouw die tijdens de levensduur van het veld in het reservoir wordt waargenomen. Het is echter belangrijk om in gedachten te houden dat afhankelijk van de drukopbouw in het reservoir, dit injectieniveau kan worden beïnvloed.

Het is ook vermeldenswaard dat geen problemen worden verwacht met betrekking tot de operabiliteit van de transportpijpleiding. Niettemin worden de volgende stappen voorgesteld om het Flow Assurance werk te verdiepen en de operationele filosofie/strategie verder te verfijnen:

- Het geselecteerde concept moet verder worden bestudeerd en gevalideerd met bijgewerkte basisontwerpen (CO_2-specificaties, pijpleidingkarakteristieken, injectieprofiel, inlaatcondities, evolutie van de reservoirdruk, putmodellen, etc.);
- De diameters van de aftakkingsleidingen verder onderzoeken aan de hand van bijgewerkte injectieprofielen;
- Verder ontwikkelen van de opstartvolgorde en bijbehorende operationele filosofie (risico's van hydraten, drogen van de leiding, enz.);
- Verder ontwikkelen van een hydraatpreventiestrategie voor het opnieuw opstarten van de putten en de eerste opstart;
- De bedrijfsfilosofie en procedures voor het opnieuw opstarten van de putten na zowel een geplande insluiting als ongewenst insluiting, gevolgd door het van druk laten via de putten, met name de manier waarop het Well Performance-team de verschillende injectieputten wil bedienen (met in acht name van een gelimiteerd drukverschil voor het integriteitsbeheer van de boorput, volledige instantane opening van de drukcontroleklep, put per put of alle putten samen, enz.). Zodra deze volgorde van operaties is gedefinieerd, kan de impact van de stappen bij het opnieuw opstarten van de putten op de dynamiek van de onderzeese leiding worden beoordeeld;
- Ontwikkel een strategie voor het verhelpen van hydraten waarbij rekening wordt gehouden met de risico's van hydraatvorming in het transport- en injectiesysteem tijdens de exploitatie;
- Verduidelijk de ontwerpscenario's van de pijpleiding met betrekking tot de waarschijnlijkheid van optreden. In dit stadium is een situatie met een onderzeese transportleiding in thermisch evenwicht met het omringende zeewater afgewezen door het projectteam en niet in overweging genomen door het Flow Assurance-team;
- Evalueer de Flow Assurance-scenario's voor zuivere CO_2, ook al zijn de huidige aannames op basis van literatuur de strengste;
- Ontwikkel het Flow Assurance-dossier voor de transportleiding waarin de impact van de BB04-scope is opgenomen;
- Ontwikkel het geïntegreerde model met de verschillende injectielocaties van alle partners om de dynamiek van het systeem en de invloed van de verschillende injectielocaties op elkaar te beoordelen.

Afkortingen

MTPA	Mega Tonnes per Annum = debiet (massa) in miljoen ton per jaar.
PLET	Pipeline End Termination = pijpleidingeinde in de vorm van een onderzeese constructie.
ILT	In-line Tee = Aftakking middels T-stuk in de transportleiding in een onderzeese constructie.
WHSIP	Wellhead shut-in pressure = druk boven in de put na insluiten.
RO	Restriction orifice = restrictieopening (in een doorstroomplaat om het debiet te regelen).
TTE	TotalEnergies
MSL	Mean Sea Level = gemiddelde zeewaterpeil
MVL	Maasvlakte

RAPPORT

Kwantitatieve Risico Analyse Aramis - zeeleiding

MER Aramis CO2-transportinfrastructuur

Klant: Aramis

Referentie: ARM-PFE-B10-ENV-EIA-2006

Status: 01/Definitief

Datum: 5 februari 2024

ARAMIS	**CCS-ARAMIS Project**
	Environment Impact Assessment – Baseline report
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Inhoud

Bijlagen

1 Inleiding

Ten geleide
Voor u ligt het detailrapport met als onderwerp kwantitatieve risicoanalyse van het op land gelegen deel van de zeeleiding bij het MER voor het Aramis initiatief (kortweg Aramis). *Het op land gelegen deel is gedefinieerd als het deel tussen compressorstation en de grens van de overgang naar territoriale wateren.* In deze rapportage wordt dit deel benoemd als 'zeeleiding'. Het Aramis initiatief bestaat uit de aanleg en exploitatie van een open CCS-infrastructuur. Hiermee is het mogelijk om bij de industrie afgevangen CO_2 te vervoeren naar leeg geproduceerde gasvelden onder de Noordzee, om het daar permanent op te slaan. Hiermee leveren de Aramis initiatiefnemers een bijdrage aan het behalen van de Nederlandse klimaatdoelstellingen. Volgens nationale wetgeving zijn, in het kader van kwantitatieve risico analyse, de onderdelen van de Aramis CCS infrastructuur verdeeld in een terminal (CO2next genaamd), een compressorstation en een zeeleiding (verbindende leiding tussen compressorstation en gasvelden, voorliggende QRA).

Het doel van dit detailrapport is om het risicoprofiel van (het op land gelegen deel) van de zeeleiding te kwantificeren door numerieke waarden toe te kennen aan waarschijnlijkheid en gevolgen van ongewone voorvallen, wat resulteert in een toetsbaar risicoprofiel. Hierbij worden (technische) gegevens en (incident) statistieken gecombineerd om inzicht te krijgen in potentiële slachtoffers, en om de afwegingen te ondersteunen over het al dan niet hoeven nemen van mitigerende maatregelen om ruimtelijke inpassing mogelijk te maken te ondersteunen

Dit detailrapport bevat een gedetailleerde beschrijving en beoordeling van het risicoprofiel van de zeeleiding binnen het Aramis initiatief. De kwantitatieve risicoprofielen van de CO2Next terminal en het compressorstation worden elk in hun eigen detailrapport beschreven en beoordeeld.

1.1 Korte introductie van het Aramis initiatief

Integrale Aramis CCS-keten
Om de klimaatdoelstellingen te behalen, is er behoefte aan additionele transportinfrastructuur voor CO_2, waarmee meerdere opslaglocaties op zee worden ontsloten voor verschillende industriële emissiebronnen. Het Aramis initiatief speelt in op die behoefte door een nieuwe integrale en open CCS-keten mogelijk te maken. Het Aramis initiatief vormt een onderdeel van deze CCS-keten en bestaat uit de aanleg en exploitatie van een open CO_2-transportinfrastructuur. Het Aramis initiatief wordt in de rapportage dan ook wel aangeduid als Aramis CO_2-transportinfrastructuur. Samen met de afvanginfrastructuur en opslaginfrastructuur vormt dit de integrale CCS keten met onderstaande samenhangende onderdelen (zie figuur 1-1).

CO_2-afvanginfrastructuur

1. CO_2-afvang bij industrie, en geschikt maken voor transport;
2. CO_2-transport naar het verzamelpunt op de Maasvlakte, middels de Porthos landleiding of per schip;

CO_2-transportinfrastructuur (Aramis initiatief)

3. CO_2-verzamelpunt op de Maasvlakte met een compressorstation en een terminal.

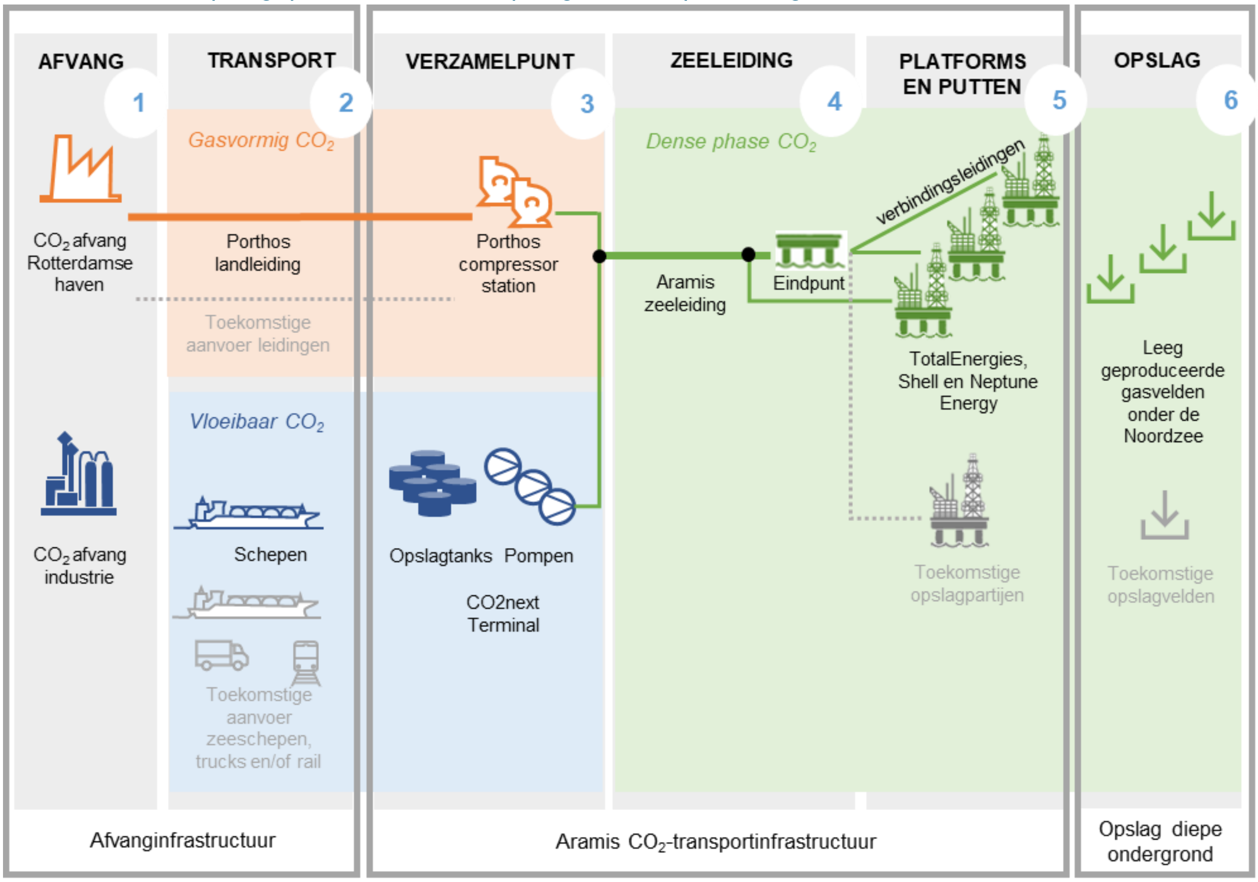
   Het compressorstation ontvangt gasvormig CO_2 dat aangevoerd wordt per landleiding (via de Porthos-landleiding) en brengt het op druk voor het transport per zeeleiding;

De terminal ontvangt vloeibaar CO_2 aangevoerd per schip. De terminal locatie bevat steigers, opslagtanks voor tijdelijke opslag van CO_2 en hogedrukpompen voor levering aan de zeeleiding. CO_2 uit het compressorstation en vanaf de terminal komen samen in de CO_2-zeeleiding;

4. CO_2-transport door de centrale CO_2-zeeleiding naar het distributieplatform op de Noordzee. Dit platform is uitgerust met een verdeelstation voor toevoer van CO_2 naar de verschillende platforms. Er zijn tevens connectiepunten in de zeeleing waar vandaan CO_2 aan platforms geleverd kan worden;
5. CO_2-injectie: via verbindingsleidingen komt de CO_2 vanaf de zeeleiding bij injectieplatform. Middels putten bij deze platforms wordt CO_2 geïnjecteerd in leeg geproduceerde gasvelden in de diepe ondergrond van de Noordzee.

CO_2-opslag diepe ondergrond

6. CO_2-opslag: permanente CO_2 opslag in de diepe ondergrond.



Figuur 1-1. Overzicht van de integrale CCS-keten met daarin de componenten die onderdeel zijn van de voorgenomen activiteit, namelijk: transport per schip, terminal CO2next, uitbreiding compressorstation Porthos, zeeleiding met eindpunt en connectiepunten, aansluitleidingen en platforms

Het Aramis initiatief

Het Aramis initiatief heeft als doel het verzamelpunt (onderdeel 3), de zeeleiding (onderdeel 4) en de injectie (onderdeel 5) te realiseren. Hiervoor wordt door het Aramis consortium (bestaande uit Shell, TotalEnergies, Gasunie en EBN) samengewerkt met CO2next (voor de terminal) en Porthos (voor het compressorstation). De opslag vindt plaats vanaf de platforms van Shell, TotalEnergies en Neptune Energy.

De afvang (onderdeel 1) en transport van CO_2 naar het verzamelpunt (onderdeel 2) vallen buiten het Aramis initiatief[1]. In het MER worden deze aspecten wel benoemd en op hoofdlijnen beschreven, omdat ze integraal onderdeel uitmaken van de integrale Aramis CCS keten.

De opslag in de diepe ondergrond (onderdeel 6) valt eveneens buiten het initiatief. Voor de diepe ondergrond gelden geen milieuregels. De mogelijke gevolgen van opslag in de diepe ondergrond wordt echter wel apart beschreven in het MER middels de deelrapporten opslag diepe ondergrond.

Bij de aanleg van Aramis wordt rekening gehouden met toekomstige uitbreiding met meer leveranciers van CO_2 en meer opslagpartijen. In eerste instantie wordt vergunning aangevraagd voor een startsituatie en de eerste uitbreidingssituatie. Dit wordt in het MER getoetst. Toekomstige initiatieven *na* de eerste uitbreidingssituatie behoren niet tot de vergunningaanvraag maar worden in het MER wel (globaal) beschreven.

De ingebruikname verwachten de Aramis initiatiefnemers in 2028, waarbij tegelijk al de eerste activiteiten zoals beschreven in de eerste uitbreidingsituatie kunnen starten. Voor het bereiken van de maximale doorvoercapaciteit is enkele jaren later als uitgangspunt in het MER aangehouden.

Een uitgebreide beschrijving van het Aramis initiatief is opgenomen in het deelrapport technische beschrijving en het samenvattend hoofdrapport MER (zie figuur 1-2).

1.2 Korte introductie op het thema externe veiligheid

1.2.1 Externe veiligheid bepaling op land

De externe veiligheid wordt berekend voor (normale) operationele fase. Hiervoor wordt een wettelijk voorgeschreven software pakket gebruikt genaamd Safeti-NL. De externe veiligheidsberekeningen hebben betrekking op mogelijke risico's op land.

Onderwerp van deze QRA is het voorgenomen deel van de zeeleiding tussen het compressorstation en de territoriale wateren in het Rotterdams havengebied, in deze rapportage verder benoemd als zeeleiding. In Figuur 5-1 is de voorgenomen route van de zeeleiding weergegeven op een ondergrond van (een deel van) de Maasvlakte.

Opmerking: de reden dat alleen het bovengenoemde op land gelegen deel van de zeeleiding onderwerp is van deze QRA, vindt zijn oorsprong in het Besluit Activiteiten Leefomgeving artikel 3.101 lid 3 onderdeel a. Daarin wordt gesteld dat: lid (3) 'Onder de aanwijzing valt niet het exploiteren van een buisleiding:' (onderdeel a) 'in de Noordzee'.

1.2.2 Relevante fases

Het MER bestudeert die aspecten van een activiteit die de fysieke leefomgeving kunnen beïnvloeden. De milieueffecten van de alternatieven en varianten voor het thema externe veiligheid zijn daar beschreven. Daarbij wordt onderscheid gemaakt tussen de aanlegfase en gebruiksfase, en worden de mogelijke effecten van een incident beschreven; namelijk:

- De aanlegfase bestaat uit de aanleg van de terminal, het aanpassen van het compressorstation en plaatsen van de buisleiding op land (en in de bodem).

[1] *Een deel van de schepen die CO_2 leveren aan de terminal is afkomstig van Aramis-initiatiefnemers.*

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- De gebruiksfase bestaat uit de start-up en shutdown van de buisleiding waarbij de druk en temperatuur van CO_2 in de buisleiding zal toenemen en afnemen. Gedurende de normale gebruiksfase stoomt wordt een constante druk en temperatuur aangenomen.

In de eerste fase van de m.e.r.-procedure voor het Aramis initiatief is afgebakend welke onderwerpen binnen dit thema relevant zijn om te onderzoeken en hoe. Dit is beschreven in de Notitie Reikwijdte en Detailniveau die 18 november 2022 definitief is vastgesteld door de Minister voor Klimaat en Energie.

1.2.3 Relevante alternatieven en varianten

In Hoofdstuk 3 van het MER is beschreven hoe de keuzes van het Aramis initiatief op de hoofdlijnen zijn gemaakt. Binnen deze hoofdkeuzes zijn nog meerdere uitwerkingsopties waaruit moet worden gekozen. Deze opties worden in het MER getoetst als alternatieven en varianten. Daarnaast geeft het MER inzicht in mitigerende maatregelen om negatieve milieugevolgen te voorkomen of verzachten. Dit kan noodzakelijk zijn om te voldoen aan milieuwet- en regelgeving, maar het kan ook los van die verplichtingen wenselijk zijn. Redelijkerwijs te treffen maatregelen worden onderzocht.

De hieronder toegelichte alternatieven en varianten zijn de huidige (realistische) keuzeopties die binnen de doelstelling van het Aramis initiatief vallen. Er zijn meer opties denkbaar; het is mogelijk dat deze in het kader van toekomstige uitbreidingen onderzocht worden.

Tabel 1-2. Overzicht te toetsen alternatieven en varianten (xxxx: geen onderdeel van de scope van de QRA)

	Voorgenomen activiteit	Alternatief / variant
Kruising Maasgeul	Microtunnel vanaf haaienvin bij Edisonbaai	Direct pipe nabij kruising Porthos leiding

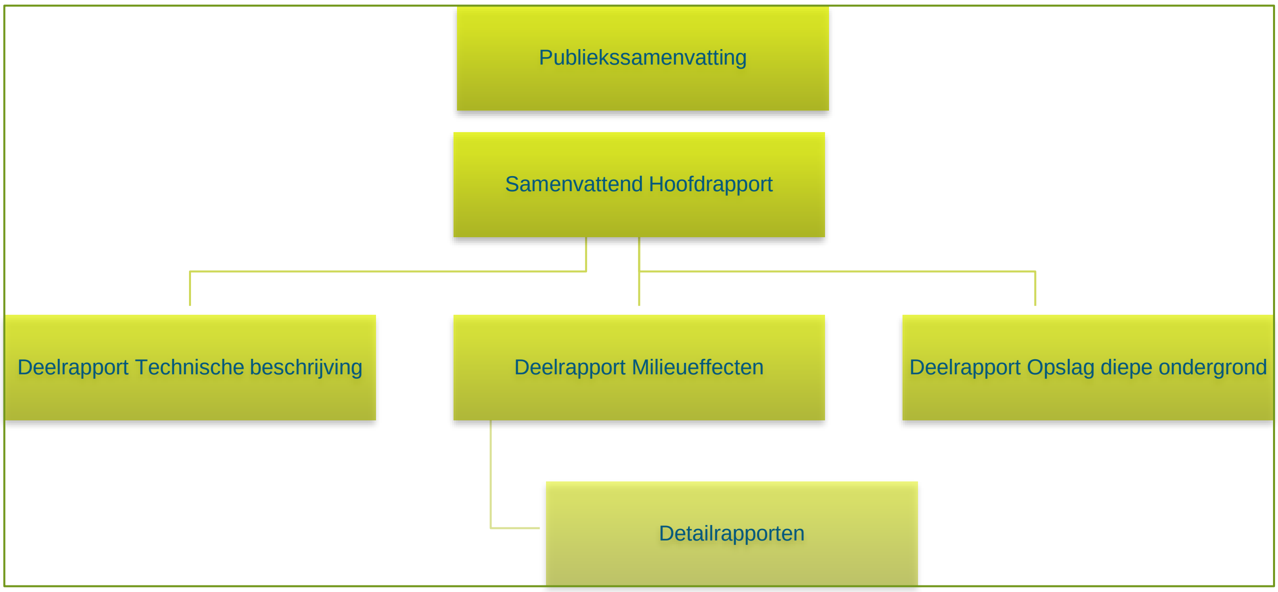
Alternatief kruising zeewering / Maasgeul
De voorgenomen activiteit is de kruising van zeewering en de Maasgeul vanaf de locatie naast de Edisonbaai, met behulp van een microtunnel. Als alternatief wordt in het MER het gebruik van een direct pipe boring onderzocht, die nabij de Porthos zeeleiding de zeewering kruist en vervolgens in een sleuf door de Maasgeul wordt gelegd.

Variant kruising op land Porthos zeeleiding
Het landdeel van de Aramis zeeleiding moet in de leidingstrook de aanwezige Porthos zeeleiding kruisen. Doordat het beide leidingen zijn met een relatief grote diameter, moet hiervoor een specifieke constructie worden toegepast. In de voorgenomen activiteit kruist de Aramis zeeleiding onder de Porthos zeeleiding door. Hiervoor moet de Aramis zeeleiding verdiept aangelegd worden. Als variant kruist de Aramis zeeleiding boven de Porthos zeeleiding, met als gevolg dat deze boven maaiveld uitkomt.

1.3 Opbouw van het MER en dit deelrapport

Voor het Aramis initiatief is een gecombineerd Plan-/ProjectMER opgesteld. Figuur 1-2 geeft de rapportagestructuur van het MER Aramis. Het MER bestaat uit een Samenvattend Hoofdrapport, voorzien van een Publiekssamenvatting. Ter onderbouwing van het Samenvattend Hoofdrapport zijn deelrapporten opgesteld. Dit betreft het deelrapport Technische beschrijving van Aramis, het deelrapport Milieueffecten met daarbij de onderliggende technische detailstudies en de deelrapporten Opslag diepe ondergrond. Doordat CO_2 in meerdere geologische voorkomens wordt opgeslagen, zijn er voor de opslag diepe ondergrond meerdere deelrapporten opgesteld.

Het voorliggende rapport is het detailrapport Externe veiligheid CO2next terminal. De bevindingen uit dit detailrapport zijn opgenomen in het Deelrapport Milieueffecten, en op hoofdlijnen in het Samenvattend Hoofdrapport.



Figuur 1-2: Overzicht rapportagestructuur MER Aramis

Opbouw van dit deelrapport

Dit deelrapport beschrijft in het volgende hoofdstuk allereerst welk kader van beleid, wet- en regelgeving van toepassing is voor het thema Externe veiligheid van de zeeleiding. Nadat in hoofdstuk 3 beschreven wordt hoe de methodiek van onderzoek en beoordeling eruit zal zien wordt in hoofdstuk 4 beschreven hoe het proces er uit zal zien in de gebruiksfase van het project. In hoofdstuk 5 worden de uitgangspunten beschreven die gebruikt worden voor de risicomodellering. In hoofdstuk 6 worden de resultaten gegeven voor de direct pipe en in het hoofdstuk erna voor de resultaten van de microtunnel. In hoofdstuk 8 worden de leemten in kennis gegeven voordat in hoofdstuk 9 de conclusies en aanbevelingen worden gegeven.

2 Reikwijdte van de QRA

Deze QRA betreft het op land gelegen deel van de zeeleiding; het buisleidingdeel vanaf het compressorstation tot de grens naar de territoriale wateren. Het beginpunt van de zeeleiding is bij het compressorstation. De zeeleiding loopt richting de daarvoor bestemde leidingstrook, volgt deze leidingstrook enkele kilometers, en verlaat deze vervolgens om uiteindelijk de zeewering te kruisen richting de territoriale wateren. De kruising van de zeewering kent twee mogelijke route opties: 1) kruising via een zogenaamde ‘microtunnel’ en 2) kruising via zogenaamd ‘direct pipe’. De verschillend routes zijn weergegeven in Figuur 5-1. Voor elk van deze opties wordt het risicoprofiel bepaald voor de maximale doorzet waar het systeem voor ontworpen wordt, zie hoofdstuk 4 betreffende ‘Doorzetgegevens’.

2.1 Aanleiding QRA

Aanvraag oprichting CO2 transportleiding.

2.2 Rapportgegevens

2.2.1 Algemeen

In onderstaande opsomming zijn de algemene rapportgegevens opgenomen:

Naam van het project	**:**	Aramis - Zeeleiding
Reden opstellen QRA	:	Inzichtelijk maken van het risicoprofiel naar externe veiligheid voor de voorgenomen zeeleiding (route)
Gevolgde methodiek	:	Safeti-NL (DNV, versie 8.8) [6] in combinatie met de Rekenvoorschrift omgevingsveiligheid – Module V buisleidingen (RIVM, versie oktober 2020) [7]
Peildatum QRA	:	Februari 2024

2.2.2 Historie QRA

Deze paragraaf is voor deze versie van de QRA-rapportage niet van toepassing om dat deze QRA-rapportage de initiële rapportage ten behoeve van de oprichtingsvergunning betreft. Wel is deze opgenomen om vast een goede rapportage indeling te verzorgen voor eventuele toekomstige actualisaties

Onderstaande tabel toont de historie van al eerdere QRA’s zoals deze bekend zijn bij het bevoegd gezag.

Datum	Referentie	Titel en toelichting
PM	PM	QRA voor oprichtingsvergunning. Omvat opstartfase en 1e uitbreidingsfase.

2.2.3 Wijzigingen in QRA

Deze paragraaf is voor deze versie van de QRA-rapportage niet van toepassing om dat deze QRA rapportage de initiële rapportage ten behoeve van de oprichtingsvergunning betreft. Wel is deze opgenomen om vast een goede rapportage indeling te verzorgen voor eventuele toekomstige actualisaties

Ten opzichte van de vigerende vergunningen worden vernieuwingen doorgevoerd zoals opgenomen in onderstaande tabel.

Aard van wijziging	Invloed op QRA

2.3 Leeswijzer

Deze rapportage bevat wettelijke en beleidsmatige informatie, informatie over de wijze van modellering in de software en (detail) technische informatie van de installatie. Afhankelijk van het doel waarmee een lezer deze rapportage leest en de technische kennis wordt aangeraden om een combinatie van bepaalde hoofdstukken van deze rapportage te lezen.

Indien het doel van de lezer is om inzicht te krijgen in de context en implicaties van de QRA wordt aangeraden om hoofdstukken 1 t/m 3 en 7 t/m 9 te lezen. Genoemde hoofdstukken bevatten geen technische informatie, maar geven het wettelijk en beleidsmatige kader en beschrijven hoe de resultaten in dat kader beschouwd moeten worden. Eventueel kan aanvullend hoofdstuk 5 worden gelezen wat een systeembeschrijving op hoofdlijnen geeft.

Indien het doel van de lezer is om de QRA te kunnen beoordelen wordt aangeraden om alle hoofdstukken te lezen. Hoofdstukken 4 t/m 6, en de bijlagen waar deze naar verwijzen, geven gedetailleerde informatie over de werkwijze waar het QRA-model mee tot stand gekomen is, en welke aannames daarvoor gedaan zijn.

3 Beleid, wet- en regelgeving

Dit hoofdstuk beschrijft welk beleid en welke wet- en regelgeving relevant is voor het Aramis initiatief voor de kwantitatieve risicoanalyse voor de zeeleiding. Dit maakt duidelijk binnen welke randvoorwaarden het Aramis initiatief tot stand moet komen.

3.1 Wettelijk kader

Een ruimtelijk plan wordt in het kader van externe veiligheid getoetst aan het landelijk wettelijk kader en het lokale beleidskader. Dit kan gemeentelijk beleid en/of provinciaal beleid zijn. Het wettelijke en beleidskader worden door een gemeente vertaald naar het omgevingsplan. Daarmee vormt het omgevingsplan het belangrijkste toetsingskader. Dit hoofdstuk geeft een overzicht van de meest relevante wetgeving en de toetsingscriteria waaraan de voorgenomen ontwikkeling in het kader van externe veiligheid wordt getoetst.

De wetgeving voor externe veiligheid in relatie tot milieubelastende activiteiten is verankerd in de Omgevingswet, bijbehorende besluiten en regelingen. Dit geldt ook voor alle andere thema's in de leefomgeving. De omgevingswet richt zich tot alle partijen die daarin actief zijn: burgers, bedrijven en overheid. De belangrijkste regels voor externe veiligheid staan in het 'Besluit activiteiten leefomgeving' (Bal) [1], 'Besluit kwaliteit leefomgeving' (Bkl) [2], en Besluit bouwwerken leefomgeving (Bbl) [3]. Een gemeente vertaalt deze regels naar het omgevingsplan. Dit geldt ook voor het beleid zoals dit is opgenomen in de gemeentelijk omgevingsvisie, de provinciale omgevingsverordening en andere relevante beleidsdocumenten. In het omgevingsplan kan een gemeente daarnaast nadere (maatwerk) regels stellen en bijvoorbeeld voor specifieke activiteiten die geen vergunningplicht kennen een vergunningplicht instellen. In het Bal zijn algemene door het rijk gestelde regels opgenomen voor milieubelastende activiteiten in fysieke leefomgeving. Het Bal stelt daarmee ook welke activiteiten milieubelastend zijn (zogenaamde aanwijzing) en welke daarvan vergunningplichtig zijn. In het Bkl zijn regels opgenomen voor het Rijk en decentrale overheden ten aanzien van omgevingswaarden, instructieregels, beoordelingsregels en regels voor monitoring. Het Bkl geeft daarmee aan hoe in een omgevingsplan rekening moet wordt gehouden met externe veiligheid van milieubelastende activiteiten. De regels in het Bal gelden 'rechtstreeks' voor milieubelastende activiteiten waarop de regels betrekking hebben. In het omgevingsplan kan een gemeente aangeven waar bepaalde functies en daarmee bepaalde activiteiten wel en niet zijn toegelaten en, eventueel, onder welke aanvullende voorwaarden.

De zeeleiding heeft te maken met een wettelijk kader onder de Mijnbouwwet en onder de Omgevingswet. De zeeleiding is een pijpleiding onder het Mijnbouwbesluit, omdat sprake is van een leiding die twee mijnbouwwerken met elkaar verbindt ten behoeve van het vervoer van stoffen, te rekenen vanaf de eerste isolatieafsluiter van het mijnbouwwerk. De desbetreffende mijnbouwwerken zijn het compressorstation en het distributieplatform. Op basis van artikel 94 en 95 van het Mijnbouwbesluit moet voor deze pijplelding een mijnbouwvergunningaanvraag worden ingediend. De zeeleiding is volgens het Bal aangewezen als milieubelastende activiteit binnen de categorie 'Buisleiding met gevaarlijke stoffen' (Bal, paragraaf §3.4.3) wat behoort tot de afdeling 'Nutssectoren en industrie'. Deze aanwijzing is gebaseerd op het transport van kooldioxide door deze buisleiding in combinatie met een uitwendige diameter van de leiding van meer dan 70 mm (Bal, Artikel 3.101, lid d). Voor een dergelijke milieubelastende activiteit dient volgens de Omgevingsregeling [4] een zogenaamde kwantitatieve risicoanalyse (QRA) te worden uitgevoerd om het risicoprofiel naar de omgeving te bepalen en te toetsen. In onderstaande paragrafen is het van toepassing zijnde wettelijk en beleidsmatig kader uitgewerkt.

Opmerking: Alleen het op land gelegen deel van de zeeleiding onderwerp is van deze QRA. Dit vindt zijn oorsprong in het Besluit Activiteiten Leefomgeving artikel 3.101 lid 3 onderdeel a. Daarin wordt gesteld dat: lid (3) 'Onder de aanwijzing valt niet het exploiteren van een buisleiding:' (onderdeel a) 'in de Noordzee'.

3.2 Wat is een QRA?

Een QRA maakt de externe veiligheidsrisico's inzichtelijk. Bij het inzichtelijk maken van externe veiligheidsrisico's wordt een tweetal begrippen gehanteerd, het 'plaatsgebonden risico' en de 'aandachtsgebieden'.

- Het plaatsgebonden risico is de kans op het overlijden van een onbeschermd en continu aanwezig persoon buiten de begrenzing van de locatie waar een activiteit wordt verricht als rechtstreeks gevolg van een ongewoon voorval veroorzaakt door die activiteit. (Artikel 5.6, Bkl). Bij risicoberekeningen in een QRA worden de risico's van de verschillende scenario's gesommeerd tot een totaal PR. Het PR is onafhankelijk is van de daadwerkelijke aanwezigheid van personen.
- Een aandachtsgebied omvat het gebied begrenst door de afstand waarbij mensen binnenshuis, zonder aanvullende maatregelen, onvoldoende beschermd kunnen zijn tegen de gevolgen van een ongewoon voorval met gevaarlijke stoffen. Onderscheid wordt gemaakt in een brandaandachtsgebied, explosieaandachtsgebied en gifwolkaandachtsgebied.

3.3 Regels voor het opstellen van een QRA

Voor het opstellen van een QRA, en daarmee het bepalen van het plaatsgebonden risico en de aandachtgebieden dient te worden aangesloten bij de rekenmethodiek zoals benoemd in de Omgevingsregeling [4], artikelen 4.10, 4.11 en 4.12. Volgens deze artikelen moet voor het exploiteren van de zeeleiding:

- Voor het berekenen van de afstand voor het plaatsgebonden risico gebruik worden gemaakt van module V van het Rekenvoorschrift omgevingsveiligheid en Safeti-NL.
- Voor het berekenen van de afstand voor een aandachtsgebied gebruik gemaakt worden van het stappenplan (RIVM), het Rekenvoorschrift omgevingsveiligheid en Safeti-NL

In het vervolg van dit rapport wordt gesproken over 'rekenvoorschriften/rekenmethodiek' waarmee bovenstaande wordt bedoeld; tenzij expliciet anders vermeld.

3.4 Landelijk toetsingskader

In het Besluit kwaliteit leefomgeving (Bkl) zijn in paragraaf 5.1.2.2 (betreffende 'veiligheid rond opslag, productie, gebruik en vervoer van gevaarlijke stoffen en windturbines') wettelijke grens- en standaardwaarden opgenomen voor het PR in relatie tot omliggende gebouwen en locaties, en is de begrenzing van de aandachtsgebieden gedefinieerd. Deze grens- en standaardwaarden en begrenzing moeten worden toegepast bij besluitvorming in het kader van de omgevingsvergunning (verlening) en van de inrichting van de fysieke leefomgeving.

Plaatsgebonden risico
<u>Grenswaarde</u>
De grenswaarde dient te worden beschouwd als een harde norm waaraan te allen tijde dient te worden voldaan.

- Van toepassing op (in de omgeving aanwezige) zeer kwetsbare gebouwen, kwetsbare gebouwen en kwetsbare locaties.

Voor het risico veroorzaakt door activiteiten die behoren tot ‘veiligheid rond opslag, productie, gebruik en vervoer van gevaarlijke stoffen en windturbines’, is een grenswaarde van toepassing gelijk aan de plaatsgebonden risicocontour van 10^{-6} per jaar (Bkl, Artikel 5.7).

- Van toepassing op de plaatsgebonden risicocontour van 10-6 per jaar van buisleidingen.
  De plaatsgebonden risicocontour 10-6 per jaar van een aan te leggen buisleiding of het vervangen van een bestaande buisleiding is gelegen op een afstand van niet meer dan 5 meter uit het hart van de leiding. Deze afstand is 4 m voor een buisleiding voor aardgas, met een druk van 1.600 tot en met 4.000 kPa. Deze afstanden omvatten het zogenaamde ‘belemmeringsgebied’ (Bal, Artikel 4.1113, lid 1) Het eerste lid is niet van toepassing als de overschrijding wordt veroorzaakt door een risico verhogend bouwwerk dat in een omgevingsplan wordt toegelaten in de directe omgeving van een buisleiding. (Bal, Artikel 4.1113, lid 2)

<u>Standaardwaarde</u>
De standaardwaarde is de nieuwe term voor de oude ‘richtwaarde’ en kan worden beschouwd als een ‘zachtere’ norm. Van deze standaardwaarde mag het bevoegd gezag slechts afwijken als ‘gewichtige redenen’ daartoe aanleiding geven. Die redenen moeten in de motivering van een besluit worden aangegeven. Er is bewust van afgezien om in het Bkl een nadere invulling van het begrip ‘gewichtige reden’ te geven. Afwijking van een standaardwaarde is primair een verantwoordelijkheid van het lokale bevoegd gezag.

- Van toepassing op (in de omgeving aanwezige) beperkt kwetsbare gebouwen en locaties. Voor het risico veroorzaakt door activiteiten die behoren tot ‘veiligheid rond opslag, productie, gebruik en vervoer van gevaarlijke stoffen en windturbines’, is een standaardwaarde van toepassing gelijk aan de plaatsgebonden risicocontour van 10-6 per jaar (Bkl Artikel 5.11, lid 1); uitgezonderd windturbines met een rotordiameter van meer dan 2 meter, daarvoor geld een standaard waarde van 10-5 per jaar (Bkl Artikel 5.11, lid 2).

De artikelen 5.7 en 5.11, eerste en tweede lid, zijn niet van toepassing op het plaatsgebonden risico van een activiteit voor beperkt kwetsbare en kwetsbare gebouwen en beperkt kwetsbare en kwetsbare locaties waar een activiteit als bedoeld in bijlage VII wordt verricht of die een functionele binding hebben met een activiteit als bedoeld in die bijlage. (Bkl Artikel 5.5).

Voor definities en indeling van zeer kwetsbare gebouwen, kwetsbare gebouwen en locaties, en beperkt kwetsbare gebouwen en locaties wordt verwezen naar bijlage VI van het Bkl.

Aandachtsgebieden
De begrenzing van de aandachtsgebieden is gedefinieerd als:

- Een brandaandachtsgebied is de locatie begrensd door de afstand, waar als gevolg van een ongeval dat leidt tot een plasbrand of een fakkelbrand, de warmtestraling ten hoogste 10 kW/m2 is (Bkl artikel 5.12, lid 1).
- Een explosieaandachtsgebied is de locatie begrensd door de afstand, waar als gevolg van een ongeval dat leidt tot:
  - een kokende vloeistof-gasexpansie-explosie (Boiling Liquid Expanding Vapor Explosion, BLEVE), de warmtestraling ten hoogste 35 kW/m2 is, en;
  - een explosie, anders dan onder a, de overdruk ten hoogste 10 kPa (0,1 bar) is (Bkl artikel 5.12, lid 2).
- Een gifwolkaandachtsgebied is de locatie begrensd door de afstand, waar als gevolg van een ongeval dat leidt tot een gifwolk, personen in een gebouw overlijden door blootstelling aan ten hoogste de bij

ministeriële regeling bepaalde vastgestelde concentratie van een gevaarlijke stof (Bkl artikel 5.12, lid 3). Het berekende gifwolkaandachtsgebied kan enkele kilometers groot zijn. Dit hangt samen met het soort en de hoeveelheden giftige stoffen die vrijkomen. Bij het besluit over een ruimtelijk ontwikkeling in de omgeving van een activiteit met gevaarlijke stoffen, is het gebied waar rekening moet worden gehouden met het groepsrisico als gevolg van een gifwolk beleidsmatig afgekapt op 1,5 kilometer (Bkl artikel 5.12, lid 4). Deze beleidsmatige afkapgrens geldt alléén voor ruimtelijke ontwikkelingen in de omgeving van een activiteit met gevaarlijke stoffen. De afkapgrens geldt dus niet voor het verlenen van de vergunning voor de activiteit met gevaarlijke stoffen zelf. Bij de beoordeling of voorschriften aan de omgevingsvergunning voor een activiteit met gevaarlijke stoffen moeten worden verbonden om de gevolgen voor de omgeving van een gifwolk te beperken, moet uitgegaan worden van het bepaalde of berekende gifwolkaandachtsgebied. Ook geldt de afkap niet bij het rekening houden met de veiligheidsrisico's van een brand, ramp, of crisis (Bkl artikel 5.2).

Groepsrisico
Volgens Artikel 5.15 van het Bkl moet binnen de aandachtsgebieden rekening worden gehouden met de kans op het overlijden van een groep van tien of meer personen per jaar als rechtstreeks gevolg van een ongewoon voorval veroorzaakt door een activiteit. Hoe met het groepsrisico, en de aanvaardbaarheid daarvan, rekening is gehouden, moet geborgd zijn in het omgevingsplan. Bij de voor het groepsrisico te maken afwegingen moet rekening worden gehouden met personen aanwezig binnen en buiten gebouwen (beschouwd binnen het aandachtsgebied). De Omgevingswet kent in geen verplichting om het groepsrisico te kwantificeren. De Omgevingswet kent wel een opdracht tot nadenken, afwegen en verantwoorden van de risico's voor een groep. Het doel van die verantwoording is het voorkomen van maatschappelijke ontwrichting (Bkl, nota van toelichting, 17.3.5 Hoofdstuk 5: Omgevingsplannen). Gemeenten en provincies kunnen ervoor kiezen om het groepsrisico te kwantificeren om de hoogte van het groepsrisico te vergelijken met een zogenaamde oriëntatiewaarde. Dit ter ondersteuning van de onderbouwing van het al dan niet kunnen aanvaarden van het groepsrisico. Dit is lokale beleidsvrijheid. Bij deze benadering wordt het bepaalde groepsrisico weergegeven als zogenaamde fN-curve, waarbij de kans (f) wordt uitgezet tegen het mogelijke aantal doden (N); afhankelijk van de bevolkingsdichtheid in de omgeving van de activiteit.

3.5 Lokaal toetsingskader

Navolgend wordt de relevante omgevingsvisie en het relevante omgevingsplan besproken, daarna wordt het van toepassing zijnde risicogebied toegelicht (voorheen veiligheidscontour); dit risicogebied is in (de toelichting op) het omgevingsplan opgenomen.

Omgevingsplan (voorheen bestemmingsplan(nen))

Ten tijde van het schrijven van deze rapportage zijn de omgevingsplannen en beschikbare informatie via overheidswebsite nog in ontwikkeling. Om deze reden is besloten om nog gebruik te maken van de bestemmingsplannen ter beschrijving van de directe omgeving van de zeeleiding.

Bestemmingsplan Maasvlakte 1
Voor zowel de variant microtunnel als direct pipe bevindt de zeeleiding zich binnen het vigerende bestemmingsplan 'Maasvlakte 1' (onherroepelijk vastgesteld d.d.23 april 2015) [9]. Figuur 3-1 toont een verbeelding van dit bestemmingsplan . Onderstaand is op hoofdlijnen beschreven welke bestemmingen binnen dit plan zijn toegestaan, en is beschreven of en zo ja welke specifieke instructies voor aandachtsgebieden van toepassing zijn.

<u>Plangebied</u>

Het gebied in de directe omgeving is hoofdzakelijk bestemd voor industriële bedrijvigheid ten behoeve van raffinage en op- en overslag van koolwaterstoffen, en voor overslag van containers. Ten Noorden van de zeeleiding, aan de Maasmond, is ruimte bestemd voor windturbines.

Binnen het bestemmingsplan is een gebied aangewezen met de bestemming 'Leiding – Leidingstrook'; deze leidingstrook loopt parallel aan de Maasvlakte weg. De zeeleiding wordt waar mogelijk in deze leidingstrook geïnstalleerd. Alleen voor het leidingdeel van het compressorstation naar de leidingstrook toe en van de leidingstrook naar de kruising van de zeewering is de zeeleiding buiten de leidingstrook gelegen. Alvorens werkzaamheden in de voor de leidingstrook bestemde gronden wordt vergund, neemt bevoegd gezag contact op met de beheerder(s) van de leiding(en) om eventueel nadere voorwaarden vast te stellen ten aanzien van de uitvoering van de werkzaamheden; dit ter bescherming van de aanwezige buisleiding(en).

In het bestemmingsplan is een maximum gesteld aan de afmetingen van windturbines die binnen het plangebied mogen worden ontwikkeld. De in deze QRA beschouwde windturbines hebben die maximaal toegestane afmeting. Het eventuele risico's van de windturbine naar de zeeleiding, uitgewerkt in hoofdstuk 6 en bijlage 1, is daarom representatief voor de maximale omgevingsplancapaciteit.

<u>Aandachtgebieden en groepsrisico</u>
Binnen de aandachtsgebieden kunnen zich ongewone voorvallen met gevaarlijke stoffen voordoen, waarbij afhankelijk van de bevolkingsdichtheid in het gebied meer of minder slachtoffers kunnen vallen. Daarnaast kan schade optreden aan gebouwen, locaties en het milieu.

Naar Verwachting wordt voor (concrete) invulling van toetsing van het groepsrisico aangesloten bij het beleid voor groepsrisicoverantwoording zoals vastgesteld door de gedeputeerde staten van Zuid-Holland [11]. In essentie wordt onderstaande werkwijze voorgeschreven (voor de formele (rechtsgeldige) tekst en toepassing wordt verwezen naar het beleidsdocument).

Een kwalitatieve beoordeling van het groepsrisico volstaat indien (artikel 4):
a. het gebied dat begrensd wordt door de afstand tot 1% letaliteit van de milieubelastende activiteit, geheel binnen het risicogebied ligt; of
b. er sprake is van een beperkte of lage personendichtheid binnen het gebied dat begrensd wordt door de afstand tot 1% letaliteit van de milieubelastende activiteit (5 personen per hectare of minder).

Ingeval van een kwantitatieve beoordeling zijn opeenvolgende stappen mogelijk.

1. Volledige inventarisatie van populatie binnen aandachtsgebied (artikel 4)
   Indien de groepsrisicoberekening wijst op een verhoogd groepsrisico of een verdere toename van het groepsrisico in de autonome situatie waarin een verhoogd groepsrisico al bestaat, beoordelen gedeputeerde staten het groepsrisico door middel van een tweede groepsrisicoberekening

2. Herbeoordeling van het groepsrisico: uitsluiten van werknemers binnen het aandachtsgebied (artikel 6)
   Indien de groepsrisicoberekening, bedoeld in artikel 6, eerste lid, wijst op een verhoogd groepsrisico of een verdere toename van het groepsrisico in de autonome situatie waarin een verhoogd groepsrisico al bestaat, beoordelen gedeputeerde staten het groepsrisico door middel van een derde groepsrisicoberekening

3. Beoordeling aanvaardbaarheid bij een verhoogd groepsrisico

Wanneer uit de nadere beoordeling van het groepsrisico blijkt dat het berekende groepsrisico nog steeds de oriëntatiewaarde overschrijdt, of als het groepsrisico verder is toegenomen ten opzichte van de autonome situatie waarin een verhoogd groepsrisico al bestaat, bepalen gedeputeerde staten de aanvaardbaarheid van de ontwikkeling in relatie tot de risico's.

Voor buisleidingen is criterium voor toetsing van groepsrisico genaamd 'de oriëntatiewaarde', gedefinieerd als een dalende lijn beginnend bij een kans van één op honderdduizend dat 10 personen komen te overlijden, waarbij voor elke vertienvoudiging van het aantal doden de frequentie met een factor honderd gereduceerd wordt (10 doden bij 10^{-4} per jaar, 100 doden bij 10^{-6} per jaar, 1000 doden bij 10^{-8} per jaar, etc).

Bestemmingsplan Maasvlakte 2

Voor de variant direct pipe bevindt de zeeleiding zich ook binnen het vigerende bestemmingsplan 'Maasvlakte 2' (onherroepelijk vastgesteld d.d. 6 september 2018) [9]. Figuur 3-2 toont een verbeelding van dit bestemmingsplan. Onderstaand is op hoofdlijnen beschreven welke bestemmingen binnen dit plan zijn toegestaan, en is beschreven of en zo ja welke specifieke instructies voor aandachtsgebieden van toepassing zijn.

<u>Plangebied</u>

Het gebied in de directe omgeving is hoofdzakelijk bestemd voor industriële bedrijvigheid ten behoeve van raffinage en op- en overslag van koolwaterstoffen, en voor overslag van containers. Ten Noorden van de zeeleiding, aan de Maasmond, is ruimte bestemd voor windturbines.

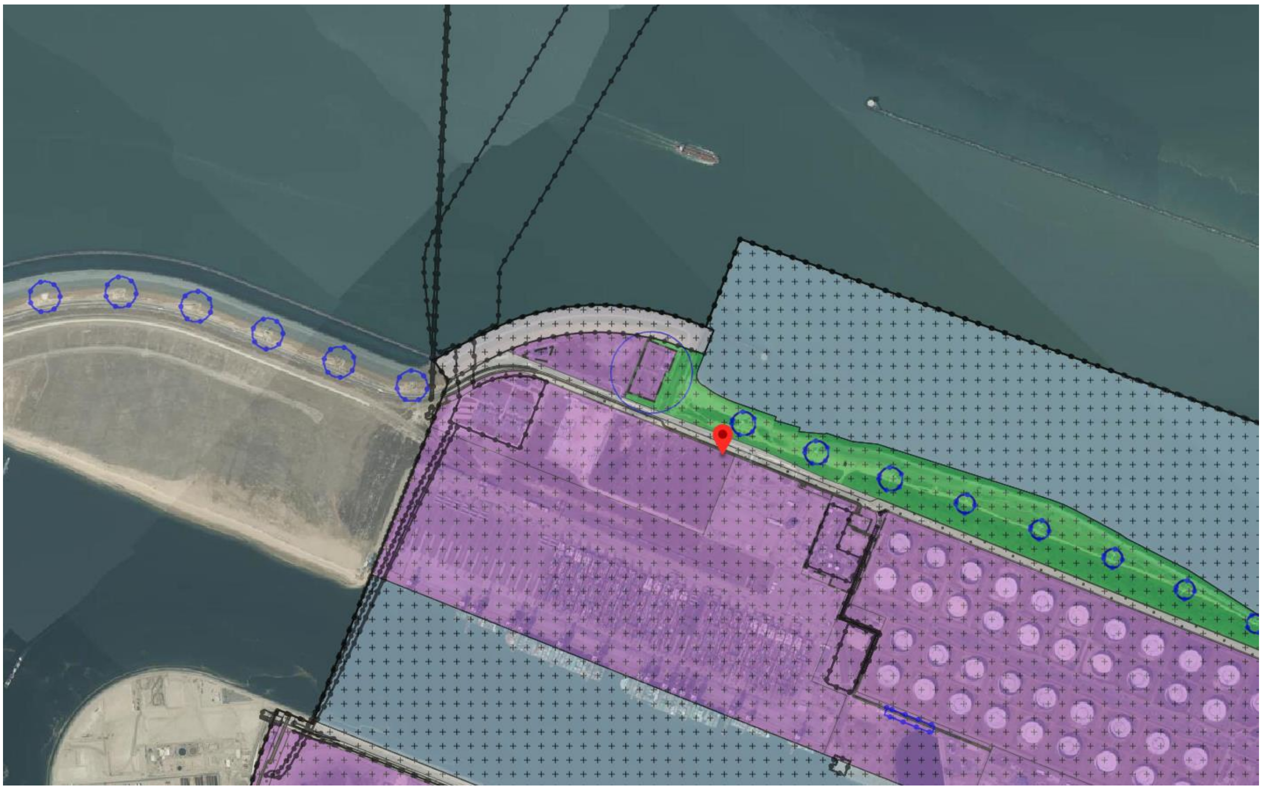
Binnen het bestemmingsplan is een gebied aangewezen met de bestemming 'Leiding – Leidingstrook'; deze leidingstrook loopt parallel aan de Maasvlakte weg. De zeeleiding wordt waar mogelijk in deze leidingstrook geïnstalleerd. Alleen voor het leidingdeel van het compressorstation naar de leidingstrook toe en van de leidingstrook naar de kruising van de zeewering is de zeeleiding buiten de leidingstrook gelegen. Alvorens werkzaamheden in de voor de leidingstrook bestemde gronden wordt vergund, neemt bevoegd gezag contact op met de beheerder(s) van de leiding(en) om eventueel nadere voorwaarden vast te stellen ten aanzien van de uitvoering van de werkzaamheden; dit ter bescherming van de aanwezige buisleiding(en).

In het bestemmingsplan is een maximum gesteld aan de afmetingen van windturbines die binnen het plangebied mogen worden ontwikkeld. De in deze QRA beschouwde windturbines hebben die maximaal toegestane afmeting. Het eventuele risico's van de windturbine naar de zeeleiding, uitgewerkt in hoofdstuk 6 en bijlage 1, is daarom representatief voor de maximale omgevingsplancapaciteit.

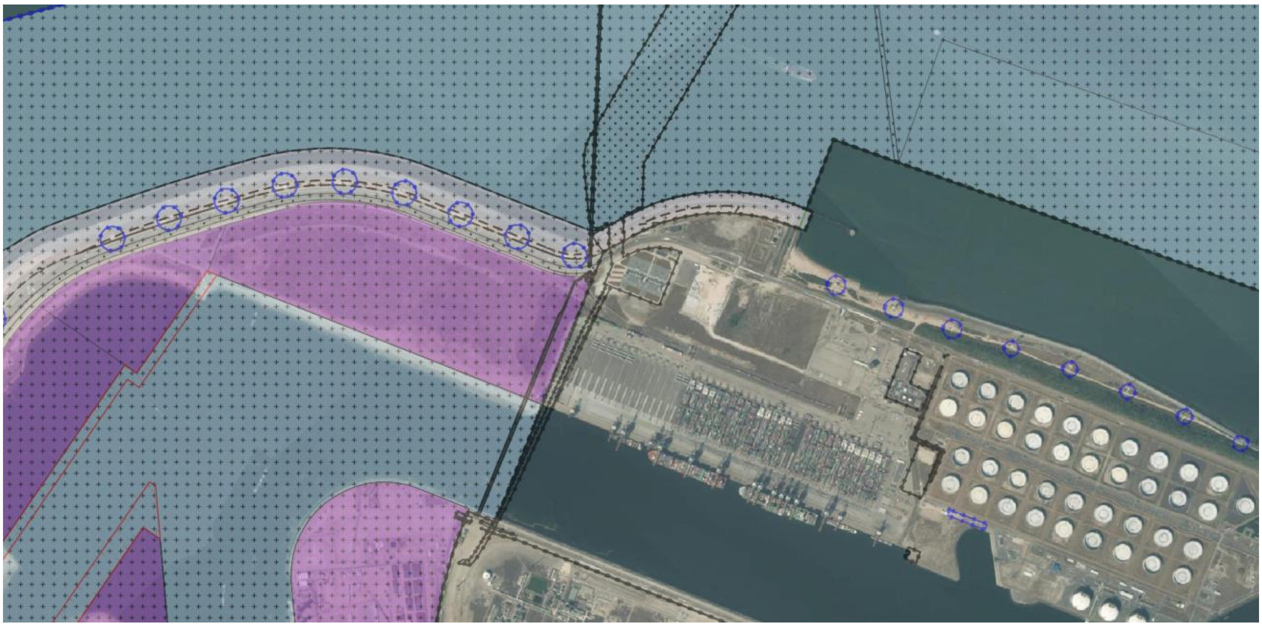
<u>Aandachtgebieden en groepsrisico</u>

Idem aan eerdere beschrijving bij Maasvlakte 1

Risicogebied Maasvlakte 1 en 2 (voorheen Veiligheidscontour)
Het tracé ligt binnen het risicogebied 'Maasvlakte 1 en 2'. Dit risicogebied heeft echter geen betrekking op de risico's veroorzaakt door buisleidingen omdat deze alleen kaders stelt ten aanzien van inrichtingen.



Figuur 3-1: Verbeelding deel omgevingsplan Maasvlakte 1



Figuur 3-2: Verbeelding deel omgevingsplan Maasvlakte 2

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4 Doorzetgegevens

Onderstaande tabel toont de doorzetgegevens in de voorgenomen bedrijfssituaties. Onderwerp van deze QRA is de ‘eindsituatie’ waarin in totaal 22 Mton/jaar door de Aramis exportleiding naar de offshore gasvelden wordt getransporteerd. De doorzet wordt gevormd door een deel afkomstig van het compressorstation en een andere deel afkomstig van de CO2next terminal.

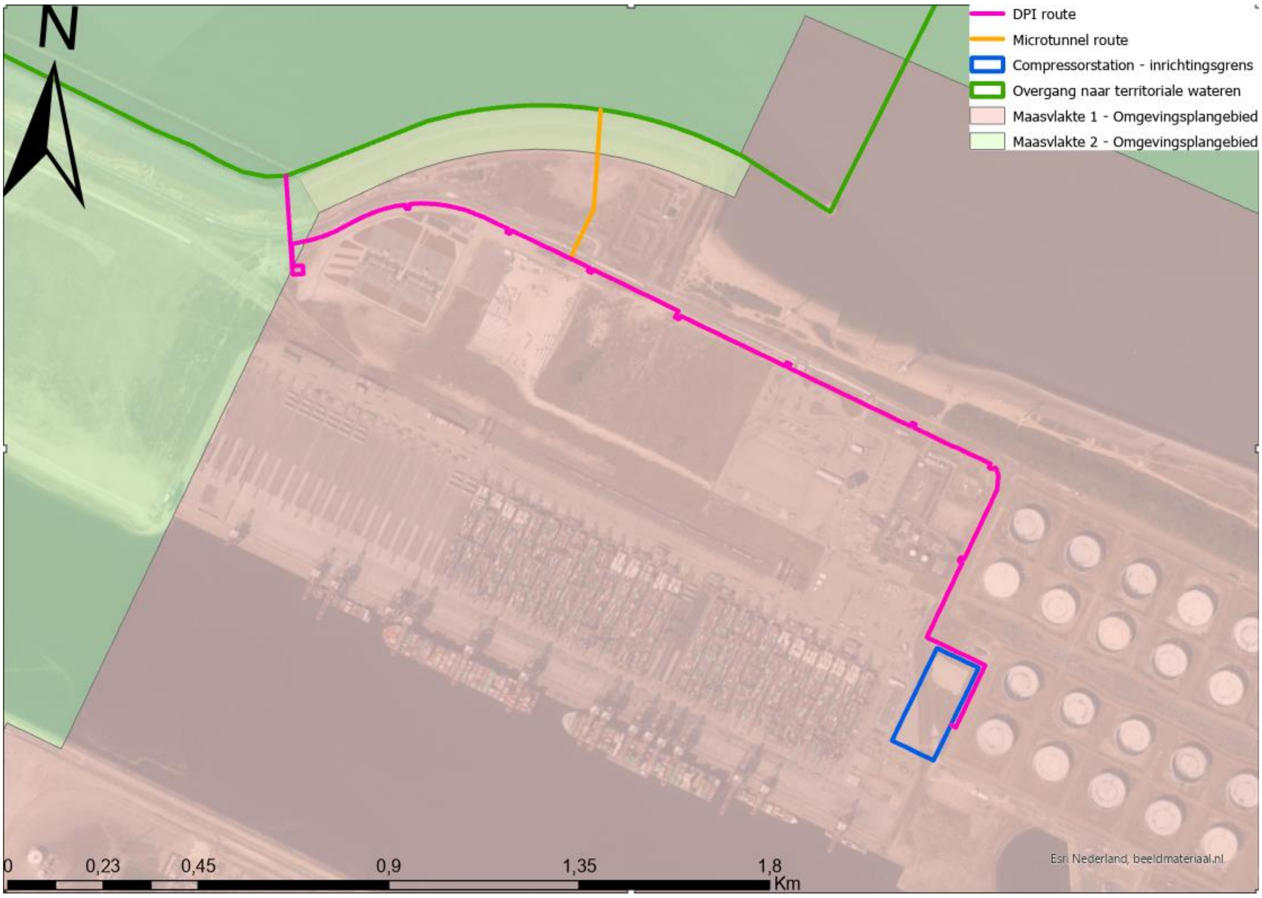
Tabel 4-1: Doorzetgegevens

Aanlevering	Startsituatie (Mton CO_2 per jaar)			Cumulatief eerste uitbreidingssituatie (Mton CO_2 per jaar)			Eindsituatie (Mton CO_2 per jaar)		
	Aramis	Niet-Aramis	Totaal	Aramis	Niet-Aramis	Totaal	Aramis	Niet Aramis	Totaal
Terminal	3,4	2	5,4	6	4	10	12	0	12
Compressorstation	2	2	4	8	2	10	10	0	10
Totaal	5,4	4	9,4	14	6	20	22	0	22

Royal HaskoningDHV

5 Systeembeschrijving zeeleiding

De systeemgrenzen zijn de inrichtingsgrens van het compressorstation (exportleiding afsluitklep) en de overgang naar territoriale wateren. Het deel van de zeeleiding dat daarmee onderwerp is van deze QRA is weergegeven in Figuur 5-1; zowel voor het microtunnel trac\e als het direct pipe tracé. Bovenstrooms de kruising met de zeewering is een zogenaamd 'beach valve station' aanwezig. Hierin bevindt zich onder andere een op afstand bedienbare klep die dicht gestuurd kan worden om de landleiding en de zeeleiding van elkaar te kunnen isoleren. Voor deze QRA is aangenomen dat zowel de afsluiter in de exportleiding van het compressorstation en de beach valve beide de functionaliteit van (automatische) noodafsluiter hebben (ESD-functionaliteit). Bij de voorgenomen activiteit kruist de Aramis leiding in de leidingstrook onder de Porthos leiding. De gronddekking over het gehele tracé is tenminste 1 meter voor beide varianten. In Tabel 5-1 zijn relevante leidingspecificaties gegeven. De doorzet wordt gevormd door een deel afkomstig van het compressorstation en een andere deel afkomstig van de CO2next terminal. Deze laatste stroom bestaat uit vloeibaar kooldioxide dat naar het compressorstation wordt gepompt, daar verwarmd wordt met restwarmte van de compressoren en vervolgens benedenstrooms de compressoren gecombineerd wordt.



Figuur 5-1: Route van zeeleiding varianten en omgevingsplangebieden.
Opmerking: Beide zeeleiding varianten hebben hun oorsprong bij het compressorstation; in de figuur is de Microtunnel variant gedeeltelijk onder de direct pipe *variant gelegen.*

Tabel 5-1: Specificaties zeeleiding

Parameter a)	**Van toepassing op tracé**	**Waarde**	**Eenheid**
Ontwerpdruk	Alle	200	bar
Operationele druk	Alle	190	bar
Ontwerp temperatuur	Alle	-25 / + 70	degC
Operationele temperatuur *(max temp toevoer vanuit compressor)* b)	Alle	0 / +65	degC
Toevoer vanuit het compressorstation e)	Alle	22	Mton/jaar
Lengte buisleiding *(ordegrootte)* d)	Direct pipe	3091	meter
	Microtunnel 1A	2363	
Uitwendige diameter c)	Alle	831,6	mm
Inwendige diameter c)	Alle	755,6	mm
Wanddikte c)	Alle	35,6 (Minimaal)	mm
Staalklasse	Alle	Carbon steel X65 (non-sour)	-
Corrosion allowance	Alle	3	mm
Ruwheidslengte buisleiding	Alle	45	µm
Gronddekking c)	Direct pipe tracé	• In leidingstraat in lengterichting 1 meter • In leidingstraat niet in lengterichting 2,7 meter (expansielussen en in- en uittrede punten) • Van leidingstraat tot entry pit 1,5 meter • Binnenkomst entry *pit direct pipe boring* 3,5 meter *(Opmerking: De overgang van 1,5 meter naar 3,5 vindt (ergens) plaats in het leidingdeel dat de leidingstraat verbindt met de entry pit, exacte ontwerp is onbekend)*. • Vanaf entry pit naar zee meer dan 3,5 meter	
	Microtunnel tracé	• In leidingstraat in lengterichting 1 meter • In leidingstraat niet in lengterichting 2,7 meter (expansielussen en in- en uittrede punten) • Van leidingstraat tot entry pit microtunnel 1,5 meter • Vanaf entry pit microtunnel naar zee meer dan 3,5 meter	

a) De gegevens uit de 'Basis of Design' [20]
b) De temperatuur van de kooldioxide in de zeeleiding wordt lager met de afstand tot het compressor station. De laagst verwachte temperatuur is die van het zeewater op de zeebodem en is ca. 4 graden Celsius.
c) De gegevens uit de 'Basis of Design' [20]
d) Betreft ordegrootte op basis van bepaling lengte in Safeti-NL
e) Dit is de maximale doorzet voor dit ontwerp en is de doorzet in de laatste fase van het project. In eerdere fasen waarbij de toelevering nog niet maximaal is, is de doorzet lager.

6 Uitgangspunten risicomodellering

Onderstaand ligt de belangrijkste algemene parameters toe zoals gehanteerd voor de analyse.

6.1 Risicomodel

De berekeningen zijn uitgevoerd met het rekenpakket Safeti-NL [6]. Gebruik van dit rekenpakket is wettelijk verplicht voor het berekenen van de externe veiligheidsrisico's van buisleidingen die geen aardgas transporteren, voorgaand is vastgelegd in de Omgevingsregeling [4]. Aan de hand van invoergegevens waaronder de hoeveelheid gevaarlijke stof, de procescondities en ontwerpspecificaties, berekent Safeti-NL de externe veiligheidsrisico's.

6.2 Stofgegevens

In onderstaande tabel zijn de stoffen weergegeven die gemodelleerd dienen te worden en de geselecteerde representatieve modelstoffen.

Tabel 6-1: Aanwezige stoffen en representatieve modelstoffen

Stof	Ontvlambaar en of toxisch?	Modelstof in Safeti-NL	Opmerking
Kooldioxide	Giftig	CARBON DIOXIDE (HSE_RR749 PROBITS)	Standaard in Safeti-NL opgenomen.

6.3 Ontsteking

De enige stof die voor de modellering beschouwd wordt is kooldioxide. Deze stof is giftig en niet ontbrandbaar; ontsteking en daaraan verwant ontstekingsbronnen zijn niet relevant voor deze QRA.

6.4 Interne domino-effecten

De zeeleiding omvat één installatie onderdeel, namelijk de zeeleiding zelf, waardoor er geen sprake is van interne domino effecten naar andere installatie onderdelen.

6.5 Externe domino-effecten

Windturbines

In de directe omgeving van de voorgenomen buisleiding zijn meerdere windturbines aanwezig. Het gaat om windturbines op de zogenaamde 'Zuidwal' binnen het omgevingsplan 'Maasvlakte 1' en windturbines op de zogenaamde 'Harde zeewering' binnen het omgevingsplan 'Maasvlakte 2'. De routering van de zeeleiding is door de invloedsgebieden van deze windturbines heen. Domino-effecten naar de zeeleiding als gevolg van faalscenario's van de winturbines (met overlappend invloedsgebied) zijn dan ook onderzocht. In bijlage 1 is beschreven hoe deze invloed is verwerkt in de bepaling van het risicoprofiel van de zeeleiding. De conclusie van deze analyse is dat voor bepaalde leiding segmenten een additionele faalkans is opgenomen.

Naast gelegen leidingen

De leidingen in de leidingstraat zijn vanwege eisen van het Leidingbureau relatief dicht bij elkaar gelegen. Een escalatie scenario ingeval van falen van een naastgelegen leiding naar de Aramis zeeleiding kan dan ook niet worden uitgesloten. Het Aramis ontwerp zal voldoen aan alle voorschriften zoals gesteld door het Leidingbureau om dit risico te minimaliseren; bijvoorbeeld doordat het ontwerp van de zeeleiding voldoet aan de HBOR richtlijnen die een verhoogde veiligheidsfactor voor de wanddikte en contrle maatregelen voorschrijven.

6.6 Gronddekking

Voor de modellering is uitgegaan van een gronddekking met zandgrond (het betreft de ophooglaag op de Maasvlakte).

Direct pipe route:

- Het leidingdeel in de leidingstraat (inclusief expansielussen) heeft een gronddekking van 1 meter
- Het leidingdeel van de leidingstraat tot aan de entry pit heeft een gronddekking van 1,5 meter
- Het leidingdeel vanaf de entrypit naar overgang met territoriale wateren heeft een gronddekking van 3,5 meter of meer

  Volgens het Rekenvoorschrift Omgevingsveiligheid – Buisleiding mag met een maximale gronddekking van 2 meter rekening worden gehouden voor het bepalen van de frequentie van falen van de leiding.

  Voor het bepalen van gevolgen van (eventuele) dominoscenario's van de windturbines naar de zeeleiding is wel met 3,5 meter gronddekking rekening gehouden.

Microtunnel route

- Het leidingdeel in de leidingstraat (inclusief expansielussen) heeft een gronddekking van 1 meter
- Het leidingdeel van de leidingstraat tot aan de entry pit heeft een gronddekking van 1 meter
- Het leidingdeel vanaf de entrypit naar overgang met territoriale wateren heeft een gronddekking van 2 meter

6.7 Bepaling faalscenario's en faalfrequentie

Voor het bepalen van de faalscenario's is aangesloten bij het Rekenvoorschrift omgevingsveiligheid voor buisleidingen [7]. Een volledige uitwerking van de parameters ingevoerd voor de faalscenario's is opgenomen in bijlage 5. Onderstaand worden de typen faalscenario's en de bepaling van de faalfrequenties kort toegelicht.

6.7.1 Faalscenario's

Volgens de rekenmethodiek [7] moeten voor ondergrondse transportleidingen de scenario's breuk van de leiding en leidinglekkage worden gemodelleerd. Over de gehele lengte van de leiding worden om het interval van 1 meter (voor deze QRA aangehouden) beide scenario's gemodelleerd. Voor het modelleren van uitstroming bij deze scenario's wordt het krater model zoals opgenomen in Safeti-NL toegepast. Het is niet verplicht om dit krater model toe te passen, maar het geeft het meest accurate inzicht in de risico's bij uitstroming.

6.7.2 Faalfrequentie

Toepassen van de faalfrequenties voor buisleidingen met chemicaliën, zoals gedefinieerd in tabel 12.3 in het rekenvoorschrift [7], resulteert in een onacceptabel risicoprofiel; de PR = 10^{-6} per jaar is gelegen op een afstand vanaf meer dan vijf meter uit het hart van de buisleiding *(tussenberekening die niet in dit rapport is* opgenomen). Op basis van een iteratief proces is onderzocht welke maatregelen nodig zijn om te zorgen dat de plaatsgebonden risico contour PR = 10-6 per jaar gelegen is binnen 5 meter vanuit het hart van de buisleiding. In Tabel 6-2 zijn de maatregelen opgenomen zoals toegepast op het ontwerp van de buisleiding en daarmee als risico reducerende factor verwerkt in de faalfrequentie zoals toegepast in de modellering. Op basis van de iteratiestappen zijn drie sets aan maatregelen gedefinieerd: 1. Basis maatregelen, 2. Aanvullende maatregelen en 3. Extra benodigde maatregelen. De extra maatregelen zijn enkel nodig voor het direct pipe tracé. De basis maatregelen zijn vastgesteld in het 'Rekenvoorschrift Omgevingsveiligheid – Buisleidingen' [7] en mogen bij voldoen aan de daarin gestelde randvoorwaarden worden toegepast. De aanvullende maatregelen, benoemd in het 'Rekenvoorschrift Omgevingsveiligheid – Toelichting' [8], mogen alleen worden toegepast na toestemming van bevoegd gezag en met voldoen aan de in [8] gestelde randvoorwaarden. In paragraaf 6.7.3 is separaat de verantwoording voor toepassing van deze maatregelen uitgewerkt. Voor de extra benodigde maatregelen is in de tabel een zelf toelichting opgenomen. In bijlage 3 is een gedetailleerde uitwerking opgenomen van de behaalde risicoreductie door toepassing van de maatregelen.

Tabel 6-2: Faaloorzaak verdeling voor buisleidingen met chemicaliën

Faaloorzaak	Toegepaste risico reducerende maatregelen
Basis toegepaste risico reducerende maatregelen	
Beschadiging door derden	Gronddekking Leiding voldoet aan stand der techniek Actief rappel Waarschuwingslint Beperkte restricties Strikte begeleiding werkzaamheden Wanddikte
Mechanisch	Leiding voldoet aan stand der techniek
Inwendige corrosie	
Uitwendige corrosie	
Natuurlijke oorzaken	
Operationeel/overig	
Aanvullende toegepaste risico reducerende maatregelen	
Mechanisch	Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie.
Inwendige corrosie	
Uitwendige corrosie	
Natuurlijke oorzaken	Ontoelaatbare zettingen c.q. spanningen kunnen door middel van een evaluatie redelijkerwijs vergaand worden uitgesloten.
Operationeel/overig	Toegepaste SIL = Berekende SIL +2
Extra benodigde risico reducerende maatregelen voor direct pipe tracé	
Natuurlijke oorzaken	Natuurlijke oorzaken kunnen worden uitgesloten *Benoemd in het 'Rekenvoorschrift Omgevingsveiligheid – Buisleidingen' [8], mag alleen worden toegepast na toestemming van bevoegd gezag.*
Windturbine – leidingdeel tussen leidingstrook en overgang naar direct pipe boring (einde entry-pit)	Gronddekking minimaal 1,5 meter over het deel van het tracé tussen de leidingstrook en de entry pit, waardoor de schokgolf veroorzaakt door de van relevante turbine onderdelen niet tot beschadiging van de leiding leidt.

	Voor het risico geïntroduceerd door windturbines zijn geen risico reducerende voorzieningen beschreven in het Rekenvoorschrift Omgevingsveiligheid – Buisleidingen. De benodigde gronddekking is bepaald op basis van het Rekenvoorschrift Omgevingsveiligheid – Windturbines [16].
Windturbine – Laatste stuk van het leidingdeel in de leidingstrook; lengte ca. 60 meter (voordat deze de leidingstrook verlaat richting entry-pit).	Dit zal gemitigeerd moeten worden door extra gronddekking of bescherming (e.g. betonplaten), mogelijkheden overleggen met Leidingenbureau Rotterdam

6.7.3 Verantwoording aanvullende maatregelen

Maatregel: Inline inspection

Om te verifiëren of de maatregelen voor de integriteit van de leiding effectief zijn zal periodiek een in-line inspectie worden uitgevoerd. Deze inspectie wordt uitgevoerd door een intelligent pig (sonde) door de buis te leiden om de wanddikte en mogelijke defecten (als gevolg van corrosie of mechanische schade) te meten. De inspectie zal worden uitgevoerd in overeenstemming met de randvoorwaarden ‘In-line inspectie (ILI)’ als omschreven in de Handleiding Risicoberekeningen Toelichting [8] en op basis van gangbare standaarden in de industrie, zoals de POF100 “specifications and requirements for in-line inspection of pipelines” door de Pipeline Operators Forum. Meerdere technologieën zijn beschikbaar om koolstofstalen leidingen in CO2 service te inspecteren. Het Aramis project is een programma gestart om de optimale ILI technologie te selecteren voor de transportleiding, met als minimale specificatie de eerdergenoemde eisen per Handleiding Risicoberekeningen.

Indien defecten worden geïdentificeerd zullen deze worden beoordeeld in een risicoanalyse met een ‘fit-for-purpose’ (bedrijfsgeschiktheids) demonstratie per NEN3650. Indien nodig zal het defect worden gerepareerd.

De eerste ILI zal binnen enkele jaren na opstarten worden uitgevoerd als baseline. Voor het bepalen van de inspectie interval zal een RBI-aanpak (Risk Based Inspection) toegepast worden waarbij monitorings informatie gebruikt wordt om mogelijke faaloorzaken te analyseren en gekoppeld aan de consequenties een inspectieregime wordt bepaald. Monitorings informatie bevat onder andere de historische druk, temperatuur en doorzet in de buisleiding, alsmede kwaliteitsmetingen aan het medium, controle metingen op het kathodische bescherming systeem en visuele/sonar inspectie resultaten m.b.t. de ligging van de leiding. Ook de resultaten van in-line inspecties worden meegenomen in het RBI proces. De maximale ILI interval bedraagt 10 jaar.

Maatregel: Evaluatie stabiliteit ondergrond

Ter onderbouwing van de toepassing van de reductie factor voor natuurlijke oorzaken is de stabiliteit van de ondergrond van de zeeleiding onderzocht ; zie bijlage 7. Specifiek is onderzocht of dermate grote verschilzettingen in de ondergrond kunnen optreden die tot gevolg hebben dat te hoge mechanische spanningen in de leiding optreden met falen van de leiding als gevolg. In het gerefereerde memo wordt onderstaande conclusie getrokken:

“Op basis van de aangetroffen zandige grondslag zijn er geen zettingen ten gevolge van de aanleg van de Maasvlakte of eerdere werkzaamheden langs het tracé, niet direct gerelateerd aan de aanleg van deze leiding meer te verwachten. Enige zetting vanuit lagen onder het zandpakket (achtergrondzetting) is niet uit te sluiten maar zal naar verwachting relatief gering zijn en optreden in het hele gebied en dus niet tot significante verschilzetting over de leiding leiden. Hierbij komt dat de leiding als geheel genomen onder het volumieke gewicht van los gepakt zand uitkomt. De belasting onder de leiding is dus hoger voordat de leiding aangebracht is. Wanneer de leiding zorgvuldig aangebracht wordt, met verdichting van de

werkvloer (0.3 m direct onder de leiding) ter voorkoming van zakking direct na aanleg is het aannemelijk dat geen significante zetting zal optreden.

Hiermee zijn dus zowel ontoelaatbare zettingen/spanningen en natuurlijke oorzaken redelijkerwijs vergaand uitgesloten en kan reductiefactor 10 worden toegepast.'

Maatregel: SIL + 2
Een overdrukbeveiligingssysteem wordt geïmplementeerd waarbij de toegepaste SIL (Safety Integrity Level) twee niveaus hoger is dan de berekende SIL-waarde. Het landdeel van de leiding zal worden getest (hydrotest) op een druk boven de 260 barg. De maximale druk die vanuit zowel het compressorstation als de terminal geleverd kan worden zal lager liggen. Daarmee is breuk als gevolg van overdruk geen realistisch scenario. Zowel op het compressorstation als op de terminal zal minimaal een SIL-2 overdruk beveiliging geïnstalleerd worden die in werking treedt op de ontwerpdruk van 200 barg.

6.8 Ruwheidslengte

De fysieke eigenschappen van de omgeving spelen een rol bij de verspreiding van een toxische wolk, hierbij is het type bebouwing (hoog- of laagbouw) of natuur in de omgeving van de zeeleiding van belang. Deze fysieke eigenschappen komen tot uiting in de zogenaamde 'ruwheidslengte'. De ruwheidslengte is berekend met behulp van 'ruwheidskaart' zoals beschikbaar gesteld door het RIVM [12]. De ruwheidskaart geeft per vierkante kilometer een 'gemiddelde' ruwheidslengte. Omdat het leidingtracé gelegen is binnen een gebied dat groter is dan één vierkante kilometer, kan de ruwheidslengte variëren langs het tracé. Volgens de ruwheidskaart is de kortste ruwheidslengte 10 mm op basis van de het vlakke openterrein (en open water). Op een kleine deel van het tracé, bij de oorsprong van de zeeleiding, is ordegrootte 300 mm vanwege de naastgelegen tanks op de MOT terminal. Een gevoeligheidsanalyse is uitgevoerd voor onderstaande drie ruwheidslengte, deze is opgenomen in bijlage 2. De resultaten van de gevoeligheidsanalyse laten zien dat de ligging van de PR 10^{-6}/jaar risicocontouren voor de verschillende ruwheidslengten niet heel sterk verschilt. Besloten is om te modelleren met een ruwheidslengte van 100 mm.

6.9 Weerscondities

Bij het berekenen van het PR, de aandachtsgebieden en GR is gebruik gemaakt van de meteogegevens van het weerstation Hoek van Holland, zoals deze in Safeti-NL zijn opgenomen. Dit is het dichtstbijzijnde representatieve weerstation.

6.10 Populatie in de omgeving

Zoals beschreven in 3.4, moet binnen het aandachtsgebied het groepsrisico verantwoord worden; dit is dan ook het gebied wat het kader geeft voor 'de populatie in de omgeving'. Gezien door de zeeleiding enkel kooldioxide getransporteerd wordt, betreft het voor deze installatie alleen het zogenaamde 'gifwolkaandachtsgebied'. De gifwolkaandachtsgebieden van de Directe pipe variant en Microtunnel variant zijn weergegeven in Figuur 7-2 respectievelijk Figuur 8-2. De populatiegegevens in de gebouwen (kantoorpersoneel) binnen het aandachtsgebied zijn ontleend uit de BAG[2] populatieservice [14] (bagselectiebasis 202401). De populatie is op pandniveau opgevraagd. Ook is voor nog niet ontwikkelde gebieden een schatting gemaakt van mogelijk toekomstige populatie op basis van de toegestane bedrijvigheid (zogenaamde 'Enkelbestemming') in combinatie met kentallen volgens het document 'PGS Deel 6 – Aanwezigheidsgegevens' [17]. Daarbij is uitgegaan van de categorie 'industrie' waarvoor een

[2] De Basisregistraties Adressen en Gebouwen (BAG) zijn onderdeel van het overheidsstelsel van basisregistraties. Gemeenten zijn bronhouders van de BAG. Zij zijn verantwoordelijk voor het opnemen van de gegevens in de BAG en voor de kwaliteit ervan. Alle gemeenten stellen gegevens over adressen en gebouwen centraal beschikbaar via de Landelijke Voorziening BAG (LV BAG). Het Kadaster beheert de LV BAG en stelt de gegevens beschikbaar.

kental van 40 personen per hectare is gegeven. Aanvullend is de populatie in het gebouw dat geïdentificeerd wordt als 'Euromax MR' toegevoegd aan de populatie; dit zat niet in het BAG bestand. De populatie in dit gebouw is gebaseerd op het oppervlak in combinatie met kentallen volgens het document 'Kentallen Populatieservice en Dataservice Kwetsbare gebouwen en locaties (KGL)' [18]. In Figuur 6-1 zijn de in het rekenmodel toegepaste populatievlakken weergegeven.

Figuur 6-1:Toegepaste populatievlakken

In onderstaande tabel zijn vakken met meer dan 10 personen gespecificeerd.

Tabel 6-3: Specificatie populatievlakken

Populatie vlak identificatie	Oppervlak [ha]	Enkelbestemming / functie	Dag – Kental dichtheid [personen/ha]	Nacht – Kental dichtheid [personen/ha]	Aantallen personen [-]	
					Dag	Nacht
Populatie vlak 1A)	95,5	Bedrijf – 1	5	1	478	96
Populatie vlak 2A)	7,2	Bedrijf-1 / Bedrijf – containers	5	1	36	7
Populatie vlak 3A)	24,7	Bedrijf – 2	40	8	989	198
Populatie vlak 4A)	17,5	Bedrijf – 3	40	8	702	140
Euromax kantoorgebouwB)	-	-	-	-	64	0

Euromax MR gebouw – kantoor deel[C)]	Ca 0,1 (= 1000 m2) 2 verdiepingen elk 0,05 ha	Hoofdcategorie: kantoorfunctie, aanvullende indeling kantoorfunctie klein (<5000m2)	1 persoon per 30 m2 (= 333 personen per ha)	Aangenomen geen personen aanwezig	34[A]	0
Euromax MR gebouw – logistieke hal [C)]	Ca 0,25 (= 2500 m2)	Hoofdcategorie: industriefunctie, aanvullende indeling: distributiecentra / logistieke centra	1 persoon per 250 m2 (= 40 personen per ha)	1 persoon per 250 m2 (= 40 personen per ha)	10	10

A) Kentallen volgens PGS Deel 6 – Aanwezigheidsgegevens [17]
B) Aantal personen volgens BAG populatieservice [14]
C) Vloeroppervlak bepaald met behulp van 'Street Smart' van Cyclomedia [19]. Kentallen volgens het document 'Kentallen Populatieservice en Dataservice Kwetsbare gebouwen en locaties (KGL)' [18]
D) Enkelbestemming volgens website ruimtelijkeplannen.nl [9]

7 Resultaten kruising zeewering door direct pipe

Dit hoofdstuk geeft het risicoprofiel zoals bepaald voor de variant waarbij de buisleidingvariant via een direct pipe de zeewering kruist.

7.1 Plaatsgebonden risico

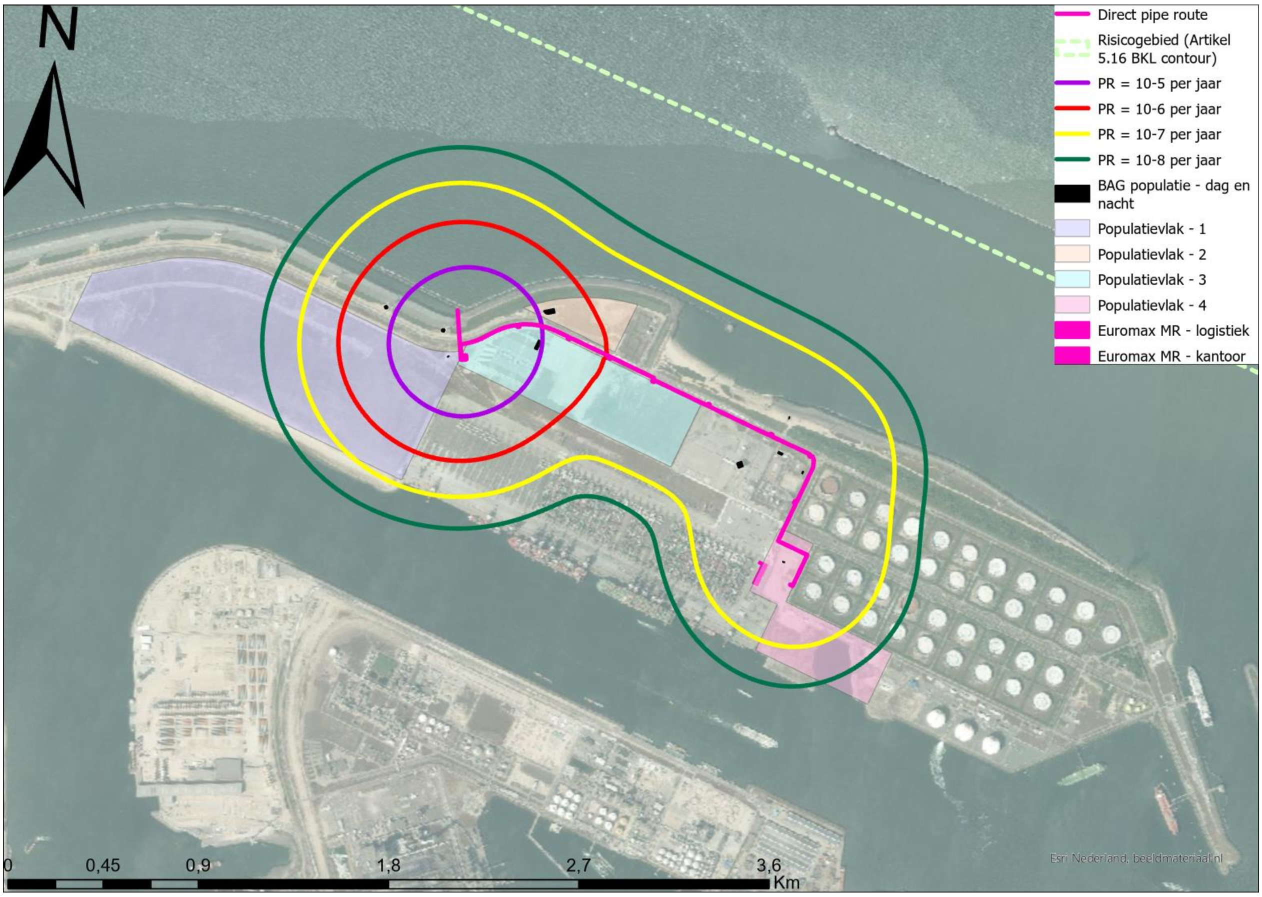
In Figuur 7-1 zijn de PR-contouren weergegeven voor de zeeleiding; een combinatie van het autonome risicoprofiel van de zeeleiding en het (additionele) risicoprofiel geïntroduceerd door de windturbine (domino-effect). Deze contouren zijn gebaseerd op de scenario's en frequenties zoals op genomen in de rekenmethodiek [7], voor een 'Chemicaliënleiding die voldoet aan de stand der techniek' met de frequentie gecorrigeerd voor de diepte ligging en met additionele risicoreductie voorzieningen zoals beschreven in paragaaf 6.7. Zoals in de betreffende paragraaf aangegeven moet bevoegd gezag goedkeuring geven op een deel van de toegepaste risicoreductie factoren; deze zijn:

Faaloorzaak	Risico reducerende maatregel
Mechanisch	Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie.
Inwendige corrosie	
Uitwendige corrosie	
Natuurlijke oorzaken	Ontoelaatbare zettingen c.q. spanningen kunnen door middel van een evaluatie redelijkerwijs vergaand worden uitgesloten.
Operationeel/overig	Toegepaste SIL = Berekende SIL +2

Met inbegrip van bovenstaande risico reducerende maatregelen voldoet het risicoprofiel niet aan het acceptatie criteria, gesteld in het Bal, dat deze maximaal 5 meter uit het hart van de leiding gelegen mag zijn. De overschrijding wordt voor het overgrote deel veroorzaakt door de additionele faalfrequentie geïntroduceerd door de windturbine (domino-effect); specifiek het leidingdeel in de leidingstrook ca 60 meter voordat deze de leidingstrook verlaat richting entry-pit. Zeer lokaal zorgt de autonome faalfrequentie van de leiding echter ook voor overschrijding (PR = 10-6 per jaar op ca. 30 meter uit het hart van de leiding). Om de PR = 10-6 per jaar contour binnen 5 meter uit het hart van de leiding te krijgen kan toepassing van onderstaande extra maatregelen worden onderzocht:

- Onderzoek naar beschermingsconstructie voor het 60 meter lange leidingdeel (laatste stuk van het leidingdeel in de leidingstrook; lengte ca. 60 meter (voordat deze de leidingstrook verlaat richting entry-pit)). Deze beschermingsconstructie zal gerealiseerd moeten worden door extra gronddekking of bescherming (e.g. betonplaten), mogelijkheden in overleg met overleg met Leidingenbureau Rotterdam.
- Onderzoek naar reductie van de autonome faalfrequentie van de leiding. Bijna alle mogelijke reductie maatregelen benoemd in de rekenvoorschriften zijn momenteel toegepast in deze QRA zijn toegepast. De enige significante maatregelen die nog volgens de rekenvoorschriften aanvullend kunnen worden toegepast zijn het 'inherent aantoonbaar volledig niet corrosief maken van de buisleiding ten opzichte van de omgeving' en/of 'het inherent aantoonbaar volledig niet corrosief maken van de buisleiding ten opzichte van het te transporteren medium'.

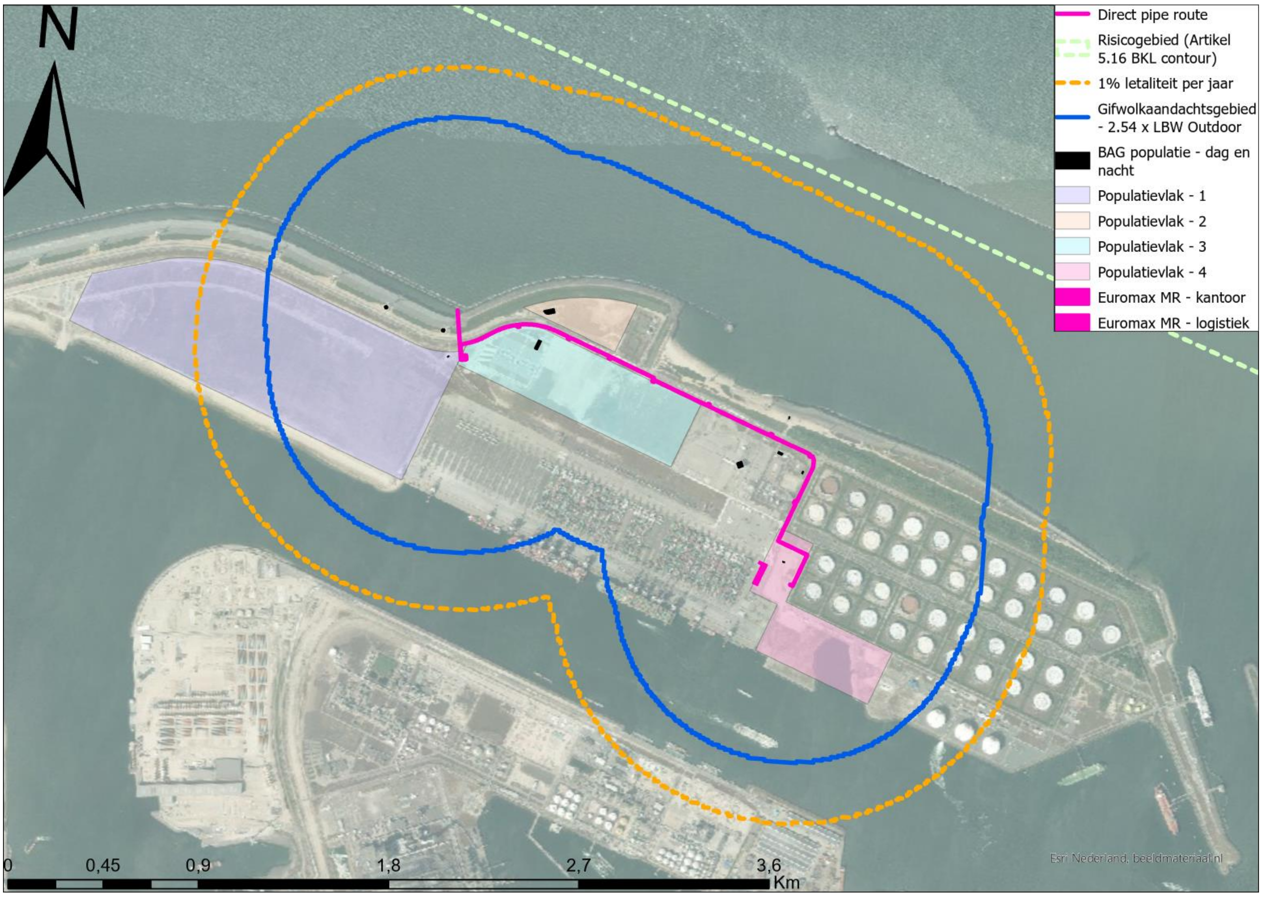
Ter volledigheid is in bijlage 4 is een afbeelding opgenomen met de plaatsgebonden risico wanneer (enkel) de standaard maatregelen worden toegepast.



Figuur 7-1: PR voor de direct pipe route

7.2 Aandachtsgebieden

In Figuur 7-2 zijn het gifwolkaandachtsgebied en de 1% letaliteit per jaar contourweergegeven. Het gifwolkaandachtsgebied is bepaald op basis van effectafstand (daar waar de concentratie “in de buitenlucht” gelijk is aan 2.54 x de concentratie van de levensbedreigende waarde). Volgens rekenvoorschriften mag het gifwolkaandachtsgebied bepaald worden op basis van dosis (= concentratie x tijd) wat zou leiden tot een kleinere contour dan die op basis van effectafstand; echter is voor kooldioxide geen relatie beschikbaar waarmee deze benadering kan worden toegepast (dit is bekend bij RIVM).[3]. vanwege voorgaand is daarom besloten het gifwolkaandachtsgebied op basis van een effectafstand te bepalen.



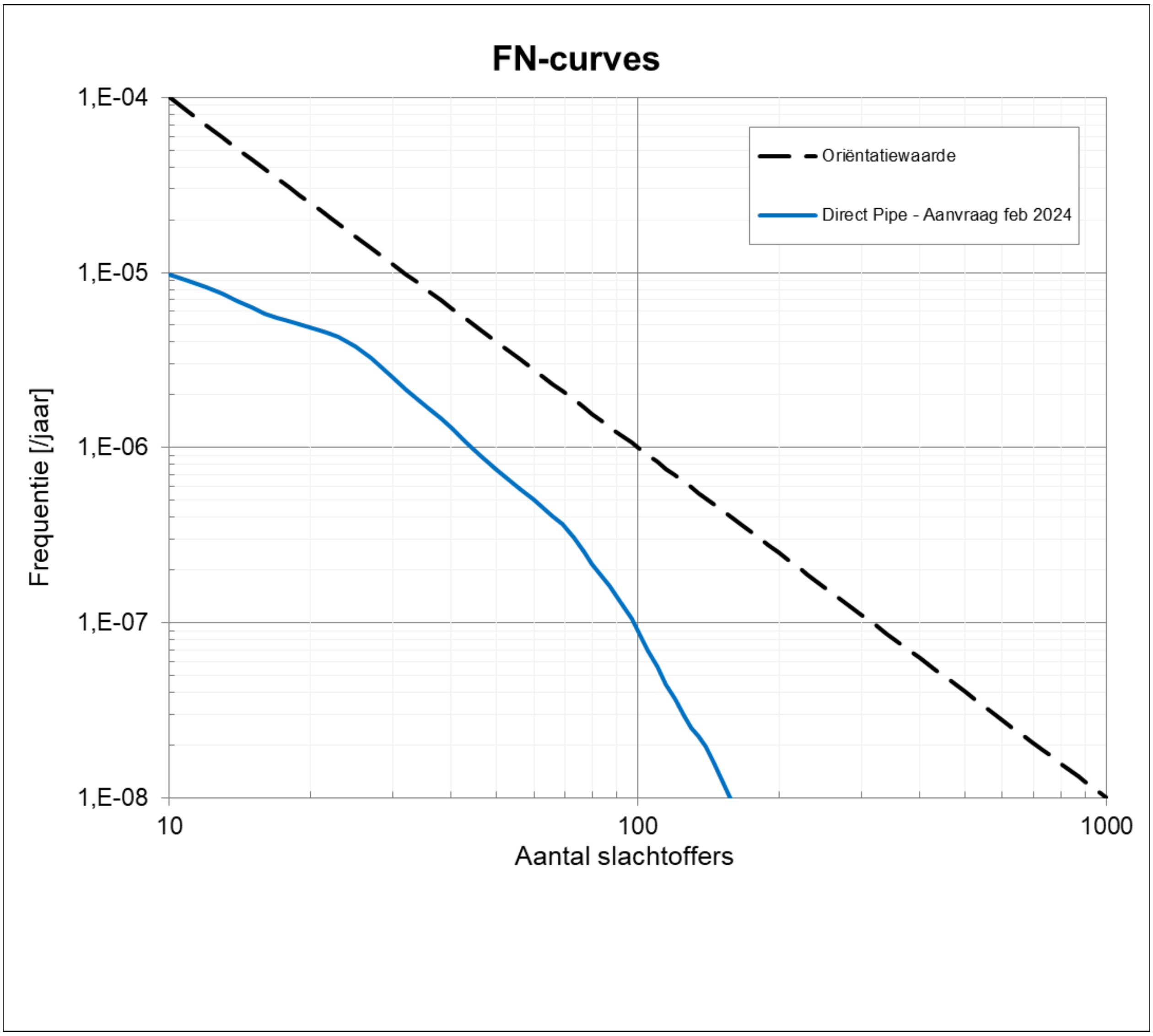
Figuur 7-2: Gifwolkaandachtsgebied voor de direct pipe route

[3] *Reactie Safeti-NL helpdesk op vraag om stof parameter voor bepalen gifwolkaandachtsgebied op basis van dosi benadering: “Voor koolstofdioxide kon de Toetsgroep Probitrelaties geen LBW N-waarde afleiden en daarom is er geen waarde voor de 'Toxic dose threshold N' opgenomen in Safeti-NL 8.8.*

Groepsrisico

Volgens het groepsrisicobeleid van de provincie Zuid-Holland, mag worden volstaan met een kwalitatieve verantwoording indien de 1% letaliteit per jaar contour geheel gelegen is binnen een risicogebied. Zoals uit de afbeelding valt af te leiden is dit het geval.

Om een vergelijking te kunnen maken van welke variant in het kader van externe veiligheid als veiliger kan worden beschouwd, is besloten om (aanvullend) het groepsrisico te bepalen. Dit is bepaald op basis van BAG populatie data, aangevuld met kentallen van aantallen personen voor de nog niet ontwikkelde gebieden en aangevuld met een kantoorgebouw en logistiek gebouw op het Euromax terrein (zie paragraaf 6.10 voor de geïnventariseerde populatie). Op basis van ingevoerde populatie ontstaat een groepsrisico waarvan de hoogte tot boven de oriëntatiewaarde uitstijgt. In Figuur 7-3 is het bepaalde groepsrisico gevisualiseerd. Al vervolgstap zou personeel van bepaalde milieubelastende activiteiten gelegen binnen het aandachtsgebied kunnen worden uitgesloten uit de populatie, met als doel inzicht te geven in het *“feitelijk aandeel van de directe omwonenden op de hoogte van het groepsrisico”*. Gezien er geen ‘omwonenden’, geïnterpreteerd als ‘anders dan werknemers’ binnen het risicogebied zal het groepsrisico naar allerverwachting onder de oriëntatie waarde uitkomen. Er zal nog wel sprake zijn van een groepsrisico omdat onder andere in de ‘Gezamenlijk brandweerkazerne’ nog personeel aanwezig is en omdat (mogelijk) bedrijvigheid aanwezig is wat niet valt binnen de milieubelastende activiteiten waarvan bijbehorend personeel mag worden uitgesloten.



Figuur 7-3: GR voor de direct pipe route

8 Resultaten kruising zeewering door microtunnel

Dit hoofdstuk geeft het risicoprofiel zoals bepaald voor de variant waarbij de buisleiding via een microtunnel de zeewering kruist.

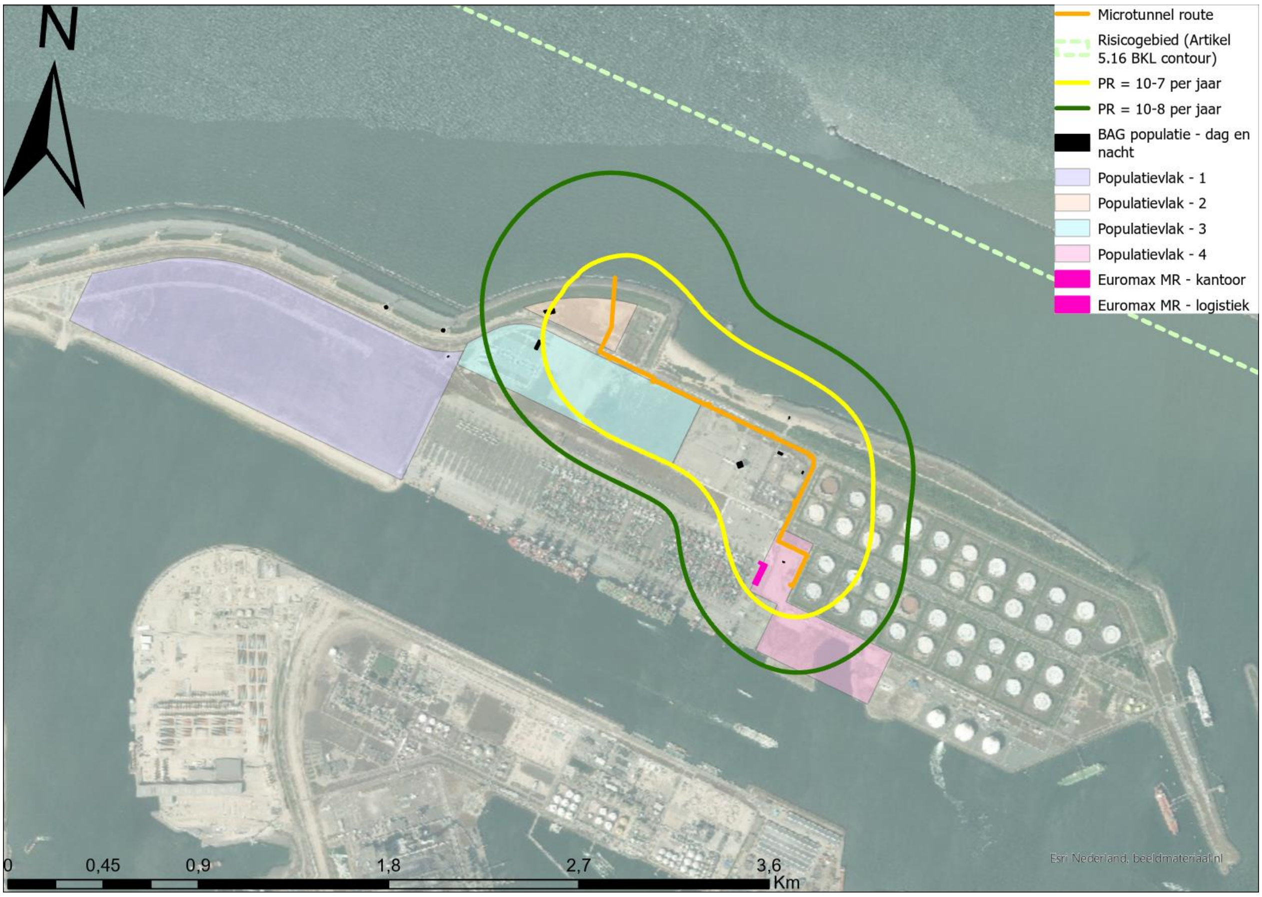
8.1 Plaatsgebonden risico

In Figuur 8-1 zijn de PR-contouren weergegeven voor de zeeleiding. Deze contouren zijn gebaseerd op de scenario's en frequenties zoals op genomen in de rekenmethodiek [7], voor een 'Chemicaliënleiding die voldoet aan de stand der techniek' met de frequentie gecorrigeerd voor de diepte ligging en met additionele risico reductie voorzieningen zoals beschreven in paragaaf 6.7. Zoals in de betreffende paragraaf aangegeven moet bevoegd gezag goedkeuring geven op een deel van de toegepaste risicoreductie factoren; deze zijn:

Faaloorzaak	Risico reducerende maatregel
Mechanisch	Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie.
Inwendige corrosie	
Uitwendige corrosie	
Natuurlijke oorzaken	Ontoelaatbare zettingen c.q. spanningen kunnen door middel van een evaluatie redelijkerwijs vergaand worden uitgesloten.
Operationeel/overig	Toegepaste SIL = Berekende SIL +2

Met inbegrip van bovenstaande risico reducerende maatregelen is er geen PR = 10^{-6} per jaar contour bepaald. Het plaatsgebonden risico voldoet daarmee aan het landelijk toetsingskader dat stelt dat de PR = 10^{-6} per jaar contour binnen 5 meter uit het hart van de leiding gelegen moet zijn.

Ter volledigheid is in bijlage 4 is een afbeelding opgenomen met de plaatsgebonden risico wanneer (enkel) de standaard maatregelen worden toegepast.

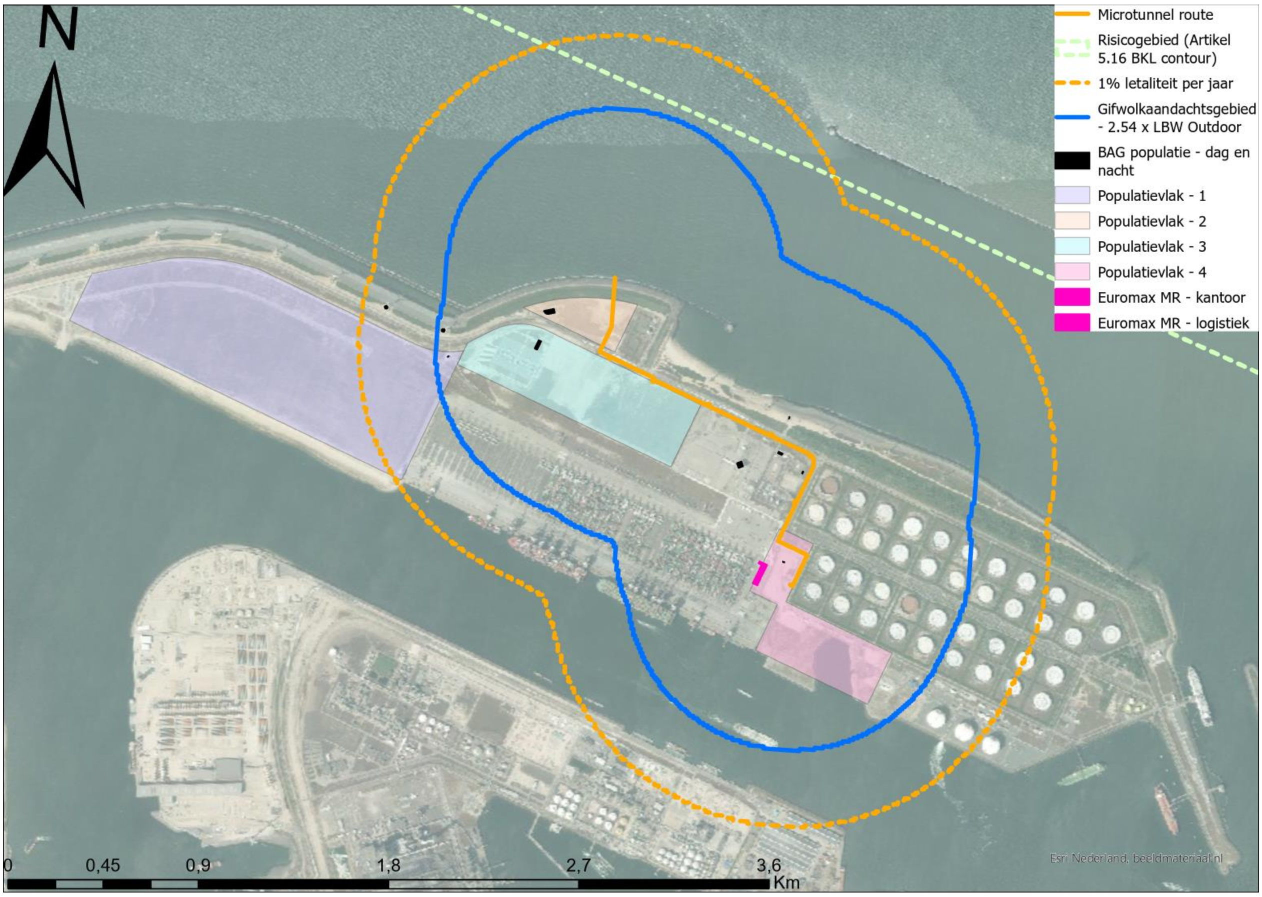


Figuur 8-1 PR-contouren voor de microtunnel route.

Royal HaskoningDHV

8.2 Aandachtsgebieden

In Figuur 8-2 zijn het gifwolkaandachtsgebied en de 1% letaliteit per jaar contourweergegeven. Het gifwolkaandachtsgebied is bepaald op basis van effectafstand (daar waar de concentratie "in de buitenlucht" gelijk is aan 2.54 x de concentratie van de levensbedreigende waarde). Volgens rekenvoorschriften mag het gifwolkaandachtsgebied bepaald worden op basis van dosis (= concentratie x tijd) wat zou leiden tot een kleinere contour dan die op basis van effectafstand; echter is voor kooldioxide geen relatie beschikbaar waarmee deze benadering kan worden toegepast (dit is bekend bij RIVM).[4]. vanwege voorgaand is daarom besloten het gifwolkaandachtsgebied op basis van een effectafstand te bepalen.



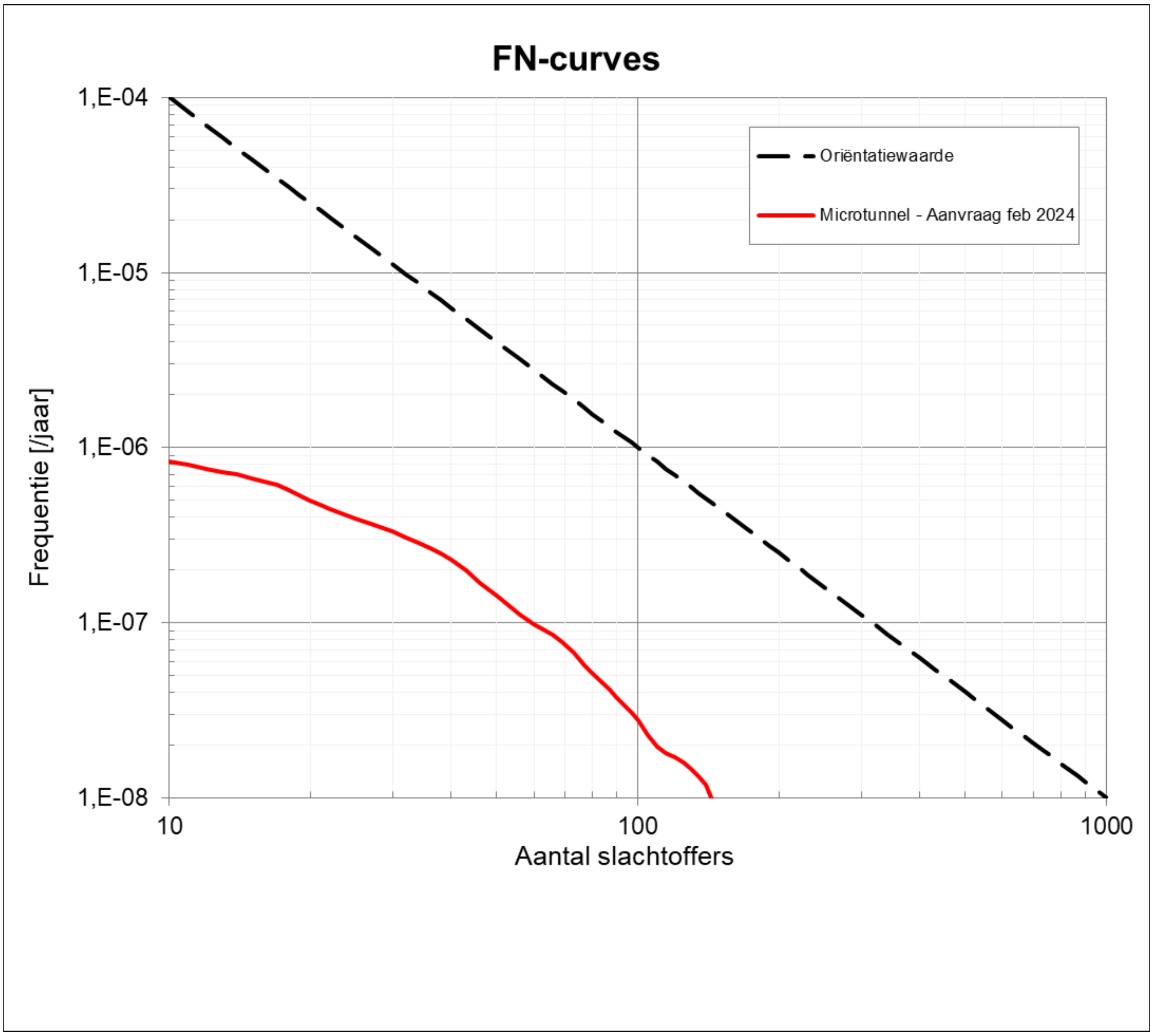
Figuur 8-2 Gifwolkaandachtsgebied voor de microtunnel route

[4] *Reactie Safeti-NL helpdesk op vraag om stof parameter voor bepalen gifwolkaandachtsgebied op basis van dosi benadering: "Voor koolstofdioxide kon de Toetsgroep Probitrelaties geen LBW N-waarde afleiden en daarom is er geen waarde voor de 'Toxic dose threshold N' opgenomen in Safeti-NL 8.8.*

Groepsrisico
Volgens het groepsrisicobeleid van de provincie Zuid-Holland, mag worden volstaan met een kwalitatieve verantwoording indien de 1% letaliteit per jaar contour geheel gelegen is binnen een risicogebied. Zoals uit de afbeelding valt af te leiden reikt een deel van de 1% letaliteit per jaar contour tot buiten het risicogebied; dit gebied is (echter) gelegen over de Noordzee waardoor er geen populatie in het gebied aanwezig is. Op basis van voorgaand lijkt een kwalitatieve verantwoording niet ontoelaatbaar.

Om een vergelijking te kunnen maken van welke variant in het kader van externe veiligheid als veiliger kan worden beschouwd, is besloten om (aanvullend) het groepsrisico te bepalen. Dit is bepaald op basis van BAG populatie data, aangevuld met kentallen van aantallen personen voor de nog niet ontwikkelde gebieden en aangevuld met een kantoorgebouw en logistiek gebouw op het Euromax terrein (zie paragraaf 6.10 voor de geïnventariseerde populatie). Op basis van ingevoerde populatie ontstaat een groepsrisico waarvan de hoogte tot beneden de oriëntatiewaarde blijft. In Figuur 8-3 is het bepaalde groepsrisico gevisualiseerd.

Al vervolgstap zou personeel van bepaalde milieubelastende activiteiten gelegen binnen het aandachtsgebied kunnen worden uitgesloten uit de populatie, met als doel inzicht te geven in het "feitelijk aandeel van de directe omwonenden op de hoogte van het groepsrisico". Gezien er geen 'omwonenden', geïnterpreteerd als 'anders dan werknemers' binnen het risicogebied zal het groepsrisico verder onder de oriëntatie waarde uitkomen. Er zal waarschijnlijk nog wel sprake zijn van een groepsrisico omdat onder andere in de 'Gezamenlijk brandweerkazerne' nog personeel aanwezig is en omdat (mogelijk) bedrijvigheid aanwezig is wat niet valt binnen de milieubelastende activiteiten waarvan bijbehorend personeel mag worden uitgesloten.



Figuur 8-3 GR voor de microtunnel route

9 Samenvatting bevindingen en toetsing wet- en regelgeving

De volgende conclusies kunnen worden getrokken ten aanzien van het plaatsgebonden risico en de aandachtsgebieden van beide door gerekende varianten:

Plaatsgebonden risico

Microtunnel variant
Voor deze variant resulteert de modelering niet in de aanwezigheid van een PR 10-6 per jaar contour; daarmee voldoet het plaatsgebonden risico van deze variant aan het acceptatie criteria, gesteld in het Bal.

Direct pipe variant
De PR 10-6 per jaar contour van de direct pipe variant reikt tot meer dan vijf meter uit het hart van de leiding, en voldoet daarmee niet aan het acceptatie criteria, gesteld in het Bal. Mitigerende maatregelen moeten worden genomen om het plaatsgebonden risico naar acceptabele omvang te reduceren:

- De bijdrage van de zeeleiding zelf moet verder gereduceerd worden. Aansluiten bij mogelijke (toegestane) mitigerende maatregelen volgens de rekenvoorschriften kan dit alleen indien de buisleiding wordt ontworpen zodat interne en/of externe corrosie niet mogelijk is.
- Mitigatie van de additionele faalkans geïntroduceerd door de windturbine (domino-effect) kan worden gemitigeerd door de leiding op de relevante segmenten te beschermen (bijvoorbeeld door een beschermconstructie of door de gronddekking te verhogen; mogelijkheden in overleg met Leidingenbureau Rotterdam. Het betreft het laatste stuk van het leidingdeel in de leidingstrook; lengte ca. 60 meter (voordat deze de leidingstrook verlaat richting entry-pit). Specificaties van deze constructie dienen nog uitgewerkt te worden.

Aandachtsgebied en groepsrisico

Microtunnel variant
Het aandachtsgebied is gelegen binnen het risicogebied. De 1% letaliteit per jaar contour reikt tot net buiten het risicogebied ; dit gebied is (echter) gelegen over de Noordzee waardoor er geen populatie in het gebied aanwezig is. Op basis van voorgaand lijkt een kwalitatieve verantwoording niet ontoelaatbaar. Om een vergelijking te kunnen maken van welke variant in het kader van externe veiligheid als veiliger kan worden beschouwd, is besloten om (aanvullend) het groepsrisico te bepalen.

Directe pipe variant
Het aandachtsgebied en de 1% letaliteit contour zijn gelegen binnen het risicogebied. Een kwantitatieve verantwoording van het groepsrisico volstaat daarom. Om een vergelijking te kunnen maken van welke variant in het kader van externe veiligheid als veiliger kan worden beschouwd, is besloten om (aanvullend) het groepsrisico te bepalen.

Groepsrisico
Voor zowel de direct pipe variant en de microtunnel variant is het groepsrisico onder de oriëntatiewaarde gelegen. Het groepsrisico van de directe pipevariant is hoger, dit wordt veroorzaakt door de plaatsgebonden risico contouren die tot verder uit het hart van de buisleiding reiken en daarbij over gebieden met populatie rijken.

10 Referenties

[1] Besluit activiteiten leefomgeving; geldend van 01-01-2024 t/m heden. Geraadpleegd via website: https://wetten.overheid.nl/

[2] Besluit kwaliteit leefomgeving; geldend van 01-01-2024 t/m heden. Geraadpleegd via website: https://wetten.overheid.nl/

[3] Besluit bouwwerken leefomgeving; geldend van 01-01-2024 t/m heden. Geraadpleegd via website: https://wetten.overheid.nl/

[4] Omgevingsregeling; geldend van 01-01-2024 t/m heden. Geraadpleegd via website: https://wetten.overheid.nl/

[5] Technische tekening: Detail of Aramis-Porthos profiles Intersection, drawing no. HDDP – 23.212.03.01, Revision 02, d.d. 17-03-2023, HDDP solutions (& TotalEnergies)

[6] Softwarepakket Safeti-NL, versie 8.8, DNV

[7] Rekenvoorschrift omgevingsveiligheid – Module: V buisleidingen, versie oktober 2020, Rijksinstituut voor Volksgezondheid en Milieu

[8] Rekenvoorschrift omgevingsveiligheid – Toelichting, versie maart 2022, Rijksinstituut voor Volksgezondheid en Milieu

[9] www.ruimtelijkeplannen.nl, bezocht op 23 februari 2024.

[10] Key decision sheet – Onshore Zeeleiding Configuration, doc no: ARM-CPT-BB3-PLR-KDS-0143, revisie 02, d.d 21-09-2022, Aramis

[11] Besluit van gedeputeerde staten van Zuid-Holland van 5 december 2023, [DOS-2023-0006729, PZH-2023- 844389726] tot vaststelling van de beleidsregel over de invulling van de groepsrisicoverantwoording bij vergunningplichtige milieubelastende activiteiten (Beleidsregel groepsrisicoverantwoording bij provinciale omgevingsvergunningen voor milieubelastende activiteiten)

[12] Ruwheidskaart met publicatiedatum 13-03-2020, https://www.rijksoverheid.nl/documenten/publicaties/2020/03/13/ruwheidskaart-2020, Rijksinstituut voor Volksgezondheid en Milieu

[13] Handboek Omgevingsveiligheid, https://omgevingsveiligheid.rivm.nl/handboek-omgevingsveiligheid, bezocht op 28-03-2023, Rijksinstituut voor Volksgezondheid en Milieu

[14] BAG populatieservice, http://populatieservice.demis.nl, download 20 januari 2024 (BAGselectiebasis: 202401).

[15] Website: https://omgevingsveiligheid.rivm.nl/stappenplan-bepalen-aandachtsgebieden, bezocht op 01-08-2023, Rijksinstituut voor Volksgezondheid en Milieu

[16] Rekenvoorschrift omgevingsveiligheid – Module: IV windturbines, versie oktober 2020, Rijksinstituut voor Volksgezondheid en Milieu

[17] Publicatiereeks Gevaarlijke Stoffen 1 – Deel 6: Aanwezigheidsgegevens, VROM, december 2003

[18] Kentallen Populatieservice en Dataservice Kwetsbare gebouwen en locaties (KGL), Projectteam Informatieproducten Externe Veiligheid, maart 2023

[19] Cyclomedia street smart, https://www.cyclomedia.com/nl/street-smart, bezocht op 19 januari 2024

[20] Basis of design

Bijlage

1. Invloed windturbines

Deze bijlage beschrijft de invloed van de windturbines op de faalscenario's van de leiding. Deze invloed wordt uitgedrukt in een additionele faalkans van de leiding waarbij een lekkage of een breuk optreed. Voor het bepalen van de additionele faalkans is aangesloten bij het Rekenvoorschrift omgevingsveiligheid – Module: IV windturbines [16].

In onderstaande paragraaf is de methodiek in generieke bewoording toegelicht. Na deze paragraaf volgt een paragraaf die de resultaten (= invloed op de Aramis buisleiding) geeft. Vervolgens wordt meer detail over de berekeningen gegeven in een paragraaf die de gebruikte specificaties toelicht en afsluitend volgt een paragraaf waarin een overzicht van alle berekende parameters is geven (wiskundige vergelijkingen om de waarden van deze parameters te berekenen zijn niet opgenomen in deze rapportage; indien gewenst kan de lezer deze terug vinden in het boven genoemde Rekenvoorschrift).

Methodiek

Wanneer een windturbine faalt en daardoor een onderdeel van de turbine op of in de directe omgeving van de buisleiding terecht komt, ontstaat door de een schokgolf die zich ondergronds voortplant. De energie van deze schokgolf kan dermate hoog zijn dat, wanneer deze interfereert met de buisleiding, deze schade kan veroorzaken aan de buisleiding. Het criterium dat wordt aangehouden voor schade is vastgelegd in de rekenmethodiek voor windturbines [16]; beschadiging treed op wanneer de stres in het materiaal van de buisleiding, veroorzaakt door de energie van de schokgolf, groter is dan de maximaal toelaatbare stres op basis van de leidingspecificaties. Volgens de rekenmethodiek kan voor elk van de faalwijzen van een windturbine (bladbreuk, mastbreuk of gondel en/of rotor afworp) een zogenaamde kritische strook worden bepaald. Dit is de afstand tot de leiding (aan weerszijde van de leiding) waarbinnen het neerkomen van het windturbinedeel tot een schokgolf zal leiden die de leiding beschadigd. De afmeting van de kritische strook verschilt per windturbine onderdeel omdat elk onderdeel een eigen hoeveelheid ()energie veroorzaakt. De maximale afstand vanaf de voet van de windturbine waarop een windturbine onderdeel terecht kan komen wordt het invloedsgebied van de windturbine genoemd. Deze maximale afstand wordt bepaald door het scenario 'bladbreuk - werpafstand bij overtoeren'. De windturbinebladen kunnen de grootste afstand overbruggen omdat deze worden weggeslingerd. Mastbreuk, waarbij de mast horizontaal terecht komt, geeft de op één na grootste afstand tot de mastvoet, en gondel en/of rotorafworp geeft de kleinste afstand tot de mastvoet. Voorgaand maakt duidelijk dat de oriëntatie van de loop van de leiding binnen het invloedsgebied bepalend is voor welke scenario's kunnen leiden tot falen van de leiding; de scenario's waarbij de betreffende turbine onderdelen binnen de kritische strook terecht kunnen komen. De additionele faalkans wordt vervolgens bepaald door voor alle relevante faalscenario's de kans dat het zwaartepunt van het betreffend windturbine onderdeel binnen deze kritische strook terecht te bepalen.

Resultaten – windturbines Zuidwal

Voor elke windturbine met een invloedsgebied dat over de buisleiding heen reikt is bepaald welke faalscenario's van de windturbine bijdragen aan de additionele faalkans voor de buisleiding. Voor deze windturbines is geconcludeerd dat deze geen significante additionele faalfrequentie naar de zeeleiding introduceren (domino-effect); de faalkans van de zeeleiding voor modellering is niet verhoogd. Afleiding om tot deze conclusie te komen is uiteengezet in onderstaande drie tabellen, waar achtereenvolgens voor de diverse faalscenario's is aangegeven:

1. Of de inslagenergie van het betreffende windturbine onderdeel zo hoog is dat deze tot schade aan de zeeleiding kan leiden,
2. Of voor scenario's waar dit het geval is de zeeleiding binnen het valbereik van het betreffende windturbine onderdeel gelegen is, en
3. Welke sectie van de zeeleiding beschadigd kan raken en met welke additionele faalfrequentie (voor scenario's waar de inslagenergie hoog genoeg is, en waar het turbine onderdeel binnen het valbereik gelegen is)

Tabel 10-1: Resultaten analyse invloed windturbines - Windturbines Zuidwal – inslagenergie

Faalscenario [-]		Penetratie diepte schokgolf [m]	Diepte ligging buisleiding [m]	Voldoende inslagenergie om schade aan leiding toe te brengen?
Bladbreuk	Nominaal toerental	0,82	1	Nee
	Overtoeren	1,01	1	Ja
Mastbreuk	Mast	0,20	1	Nee
	Gondel en rotor	2,06	1	Ja
	Blad	0,74	1	Nee
Gondel en of rotor afworp	Gondel en rotor	2,06	1	Ja
	Blad	0,74	1	Nee

Tabel 10-2: Resultaten analyse invloed windturbines - Windturbines Zuidwal – valbereik

Faalscenario [-]		Afmeting kritische strook [m]	Minimale afstand tot kritische strook [m]^A), B)	Maximaal Valbereik vanaf mastvoet [m]	Valbereik binnen kritische strook [J/N]
Bladbreuk	Overtoeren	0,32	114,84	259	Ja
Mastbreuk	Gondel en rotor	3,6	113,2	85	Nee
Gondel en of rotor afworp	Gondel en rotor	3,6	113,2	11	Nee

A. Minimaal 115 meter tot leiding deel dat 1 meter gronddekking heeft.
B. Deze kolom geeft de minimale afstand tot de kritische strook; deze wordt bepaald door afstand tot de leiding te verminderend met de helft van de kritische strook (de kritische strook strekt zich uit aan weerszijde van de leiding).

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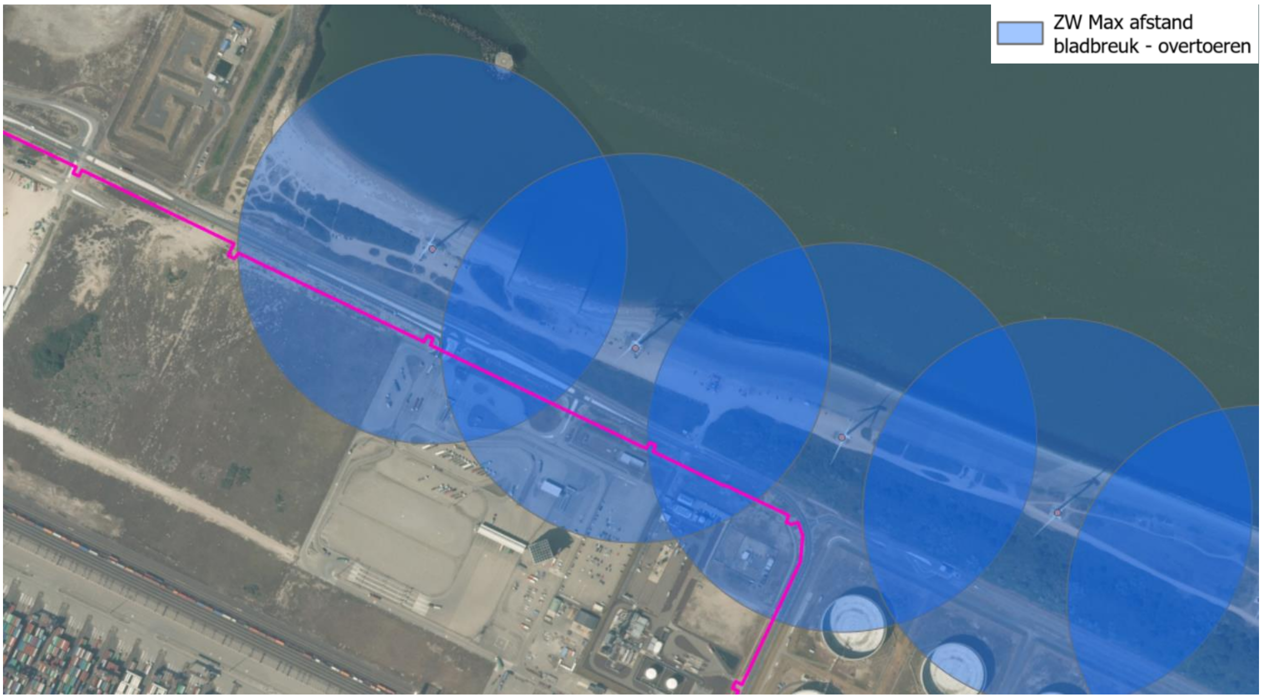
Tabel 10-3: Resultaten analyse invloed windturbines - Windturbines Zuidwal – Faalscenario's relevant voor zeeleiding

Faalscenario [-]		Beschadigd leiding segment	Additionele faalfrequentie [-/meter.jaar]	Additionele faalfrequentie [-/kilometer.jaar]
Bladbreuk	Overtoeren	Zie Figuur 10-1	4,8 x 10^{-12} Geen *significante bijdrage daarom niet meegenomen in model*	4,8 x 10^{-09} Geen *significante bijdrage daarom niet meegenomen in model*



Figuur 10-1: Windturbines Zuidwal - Zeeleiding segmenten waar schade kan ontstaan door interactie met windturbine onderdelen

Resultaten – windturbines Harde zeewering

Voor elke windturbine met een invloedsgebied dat over de buisleiding heen reikt is bepaald welke faalscenario's van de windturbine bijdragen aan de additionele faalkans voor de buisleiding. Voor deze windturbines is geconcludeerd dat deze wel een significante additionele faalfrequentie naar de zeeleiding introduceren (domino-effect); de faalkans van de zeeleiding voor modellering is wel verhoogd. Afleiding om tot deze conclusie te komen is uiteengezet in onderstaande drie tabellen, waar achtereenvolgens voor de diverse faalscenario's is aangegeven:

1. Of de inslagenergie van het betreffende windturbine onderdeel zo hoog is dat deze tot schade aan de zeeleiding kan leiden,
2. Of voor scenario's waar dit het geval is de zeeleiding binnen het valbereik van het betreffende windturbine onderdeel gelegen is, en
3. Welke sectie van de zeeleiding beschadigd kan raken en met welke additionele faalfrequentie (voor scenario's waar de inslagenergie hoog genoeg is, en waar het turbine onderdeel binnen het valbereik gelegen is)

Tabel 10-4: Resultaten analyse invloed windturbines - Windturbines Harde zeewering – inslagenergie

Faalscenario [-]		Penetratie diepte schokgolf [m]	Diepte ligging buisleiding [m]	Voldoende inslagenergie om schade aan leiding toe te brengen?
Bladbreuk	Nominaal toerental	1,19	1	Ja
			1,5	Nee
			3	Nee
	Overtoeren	1,49	1	Ja
			1,5	Nee
			3	Nee
Mastbreuk	Mast	0,21	1	Nee
			1,5	Nee
			3	Nee
	Gondel en rotor	2,57	1	Ja
			1,5	Ja
			3	Nee
	Blad	1,05	1	Ja
			1,5	Nee
			3	Nee
Gondel en of rotor afworp	Gondel en rotor	2,57	1	Ja
			1,5	Ja
			3	Nee
	Blad	1,05	1	Ja
			1,5	Nee
			3	Nee

Tabel 10-5: Resultaten analyse invloed windturbines - Windturbines Harde Zeewering – valbereik

Faalscenario [-]		Diepte ligging [m]	Afmeting kritische strook [m]	Minimale afstand tot kritische strook [m] A), B)	Maximaal Valbereik vanaf mastvoet [m]	Valbereik binnen kritische strook [J/N]
Bladbreuk	Nominaal toeren tal	1	1,28	91,35	120	Ja
	Overtoeren	1	2,22	90,98	317	Ja
Mastbreuk	Gondel en rotor	1	4,74	89,63	83	Nee
		1,5	4,17	89,92	83	Nee
	Blad	1	0,65	89,63	135	Ja
Gondel en of rotor afworp	Gondel en rotor	1	4,74	89,63	13	Nee

Faalscenario [-]		Diepte ligging [m]	Afmeting kritische strook [m]	Minimale afstand tot kritische strook [m][A), B)]	Maximaal Valbereik vanaf mastvoet [m]	Valbereik binnen kritische strook [J/N]
		1,5	4,17	89,92	13	Nee
	Blad	1	0,65	91,67	58,5	Nee

A. Minimaal 92 meter tot leiding deel dat 1 meter dan wel 1,5 meter gronddekking heeft.
B. Deze kolom geeft de minimale afstand tot de kritische strook; deze wordt bepaald door afstand tot de leiding te verminderend met de helft van de kritische strook (de kritische strook strekt zich uit aan weerszijde van de leiding).

Tabel 10-6: Resultaten analyse invloed windturbines - Windturbines Harde Zeewering – Faalscenario's relevant voor zeeleiding

Faalscenario [-]		Beschadigd leiding segment	Additionele faalfrequentie [-/meter.jaar]	Additionele faalfrequentie [-/kilometer.jaar]
Bladbreuk	Nominaal toerental	Zie Figuur 10-2 – Het leiding segment waar de groene cirkel overlapt met het leiding deel ingesloten tussen de pijlen met nummers 1 en 2	$2{,}0 \times 10^{-08}$	$2{,}0 \times 10^{-05}$
	Overtoeren	Zie Figuur 10-2 – Het leiding segment waar de blauwe cirkel overlapt met het leiding deel ingesloten tussen de pijlen met nummers 1 en 2	$2{,}6 \times 10^{-11}$ Geen *significante bijdrage daarom niet meegenomen in model*	$2{,}6 \times 10^{-08}$ Geen *significante bijdrage daarom niet meegenomen in model*
Mastbreuk	Blad	Zie Figuur 10-2 – Het leiding segment waar de oranje cirkel overlapt met het leiding deel ingesloten tussen de pijlen met nummers 1 en 2	$7{,}0 \times 10^{-07}$	$7{,}0 \times 10^{-04}$

Op basis van bovenstaand is een additionele faalfrequentie van $7{,}2 \times 10^{-07}$ aangehouden per meter per jaar (=$7{,}2 \times 10^{-04}$ per kilometer per jaar) voor het segment van de zeeleiding dat binnen de oranje cirkel georiënteerd zoals aangegeven in Figuur 10-2. Deze frequentie is een optelsom van de scenario's bladbreuk – nominaal toerental en mastbreuk – blad. Voor het scenario bladbreuk – nominaal toerental (groene cirkel) is daarmee conservatief aangenomen dat dit scenario een (iets) groter gebied kan bestrijken dan rekenkundig bepaald.

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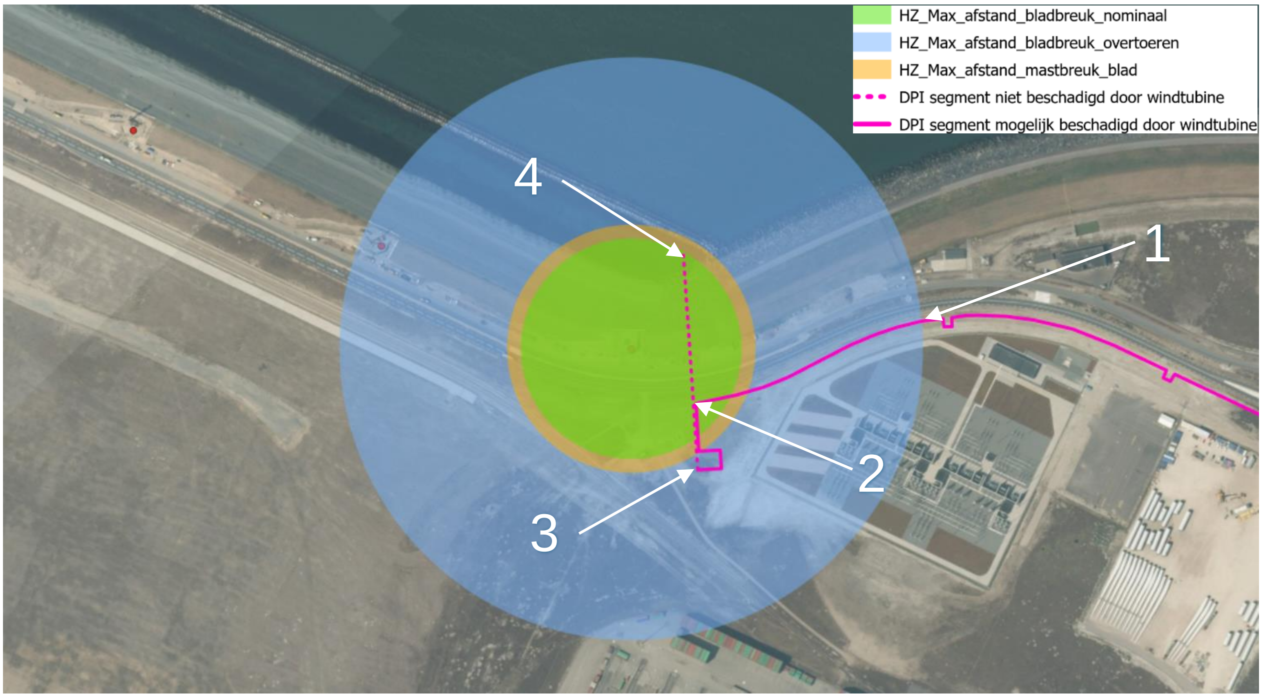

Figuur 10-2: Windturbines Harde Zeewering - Zeeleiding segmenten waar schade kan ontstaan door interactie met windturbine onderdelen. Het gestippelde paarse leiding segment ingesloten tussen de pijlen met nummers 3 en 4, kan niet beschadigd raken omdat de diepte ligging minimaal 3,5 meter bedraagt; dit is groter dan de penetratie diepte van een schokgolf veroorzaakt door inslag van een windturbine onderdeel. Het paarse leiding segment ingesloten tussen de pijlen met nummers 2 en 3, kan niet beschadigd raken omdat de leiding niet gelegen is binnen het valbereik van turbine onderdelen die voor schade kunnen zorgen (dit deel van het tracé heeft een diepte ligging van 1,5 meter waardoor de scenario's 'mastbreuk – gondel en rotor' en 'gondel en rotor afworp – gondel en rotor' (zie tabel Tabel 10-6) genoeginslag energie hebben om de zeeleiding te beschadingen, echter ligt de zeeleiding buiten het valbereilk van de windturbine onderdelen van deze scenario's).

Technische specificaties zeeleiding en uitwerking berekeningen

In onderstaande tabel zijn de leidingspecificaties opgenomen die zijn gebruikt om de toelaatbare stress te bepalen voordat vervorming optreed; vervorming in deze analyse is gelijk genomen aan het falen van de buisleiding waarbij kooldioxide vrijkomt.

Tabel 10-7: Zeeleiding specificaties voor bepaling windturbine invloed

Leiding	Waarde	Eenheid	Bron
Elasticiteit	2,07E+11	J	
SMYS	4,21E+08	Pa	
Druk	2,0E+06	Pa	
Wanddikte leiding	35,6	mm	
Buiten diameter leiding	831,6	mm	

<u>Windturbine specificaties – Zuidwal</u>

In onderstaande tabel zijn de specificaties van de windturbines aan de Zuidwal opgenomen. Deze gegevens zijn door Eneco (Assetmanagement) gecontroleerd en akkoord bevonden.

Tabel 10-8: Specificaties windturbines Zuidwal: Vestas V90 – 3MW

Turbinekenmerken	Eenheid	Waarde
Nominaal toerental	rpm	18,4
Hoogte rotatiepunt	m	80,0
Rotordiameter	m	90,0
Lengte afgebroken blad	m	44,0
Oppervlak afgebroken blad	m^2	109,9
Massa blad	ton	6,7
Bladzwaartepunt	m	11,2
Hoogte hub	m	4,5
Breedte hub	m	4,5
Lengte hub	m	4,0
Massa hub	ton	8,9
Massa rotor	ton	29,0
Hoogte gondel	m	4,2
Breedte gondel	m	3,8
Lengte gondel	m	10,7
Massa gondel	ton	77,5
Lengte mast	m	80,0
Diameter mast	m	3,7
Massa mast	ton	146,0

Windturbine specificaties – Harde Zeewering

In onderstaande tabel zijn de specificaties van de windturbines aan de Harde Zeewering opgenomen. Deze gegevens zijn door Eneco (Assetmanagement) gecontroleerd en akkoord bevonden.

Tabel 10-9: Specificaties windturbines Harde Zeewering: Vestas V117 – 4,3MW

Turbinekenmerken	Eenheid	Waarde
Nominaal toerental	rpm	13,6
Hoogte rotatiepunt	m	86,0
Rotordiameter	m	117,0
Lengte afgebroken blad	m	57,2
Oppervlak afgebroken blad	m^2	176,7
Massa blad	ton	15,0
Bladzwaartepunt	m	17,1
Hoogte hub	m	3,8
Breedte hub	m	3,8
Lengte hub	m	5,5
Massa hub	ton	40,0
Massa rotor	ton	85,0
Hoogte gondel	m	6,9
Breedte gondel	m	4,2
Lengte gondel	m	12,8
Massa gondel	ton	100,0
Lengte mast	m	76,0
Diameter mast	m	7,5
Massa mast	ton	160,0

Berekende parameters – Windturbines Harde zeewering

Tabel 10-10: Windturbine Harde Zeewering – berekening kritische strook

Parameter	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Kritische strook – 1 meter gronddekking	1,28	2,22	0,00	4,74	0,65	4,74	0,65	m
Kritische strook – 1,5 meter gronddekking	0,00	0,00	0,00	4,17	0,00	4,17	0,00	m
Kritische strook – 3,5 meter gronddekking	0,00	0,00	0,00	0,00	0,00	0,00	0,00	M
Penetratiediepte	1,19	1,49	0,21	2,57	1,05	2,57	1,05	m

Tabel 10-11: Windturbine Harde Zeewering - berekening penetratiediepte

Parameter	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Penetratiediepte	1,19	1,49	0,21	2,57	1,05	2,57	1,05	m
Toelaatbare extra stress	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	Pa
Kinetische energie	1,71E+07	3,04E+07	7,85E+05	1,18E+08	1,27E+07	1,18E+08	1,27E+07	J
Elasticiteit	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	J
k1 (coëfficiënt)	0,3048	0,3048	0,3048	0,3048	0,3048	0,3048	0,3048	-
k2 (coëfficiënt)	4,44	4,44	4,44	4,44	4,44	4,44	4,44	-
k3 (coëfficiënt)	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	-
Type bron	puntbron	puntbron	lijnbron	puntbron	puntbron	puntbron	puntbron	-
k4 (coëfficiënt)	1	1	0,43	1	1	1	1	-
k5 (coëfficiënt)	2,5	2,5	1,5	2,5	2,5	2,5	2,5	-
k6 (coëfficiënt)	0,77	0,77	0,77	0,77	0,77	0,77	0,77	-

Tabel 10-12: Windturbine Harde Zeewering - berekening toelaatbare extra stress

	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Toelaatbare extra stress	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	Pa
Minimum vloeigrens (SMYS)	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	Pa
Intern gasdruk	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	Pa
Leiding diameter	831,6	831,6	831,6	831,6	831,6	831,6	831,6	mm
Wanddikte	35,6	35,6	35,6	35,6	35,6	35,6	35,6	mm

Tabel 10-13: Windturbine Harde Zeewering - berekening kinetische energie

	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Kinetische energie	1,71E+07	3,04E+07	7,85E+05	1,18E+08	1,27E+07	1,18E+08	1,27E+07	J
Massa	1,50E+04	1,50E+04	1,60E+05	1,40E+05	1,50E+04	1,40E+05	1,50E+04	kg
Valversnelling	9,81	9,81	9,81	9,81	9,81	9,81	9,81	m/s2
Hoogte	86	86	76	86	86	86	86	m
Begin snelheid	24,35	48,71						m/s
Fractie (coëfficiënt)	1,00	1,00	1	1	1	1	1	-
Toerental	13,6	27,2						tpm
Lengte	57,2	57,2	76					m
Ligging zwaartepunt	17,1	17,1	38					m
Ligging zwaartepunt / lengte	3,35	3,35						-

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Berekende parameters – Windturbines Zuidwal

Tabel 10-14: Windturbine Zuidwal - berekening penetratiediepte

	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Penetratiediepte	0,82	1,01	0,20	2,06	0,74	2,06	0,74	m
Toelaatbare extra stress	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	Pa
Kinetische energie	6,82E+06	1,15E+07	7,16E+05	6,78E+07	5,26E+06	6,78E+07	5,26E+06	J
Elasticiteit	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	2,07E+11	J
k1 (coëfficiënt)	0,3048	0,3048	0,3048	0,3048	0,3048	0,3048	0,3048	-
k2 (coëfficiënt)	4,44	4,44	4,44	4,44	4,44	4,44	4,44	-
k3 (coëfficiënt)	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	2,03E-04	-
Type bron	puntbron	puntbron	lijnbron	puntbron	puntbron	puntbron	puntbron	-
k4 (coëfficiënt)	1	1	0,43	1	1	1	1	-
k5 (coëfficiënt)	2,5	2,5	1,5	2,5	2,5	2,5	2,5	-
k6 (coëfficiënt)	0,77	0,77	0,77	0,77	0,77	0,77	0,77	-

Tabel 10-15: Windturbine Zuidwal - berekening toelaatbare extra stress

	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Toelaatbare extra stress	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	3,97E+08	Pa
Minimum vloeigrens (SMYS)	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	4,21E+08	Pa
Intern gasdruk	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	2,00E+06	Pa
Leiding diameter	831,6	831,6	831,6	831,6	831,6	831,6	831,6	mm
Wanddikte	35,6	35,6	35,6	35,6	35,6	35,6	35,6	mm

Tabel 10-16: Windturbine Zuidwal - berekening kinetische energie

	Bladbreuk		Mastbreuk			Gondel en rotorafworp		Eenheid
	Nominaal toerental	Overtoeren	Mast	Gondel en rotor	Blad	Gondel en rotor	Blad	
Kinetische energie	6,82E+06	1,15E+07	7,16E+05	6,78E+07	5,26E+06	6,78E+07	5,26E+06	J
Massa	6,70E+03	6,70E+03	1,46E+05	8,64E+04	6,70E+03	8,64E+04	6,70E+03	kg
Valversnelling	9,81	9,81	9,81	9,81	9,81	9,81	9,81	m/s2
Hoogte	80	80	80	80	80	80	80	m
Begin snelheid	21,58	43,16						m/s
Fractie (coëfficiënt)	1,00	1,00	1	1	1	1	1	-
Toerental	18,4	36,8						tpm
Lengte	44	44	80					m
Ligging zwaartepunt	11,2	11,2	40					m
Ligging zwaartepunt / lengte	3,93	3,93						-

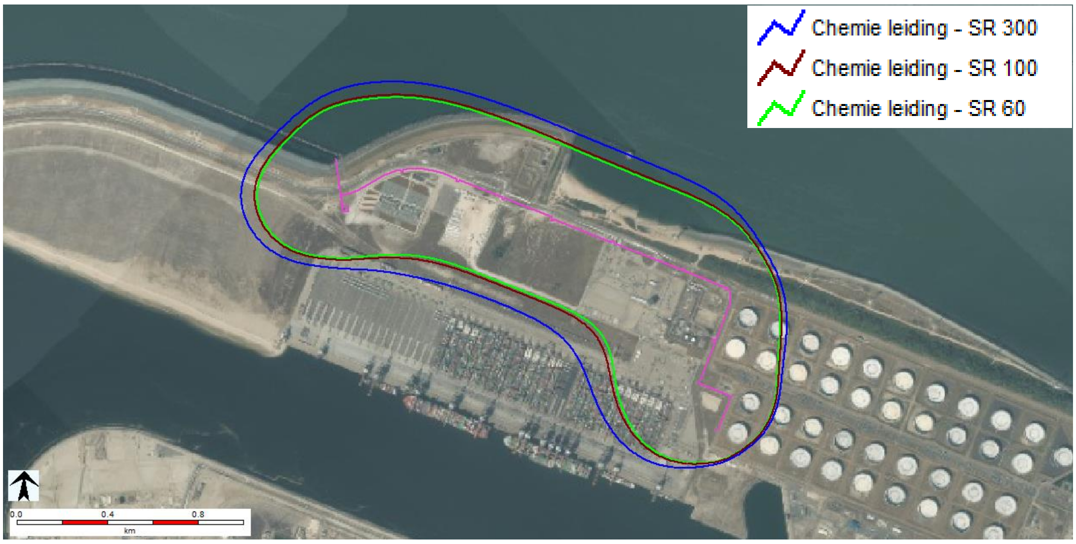
Bijlage

2. Gevoeligheidsanalyse ruwheidslengte

In Safeti-NL is voor de ruwheidslengte de standaard waarde van 300 mm ingesteld. Deze gevoeligheidsanalyse heeft tot doel te evalueren of deze standaardwaarde passend is bij de geometrie van het terrein omliggend aan het zeeleiding tracé. Deze evaluatie werd nodig geacht omdat het omliggende terrein divers van geometrie is: vlakke zee, hoge opslagtanks en (gestapelde containers) bij buurbedrijvenen braakliggend terrein. Onderstaande figuur geeft de plaatsgebonden risicocontouren 10-6 (PR = 10-6/jaar) bij verschillende ruwheidslengtes (in de legenda van onderstaande figuur afgekort met 'SR' = surface roughness). Het doel van deze figuur is de invloed van verschillende waarden van de ruwheidslengte op het risicoprofiel inzichtelijk te maken. De voor deze gevoeligheidsanalyse ingevoerde parameters zijn niet (exact) overeenkomstig de parameters zoals beschreven in hoofdstuk 5 betreffende 'Systeembeschrijving zeeleiding', waardoor de ligging van de PR = 10^{-06} per jaar contouren niet vergeleken kan worden met de plaatsgebonden risicocontouren zoals gepresenteerd in de resultaten in hoofdstukken 7 en 8. Dit vormt echter geen probleem voor deze gevoeligheidsanalyse omdat enkel het onderlinge verschil in ligging, veroorzaakt door het verschil in toegepaste ruwheidslengte, van belang is voor de conclusie van deze gevoeligheidsanalyse.

Voor onderstaande waarden van de ruwheidslengte zijn de PR = 10^{-06} per jaar contouren bepaald. Uit het resultaat blijkt dat binnen dit bereik van ruwheidslengtes de ligging van de contouren niet sterk verschilt.

- 300 mm (basis instelling in Safeti-NL)
- 100 mm (vrijwel vlak, af en toe grote obstakels
- 60 mm (een 'gemiddelde' van de vlakken waar de zeeleiding binnen is gelegen)



Op basis van de gevoeligheidsanalyse is besloten om te modelleren met een ruwheidslengte van 100 mm. Deze keuze is gemaakt om recht te doen aan het vlakke karakter van het gebied ten noorden van de zeeleiding en tegelijkertijd rekening te houden met (mogelijke) ontwikkeling van het terrein ten zuiden van de zeeleiding. Opgemerkt wordt dat het kiezen van een andere ruwheidslengte naar aller waarschijnlijkheid geen significante invloed op het risicoprofiel zou hebben gehad.

Bijlage

3. Risico reducerende voorzieningen

Deze bijlage beschrijft de risico reducerende voorzieningen (verder voorzieningen) die zijn genomen ten aanzien van de buisleiding. De beschreven voorzieningen reduceren de kans van falen van de leiding. Voor mogelijke voorzieningen is aangesloten bij het rekenvoorschrift omgevingsveiligheid – module V buisleidingen [7]. Dit rekenvoorschrift geeft voorzieningen waarvoor een reductie op de faalkans mag worden toegepast en geeft de bijbehorende reductiefactor. Ook zijn voorwaarden geformuleerd waar de voorziening aan moet voldoen om deze van toepassing te mogen beschouwden.

Het vertrekpunt van de analyse om tot de faalkans van de buisleiding te komen is het overzicht van *'Faalfrequentie en faaloorzaken verdeling voor chemicaliënleiding''* zoals opgenomen in het rekenvoorschrift. Op basis van data is per faaloorzaken bepaald wat de faalfrequentie is. De faalfrequentie van de leiding volgt uit de optelsom van de faalfrequentie van alle faaloorzaken. De mogelijke faaloorzaken zijn verdeeld in onderstaande categorieën:

- Beschadiging door derden
- Mechanisch
- Inwendige corrosie
- Uitwendige corrosie
- Natuurlijke oorzaken
- Operationeel

Voor de faaloorzaken 'beschadiging door derden', 'inwendige corrosie' en 'uitwendige corrosie' zijn in het rekenvoorschrift voorzieningen gedefinieerd die direct mogen worden toegepast indien aan de randvoorwaarde van deze voorzieningen wordt voldaan. Voor de overige faaloorzaken zijn voorzieningen gegeven, maar deze mogen pas worden toegepast na overleg met bevoegd gezag.

In de volgende paragraaf wordt de basis faalfrequentie gegeven. Daarna volgt een paragraaf waarin in de risico reducerende voorzieningen die direct mogen worden genomen besproken worden. Op basis van de basis faalfrequentie en de voorzieningen wordt vervolgens het plaatsgebonden risicobepaald. Op basis van het toetsingskader, zoals besproken in paragraaf 3.2, wordt bepaald of een additionele risicoreductie nodig is, en zo ja wat de omvang is.

Basis faalfrequentie

Voor de basis faalfrequentie wordt uitgegaan van een leiding die voldoet aan de stand der techniek (voorwaarden).

Tabel 10-17: Faalfrequentie en faaloorzaak verdeling voor chemicaliënleidingen die voldoen aan 'stand der techniek' *[7]*

Faaloorzaakverdeling voor buisleidingen met chemicaliën die voldoen aan 'stand der techniek'					
Faaloorzaak	Faalfrequentie [per km.jaar]			Aandeel (%)	
	Breuk	Lek	Totaal	Breuk	Lek
Beschadiging door derden	1,77E-05	2,63E-05	1,71E-04	47,9%	21,9%
Mechanisch	7,96E-06	3,86E-05	1,77E-04	21,5%	32,2%
Inwendige corrosie	1,41E-06	1,17E-05	4,97E-05	3,8%	9,8%
Uitwendige corrosie	4,25E-06	3,52E-05	1,49E-04	11,5%	29,3%
Natuurlijke oorzaken	2,26E-06	3,60E-06	2,27E-05	6,1%	3,0%
Operationeel/overig	3,40E-06	4,56E-06	3,09E-05	9,2%	3,8%
Totaal	3,70E-05	1,20E-04	6,00E-04	100%	100%

Toegepaste risico reducerende voorzieningen

In onderstaande tabel is een overzicht opgenomen van faaloorzaken en toegepaste reducerende voorzieningen. Binnen deze faaloorzaak 'Beschadiging door derden' zijn diverse clusters gedefinieerd van mogelijke reducerende voorzieningen; binnen de clusters mag rekenkundig één reducerende voorziening in de modellering worden opgenomen. Wiskundige vergelijkingen om de reductiefactoren te berekenen zijn niet opgenomen in deze rapportage; indien gewenst kan de lezer deze terug vinden in boven genoemd Rekenvoorschrift.

Tabel 10-18: Tabel 20 Overzicht toegepaste voorzieningen en reductiefactor

Faaloorzaak	Cluster	Maatregel	Toegepast	Reductie
Beschadiging door derden	-	Mitigatie door gronddekking	J	1 meter: 1,47 1,5 meter: 4,87 3,5 meter 16,18
	Cluster 1 - Actief rappel	Geen maatregel uit cluster 1 of buisleiding die voldoet aan stand-der-techniek-voorwaarden	J	1
		Actief rappel.	J	-
	Cluster 2 - Afdekking met beschermend materiaal	Waarschuwingslint	J	1,67
		Beschermplaten	-	-
		Waarschuwingslint + Beschermplaten	-	-
	Cluster 3 - Beheermaatregelen	Vergaande restricties	-	-
		Grave/boren verboden	-	-
		Beperkte restricties	J	1,6
	Cluster 4 - Fysieke barriéres op maaiveld	Hekwerk	-	-
		Dijklichaam	-	-
		Barriére op het maaiveld	-	-
	Cluster 5 - overige maatregelen	Strikte begeleiding werkzaamheden (cluster 1 - geen maatregel)	-	-

		Camera toezicht (cluster 1 - geen maatregel)	-	-
		Strikte begeleiding werkzaamheden (cluster 1 - actief rappel)	J	2,5
		Camera toezicht (cluster 1 - actief rappel)		-
	Cluster 6 - Extra gronddekking 1)	Aantal meters extra gronddekking	-	-
	Cluster 7	Wanddikte exclusief corrosietoeslag is minimaal 15 mm	J	10
	Mechanisch falen	Het verlagen van de maximaal toegestane operatie druk tot een niveau waarbij de operational stress beneden 30% SMYS (Specified Minimum Yield Stress) komt	-	-
		Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie	J	10
	Inwendige corrosie	Het te transporteren medium is inherent aantoonbaar volledig niet-corrosief ten opzichte van het materiaal van de buisleiding (en vice versa)	-	-
		Het te transporteren medium is afdoende niet corrosief gemaakt ten opzichte van het materiaal van de buisleiding, maar voorzorgsmaatregelen en bewaking/ beveiligingen zijn noodzakelijk. Deze kunnen mogelijkerwijs falen	-	-
		Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie	J	10
	Uitwendige corrosie	Het buismateriaal is inherent volledig niet-corrosief ten opzichte van de omgeving	-	-
		Uitvoeren van een passende high-resolution metal loss In-Line Inspectie (ILI) gecombineerd met gedegen defectanalyse en indien benodigd reparatie	J	10
	Natuurlijke oorzaken	Ontoelaatbare zettingen c.q. spanningen kunnen door middel van een evaluatie redelijkerwijs vergaand worden uitgesloten	J	10
		Natuurlijke oorzaken kunnen worden uitgesloten	-	-
	Operationeel/overig	Toegepaste SIL = Berekende SIL +1	-	-
		Toegepaste SIL = Berekende SIL +2	J	100

1. Verdisconteerd in eerste rij ‘mitigatie door gronddekking’

Toegepaste faalfrequentie met implementatie van risico reducerende voorzieningen

Tabel 10-19: Toegepaste faalfrequentie na implementatie reductiefactoren

Faaloorzaak verdeling voor buisleidingen met chemicaliën.		
Faaloorzaak	Faalfrequentie [per km.jaar]	
	Breuk	Lek
Beschadiging door derden – leidingsegment met 1 meter gronddekking	1,80E-07	2,68E-07
Beschadiging door derden – leidingsegment met 1,5 meter gronddekking	5,44E-08	8,08E-08
Beschadiging door derden – leidingsegment met 3,5 meter gronddekking	1,64E-08	2,43E-08
Mechanisch	7,96E-07	3,86E-06
Inwendige corrosie	1,41E-07	1,17E-06
Uitwendige corrosie	4,25E-07	3,52E-06
Natuurlijke oorzaken	2,26E-07	3,60E-07
Operationeel/overig	3,40E-08	4,56E-08
Windturbine – enkel direct pipe tracé en over segment zoals beschreven in bijlage 2	7,18E-04	-

Toelichting

Voor de leiding wordt een veiligheidsbeheersysteem (VBS) opgesteld in overeenstemming met NEN3655. Het VBS heeft als doelstelling om veilig en betrouwbaar transport te bewerkstelligen en om incidenten te voorkomen, alsmede om aan de vingerende wet- en regelgeving te voldoen.

Als onderdeel van het VBS wordt gedefinieerd welke activiteiten worden uitgevoerd om de integriteit van de leiding te beheersen.

Belangrijke operationele parameters zoals druk, temperatuur en doorzet zullen continue worden gemonitord.

De ligging van de leiding zal bepaald worden door middel van visuele (camera) inspectie of sonar survey langs het leidingtracé, waaruit, door vergelijking met de gegevens die vooraf en tijdens de installatie zijn verkregen, kan worden afgeleid hoe de leiding en de bodem zich gedragen.

Ter preventie van interne corrosie zal de kwaliteit van het medium, en specifiek de aanwezigheid van onzuiverheden die tot corrosie kunnen leiden, worden gemonitord bij de emittanten en nogmaals bij het compressor station en de terminal. Tevens bestaat de mogelijkheid om een monster van het medium te nemen voor kwaliteitsanalyse in een laboratorium.

Om externe corrosie te vermijden zal de leiding volledig worden beschermd door een coating. Tevens wordt kathodische bescherming geïnstalleerd op zowel het land- als zeedeel van de leiding om corrosie bij beschadigingen aan de coating te voorkomen. De status van de coating en goede werking van het kathodische beschermingssysteem zal worden gemonitord door middel van controlemetingen zowel op het land- als zeedeel van de leiding.

Voor het landdeel van de leiding zal bij notificatie van werkzaamheden via KLIC (Kabel en Leidingen Informatie Centrum), afstemming en strikte begeleiding van grondroerende werkzaamheden in de nabijheid van de Aramis leiding plaatsvinden.

De conditie van het overdruk beveiligingssysteem zal regelmatig worden gecontroleerd en de juiste werking zal periodiek worden vastgesteld met behulp van een functionele test (als onder deel van de SIL classificatie).

Om te verifiëren of de maatregelen voor de integriteit van de leiding effectief zijn zal periodiek een in-line inspectie worden uitgevoerd. Deze inspectie wordt uitgevoerd door een intelligent pig (sonde) door de buis te leiden om de wanddikte en mogelijke defecten (als gevolg van corrosie of mechanische schade) te meten. De inspectie zal worden uitgevoerd in overeenstemming met de randvoorwaarden 'In-line inspectie (ILI)' als omschreven in de Handleiding Risicoberekeningen Toelichting en op basis van gangbare standaarden in de industrie, zoals de POF100 "specifications and requirements for in-line inspection of pipelines" door de Pipeline Operators Forum. Meerdere technologieën zijn beschikbaar om koolstofstalen leidingen in CO2 service te inspecteren. Het Aramis project is een programma gestart om de optimale ILI technologie te selecteren voor de transportleiding, met als minimale specificatie de eerdergenoemde eisen per Handleiding Risicoberekeningen.

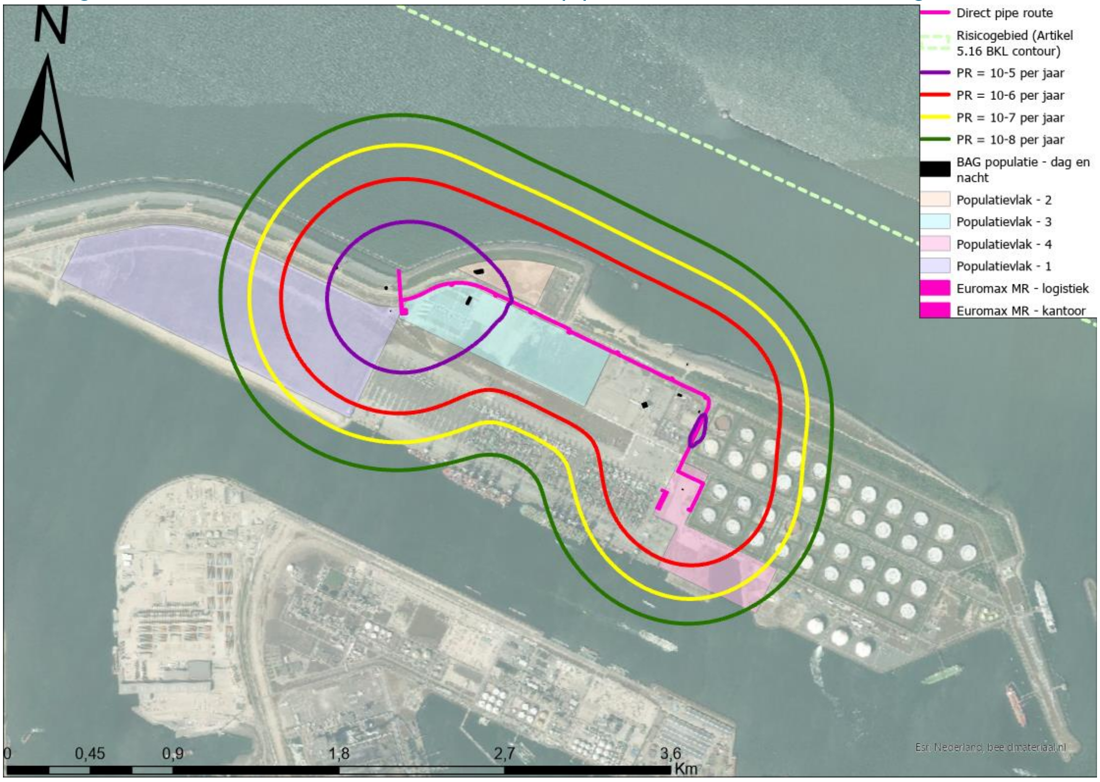
Indien defecten worden geïdentificeerd zullen deze worden beoordeeld in een risicoanalyse met een 'fit-for-purpose' (bedrijfsgeschiktheids) demonstratie per NEN3650. Indien nodig zal het defect worden gerepareerd.

De eerste ILI zal binnen enkele jaren na opstarten worden uitgevoerd als baseline. Voor het bepalen van de inspectie interval zal een RBI-aanpak (Risk Based Inspection) toegepast worden waarbij monitorings informatie gebruikt wordt om mogelijke faaloorzaken te analyseren en gekoppeld aan de consequenties een inspectieregime wordt bepaald. Monitorings informatie bevat onder andere de historische druk, temperatuur en doorzet in de buisleiding, alsmede kwaliteitsmetingen aan het medium, controle metingen op het kathodische bescherming systeem en visuele/sonar inspectie resultaten m.b.t. de ligging van de leiding. Ook de resultaten van in-line inspecties worden meegenomen in het RBI proces. De maximale ILI interval bedraagt 10 jaar.

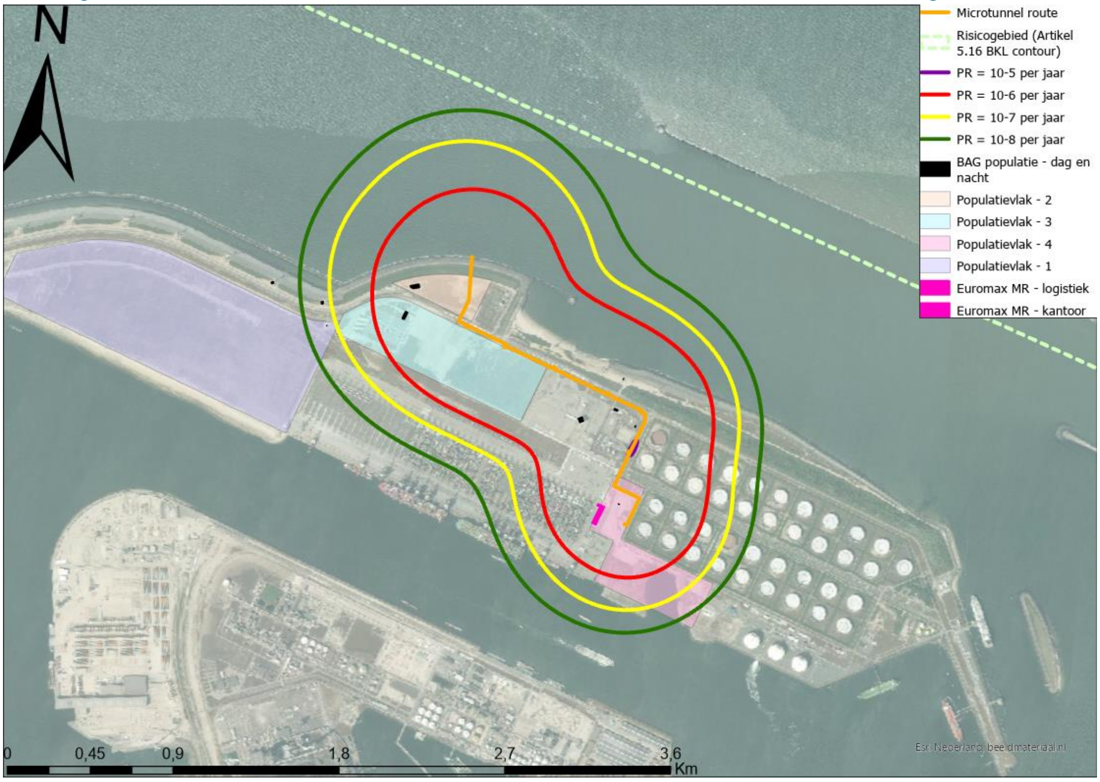
Appendix

4. Plaatsgebonden risico contouren - standaard risicoreducerende maatregelen

Plaatsgebonden risicocontouren voor de direct pipe route met 'standaard mitigerende maatregelen'



Plaatsgebonden risicocontouren voor de microtunnel route met 'standaard mitigerende maatregelen'



Bijlage

5. Uitwerking uitstromingscenario's

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Uitwerking uitstroming scenario's
In Tabel 10-20 zijn gegevens zoals ingevoerd om het leidingsysteem te modelleren opgenomen. In Tabel 10-21 zijn de gegevens voor de faalscenario's opgenomen

De exportklep van het compressorstation en de beach valve hebben beide een ESD functie. Ingeval van een breuk zullen deze kleppen binnen 120 seconden gesloten zijn (= tijdsbestek van detectie, initiatie, en uitvoering).

Tabel 10-20: Leiding gegevens faalscenario

Parameter	Waarde	Eenheid	Toelichting
Modelstof	Koolstofdioxide	[-]	Modelstof standaard aanwezig in Safeti-NL
Rekenmodel	Long pipeline	[-]	
Druk	200	bar	
Temperatuur	9,8	graden Celsius	Standaard te gebruiken instelling Safeti-NL volgens rekenvoorschrift voor buisleidingen
Ruwheidslengte buisleiding	45	µm	Standaard te gebruiken instelling Safeti-NL volgens rekenvoorschrift voor buisleidingen
Diepte ligging	Zie paragraaf 6.6 met betrekking tot 'Gronddekking'	meter	expansielussen en in- en uittrede punten leidingstraat zijn met een meter gronddekking gemodelleerd.
Grondsoort bedekking	Zandgrond	[-]	Grondsoort standaard aanwezig in Safeti-NL
Lengte zeeleiding (terugstroming)	> 150	km	

Tabel 10-21: Safeti-NL model gegevens

Parameter	Waarde	Eenheid	Toelichting
Uitstroommodel	Kratermodel	[-]	
Uitstroom richting	Verticaal	[-]	
Model hoogte	0,01	m	Standaard te gebruiken instelling Safeti-NL volgens rekenvoorschrift voor buisleidingen
Toevoerdebiet vanuit compressor station (pumped-in flow)	700	kg/s	Risicoprofiel zeeleiding gebaseerd op maximale doorzet
Diameter breuk	Full bore	[-]	Ingevoerd als 'relative aperture = 1'
Diameter lek	20	mm	Vaste waarde volgens rekenvoorschrift voor buisleidingen

Appendix

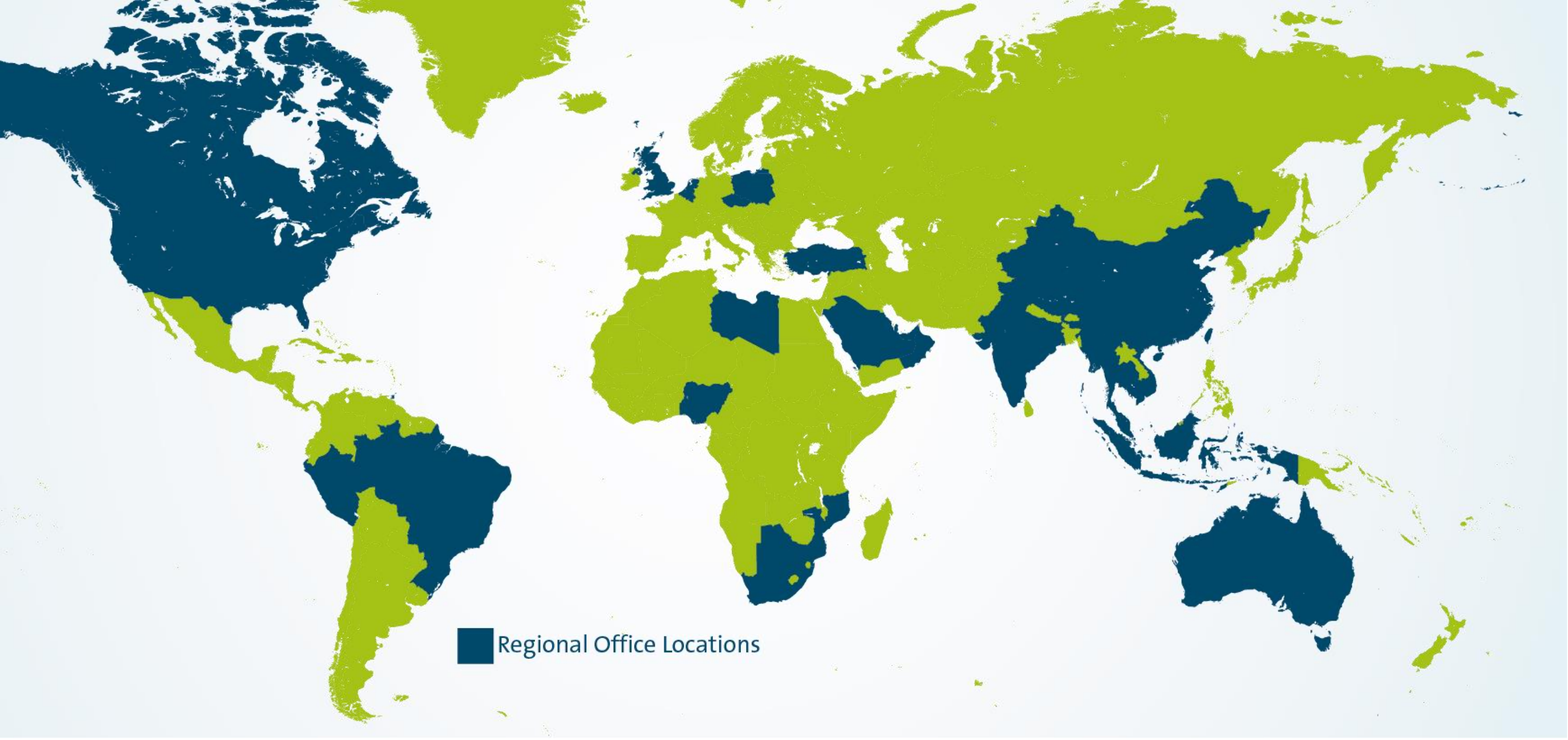
6. SMEZ rapport

Separate bijlage

Appendix

7. Memo met onderwerp: CCS Aramis – Ondergrond’

Separate bijlage



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Equipment Item	Equipment Item Type	Scenario Name	Scenario Type	Path To Root	Substance	Inventory [kg]	Location X [m]	Location Y [m]	Event frequency [/AvgeYear]	Hole Size / Pipe Diameter [m]	Weather	Discharge mass [kg]	Discharge rate [kg/s]	Release duration [s]	Largest Distance to 1% lethality [m]	Largest Distance to VRW [m]	Largest Distance to AGW [m]	Largest Distance to LBW [m]	Probability of direct ignition [fraction]	Largest distance to LFL [m]	Largest Distance 1% lethality [m]	Correponding event (1% lethality)	Largest distance to 35 kW/m2 [m]	Largest distance to 10 kW/m2 [m]	Largest distance to 3 kW/m2 [m]	Largest Distance to 0.3 bar [m]	Largest Distance to 0.1 bar [m]
Trunkline - Windturbine bijdrage	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	B 3		33102,63	58,46738406	827,8382919												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 1.5		33102,63	58,46738406	1018,424021												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 5		33102,63	58,46738406	806,7507861												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 9		33102,63	58,46738406	435,9933306												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	7,27561E-09	1,0685798	B 3		33102,63	87,04525227	955,7151732												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	7,27561E-09	1,0685798	D 1.5		33102,63	87,04525227	1238,422797												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	7,27561E-09	1,0685798	D 5		33102,63	87,04525227	932,5176186												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	7,27561E-09	1,0685798	D 9		33102,63	87,04525227	460,5568505												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	5,89325E-07	1,0685798	B 3		33102,63	13,8383363	629,8151716												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	5,89325E-07	1,0685798	D 1.5		33102,63	13,8383363	742,3832718												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	5,89325E-07	1,0685798	D 5		33102,63	13,8383363	602,2688388												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	5,89325E-07	1,0685798	D 9		33102,63	13,8383363	513,4075395												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	B 3		33102,63	35,46552669	746,5299381												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 1.5		33102,63	35,46552669	893,5733439												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 5		33102,63	35,46552669	697,9631643												
Trunkline - Windturbine bijdrage	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\Windturbine\Trunkline - Windturbine bijdrage\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61358,793	444853	6,54805E-08	1,0685798	D 9		33102,63	35,46552669	473,5718304												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45666E-09	1,0685798	B 3		33102,63	4,791979394	631,7620087												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45666E-09	1,0685798	D 1.5		33102,63	4,791979394	681,0396041												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45666E-09	1,0685798	D 5		33102,63	4,791979394	621,8222113												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45666E-09	1,0685798	D 9		33102,63	4,791979394	538,2311759												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	B 3		33102,63	14,11671618	684,0451246												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 1.5		33102,63	14,11671618	763,1961023												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 5		33102,63	14,11671618	643,9374967												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 9		33102,63	14,11671618	531,8519031												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,21154E-09	0,02	B 3		35,63924	180	0,612010111												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,21154E-09	0,02	D 1.5		35,63924	180	0,680563874												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,21154E-09	0,02	D 5		35,63924	180	0,608762803												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,21154E-09	0,02	D 9		35,63924	180	0,585417678												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,79835E-11	1,0685798	B 3		33102,63	58,00442309	912,7162172												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,79835E-11	1,0685798	D 1.5		33102,63	58,00442309	1120,021241												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,79835E-11	1,0685798	D 5		33102,63	58,00442309	842,1333859												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,79835E-11	1,0685798	D 9		33102,63	58,00442309	478,2087884												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	B 3		33102,63	32,34965335	754,162309												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 1.5		33102,63	32,34965335	950,7619763												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 5		33102,63	32,34965335	700,1514887												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,61851E-10	1,0685798	D 9		33102,63	32,34965335	478,0068432												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,47512E-09	1,0685798	B 3		33102,63	31,99612735	832,7293086												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,47512E-09	1,0685798	D 1.5		33102,63	31,99612735	1019,247689												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,47512E-09	1,0685798	D 5		33102,63	31,99612735	780,7049107												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,47512E-09	1,0685798	D 9		33102,63	31,99612735	674,9906212												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	8,97468E-09	0,02	B 3		35,65768	180	0,611901357												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	8,97468E-09	0,02	D 1.5		35,65768	180	0,680200994												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	8,97468E-09	0,02	D 5		35,65768	180	0,608672731												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	8,97468E-09	0,02	D 9		35,65768	180	0,585338195												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,63903E-10	1,0685798	B 3		33102,63	44,54251839	928,199653												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,63903E-10	1,0685798	D 1.5		33102,63	44,54251839	1126,549001												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,63903E-10	1,0685798	D 5		33102,63	44,54251839	858,6286588												
Trunkline - Segment 2 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	Microtunnel route\200 barg - Mogelijke RR - SIL 2\Wel ESD\Trunkline - Segment 2 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62010,83	444970	1,63903E-10	1,0685798	D 9		33102,63	44,54251839	684,207471												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,80041E-11	1,0685798	B 3		33102,63	47,60284399	869,6638833												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,80041E-11	1,0685798	D 1.5		33102,63	47,60284399	1109,859805												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,80041E-11	1,0685798	D 5		33102,63	47,60284399	806,9215772												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,80041E-11	1,0685798	D 9		33102,63	47,60284399	489,9290173												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	B 3		33102,63	15,25659168	683,0570428												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 1.5		33102,63	15,25659168	780,6838318												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 5		33102,63	15,25659168	641,6529022												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 9		33102,63	15,25659168	523,722035												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	B 3		33102,63	29,87437881	805,5383621												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 1.5		33102,63	29,87437881	992,3923628												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 5		33102,63	29,87437881	774,4919246												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,62037E-10	1,0685798	D 9		33102,63	29,87437881	642,8147893												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45833E-09	1,0685798	B 3		33102,63	5,637040815	644,3896331												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45833E-09	1,0685798	D 1.5		33102,63	5,637040815	697,4305612												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45833E-09	1,0685798	D 5		33102,63	5,637040815	630,8404253												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	1,45833E-09	1,0685798	D 9		33102,63	5,637040815	555,8553767												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,22208E-09	0,02	B 3		35,63346	180	0,612044055												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,22208E-09	0,02	D 1.5		35,63346	180	0,680666496												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,22208E-09	0,02	D 5		35,63346	180	0,608791007												
Trunkline - Segment 1 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		62938,695	443812	9,22208E-09	0,02	D 9		35,63346	180	0,585442618												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	B 3		33102,63	32,61070986	855,4516623												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 1.5		33102,63	32,61070986	1086,780712												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 5		33102,63	32,61070986	821,4092334												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 3_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 3_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 9		33102,63	32,61070986	747,6066058												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,67912E-11	1,0685798	B 3		33102,63	45,71120839	921,0102899												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,67912E-11	1,0685798	D 1.5		33102,63	45,71120839	1122,160455												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,67912E-11	1,0685798	D 5		33102,63	45,71120839	853,6840579												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,67912E-11	1,0685798	D 9		33102,63	45,71120839	664,7325865												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,36009E-09	1,0685798	B 3		33102,63	6,267606966	786,8785437												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,36009E-09	1,0685798	D 1.5		33102,63	6,267606966	914,2688284												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,36009E-09	1,0685798	D 5		33102,63	6,267606966	738,8692459												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,36009E-09	1,0685798	D 9		33102,63	6,267606966	778,5284254												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	9,03528E-09	0,02	B 3		35,65868	180	0,611895611												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	9,03528E-09	0,02	D 1.5		35,65868	180	0,680180318												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	9,03528E-09	0,02	D 5		35,65868	180	0,608667899												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	9,03528E-09	0,02	D 9		35,65868	180	0,585333886												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	B 3		33102,63	16,26776734	753,6556396												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 1.5		33102,63	16,26776734	780,016427												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 5		33102,63	16,26776734	739,4368966												
Trunkline - Segment 1,5 meter gronddekking	Long pipeline	RDS 4_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 1,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 4_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61304,27	444836	1,51121E-10	1,0685798	D 9		33102,63	16,26776734	748,583337												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,47636E-09	1,0685798	B 3		33102,63	31,88503481	853,3547701												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,47636E-09	1,0685798	D 1.5		33102,63	31,88503481	1061,70911												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,47636E-09	1,0685798	D 5		33102,63	31,88503481	813,1990634												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 2_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 2_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,47636E-09	1,0685798	D 9		33102,63	31,88503481	746,9624137												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,6404E-10	1,0685798	B 3		33102,63	45,83381415	920,2594528												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,6404E-10	1,0685798	D 1.5		33102,63	45,83381415	1122,088698												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,6404E-10	1,0685798	D 5		33102,63	45,83381415	853,1649113												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Breuk	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Breuk\Hoek van Holland, dag Dag\RDS 1_Breuk	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	1,6404E-10	1,0685798	D 9		33102,63	45,83381415	662,31976												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	8,9822E-09	0,02	B 3		35,65769	180	0,61190131												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	8,9822E-09	0,02	D 1.5		35,65769	180	0,680200828												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	8,9822E-09	0,02	D 5		35,65769	180	0,608672688												
Trunkline - Segment 3,5 meter gronddekking	Long pipeline	RDS 1_Lek	Rationalised Discharge Scenario	DPI route\200 barg - Mogelijke RR - SIL2\Wel ESD\Trunkline - Segment 3,5 meter gronddekking\Auto-generated sections\Lek\Hoek van Holland, dag Dag\RDS 1_Lek	CARBON DIOXIDE (HSE_RR749 PROBITS)		61310,996	444765	8,9822E-09	0,02	D 9		35,65769	180	0,585338155												

Notitie / Memo

HaskoningDHV Nederland B.V.
Mobility & Infrastructure

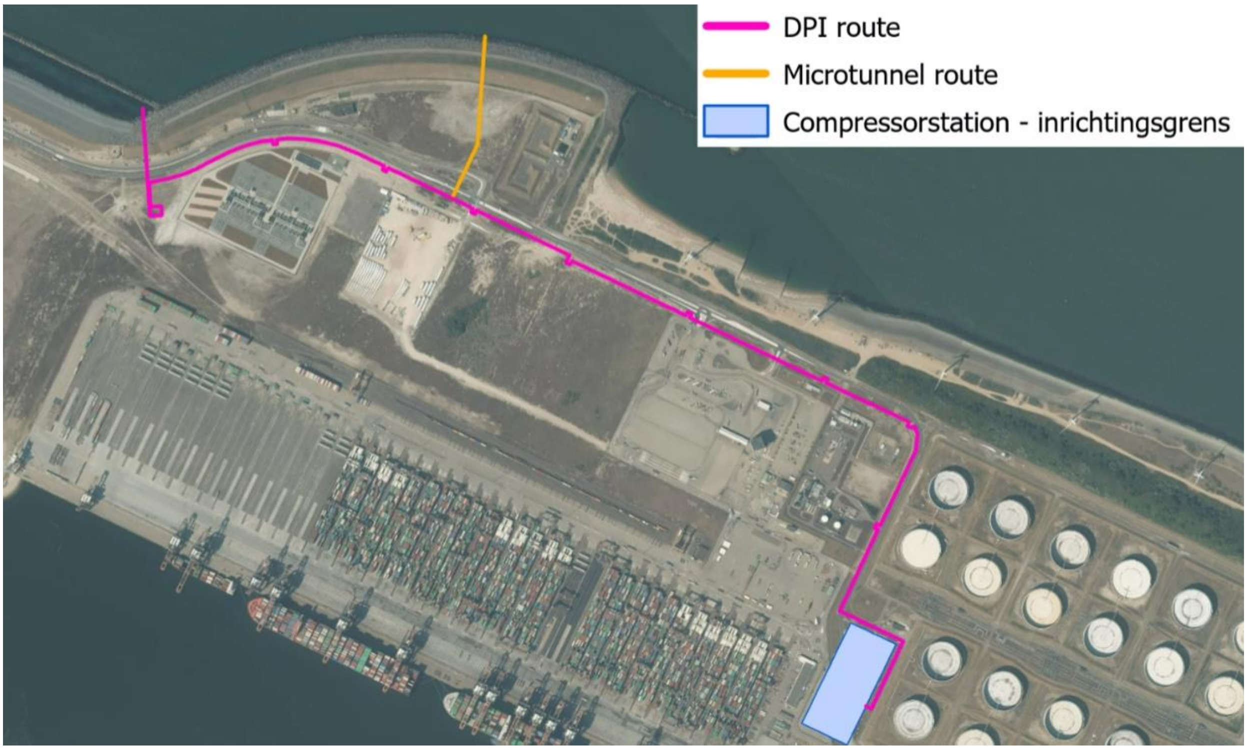
Aan:	Aramis Project Team
Van:	Tom Hijnekamp
Datum:	02 februari 2024
Kopie:	Paul Mink
Ons kenmerk:	BH8744-MI-ME-240125-0924
Classificatie:	Projectgerelateerd
Gecontroleerd door	Gilles Colard

Onderwerp: **CCS Aramis - Ondergrond**

1 Inleiding

In de Aramis pijpleiding QRA is voorgesteld om een reductiefactor 10 op de faaloorzaak natuurlijke oorzaken toe te passen. Voor het toepassen van deze reductiefactor is het nodig om aan te tonen dat de ondergrond stabiel is.In deze memo wordt de ondergrond van de trunkline van CCS Aramis beschouwd. Hiertoe is eerst de randvoorwaarde voor toepassing van de reductiefactor weergegeven, gevolgd door de uitgangspunten van de leiding en de grondopbouw. Met als laatste welke factor toegepast kan worden op basis van deze gegevens.

In onderstaande figuur is de locatie van de beschouwde leiding weergegeven. Inmiddels is bekend dat de microtunnel route (met geel aangegeven) het voorkeurstraject is en de DPI route (met roze aangegeven) links van de microtunnel route is daarom ook niet verder meegenomen in deze memo.



Figuur 1.1 Ligging van de Aramis leiding.

2 Referenties

[1] Rekenvoorschrift omgevingsveiligheid, Rijksinstituut voor Volksgezondheid en Milieu, versie maart 2022.

[2] Dinoloket.nl, portal met publiek beschikbare gegevens van de ondergrond, datum van raadpleging 25-01-2024.

[3] NEN-EN 9997-1+C1, ‘Geotechnisch ontwerp van constructies – Deel 1: Algemene regels’, d.d. november 2017

[4] Luchtfototijdreis.nl, website met luchtfoto’s vanaf 2006. Datum van raadpleging 25-01-2024.

3 Randvoorwaarden ‘natuurlijke oorzaken’

In Figuur 3.1 is de randvoorwaarden voor toepassing van de reductiefactor voor natuurlijke oorzaken weergegeven uit het rekenvoorschrift [1].

Randvoorwaarden ‘natuurlijke oorzaken’

Ontoelaatbare zettingen/spanningen kunnen vergaand worden uitgesloten
Ontoelaatbare zettingen c.q. spanningen kunnen door middel van een evaluatie redelijkerwijs vergaand worden uitgesloten:

- Door nagaan van de bodemgesteldheid, met inventarisatie van kritische gebieden (b.v. mijnbouw, kunstwerken, veengebieden),
- Bij kritische gebieden een beheerste situatie te creëren, bijvoorbeeld meten/berekeningen van spanningen, meten met zet-/zakbakens, uitvoeren met rekstrookjes, onderheien, overdimensionering constructief ontwerp, ontbreken van koppelingen en overige appendages, spanningsvrije ligging.

Rapportage van de evaluatie dient binnen 1 jaar na het claimen van de reductiefactor beschikbaar te zijn.

Natuurlijke oorzaken kunnen worden uitgesloten
Natuurlijke oorzaken kunnen worden uitgesloten wanneer een onderbouwende rapportage het bewijs levert van een dichte en stabiele ondergrond (bijvoorbeeld zandgronden).

- Door nagaan van de bodemgesteldheid op basis waarvan kritische gebieden kunnen worden uitgesloten (b.v. stabiele klei, zand),
- Ontoelaatbare zettingen c.q. spanningen zijn aantoonbaar uitgesloten (b.v. op basis van langjarige casuïstiek).

Figuur 3.1 Uitsnede van het Rekenvoorschrift omgevingsveiligheid [1].

4 Leiding

Hieronder zijn de ligging van de leiding en de belangrijkste eigenschappen met invloed op de zetting weergegeven.

4.1 Ligging

Vanaf het compressor station in het zuiden tot aan de verbinding naar de microtunnel in Figuur 1.1 ligt de leiding in een leidingstrook. Hierin wordt de leiding door middel van openontgraving aangelegd waarna de sleuf weer wordt aangevuld met de ontgraven grond en wordt het maaiveld hersteld.

De dekking hier betreft voor het merendeel 1.0 m met uitzondering van kruisingen en mogelijke expansielussen waarbij de maximale dekking op 2.7 m uitkomt. De verbinding naar de microtunnel (oranje deel) ligt buiten de leidingstrook en de dekking hier verloopt van 2 tot 1.5 m.

De kruisingen zijn zichtbaar als verdikking of lus in de DPI route in Figuur 1.1.

4.2 Afmeting en gewicht

Stalen leiding:

- Binnendiameter 756 mm.
- Buitendiameter 832 mm.
- PE, 3 mm coating en mantelbuis met buitendiameter 1000 mm en wanddikte 11 mm.
- Isolatiemateriaal (PUR), tussen de coating en de mantelbuis.

Volumieke gewichten:

- Staal 7800 kg/m^3 of 76.5 kN/m^3.
- Volumiek gewicht van het medium is temperatuursafhankelijk, volumiek gewicht is;
  - Minimaal 450.9 kg/m^3 of 4.45 kN/m^3 (bij 0 °C).
  - Maximaal 1070.4 kg/m^3 of 10.5 kN/m^3 (bij 65 °C).
- PE-HD, 0.963 g/cm^3 of 9.4 kN/m^3.
- PUR, 180 kg/m^3 of 1.76 kN/m^3.

Wanneer de gewichten en afmetingen van de leiding gecombineerd worden komt er een gemiddeld volumiek gewicht uit van tussen de 12.8 en 16.2 kN/m^3, afhankelijk van de temperatuur.

5 Grondopbouw en geschiedenis

Met betrekking tot zetting zijn voornamelijk de bovenste meters onder maaiveld relevant. In dit geval is er vanwege de ligging op de Maasvlakte in de opgespoten bovenste meters alleen zand te verwachten, dit is nagegaan door de sonderingen en boringen in het Dinoloket [2] in de directe omgeving na te gaan. Onder dit pakket kunnen kleilagen voorkomen als zijn die (inmiddels) wel gering in dikte en is dus niet de verwachting dat deze tot zetting zullen leiden. In het opgespoten pakket zijn wel relatief los gepakte (zand)lagen zichtbaar, het voorkomen hiervan is dus niet uit te sluiten.

Met betrekking tot de zetting is dit echter nog steeds een zeer gunstige grondslag. Enerzijds omdat zandgronden niet erg zettingsgevoelig zijn en anderzijds omdat eventuele zetting in zand relatief snel optreedt waardoor de zetting ten gevolge van werkzaamheden in het verleden ook vrijwel uitgesloten kan worden.

In tabel 2.b van de NEN9997 [3] worden conservatieve waarde gegeven voor de volumieke gewichten van grond. Voor zand geldt:

- 17 en 19 kN/m^3 voor los gepakt droog en nat zand
- 18 en 20 kN/m^3 voor matig gepakt droog en nat zand

5.1 Recente geschiedenis

Op basis van luchtfoto's vanaf 2006 [4] is te zien dat vanaf 2013 de weg waarnaast de leiding komt te liggen aanwezig is. De mogelijke zetting ten gevolge van deze aanleg is naar verwachting allemaal opgetreden.

Nabij de aansluiting op de microtunnel is echter wel iets gebeurd na de aanleg van de weg, vanaf 2021 is hier zand zichtbaar op de luchtfoto's, dit lijkt echter op egaliseren van het maaiveld en niet zozeer ophogen. Deze werkzaamheden zullen ten tijde van de aanleg van de leiding geen of nog slechts zeer geringe zetting als gevolg hebben.

6 Beschouwing

Op basis van de aangetroffen zandige grondslag zijn er geen zettingen ten gevolge van de aanleg van de Maasvlakte of eerdere werkzaamheden langs het tracé, niet direct gerelateerd aan de aanleg van deze leiding meer te verwachten. Enige zetting vanuit lagen onder het zandpakket (achtergrondzetting) is niet uit te sluiten maar zal naar verwachting relatief gering zijn en optreden in het hele gebied en dus niet tot significante verschilzetting over de leiding leiden.

Hierbij komt dat de leiding als geheel genomen onder het volumieke gewicht van los gepakt zand uitkomt. De belasting onder de leiding is dus hoger voordat de leiding aangebracht is. Wanneer de leiding zorgvuldig aangebracht wordt, met verdichting van de werkvloer (0.3 m direct onder de leiding) ter voorkoming van zakking direct na aanleg is het aannemelijk dat geen significante zetting zal optreden.

Hiermee zijn dus zowel ontoelaatbare zettingen/spanningen en natuurlijke oorzaken redelijkerwijs vergaand uitgesloten en kan reductiefactor 10 worden toegepast.

Rijksdienst voor het Cultureel Erfgoed
Ministerie van Onderwijs, Cultuur en Wetenschap

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Onze referentie

Aantal Bijlagen
-

Datum 21 augustus 2023
Betreft 22A030-01 Geofysisch conceptrapport Aramis

Geachte mevrouw Van Munster,

Hierbij deel ik mede dat de Rijksdienst voor het Cultureel Erfgoed (RCE) het conceptrapport Aramis geofysisch van d.d. 03-08-2023 met referentienummer 22A030-01 goedkeurt.

Dit advies is verzorgd door:

- L. Derksen MA, KNA archeoloog specialisme waterbodems

Mochten er naar aanleiding van dit advies nog vragen zijn, neem dan gerust contact op via de contactgegevens aan de rechterzijde.

Met vriendelijke groet,

Leon Derksen
Adviseur Archeologie voor waterbodems
Rijksdienst voor het Cultureel Erfgoed

Samenvatting (Abstract in Dutch)

In opdracht van TotalEnergies Nederland B.V. heeft Periplus Archeomare een archeologische analyse uitgevoerd van de geofysische onderzoeksresultaten van het Aramis pijpleidingtracé.

Een grote hoeveelheid onderzoeksgegevens (*sidescan-sonar, magnetometer, multibeam echosounder* en *subbottom-profiler*) van een gebied met een totale oppervlakte van 243 km2 is geanalyseerd om een archeologische beoordeling uit te voeren.

Deze analyse van geofysische onderzoeksresultaten is de tweede stap in de AMZ-cyclus, na de bureaustudie. Het doel van deze analyse is het toetsen van de op de bureaustudie gebaseerde verwachting voor archeologische resten in het gebied. De verwachting omvat overblijfselen van scheepvaartgerelateerde resten (wrakken), vliegtuigen uit de Tweede Wereldoorlog en prehistorische nederzettingen.

Sidescan-sonar en multibeam-contacten
Binnen het onderzochte gebied is aan in totaal acht contacten een archeologische verwachting toegekend. In overeenstemming met de Nederlandse wet- en regelgeving mogen hier geen bodemverstoringen plaatsvinden. Indien er binnen een straal van 100 meter van een potentiële archeologische locatie activiteiten plaatsvinden, wordt in overleg met de Rijksdienst voor het Cultureel Erfgoed (RCE) van geval tot geval bekeken of de 100 meter gehandhaafd moet blijven.

Feature	NCN	Easting	Northing	Route section	Distance
BK_FSEA_SSS_0022	-	551288	5924521	D	**+50**
BK_FSEA_SSS_0179	-	555839	5929168	D	-240
BJ_FD_SSS_0015	-	548443	5894128	F	+230
BB_FS_SSS_0683	219	570384	5762003	East	-540
BH_FSEA_SSS_0104	531	559172	5935317	C	**+25**
BK_FSEA_SSS_0163	967	550165	5921956	D	**-56**
BN_FD_SSS_0025	945	576689	5920367	E Neptune	+220
BB_FS_SSS_0433	-	570711	5761481	East	-210

Tabel 1. Side scan sonar contacten met een archeologische verwachting.

Drie van de acht contacten vallen binnen 100 meters van de geplande route.

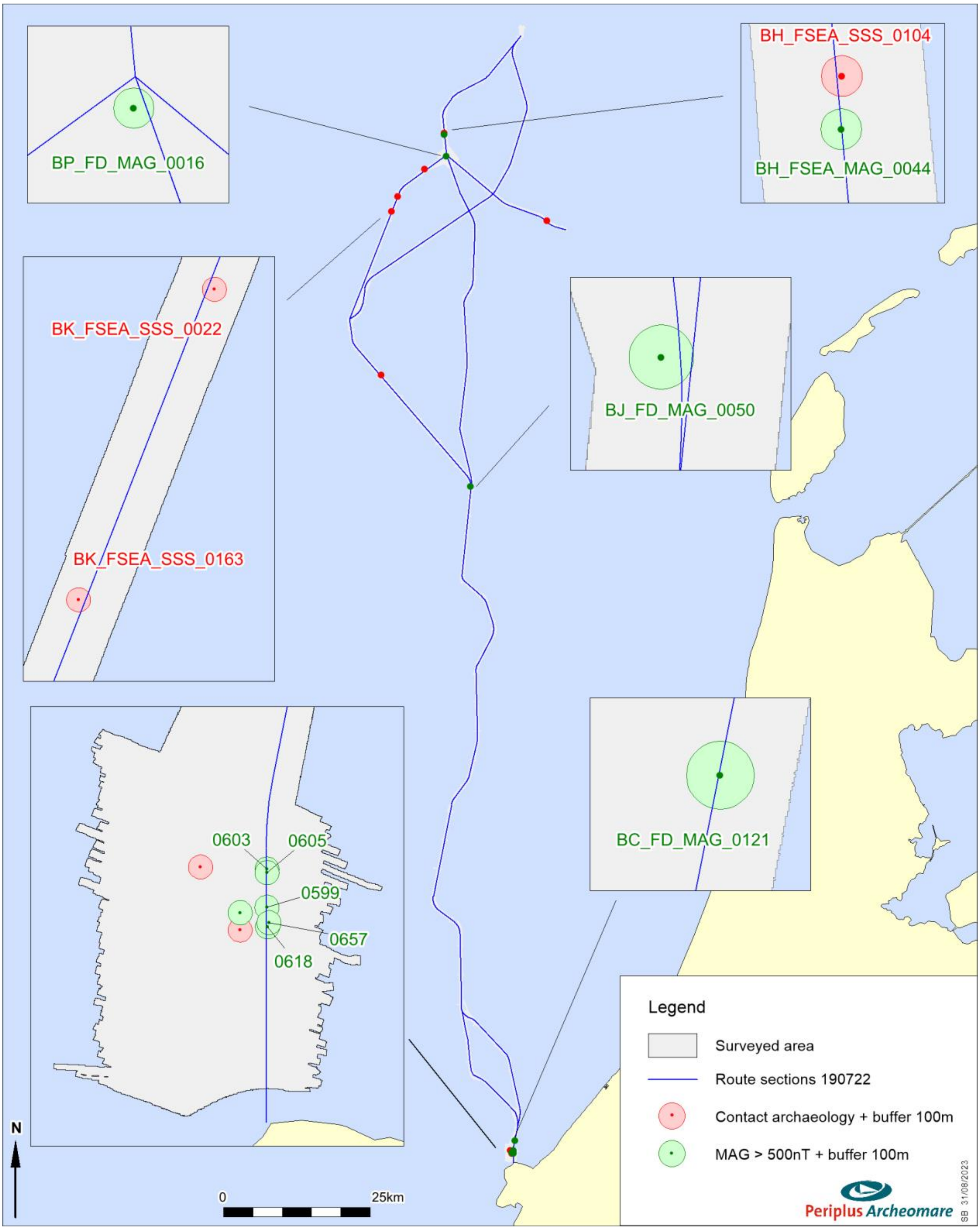
Magnetische afwijkingen

In totaal zijn op 2748 locaties magnetische afwijkingen waargenomen. Op tien locaties zijn magnetische afwijkingen met een piek-tot-piekwaarde van meer dan 500 nT in kaart gebracht, die niet gerelateerd kunnen worden aan bekende objecten zoals pijpleidingen of kabels en die van potentieel archeologisch belang kunnen zijn. De objecten die deze afwijkingen veroorzaken, zijn niet zichtbaar op sidescan-sonar- of multibeam-beelden en worden daarom geacht in de zeebodem te zijn begraven. Deze objecten kunnen (naast archeologische objecten) onder meer puin, explosieven, verloren ankers, et cetera zijn. Zolang het karakter van deze objecten niet is vastgesteld, worden de objecten geacht van potentieel archeologisch belang te zijn. Negen van de tien contacten vallen binnen een straal van 100 meter van de voorgestelde route.

Target	E	N	nT	Section	Distance
BAB_FS_UXO_0010	570711	5761625	808	East	-210
BAB_FS_UXO_0599	570931	5761671	514	East	**+5**
BAB_FS_UXO_0603	570932	5761987	2312	East	**+8**
BAB_FS_UXO_0605	570933	5761957	1158	East	**+8**
BAB_FS_UXO_0618	570936	5761510	729	East	**+11**
BAB_FS_UXO_0657	570948	5761543	1348	East	**+22**
BC_FD_MAG_0121	571170	5763666	666	East	**+4**
BH_FSEA_MAG_0044	559169	5935057	578	C	**-2**
BJ_FD_MAG_0050	563642	5875159	2089	F	**-59**
BP_FD_MAG_0016	559490	5931390	591	B	**-60**

Tabel 2. Magnetische anomalieën groter dan 500 nT met een archeologische verwachting.

Een overzicht van de contacten en magnetische anomalieën is weergegeven in de volgende figuur.



Figuur 1 Overzicht van de potentieel archeologische contacten binnen het onderzochte gebied.

In overeenstemming met de Nederlandse wet- en regelgeving mogen geen bodemverstoringen plaatsvinden op deze locaties. Indien binnen een straal van 100 meter van een potentiële archeologische locatie activiteiten plaatsvinden, wordt in overleg met de Rijksdienst voor het Cultureel Erfgoed (RCE) van geval tot geval bekeken of de 100 meter gehandhaafd moet blijven. Alle locaties van potentieel archeologisch belang binnen een straal van 100 meter van de voorgestelde route zijn weergegeven in figuur 1.

Prehistorische resten

Gebieden met een archeologische potentie voor prehistorische vondsten zijn hieronder samengevat

Depositional environment Areas of potential archaeological interest	**Lithostratigraphic Unit**	**Time of deposition**	**Archaeological period**
Peat-covered aeolian and small scale fluvial deposits	Boxtel Formation	*Late Glacial* and Early *Holocene*	Late Paleolithic and Early Mesolithic
Catchment of the Rhine	Kreftenheye Formation	Pleniglacial	Middle Paleolithic
Shores of lakes and lagoons	Brown Bank Member	Early *Weichselian*	Middle Paleolithic to Early Mesolithic

De fysieke kwaliteit, dat wil zeggen de integriteit en het behoud van prehistorische resten, is sterk afhankelijk van de mate waarin prehistorische landschappen en archeologische niveaus daarin zijn aangetast door erosie. De seismische gegevens geven aan dat een deel van het Pleistoceen-landschap is geërodeerd tijdens de mariene transgressie in het vroege Holoceen, waardoor de integriteit van mogelijke prehistorische nederzettingen is aangetast. Lokaal kunnen de geologische eenheden die zijn gedefinieerd als potentiële lagen met prehistorische overblijfselen intact zijn gebleven, vooral in gebieden waar veen is gevonden. De interpretatie van lithostratigrafische eenheden en het karakter van de laaggrenzen (erosief versus niet-erosief) uit de seismische gegevens is gebaseerd op de beschikbare geologische gegevens en het oordeel van deskundigen. De seismische interpretatie moet worden geverifieerd door middel van vibrocore-bemonstering. De werkelijke geologische sequenties die in het gebied aanwezig zijn en de integriteit van de laaggrenzen zullen worden geverifieerd, wat een instrument zal bieden voor verdere analyse van de prehistorische landschappen en het specificeren en testen van het archeologische potentieel.

Advies prehistorie

Periplus Archeomare beveelt aan verder archeologisch onderzoek uit te voeren dat zich richt op het ontstaan en de integriteit van paleo-landschappen langs de Aramis-routetrajecten voor algemene archeologische onderzoeksdoeleinden. Dit onderzoek omvat een inventarisatie van veldonderzoek door middel van vibrocore-bemonstering conform de Nederlandse Kwaliteitsnorm voor Archeologie (KNA Waterbodems 4.1). Er wordt een geotechnische campagne uitgevoerd om een geologisch model te genereren van de ondergrond van de pijpleidingcorridor en om de fysische eigenschappen van de aanwezige sedimentlagen te bepalen. Wij adviseren om een aantal vibrocore-locaties aan te wijzen waar sedimentmonsters worden verzameld die gebruikt kunnen worden voor geo-archeologisch onderzoek.

De intacte monsters moeten door een (senior) prospector worden onderzocht en beschreven volgens de Standaard Boorbeschrijvingsmethode (SBB). Monsters worden geselecteerd en gestabiliseerd om te worden geanalyseerd door specialisten op het gebied van OSL- en radiokoolstofdatering, sedimentpetrografie, palynologie, micropaleontologie (foraminiferen, ostracoden, diatomeeën, et cetera), macroresten van planten en dieren en weekdieren om inzicht te krijgen in de ontwikkeling van landschappen in de loop van de tijd en de mate waarin deze paleolandschappen bewaard zijn gebleven.

Conform de Nederlandse Kwaliteitsnorm voor Archeologie (KNA Waterbodems 4.1) moet er een Programma van Eisen (PvE) en/of Plan van Aanpak (PvA) worden opgesteld. Dit PvE/PvA omvat de doelstelling, de onderzoeksstrategie en -methodiek, de kaders en de praktische uitvoering van het onderzoek, zodat het proces soepel verloopt en meervoudig gebruik van de op uniforme wijze verkregen data wordt bereikt. Geadviseerd wordt om deze PvE/PvA ter goedkeuring voor te leggen aan het Bevoegd Gezag en de RCE. Na afronding van het inventariserend veldonderzoek kunnen tijdens de aanleg van de pijpleiding gegevens worden verzameld die – vanuit archeologisch oogpunt – op gedetailleerd niveau waardevolle informatie opleveren. Het kan zeer nuttig zijn om deze informatie vanuit archeologisch oogpunt verder te onderzoeken. Het verdient aanbeveling om, nadat de plannen zijn uitgewerkt, in overleg met de RCE de mogelijkheden hiervoor te onderzoeken.

Tijdens de installatie van de leiding kunnen archeologische voorwerpen worden ontdekt die volledig zijn begraven of tijdens het geofysisch onderzoek niet als archeologisch object zijn herkend. Wij adviseren passieve archeologische begeleiding op basis van een goedgekeurd Programma van Eisen. Passieve archeologische begeleiding houdt in dat een archeoloog tijdens de uitvoering van de werkzaamheden niet aanwezig is, maar altijd op afroep beschikbaar is. Het opvolgen van deze aanbeveling voorkomt vertragingen tijdens de werkzaamheden wanneer er onverwacht archeologische resten worden aangetroffen. Op grond van de Erfgoedwet is het verplicht om deze bevindingen te melden aan de toezichthouder (Minister van OCW). Deze melding moet ook worden opgenomen in het bestek van het werk.

Aramis Pipeline

An archaeological assessment
Of geophysical survey results

Authors
R.W. Cassée, R. van Lil and S. van den Brenk

At the request of

TotalEnergies EP Nederland B.V.

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Colophon

Periplus Archeomare Report 22A030-01
Aramis Pipeline – An archaeological assessment of geophysical survey results
Authors: R.W. Cassée, R. van Lil and S. van den Brenk

At the request of TotalEnergies Nederland B.V.
Contact: C. Martini

The report has been reviewed by the Cultural heritage Agency of the Netherlands

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Authorization:

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Table 1. Dutch archaeological periods

Period	Time in Years				
Post-medieval / Modern Times	1500	A.D.	-	Present	
Late medieval period	1050	A.D.	-	1500	A.D.
Early medieval period	450	A.D.	-	1050	A.D.
Roman Times	12	B.C.	-	450	A.D.
Iron Age	800	B.C.	-	12	B.C.
Bronze Age	2000	B.C.	-	800	B.C.
Neolithic (New Stone Age)	5300	B.C.	-	2000	B.C.
Mesolithic (Stone Age)	8800	B.C.	-	4900	B.C.
Paleolithic (Early Stone Age)	300.000	B.C.	-	8800	B.C.

Table 2. Administrative details

Location:	North Sea	
Province	Zuid-Holland	
Municipality	Rotterdam	
Toponym Dutch:	Aramis pipeline	
Chart:	1801-01, 1811-01	
Coordinates Geodetic datum: ETRS89 Projection: UTM31N	Geophysical survey area	
	Centre	E 564 944 - N 5 856 821
	Northwest	E 580 104 - N 5 953 697
	Northeast	E 542 599 - N 5 953 697
	Southwest	E 542 599 - N 5 759 945
	Southeast	E 580 104 - N 5 759 945
Depth (LAT):	4.8 to 39.6 meter, average 27.0 meter	
Area (km^2):	Survey area	243.25 km^2
Environment:	Tidal currents, salt water	
Area use:	Shipping, fishing, oil, and gas industry	
Area administrator:	Rijkswaterstaat Zee en Delta	
Competent authority	Rijkswaterstaat Zee en Delta	
Advising body	Cultural Heritage Agency of the Netherlands L. Derksen	
ARCHIS-research report (CIS-code):	5330686100	
Periplus-project reference:	22A030-01	
Period	May - August 2023	

Samenvatting (Abstract in Dutch)

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In overeenstemming met de Nederlandse wet- en regelgeving mogen geen bodemverstoringen plaatsvinden op deze locaties. Indien binnen een straal van 100 meter van een potentiële archeologische locatie activiteiten plaatsvinden, wordt in overleg met de Rijksdienst voor het Cultureel Erfgoed (RCE) van geval tot geval bekeken of de 100 meter gehandhaafd moet blijven. Alle locaties van potentieel archeologisch belang binnen een straal van 100 meter van de voorgestelde route zijn weergegeven in figuur 1.

Prehistorische resten

De fysieke kwaliteit, dat wil zeggen de integriteit en het behoud van prehistorische resten, is sterk afhankelijk van de mate waarin prehistorische landschappen en archeologische niveaus daarin zijn aangetast door erosie. De seismische gegevens geven aan dat een deel van het Pleistoceen-landschap is geërodeerd tijdens de mariene transgressie in het vroege Holoceen, waardoor de integriteit van mogelijke prehistorische nederzettingen is aangetast. Lokaal kunnen de geologische eenheden die zijn gedefinieerd

als potentiële lagen met prehistorische overblijfselen intact zijn gebleven, vooral in gebieden waar veen is gevonden. De interpretatie van lithostratigrafische eenheden en het karakter van de laaggrenzen (erosief versus niet-erosief) uit de seismische gegevens is gebaseerd op de beschikbare geologische gegevens en het oordeel van deskundigen. De seismische interpretatie moet worden geverifieerd door middel van vibrocore-bemonstering. De werkelijke geologische sequenties die in het gebied aanwezig zijn en de integriteit van de laaggrenzen zullen worden geverifieerd, wat een instrument zal bieden voor verdere analyse van de prehistorische landschappen en het specificeren en testen van het archeologische potentieel.

Advies prehistorie

Periplus Archeomare beveelt aan verder archeologisch onderzoek uit te voeren dat zich richt op het ontstaan en de integriteit van paleo-landschappen langs de Aramis-routetrajecten voor algemene archeologische onderzoeksdoeleinden. Dit onderzoek omvat een inventarisatie van veldonderzoek door middel van vibrocore-bemonstering conform de Nederlandse Kwaliteitsnorm voor Archeologie (KNA Waterbodems 4.1). Er wordt een geotechnische campagne uitgevoerd om een geologisch model te genereren van de ondergrond van de pijpleidingcorridor en om de fysische eigenschappen van de aanwezige sedimentlagen te bepalen. Wij adviseren om een aantal vibrocore-locaties aan te wijzen waar sedimentmonsters worden verzameld die gebruikt kunnen worden voor geo-archeologisch onderzoek.

De intacte monsters moeten door een (senior) prospector worden onderzocht en beschreven volgens de Standaard Boorbeschrijvingsmethode (SBB). Monsters worden geselecteerd en gestabiliseerd om te worden geanalyseerd door specialisten op het gebied van OSL- en radiokoolstofdatering, sedimentpetrografie, palynologie, micropaleontologie (foraminiferen, ostracoden, diatomeeën, et cetera), macroresten van planten en dieren en weekdieren om inzicht te krijgen in de ontwikkeling van landschappen in de loop van de tijd en de mate waarin deze paleolandschappen bewaard zijn gebleven.

Conform de Nederlandse Kwaliteitsnorm voor Archeologie (KNA Waterbodems 4.1) moet er een Programma van Eisen (PvE) en/of Plan van Aanpak (PvA) worden opgesteld. Dit PvE/PvA omvat de doelstelling, de onderzoeksstrategie en -methodiek, de kaders en de praktische uitvoering van het onderzoek, zodat het proces soepel verloopt en meervoudig gebruik van de op uniforme wijze verkregen data wordt bereikt. Geadviseerd wordt om deze PvE/PvA ter goedkeuring voor te leggen aan het Bevoegd Gezag en de RCE. Na afronding van het inventariserend veldonderzoek kunnen tijdens de aanleg van de pijpleiding gegevens worden verzameld die – vanuit archeologisch oogpunt – op gedetailleerd niveau waardevolle informatie opleveren. Het kan zeer nuttig zijn om deze informatie vanuit archeologisch oogpunt verder te onderzoeken. Het verdient aanbeveling om, nadat de plannen zijn uitgewerkt, in overleg met de RCE de mogelijkheden hiervoor te onderzoeken.

Tijdens de installatie van de leiding kunnen archeologische voorwerpen worden ontdekt die volledig zijn begraven of tijdens het geofysisch onderzoek niet als archeologisch object zijn herkend. Wij adviseren passieve archeologische begeleiding op basis van een goedgekeurd Programma van Eisen. Passieve archeologische begeleiding houdt in dat een archeoloog tijdens de uitvoering van de werkzaamheden niet aanwezig is, maar altijd op afroep beschikbaar is. Het opvolgen van deze aanbeveling voorkomt vertragingen tijdens de werkzaamheden wanneer er onverwacht archeologische resten worden aangetroffen. Op grond van de Erfgoedwet is het verplicht om deze bevindingen te melden aan de toezichthouder (Minister van OCW). Deze melding moet ook worden opgenomen in het bestek van het werk.

Summary

TotalEnergies Nederland B.V. has contracted Periplus Archeomare B.V. to conduct an archaeological assessment of geophysical survey results of the Aramis pipeline route survey.

A large quantity of survey data (*side scan sonar, magnetometer, multibeam echosounder* and *subbottom profiling*) covering a total area of 243 km^2 have been analyzed to conduct an archaeological assessment.

The current analysis of geophysical survey results is the second step in the AMZ-cycle, following the desk study. The purpose of this assessment is to test the desk study-based expectancy for archaeological remains in the area. The expectancy covers remains of shipping related objects (wrecks), airplanes from World War II and prehistoric settlements.

Side scan sonar and multibeam contacts

Within the surveyed area, an archaeological expectation was assigned to a total of 8 contacts. In accordance with Dutch Law and Legislation no seabed disturbances should be carried out within 100 meters of each of the marked locations. If any activities will take place within 100 meters of a potential archaeological location, it will be examined on a case-by-case basis whether the 100 meters should be maintained in consultation with the Cultural Heritage Agency of the Netherlands (RCE).

Feature	NCN	Easting	Northing	Route section	Distance
BK_FSEA_SSS_0022	-	551288	5924521	D	**+50**
BK_FSEA_SSS_0179	-	555839	5929168	D	-240
BJ_FD_SSS_0015	-	548443	5894128	F	+230
BB_FS_SSS_0683	219	570384	5762003	East	-540
BH_FSEA_SSS_0104	531	559172	5935317	C	**+25**
BK_FSEA_SSS_0163	967	550165	5921956	D	**-56**
BN_FD_SSS_0025	945	576689	5920367	E Neptune	+220
BB_FS_SSS_0433	-	570711	5761481	East	-210

Three of the eight contacts fall within 100 meters of the proposed route.

Magnetic anomalies

A total of 2748 magnetic anomalies have been observed. At 10 locations magnetic anomalies with a peak-to peak value over 500 nT have been mapped which cannot be related to known objects like pipelines or cables and may be of potential archaeological interest. The objects that cause these anomalies are not visible on side scan sonar or multibeam images and are therefore considered to be buried in the seabed. These objects could, apart from archaeological objects, include debris, UXO, lost anchors, et cetera. As long as the character of these objects has not been determined, the objects are considered to be of potential archaeological interest.

Target	E	N	nT	Section	Distance
BAB_FS_UXO_0010	570711	5761625	808	East	-210
BAB_FS_UXO_0599	570931	5761671	514	East	**+5**
BAB_FS_UXO_0603	570932	5761987	2312	East	**+8**
BAB_FS_UXO_0605	570933	5761957	1158	East	**+8**
BAB_FS_UXO_0618	570936	5761510	729	East	**+11**
BAB_FS_UXO_0657	570948	5761543	1348	East	**+22**
BC_FD_MAG_0121	571170	5763666	666	East	**+4**
BH_FSEA_MAG_0044	559169	5935057	578	C	**-2**
BJ_FD_MAG_0050	563642	5875159	2089	F	**-59**
BP_FD_MAG_0016	559490	5931390	591	B	**-60**

Table 3. Magnetic anomalies over 500 nT with an archaeological expectation.

Nine of the ten contacts fall within 100 meters of the proposed route.

In accordance with Dutch Law and Legislation no seabed disturbances should be carried out within 100 meters of each of the marked locations. If any activities will take place within 100 meters of a potential archaeological location, it will be examined on a case-by-case basis whether the 100 meters should be maintained in consultation with the Cultural Heritage Agency of the Netherlands (RCE). All locations of potential archaeological interest within 100 meters of the proposed route are shown in the next figure.

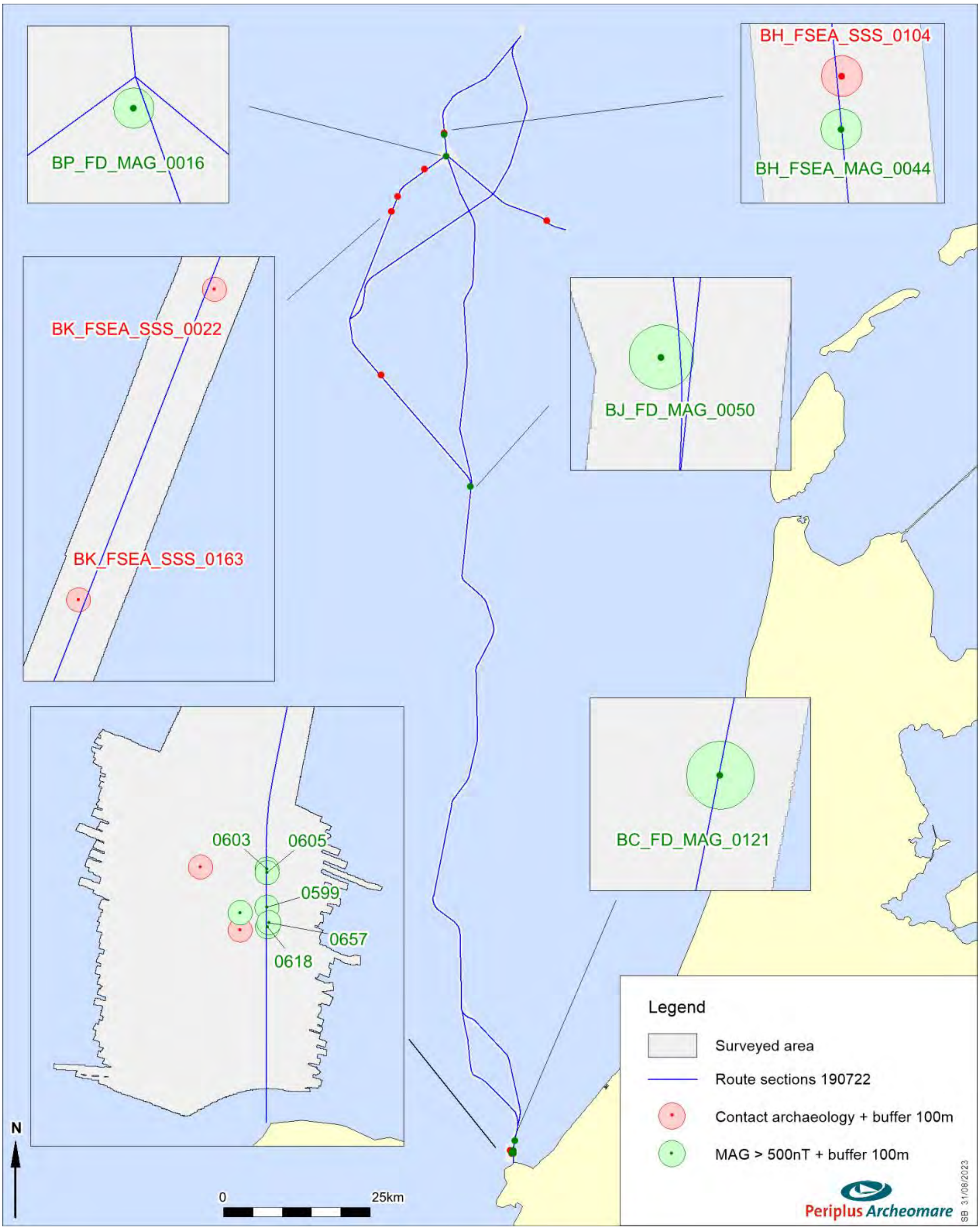

Figure 1. Overview of the potential archaeological targets within 100 meters of the proposed route

Prehistoric remains
Areas of potential archaeological interest listed below.

Depositional environment Areas of potential archaeological interest	Lithostratigraphic Unit	Time of deposition	Archaeological period
Peat-covered aeolian and small scale fluvial deposits	Boxtel Formation	*Late Glacial* and Early *Holocene*	Late Paleolithic and Early Mesolithic
Catchment of the Rhine	Kreftenheye Formation	Pleniglacial	Middle Paleolithic
Shores of lakes and lagoons	Brown Bank Member	Early *Weichselian*	Middle Paleolithic to Early Mesolithic

The physical quality, that is, the integrity and preservation of prehistoric remains is highly dependent on the extent to which prehistoric landscapes and archaeological levels herein have been affected by erosion. The seismic data indicate that part of the *Pleistocene* landscape has eroded during the Early *Holocene* marine ingression, thus affecting the integrity of possible prehistoric settlements. Locally the geological units defined as potential containers of prehistoric remains may have been preserved intact, especially in areas where peat has been found. The interpretation of lithostratigraphic units and the character of the layer boundaries (erosive versus non-erosive) from the seismic data is based on the geological data available and expert judgement. The seismic interpretation shall be ground-truthed by vibrocore sampling. The actual geological sequences present in the area and the integrity of layer boundaries will be verified, thus offering a tool for further analysis of the prehistoric landscapes and specify and test the archaeological potential.

Recommendation

Prehistory
Periplus Archeomare recommends conducting further archaeological research that focuses on the genesis and integrity of paleo-landscapes along the Aramis route trajectories for general archaeological research purposes. This research comprises an inventory of field research by means vibrocore sampling in accordance with the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1). A geotechnical campaign is carried out to generate a geological model of the subsurface of the pipeline corridor and to determine the physical properties of the sediment layers present. We recommend designating a number of vibrocore locations where sediment samples are collected that can be used for geo-archaeological research.

The intact samples must be examined by a (senior) prospector and described in accordance with the *Standaard Boorbeschrijvingsmethode* (SBB). Samples are selected and stabilized to be analyzed by specialists in the field of OSL and radiocarbon age dating, sediment petrography, palynology, micropaleontology (foraminifera, ostracods, diatoms, et cetera), macro-remains of plants and animals and molluscs to gain insight into the development of landscapes over time and the extent to which these paleolandscapes have been preserved.

In accordance with the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1), a Program of Requirements (PvE) and / or Plan of Action (PvA) must be drawn up. The PvE/PvA includes the objective, the research strategy and methodology, the frameworks and the practical implementation of the research, so that the process runs smoothly, and multiple use of the data acquired in a uniform manner is achieved. It is advised to submit this PvE / PvA for approval to the Competent Authorities and the RCE. After completion of the inventory field research, during the construction of the pipeline, data can be collected that - from an archaeological point of view - provides valuable information at a detailed level. It can be very useful to investigate this information further from an archaeological point of view. It is advised to investigate the possibilities for this in consultation with the RCE, once the plans have been worked out.

During the installation of the pipeline, archaeological objects may be discovered which were completely buried or not recognized as an archaeological object during the geophysical survey. We recommend passive archaeological supervision based on an approved Program of Requirements. Passive archaeological supervision means that an archaeologist is not present during the execution of the work but always available on call. Following this recommendation would prevent delays during the work when unexpectedly archaeological remains are found. In accordance with the Erfgoedwet, it is required to report those findings to the enforcing authority (Minister of OCW). This notification must also be included in the Scope of Work.

1 Introduction

TotalEnergies Nederland B.V. has contracted Periplus Archeomare B.V. to conduct an archaeological assessment of geophysical survey results of the Aramis pipeline route survey.

The area of investigation (243 km^2) is located in the North Sea, and runs from Maasvlakte II to offshore block L4 over a distance of 192 km.

Figure 2. Location map of the area of investigation

1.1 Background

TotalEnergies plans to build a new pipeline from Maasvlakte 2 to offshore blocks L4/K6 as part of the Carbon Capture and Storage (CCS) project Aramis. The CCS system will consist of an onshore pipeline, the compressor station, an offshore pipeline and the storage of CO_2 in the deep subsoil of the North Sea (figure 3). The capture of CO_2 from the harbour's industries and the use of CO_2 of the storage of it underground is one of the measures to achieve the climate objectives. The area to be surveyed encompasses:

(1) the shore approach/Landfall pipeline routing for HDD and dredging part at Maasvlakte
(2) the offshore rigid pipeline routing from Maasvlakte to blocks L4/K6
(3) the offshore distribution hub[1].

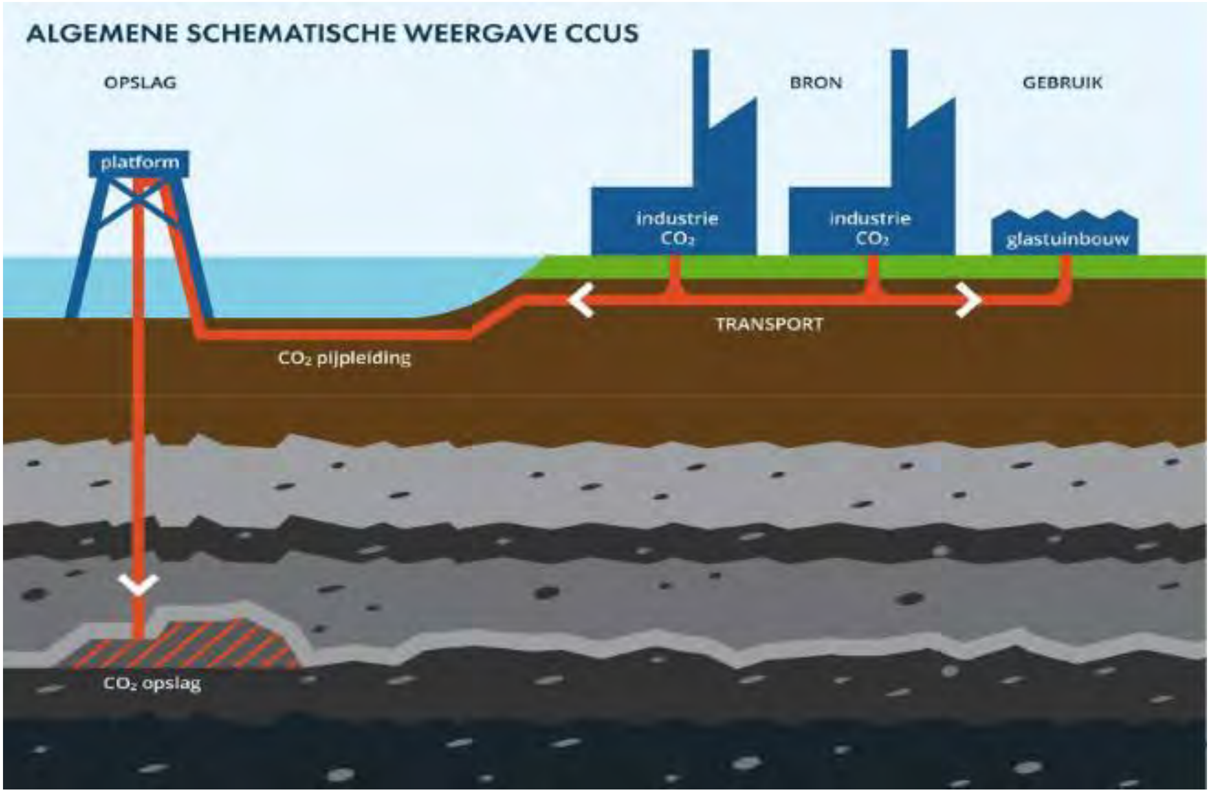

Figure 3: Schematic representation of the transport and storage system.

Offshore, the proposed 32 inch pipeline will be trenched into the seabed to a maximum depth of one meter[2].

In the Erfgoedwet[3] the protection of the archaeological heritage is embedded. Planned activities, such as the installation of a pipeline in the North Sea, may affect the archaeological values if present. If the remains are in jeopardy, there is a statutory obligation to conduct archaeological research. In line with this obligation an archaeological desk study has been carried out.

[1] Porthos project

[2] Concept Notitie Reikwijdte en Detailniveau Aramis CO2-transportinfrastructuur

[3] De Erfgoedwet became effective on the 1st of July 2016.

An archaeological desk study is the first step in the so-called *AMZ* cycle (Archeologische Monumenten Zorg). The *AMZ* cycle includes a description of procedures for subsequent phases of archaeological research to be performed in order to ensure the protection of archaeological heritage in the Netherlands.

The second phase of the *AMZ* cycle is an inventory archaeological field study. As a rule, this field study comprises a geophysical survey of the seabed. The survey executed by Fugro was not primarily set to provide data to be used in the course of archaeological research. However, a scan of the survey data acquired, prove these data to be fit for an archaeological assessment.

The separate phases of the AMZ-cycle are embedded in the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1). This standard dictates a mandatory workflow for archaeologists. A detailed description of the different phases of archaeological research is included in appendix 4.

1.2 Results desk study

In January 2022 an archaeological desk study has resulted in specific information on the archaeological remains which are to be expected within the entire area of interest of the Aramis pipeline[4]. The results of the desk study will be discussed below.

The area of interest has high expectations for the presence of (remains of) ship wrecks and WWII plane wrecks. Intact prehistoric landscapes and related *in situ* remains of Palaeolithic and Early Mesolithic camp sites and inhumations are expected to have been preserved in places.

The proposed pipeline routes have not been investigated by detailed geophysical surveys yet. These areas may contain more undiscovered shipwrecks or remains of shipwrecks than are currently known.

At this stage little is known about the integrity of the *Pleistocene* landscape. By means of subbottom profiling the occurrence geological units (both horizontal as vertical) and archaeological levels herein can be mapped. The character of layer boundaries (erosive or non-erosive) can be interpreted. It is unlikely however that archaeological remains of Paleolithic and Mesolithic camp sites can be identified with sufficient certainty (based on the geophysical and geotechnical surveys) to impose restrictions on pipeline development. At this stage focus should therefore not be put on tracing prehistoric camp sites but on a pragmatic employment of geophysical techniques in order to obtain a better insight in (the integrity of) the *Pleistocene* landscape. The insights gained shall be used to a) refine the archaeological expectancy model and b) allocate areas with a high expectancy for *in situ* prehistoric remains.

In accordance with the AMZ cycle it is advised to conduct a field investigation (in Dutch '*Inventariserend veldonderzoek opwaterfase*') in order to test the archaeological predictive model and further specify the type, vertical and lateral extent, age, integrity and preservation of shipwrecks, prehistoric landscapes and potential archaeological levels.

[4] Van den Brenk en van lil, 2022

Archaeological Expectancy	Method		Goal	Remarks
Ship and aircraft wrecks	Geophysical	Side Scan Sonar	detect and map wreck sites	wrecks exposed at, or protruding from the seabed
		Multibeam	characterize wreck sites morphologically; detect (partially) buried wrecks by the occurrence of scours	in addition to side scan sonar
		Sub-bottom Profiler	detect buried objects including possible shipwrecks and remains of aircraft	nature of the buried object cannot be determined directly
		Magnetometer		
Prehistoric settlements (camp sites)		Sub-bottom Profiler	map the Pleistocene landscape; specify expectancy	supported by, and validated with drill data
	Geotechnical	Geological Sampling	determine lithostratigraphy, soil layer boundaries (erosive or gradual) and characteristics of soil formation and maturation; specify expectancy	designation of borehole and/or vibrocore locations for geo-archaeological research based on SBP data
		Cone Penetration Test	determine lithostratigraphy	correlate with drilling data

In general, similar investigations carried out in the past consist of a geophysical survey with *side scan sonar*, *magnetometer* and *subbottom profiler* and a geotechnical survey. The resulting data should be assessed after the general processing, interpretation and reporting has been performed by the survey contractor.

The archaeological assessment of the data shall be conducted by a geophysical specialist (KNA prospector Waterbodems). The data quality from the surveys needs to match the demands for this archaeological assessment. To ensure compatibility between the site investigation and the required quality for this assessment it is recommended to define a Program of Requirements (In Dutch: 'Programma van Eisen') in accordance with the 'KNA' (the Dutch quality standards for archaeological research), to be authorized by the competent authority.

1.3 Objective

The purpose of the archaeological assessment is to test the desk study-based expectancy for archaeological remains in the area. The expectancy covers remains of shipping related objects (wrecks), airplanes from World War II and prehistoric settlements.

The goals set for this assessment are:

- To determine the historical or archaeological value of contacts found in the geophysical survey;
- To validate the locations of known wrecks;
- Assess the prehistoric landscape based on seismic data.

1.4 Research questions

For the inventory archaeological field study, the following research questions have been defined in the Program of Requirements[5].

Primary Question : Are any archaeological remains present within the Area of Interest and to what extent are these remains traceable?
With respect to side scan sonar, magnetometer and multibeam survey:
- Are there any phenomena visible on the seabed?

If so:
- What is the description of these phenomena?
- Do these phenomena have a man-made or natural origin?

If these phenomena can be designated to be man-made:
- What classification can be attached?

If these phenomena can be classified as archaeological:
- Is it possible to interpret the nature of the archaeological objects?

If these phenomena can be identified as natural:
- What is the nature of these natural phenomena?
- Based on the acoustic image is it possible to designate zones of high, middle or low marine activity on the seabed?

If so:
- How can these zones be interpreted?

General:
- What is the relation between the observed objects and the topography of the seabed? Based on this relationship can risk-prone areas be marked selectively?
- If no acoustic phenomena can be observed, are there any clues that this is a consequence of either natural erosion, sedimentation or human interference?

With respect to the seismic data:
- What is the depth of the top of the Pleistocene and Holocene landscape(s) relative to a) LAT and b) the present seabed?
- What lithostratigraphic units can be distinguished along the pipeline routes?

The answer to this question shall include information on:
- the classification,
- the occurrence (lateral extent and depth),
- the lithologic and stratigraphic characteristics,
- the age and depositional environment,
- the character of the layer boundaries (gradual or instantaneous |erosive) of these units.

- Are channel-like features observed?

If so:
- What are the characteristics of the channel-like features in terms of spacial distribution (width, depth, shape, extent), channel infill composition, stratigraphic position and age.

- Are occurrences of peat and/or organic clay observed?

[5] Van den Brenk and van Lil, 2022.

If so:

- What is the spacial distribution (depth, extent) stratigraphic position and age of these deposits.

- Are intact prehistoric landscapes affected by the installation of the pipeline based on their vertical position related to the seabed?
- Are there any indications observed on the seismic profiles for the presence of buried (man-made) objects?

If so:

- Based on the presence of buried objects and their correlation with side scan sonar, magnetometer en multibeam data can something be said about the nature of these buried objects?

2 Methodology

2.1 Introduction

As part of the installation of the pipeline, a geophysical and geotechnical survey has been carried out by Fugro. The aim of the survey was to contribute to the bathymetrical, morphological, and geological understanding of area of interest, as defined in the scope of work. The results have been compiled in a survey report[6].

This geophysical survey provides the information needed for the planning and preparation of the geotechnical survey. The outcome of the geotechnical survey will be combined with the seismic data to create an Integrated Ground Model (IGM).

The following methods have been deployed:

- Side scan sonar (SSS)
- magnetometer (MAG)
- multibeam echo sounder (MBES)
- sub-bottom profiler (SBP)
- ultra-high resolution seismic (UHR)

The results of the survey and geotechnical activities have been recorded in reports, listings, drawings, and images. Prior to the execution of the archaeological assessment the quality and completeness of the delivered survey data have been judged. It is concluded that the data is of high quality and that the data are fit for the purpose of this archaeological assessment.

SSS	- event listings containing all contacts observed. - Geotiffs mosaics of all contacts listed
MAG	- event listings containing all anomalies observed
MBES	- validated *multibeam* XYZ point cloud dataset (grid 25x25cm)
SBP/UHR	- representative subbottom profiles
Report	- survey reports

Table 4. Data used for archaeological assessment.

[6] Fugro report F192961_REP_007 01, rev 00, 23 September 2022.

2.2 Geophysical survey

The geophysical survey was carried out by Fugro between July 2022 and April 2023. For the execution of the survey the vessels '*MV Fugro Discovery*', '*MV Fugro Seeker*', and the '*Fugro Searcher*' were employed. An overview of the survey campaign and the employed methods is presented in the table below.

Region	Survey Type	Vessel	Survey		Survey Methods
			Start	End	
Offshore	Geophysical	MV Fugro Discovery	11-11-2022	12-12-2022	Multibeam (MBES), Sub Bottom Profiler (SBP), Side Scan Sonar (SSS), Two-dimensional Ultra-heigh Resolution (2DUHR), and Magnetometer
Nearshore	Geophysical	MV Fugro Seeker	11-07-2022	22-09-2022	Multibeam (MBES), Sub Bottom Profiler (SBP), Side Scan Sonar (SSS), and Two-dimensional Ultra-heigh Resolution (2DUHR)
Offshore	Geophysical	MV Fugro Searcher	09-10-2022	23-01-2023	Multibeam (MBES), Sub Bottom Profiler (SBP), Side Scan Sonar (SSS), and Two-dimensional Ultra-heigh Resolution (2DUHR), and a Sparker
Offshore & Nearshore	Geotechnical	MV Normand Mermaid	11-11-2022	24-01-2023	CPT and Vibrocore
Offshore & Nearshore	Geotechnical	MV Kommandor Orca	02-12-2022	12-12-2022	CPT and Vibrocore

Table 5. Overview of the survey campaigns and the employed survey methods (source: Fugro report F197217-REP-001 | 01 | 18 April 2023).

77 geotechnical locations were investigated during the geotechnical surveys. All locations comprise of Vibrocore (VC) and Cone Penetration Test (CPT).

Details about the geophysical and geotechnical surveys can be found in the integrated Geophysical and Geotechnical reports in Appendix 3

2.3 Known objects.

Fugro has summarized the *side scan sonar* contacts and *magnetometer* anomalies encountered within the survey area in detailed event listings. From different databases the occurrence of a number of objects within the area is known, as described in the desk study[7]. The contacts included in the survey event listings are compared with the database objects in the area. For this comparison four different datasets are used:

- The Hydrographic Service database (hereafter referred to as NLhono database);
- The Rijkswaterstaat SonarReg database (hereafter referred to SR database);
- The Dutch Cultural Heritage Agency database ARCHIS;
- The Dutch Nationaal Contact Nummer database (hereafter referred to as NCN);
- The NCN database contains all basic information (E, N, and description) of the Nlhono, SR and Archis databases. More detailed information is gathered through the other datasets.

[7] Van den Brenk en van lil, 2022

The National Contact Number (NCN)

The NCN database combines the data from three governmental databases:

- The Dutch Continental Shelf and Westerschelde wrecks register from the Hydrographic Service of the Royal Netherlands Navy;
- The SonarReg object database of Rijkswaterstaat;
- The ARCHIS database (the official archaeological database of the Ministry of Cultural Heritage)

The permission for the use of the NCN database for the analysis was granted by the owner (Rijkswaterstaat Zee en Delta).

In addition to shipwrecks, information on contacts referred to as ‘foul’ or ‘obstruction’ are included. From these objects the origin is not always known, but information on the location, dimensions and other valuable information is listed. Besides the databases other sources containing information on wrecks and historic finds are consulted for comparison with the survey results.

All known data is combined and plotted in GIS. In this way an overview is made of the areas in which archaeological remains are present or to be expected. The known contacts are a reference framework for the assessment of data recorded during the route survey.

2.4 Archaeological assessment of survey data

The geophysical and hydrographic survey techniques employed include *side scan sonar* (SSS), *magnetometer* (MAG), *multibeam* (MBES), subbottom profiling (SBP) and ultra-high resolution multi-channel seismic (UHRS). The natures of those methods differ, with coherent strengths and weaknesses.

Table 6 provides a summary of the objective(s) the methods employed and the nature of those methods in terms of seabed penetration and coverage. Data are cross correlated because the methods are complementary. E.g., *multibeam* data can aid in the interpretation of a *side scan sonar* contact by providing information on its height with respect to the surrounding seabed, the occurrence of scouring next to the contact, and the accuracy and precision of the object. CPT's, borehole and vibrocore data will aid in the determination of geological units from seismic strata.

Method	Objective	Seabed		Accuracy and Precision	Cross Correlation
		Penetration	Coverage		
SSS	Identification of outcropping objects; seabed classification	No	Full	High	MBES / MAG
MBES	Charting of seabed morphology; identification of scours	No	Full	Very high	SSS
MAG	Identification of magnetic anomalies induced by ferromagnetic objects	Yes*1	Full*2	Accuracy = high Precision = poor*3	SSS
SBP/UHRS	Identification of seismic strata and buried objects such as pipelines, cables and boulders	Yes	No Profile data beneath sailed line	High	BH/VC/CPT*4 MAG
BH/VC	Determination physical properties of sediments and lithostratigraphy	Yes VC appr. 5 m bsb BH 60 to 80 m bsb	No Point location	High	CPT/ SBP/UHRS
CPT	Determination of physical properties of sediments and lithostratigraphy	Yes Up to 50 to 80 m bsb	No Point location	High	BH/VC/ SBP/UHRS

Table 6. Characteristics of geophysical and geotechnical methods employed.

NOTE:

*1 detection dependent on size of the ferromagnetic object, depth of burial, height of *magnetometer* above the seabed and distance cross course.

*2 distant and/or deeply buried objects can be missed.

*3 accuracy: perpendicular to ship heading = ½ * spacing of sailed lines; parallel to ship heading = approximately 1 m.

*4 interpretation of geology through correlation of seismic data with BH/VC/CPT-data.

With *side scan sonar* all objects and structures on the seabed can be made visible. Seabed sediment of different composition can be distinguished by their characteristic reflection. *Multibeam* images reveal the morphology of the seabed. Large objects and scouring can be mapped. Smaller objects, like thin cables, or flat objects lying on the seabed often are impossible to identify in *multibeam* images.

The strength of *side scan sonar* resides in the ability to visualize differences in reflectivity of seabed sediments and exposed objects. Variations in seabed composition cannot be observed in *multibeam* data, unless those variations are accompanied by morphological changes. This also applies for objects which are barely elevated above the seabed. Another strength of *side scan sonar* is the full coverage which is accomplished with a limited number of survey lines. A limitation of *side scan sonar* buried objects cannot be found with this technique.

The strength of *multibeam* lies in the high accuracy and high precision images of the seabed morphology the technique provides. Sand waves and current ripples can clearly be observed in *side scan sonar* data, but the height of those sedimentary structures can far better be established by means of *multibeam*. However, buried objects generally cannot not be traced with *multibeam*, scours caused by shallowly buried objects can lead to the identification of buried objects.

In this study *side scan sonar* and *multibeam* data were combined in the identification of objects which are of potential archaeological interest. The listing of potential archaeological objects is considered to be complete as far as it concerns exposed objects, although the presence of buried non-ferro-magnetic archaeological objects or objects which erroneously have been labelled as non-archaeological, can never be fully excluded.

Magnetometer contacts are identified by the presence of ferro-metallic objects which induce an anomaly in the earth magnetic field. These objects can be buried or lying on the seabed. Unlike *side scan sonar* and *multibeam* the contacts are tagged at the sailed survey line. The actual object can be located at both sides of the survey line. Given the 70-meter spacing of the run lines the precision perpendicular to the line is in the order of 35 meter. The precision parallel to the run line is in the order of one meter.

The strength of a *magnetometer* lies in its ability to trace buried objects, if those objects are ferro-magnetic. The technique provides a strong tool in mapping continuous linear structures like buried cables and pipelines. Also, an indication of the presence and distribution of isolated ferro-magnetic objects in an area of investigation is obtained.

An important limitation of the *magnetometer* is the poor accuracy and precision of the positions, size and weight of the objects found. An object must be boxed in by sailing additional lines with a *magnetometer* to pinpoint the location of the object. The measured amplitude of a magnetic anomaly is determined by different parameters, such as the size of the object, the depth of burial, the height of the *magnetometer* above the seabed and the distance cross course. Because the measured anomaly is influenced by multiple unknown parameters it is a priori not possible to deduce the size | iron content of the object from the measured anomaly. Magnetic anomalies are in many cases induced by buried objects. From the character of the magnetic anomaly (monopole or dipole) it is not possible to identify the nature of this buried object.

The listing of *magnetometer* anomalies is expected to be complete as far as it concerns large ferro-magnetic objects. As the line spacing employed is 100 meters it cannot be excluded that especially small distant buried objects have been missed.

Fugro processed their survey data and produced detailed event listings of the *side scan sonar* and *magnetometer* contacts encountered within the survey areas. Like the known objects the locations of the contacts are plotted in a GIS.

In the course of this archaeological assessment a selection was made based on the dimensions of the reported contacts. All contacts have been assessed, and the fraction of contacts larger than or equal to four (4) meters is investigated in more detail, because these objects are considered to be more likely to be related to wreck sites than the smaller contacts. This choice is based on best professional judgment and not prescribed by legislation or the KNA. The purpose of this analysis is to identify contacts that could reflect potential archaeological sites.

This is done by analyses of:
- *Side scan sonar* images included in the survey reports;
- raw *side scan sonar* data (XTF-files);
- raw *multibeam*-data (xyz-files);
- values of magnetic anomalies reported in the survey reports;
- comparison of *side scan sonar* and *magnetometer* contacts;

Apart from the survey data studied the geological constellation and seabed morphology of the area are considered as outcrops of geological strata and sedimentary structures can lead to (apparent) anomalies in the *side scan sonar* record.

The *side scan sonar* images are scanned to define potential archaeological sites. A selection of contacts was made of contacts to be studied in detail. The interpretation and selection of *side scan sonar* contacts is based on best professional judgment. If desired or needed the exact nature of the contacts observed can be established with certainty through the execution of additional research by means of a ROV or divers in a following phase.

Fugro has acquired and processed shallow seismic data using a sub-bottom profiler (SBP) and an ultra-high resolution multi-channel sparker (UHR). The processing involved an analysis of seismic profiles which had a line spacing of 70 m for both the main lines and the cross lines. Observed seismic strata have been digitized and – based on known geological data from the area – lithostratigraphic units have been identified. The base of each lithostratigraphic unit has been interpolated into a grid. The results have been summarized and reported. In addition to the identification and occurrence of lithostratigraphic units, seismic anomalies which are expected to reflect potential hazardous phenomena have been identified.

2.5 Data Analysis

The first step in the data analysis is to cross-reference known objects within the surveyed area with the survey data. For the comparison the results of the desk study and the survey datasets were used. All the known objects were projected in a GIS together with the survey data.

For cross-reference it was assumed that all present possible contacts and anomalies have been reported and described by the survey contractor. The raw data was used only to verify the description of found objects and anomalies as reported.

The positions of the interpreted contacts from the different surveys were compared with the positions of the known objects collected from the databases. Besides that, all the positions of both the survey contacts and the known objects were plotted on the high resolution *multibeam* grid to visualize the morphological influence of the presence of these objects. This assisted in the determination of possible archaeological value of the present remains. If an object had a potential archaeological value, the description of the object was finalized.

Besides the objects detected from the *side scan sonar* survey also the *magnetometer* contacts were plotted on the high resolution *multibeam* grid. For the *magnetometer* contacts that corresponded with the *side scan sonar* contacts within 50 meters of each other, these contacts were related. When in the vicinity of a magnetic anomaly no visible object was found the size of the anomaly defines whether the buried object causing the magnetic anomaly is of potential archaeological interest. If the magnetic anomaly of a contact is more than 500 nT (nano-Tesla) then it is stated that the contact could possibly be of archaeological value[8]. All the *magnetometer* contacts above 500 nT but within 25 meters of the existing cable and pipeline routes are exempt for further investigation. It must be stressed that within this assessment no distinction can be made between anomalies related to possible archaeological objects or anomalies related to (for example) unexploded ordinance (UXO's).

An archaeological assessment has been undertaken for all visible contacts. This interpretation is based on the best 'professional judgment'.

The interpreted seismic data have been assessed to test the archaeological expectation with respect to remains of prehistoric settlements in the area. The archaeological desk study has resulted in the identification of lithostratigraphic units which could contain archaeological levels. The grids produced by Fugro have been used to get an insight in both the lateral and vertical distribution of the lithostratigraphic units and the expected archaeological levels herein. Thus, testing the desk study based archaeological expectation. An important factor included in the assessment is the integrity of layer boundaries, because erosion by natural processes poses a significant threat to archaeological levels. Based on the assessment, zones along the pipeline route which are expected to contain archaeological remains are mapped and presented. The results are reviewed in the context of the activities planned to predict possible influence on the potential archaeological remains.

The analysis was executed in June 2023 by R.W. Cassée (KNA Archaeologist Ma specialism Waterbodems), R. van Lil and S. van den Brenk (both KNA senior prospector). The investigation is carried out according to specifications set up within the Dutch Quality Standard for Archaeology (*KNA Waterbodems 4.1; protocol 4103*).

[8] The designated value of 50 nT to discriminate between anomalies that are induced by objects of possible archaeological value (>50nT) and that are not (<50 nT) is arbitrary. Given the employed lines spacing of 70 m, an anomaly that solely is observed on one survey line could be located within 35 m on either side of this survey line. It is estimated that an iron mass of 1000 kg located at 10 m from the magnetometer will result in a 50 nT magnetic anomaly. On the other hand, an iron mass of 1 kg located within 3 m of the magnetometer will also result in a 50 nT anomaly, albeit that the anomaly with will be less. It is estimated that an iron mass of 100 kg that is located at 30 m from the magnetometer will result in an anomaly of less than 2 nT. This value is often below the limit of detection. If those small values were to be labelled as anomalies caused by objects of possible archaeological interest all magnetic anomalies found in the survey area were to be labelled as such. Therefore, the arbitrary value of 50 nT is chosen, given the current line spacing. If a closer line spacing is used a larger value shall be considered.

2.6 Used Sources

The following sources were used for the analysis:

- Survey data Fugro, original survey data and reported interpretations;
- Archaeological desk study Periplus (19A029-01);
- ARCHIS database Cultural Heritage Agency;
- Archeomare Database;
- Nlhono database Hydrographic Service of the Royal Netherlands Navy;
- Wrecksite.eu;
- Database, Nationaal Contact Nummer (NCN).

For a complete list of used sources and literature see the reference list at page 67.

Italic written words are explained in the glossary at page 65.

3 Results

3.1 Seabed bathymetry and morphology

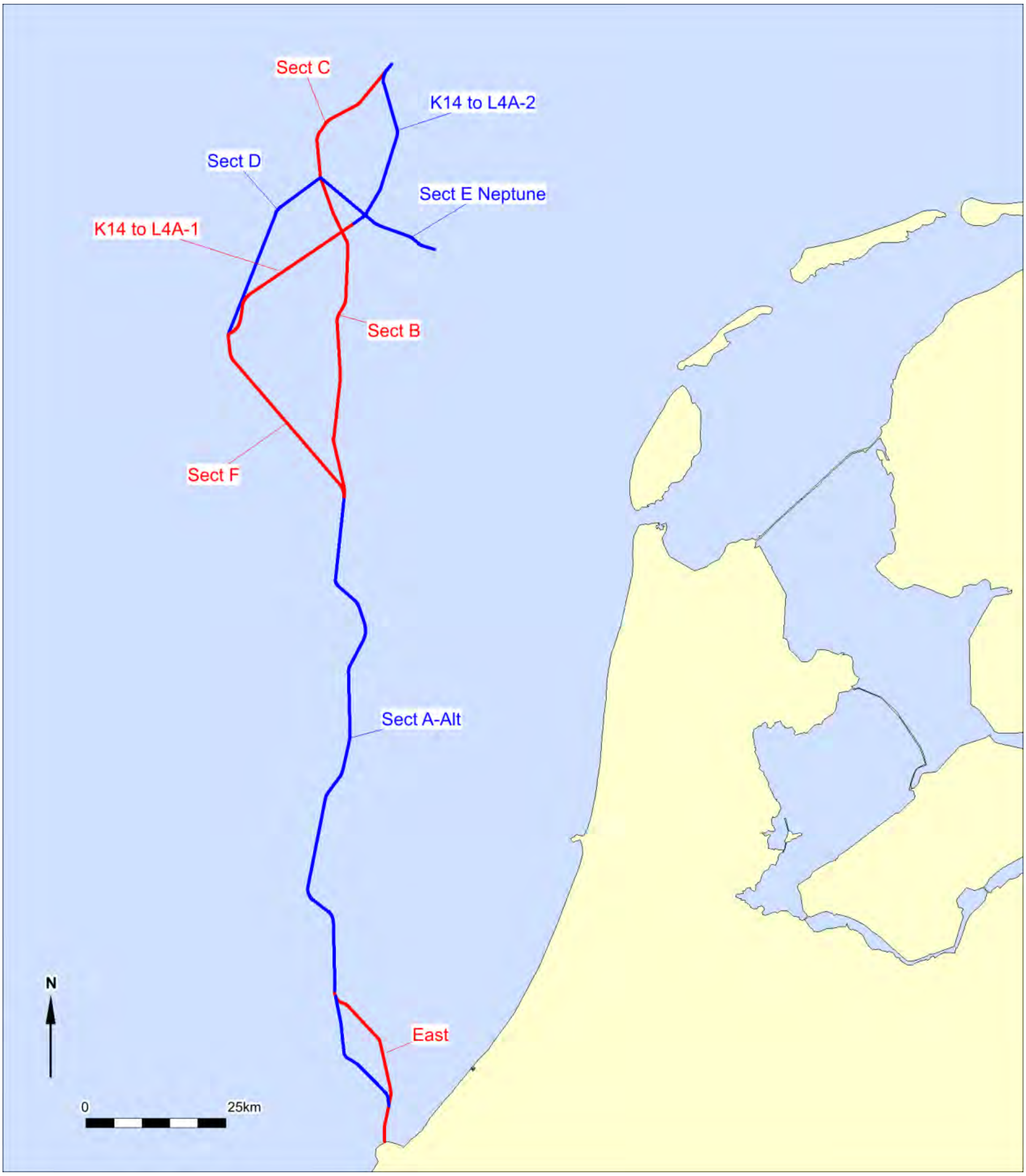

Figure 4. Sections bathymetric profiles based on the multibeam recordings (source data: Fugro 2022)

Based on the 2022 survey data the water depth within the survey corridor varies from 4.8 to 39.6 m, with an average depth of 27.0 m LAT. Bathymetric profiles along the different sections are presented in the next figure.

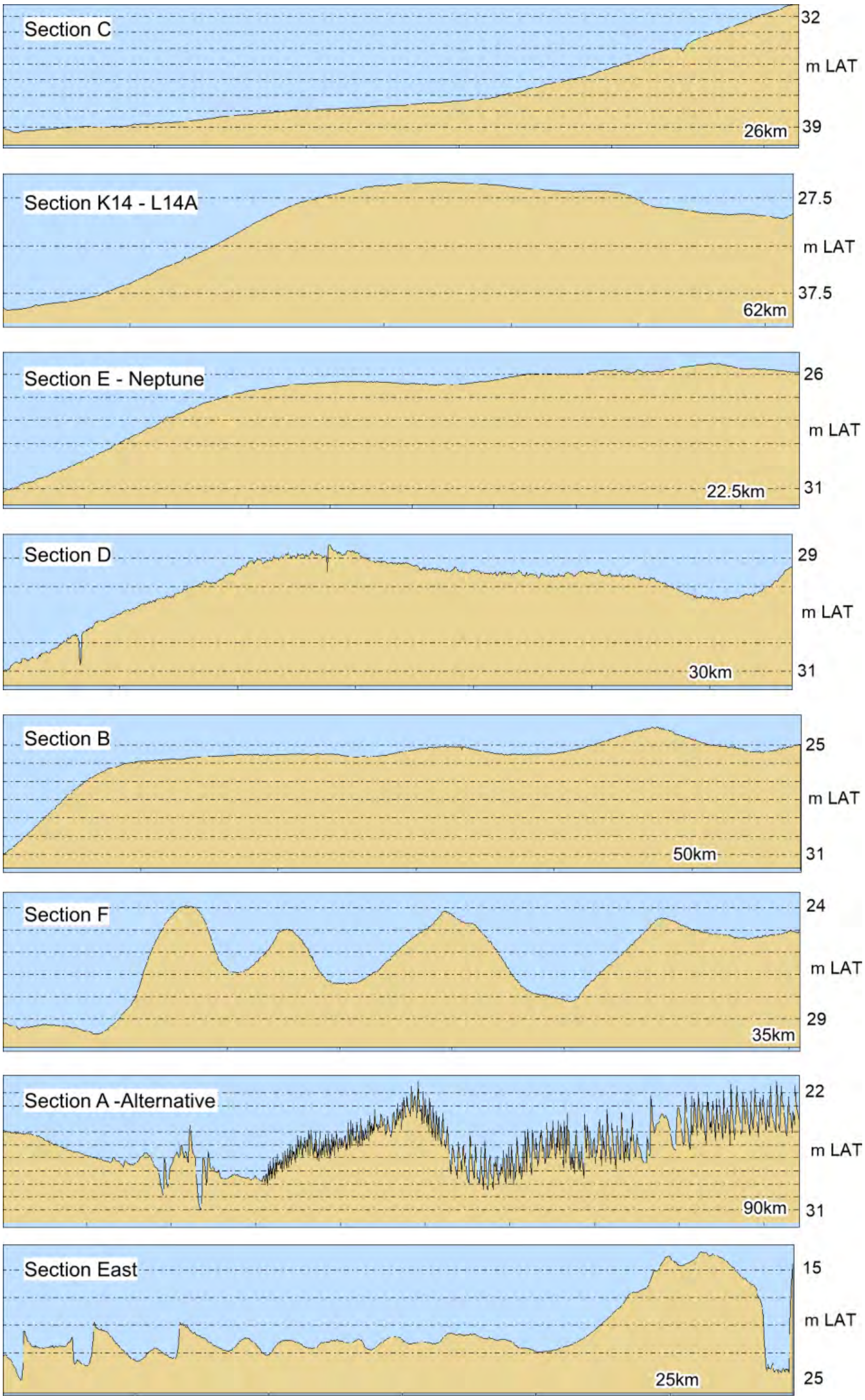

Figure 5. The seabed profiles along the different sections from north to south.

Seabed morphology

The seabed along the route is characterized by a complex pattern of bedforms of various orders. Those bedforms include very large ridges (hereafter sand banks), sand dunes, mega ripples and small ripples. The sand banks are some 2 to 2.5 km wide and stretch more or less north - south. The sand banks are separated by low-lying areas. The difference in height between the troughs and crests of the sand banks is up to 7.5 m. The wavelength of the sand dunes varies, the height of the ranges from 1 m to 3 m. Superimposed on the major sand dunes and sand banks lie mega ripples with an average wavelength of 20 m. The height of the mega ripples ranges from 0.2 m to 0.4 m. The mega ripple crests stretch west northwest - east.

Migration rate

The mobility of the seabed sediments imparts major implications to the prospection of archaeological remains in the area. Wreck remains can be covered by a layer of sandy seabed sediments, as a result the remains are not exposed to the seabed and cannot be traced with *side scan sonar.* Remains can become exposed at a later stage due to the ongoing migration of the sand dunes.

Each of the morphological features in the area has its typical migration rate. The position of the north-south oriented sand banks is fairly stable. Van der Meulen et al. (2004) reported a migration rate for sand dunes of over 20 m/year near the island of Texel, with typical migration rates decreasing southwards to a stationary (0 – 3 m/year) field near the entrance of the Rotterdam Harbour[9]. Deltares studied the migration rate of sand dunes in the Prinses Amalia WFZ and concluded that the dunes in this area migrate some 4 m/year[10].

To assess the migration rate of sand dunes in the IJmuiden Ver wind farm zone a comparison of *multibeam* data acquired 30 days apart was made. Within this short period of time a sand dune had migrated two meters and the shape of the sand dune had altered[11].

[9] Meulen, M.J. van der, et al. 2004.

[10] Fugro survey report P904162, Volume 3.

[11] Van Lil et al. 2023

3.2 Known objects: As Found positions versus database positions.

In the archaeological desk study report a total of 316 archaeological records, 458 shipwrecks, and 3494 other known objects have been reported.

However, the survey area (243 km^2) is considerably smaller than the area which had been defined as area of investigation for the archaeological desk study (11.355 km^2). Additionally, since the finalization of the archaeological desk study, new objects have been added to the NCN-database. The known objects which, according to their database positions are located within the survey area are listed in the table below.

Type	amount
Anchor with chain	2
Seabed distortion	9
Cable or chain	27
Unidentified object	124
Boulder	1
Wreck and wreck remains	8
Total	**171**

Table 7. Known objects within the surveyed area.

The SSS and MBES contacts and the MAG anomalies encountered during this survey have been stored in event listings. The positions of the contacts and anomalies in these listings are compared with the theoretical positions of objects in the NCN database. To conduct this comparison all SSS contacts and MAG anomalies found within a range of 25 meters around the database locations are selected.

The outcome of this comparison can be:

- The As Found position of a shipwreck is in agreement with the database position of a known wreck;
- The As Found position of a contact is in agreement with the position of a contact listed in the database, but the interpretations do not match;
- The As Found position of a shipwreck is not in agreement with the database position of a known wreck;
- A wreck listed in the database has not been found;
- A new wreck has been found.

Known NCN objects found

A total of 37 out of 171 known NCN objects were found during the survey.

NCN	Contact type	E	N	Survey_ID
219	Wreck remains	570384	5762003	BB_FS_SSS_0683
531	Wreck	559172	5935317	BH_FSEA_SSS_0104
967	Wreck remains	550165	5921956	BK_FSEA_SSS_0163
4543	Unidentified object	571058	5762056	BB_FS_MAG_0458
4547	Unidentified object	570585	5761590	BB_FS_SSS_0483
4559	Unidentified object	570645	5763097	BC_FD_MAG_0089
4623	Unidentified object	571139	5761040	BB_FS_MAG_0080
8099	Unidentified object	570782	5761179	BB_FS_MAG_0083
8104	Cable / Chain	570716	5761482	BB_FS_SSS_0433

NCN	Contact type	E	N	Survey_ID
8111	Unidentified object	569849	5761781	BB_FS_MAG_0129
8120	Unidentified object	570177	5761705	BB_FS_MAG_0164
8121	Cable / Chain	570729	5761506	BAB_FS_UXO_0074
13434	Unidentified object	571042	5761479	BB_FS_SSS_0431
13881	Unidentified object	570170	5761683	BB_FS_MAG_0139
13882	Unidentified object	570722	5761528	BAB_FS_UXO_0033
17443	Cable / Chain	570751	5760384	BB_FS_SSS_0019
17446	Unidentified object	569970	5761679	BB_FS_SSS_0513
17852	Unidentified object	570668	5761516	BB_FS_MAG_0147
17863	Unidentified object	570285	5761300	BB_FS_SSS_0307
17866	Unidentified object	570283	5761184	BB_FS_SSS_0241
17870	Seabed distortion	569820	5761550	BB_FS_SSS_0465
17873	Cable / Chain	570079	5761633	BB_FS_MAG_0106
17883	Unidentified object	571009	5761365	BB_FS_SSS_0355
19203	Unidentified object	570846	5761183	BB_FS_MAG_0089
19214	Unidentified object	570608	5761553	BB_FS_SSS_0464
19222	Unidentified object	571021	5761490	BB_FS_SSS_0439
19585	Unidentified object	562818	5899439	BF_FD_SSS_0019
20270	Unidentified object	571246	5761234	BB_FS_MAG_0141
20279	Seabed distortion	570157	5761591	BB_FS_SSS_0481
20280	Unidentified object	570772	5761331	BB_FS_SSS_0328
20282	Unidentified object	570154	5761363	BB_FS_SSS_0374
20283	Seabed distortion	570757	5760383	BB_FS_SSS_0019
20288	Unidentified object	571165	5761318	BB_FS_MAG_0143
29706	Unidentified object	569875	5762289	BB_FS_SSS_0835
33006	Unidentified object	563254	5896797	BF_FD_SSS_0026
33416	Unidentified object	558944	5814439	BD_FD_SSS_0218
33993	Cable / Chain	570971	5761365	BB_FS_SSS_0363

Table 8. As Found NCN objects

Known wrecks found and not found

NCN	E	N	Description	Arch value	Survey_ID
219	570384	5762003	Fishing vessel reported lost in 1945	Unknown	BB_FS_SSS_0683
531	559172	5935317	Wreck reported in 2011. 24x11x2.5m	Unknown	BH_FSEA_SSS_0104
967	550165	5921956	HMS Ivanhoe, sunk 01-09-1940 (ARCHIS ID 4030384100)	Yes	BK_FSEA_SSS_0163
1133	564181	5917118	Wreck reported in 1941, not found during several surveys	No	(not found)
1822	571084	5760899	Sailing vessel Lindis Farne, sunk 03-01-1908. Wreck cleared away according to Hydrographic service	No	(not found)
1902	569952	5777662	Wreck reported in 1945, not found during several surveys	No	(not found)

NCN	E	N	Description	Arch value	Survey_ID
2113	566176	5846859	Steam ship Nipponia, sunk 13-10-1908. Wreck cleared away to a depth of 17 m in 1909. Remains not found during several surveys	No	(not found)
32851	570262	5762370	Motorvessel Clearwater, sunk 29-08-1968. Wreck raised in 1968 according to Hydrographic service	No	(not found)

Table 9. Known shipwrecks found and not found

The five shipwrecks that have not been found during the survey are probably in a different location or completely salvaged in the past, because they were also not found during previous surveys. If they were covered in the seabed, this would have resulted in magnetic anomalies at the locations.

Examples of the shipwrecks that have been found are presented below.

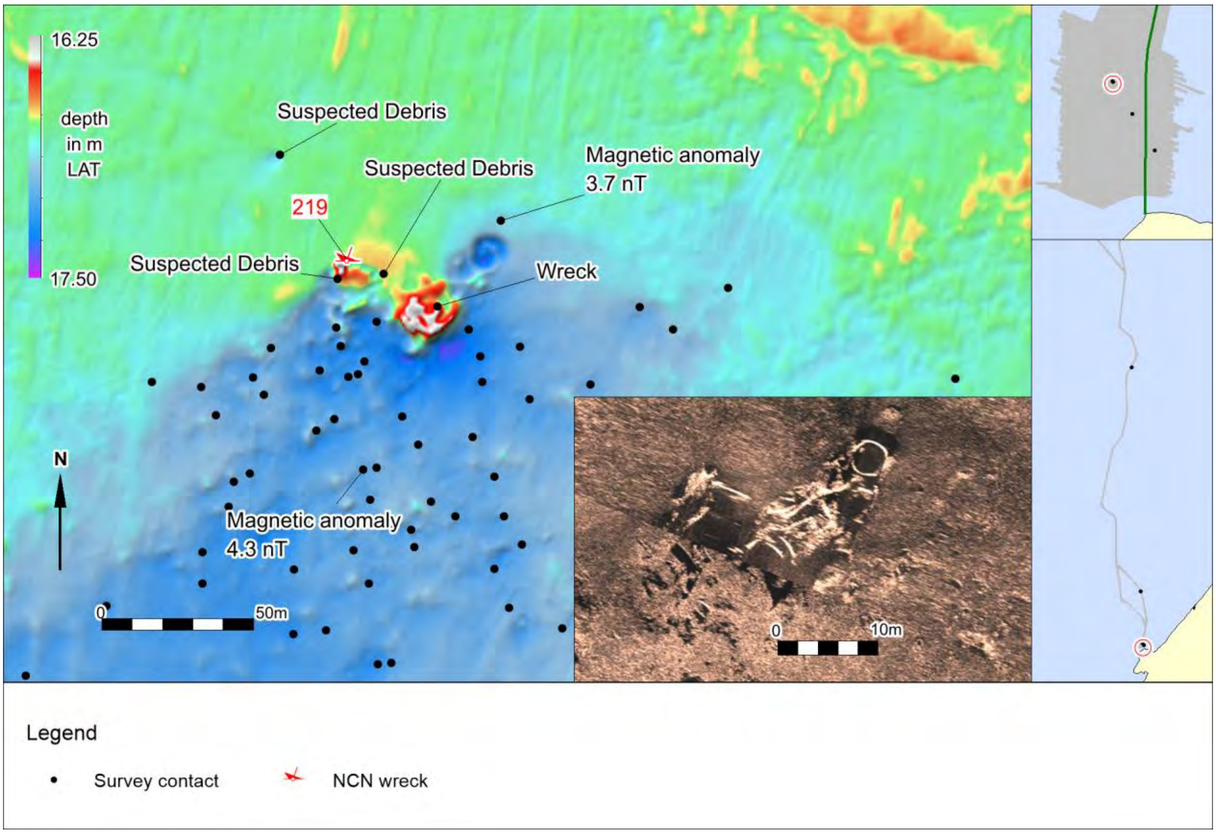

Figure 6. Multibeam image of NCN 219

NCN 219 represents the location of a fishing vessel reported lost in 1945. Both side scan sonar en multibeam images show an area of 22 x 20m scattered with debris at a depth of 17m LAT. Relatively small magnetic anomalies are observed in the surroundings of the area. The location is situated 544 meter west of the proposed route section C-East. The possible wreck remains have not been identified yet, so the archaeological value is not known. It is advised to avoid this location including a buffer zone of 100 meters during pipeline construction.

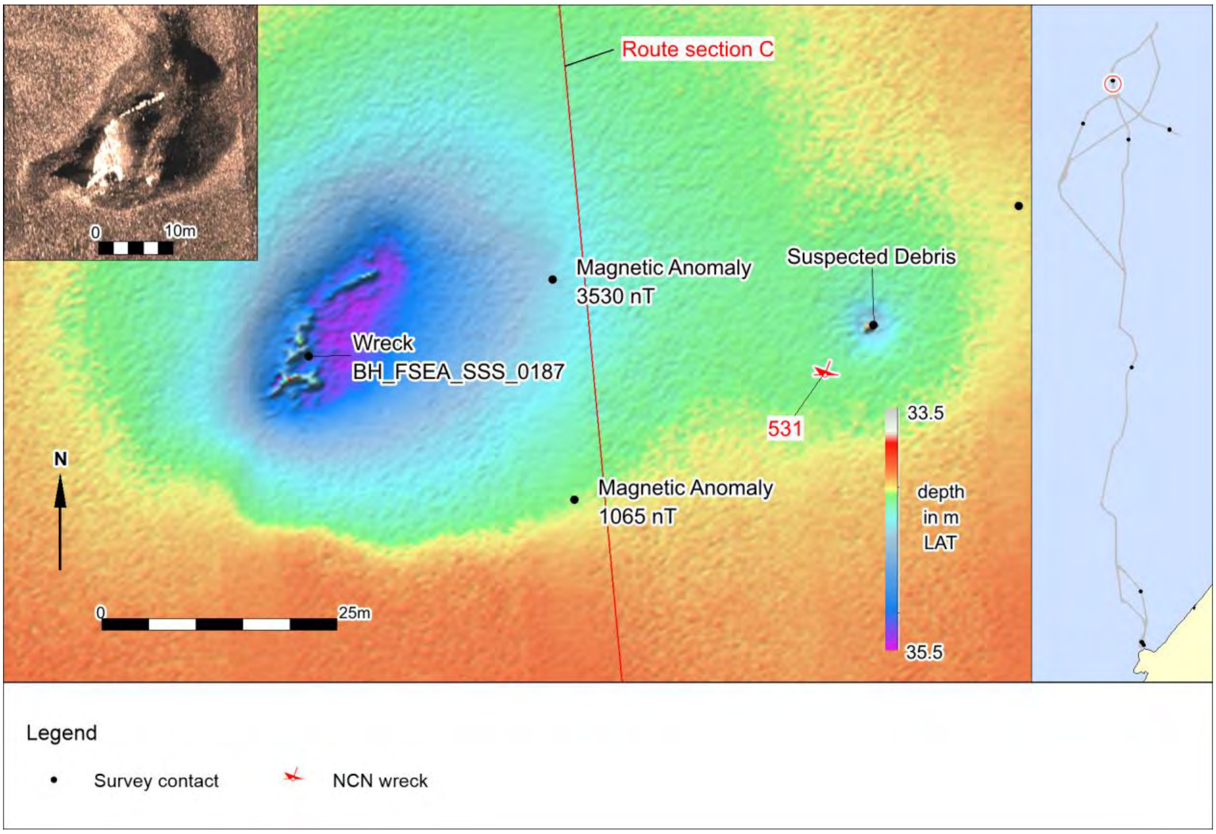

Figure 7. Sonar and multibeam image of NCN 531

NCN 531 is an unidentified wreck reported by the Hydrographic Office in 2011. Both side scan sonar en multibeam images show an area of 63 x 18m at the theoretical location of NCN 531 with a large structure in the west and a smaller object in the east at a depth of 34m LAT. Both locations lie within 30 meters of the proposed route (Section C) In between, very large magnetic anomalies are observed suggesting buried remains. The possible wreck remains have not been identified yet, so the archaeological value is not known. It is advised to avoid this location including a buffer zone of 100 meters during pipeline construction.

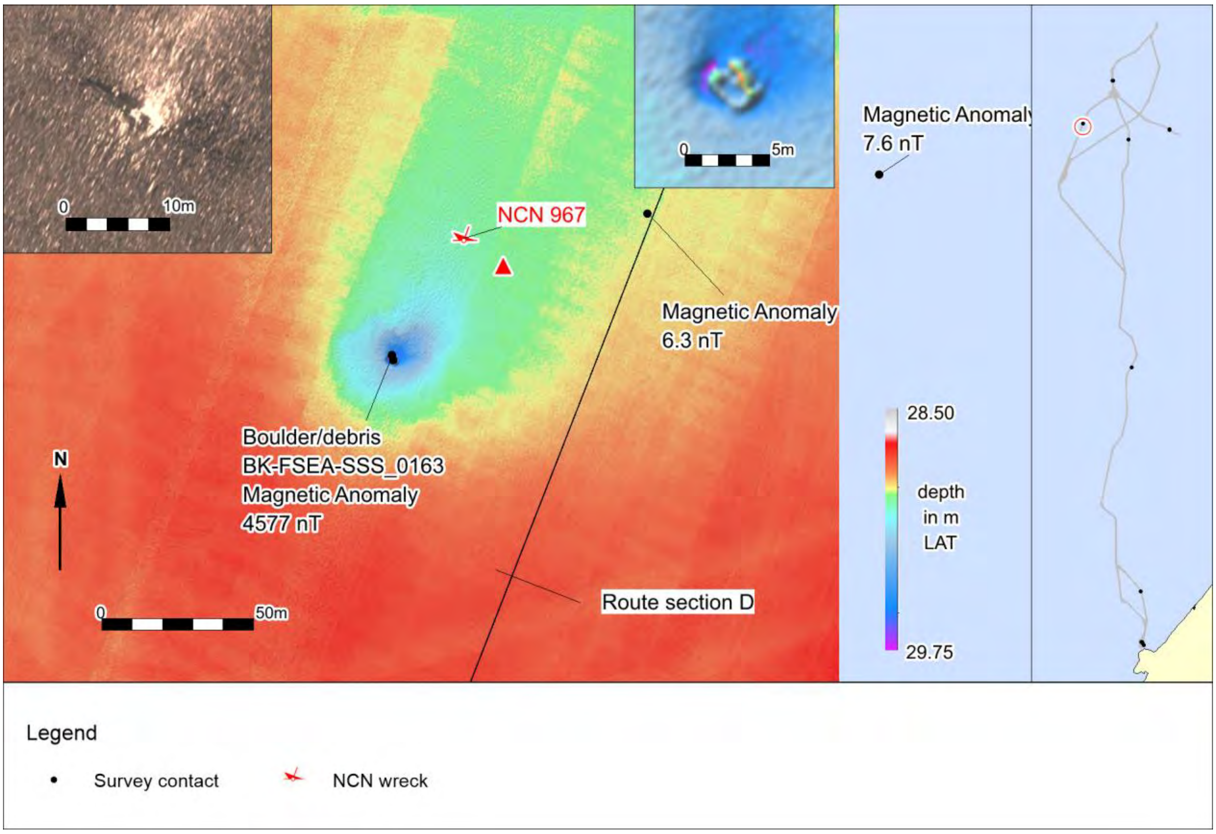

Figure 8. Sonar and multibeam image of NCN 967

Contact BK-FSEA-SSS-0163 is a square object of 2.9 x 2.6 m at a depth of 29m LAT surrounded by scouring. At the location, a very large magnetic anomaly of 4577 nT was observed. Smaller anomalies lie to the east of the object and may present buried wreck remains. The object is located within 50 meters of the theoretical position of NCN 967. This represents the wreck of the HMS *Ivanhoe*, a British destroyer built for the Royal Navy in the mid-1930's. Together with sistership HMS *Esk* it hit a mine on August 31, 1940 and sunk. The location of the wreck of the HMS ESk is confirmed and lies 2900m to the east.

The location is situated 63 meter west of the proposed route section D. If these are the remains of the HMS Ivanhoe, it is considered to be of archaeological value. It is advised to avoid this location including a buffer zone of 100 meters during pipeline construction.

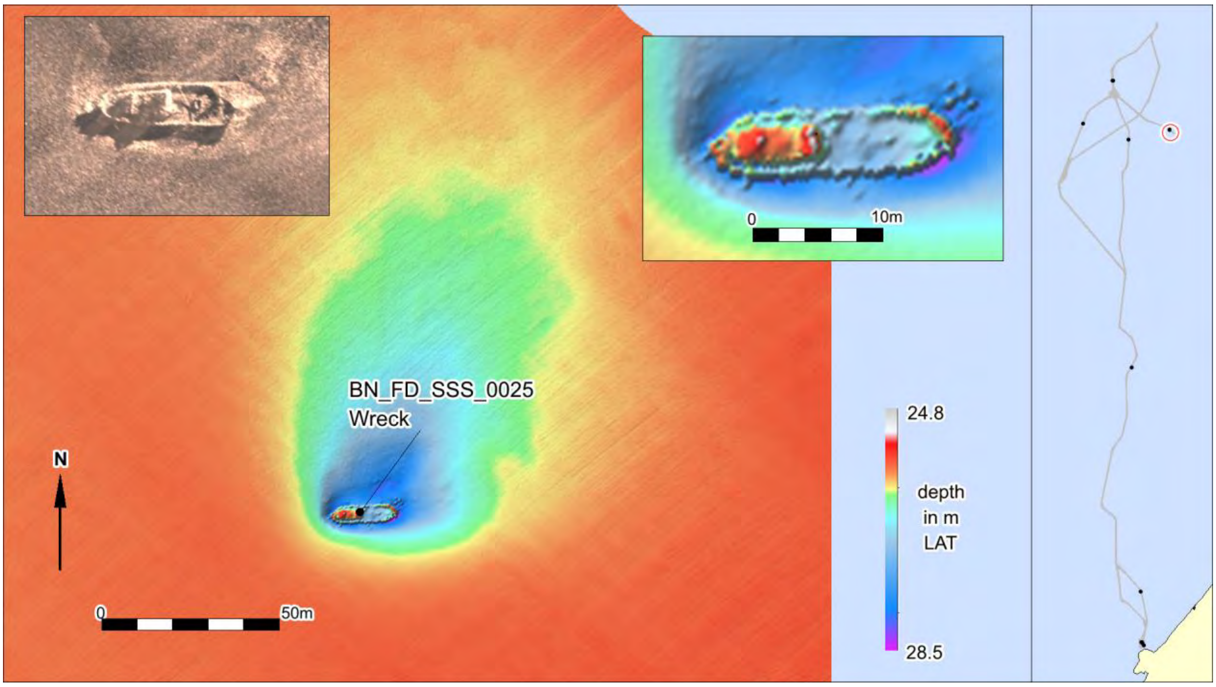

Figure 9. Sonar and multibeam image of contact BN_FD_SSS_0025

Contact BN-FD-SSS-0025 is an unidentified wreck. Both side scan sonar en multibeam images show a clear shipwreck with dimensions of 19.7 x 5.1 x 1.0 m at a depth of 25 m LAT. The location lies 220 m northeast of proposed pipeline section E.

The wreck has the characteristics of a fishing trawler. This might be a known wreck (NCN 945) which theoretical location is situated 200 meters to the north, just outside of the surveyed area. NCN 945 represents the fishing trawler *Stormvogel* (IJM 9) sunk at 7-04-1981 and has no archaeological value.

3.3 Side scan sonar

Fugro has identified 3806 *side scan sonar* contacts within the surveyed corridor. The classification of the contacts is listed below.

Classification	**Amount**
Boulder	3010
Debris	159
Depression Pockmark	5
Fishing Gear	7
Mattress	2
Pipeline	4
Seabed Mound	98
Suspected Debris	517
Wreck	4
Total	**3806**

Table 10. Side scan sonar contacts identified by Fugro

The objects classified as '*Boulder*' are found throughout the whole surveyed area. These probably also include clay boulders, because known stone boulders in the North Sea only occur north of the city of Den Helder.
All contacts which match known objects have been discussed in the previous paragraph. The remaining *side scan sonar* contacts and images have been scanned and checked for the presence of potential archaeological contacts. This is done by analyses of:

- *Side scan sonar* geotiffs;
- *Multibeam* grids;
- Comparison of *side scan sonar* and *magnetometer* contacts.

Apart from the survey data studied, the geological constellation and seabed morphology of the area are taken into account, as outcrops of geological strata and sedimentary structures can lead to (apparent) anomalies in the *side scan sonar* record.

All side scan sonar contacts greater than four meters in any dimension, 117 in total, have been examined in detail, because these objects are considered to be more likely to be related to wreck sites than the smaller contacts. The purpose of this analysis is to identify contacts that could reflect potential archaeological sites.

A summary of the outcome of the detailed inspection of selected contacts larger than four meters is presented in the table below. It should be noted that the seven contacts that are classified as '*wreck*' refer to four different wrecks, which are already discussed in the previous paragraph. Appendix 3 contains a complete listing of the results of this assessment.

Category	Amount
Anchor	1
Buoy anchor	1
Cable/chain	10
Matress	3
Natural ridge	1
Pipeline	4
Seabed disturbance	11
Shell bed	1
Shipwreck	7
Spudcan depression	4
Unidentified object	74
Total	**117**

Table 11. Results of the assessment of selected side scan sonar contacts

At total of seven side scan sonar contacts larger than four meters are attributed to four different wreck sites (which have been discussed in section 3.2) and three possible new wreck sites. Additionally, one side scan sonar contact is attributed to a large anchor. The summary of the side scan sonar records with potential archaeological interest is listed below.

Feature	Easting	Northing	Fugro	L	W	H	Z	Interpretation PPA
BK_FSEA_SSS_0022	551288	5924521	Boulder	5.6	2.9	5.2	-29.8	Buried remains with magnetic anomalies - wreck remains
BK_FSEA_SSS_0179	555839	5929168	Boulder	6.7	5.7	1.0	-30.3	Large anchor shaft 3.2m arms 2.1m with scouring
BJ_FD_SSS_0015	548443	5894128	Debris	5.6	1.8	0.0	-26.4	Elongated object 5.6m - wreck remains
BB_FS_SSS_0433	570711	5761481	Wreck	4.3	2.4	0.3	-18.9	Oval contact, possibly wreck remains

Table 12. Listing of side scan sonar records with potential archaeological interest.

The results with examples of the four objects are discussed below.

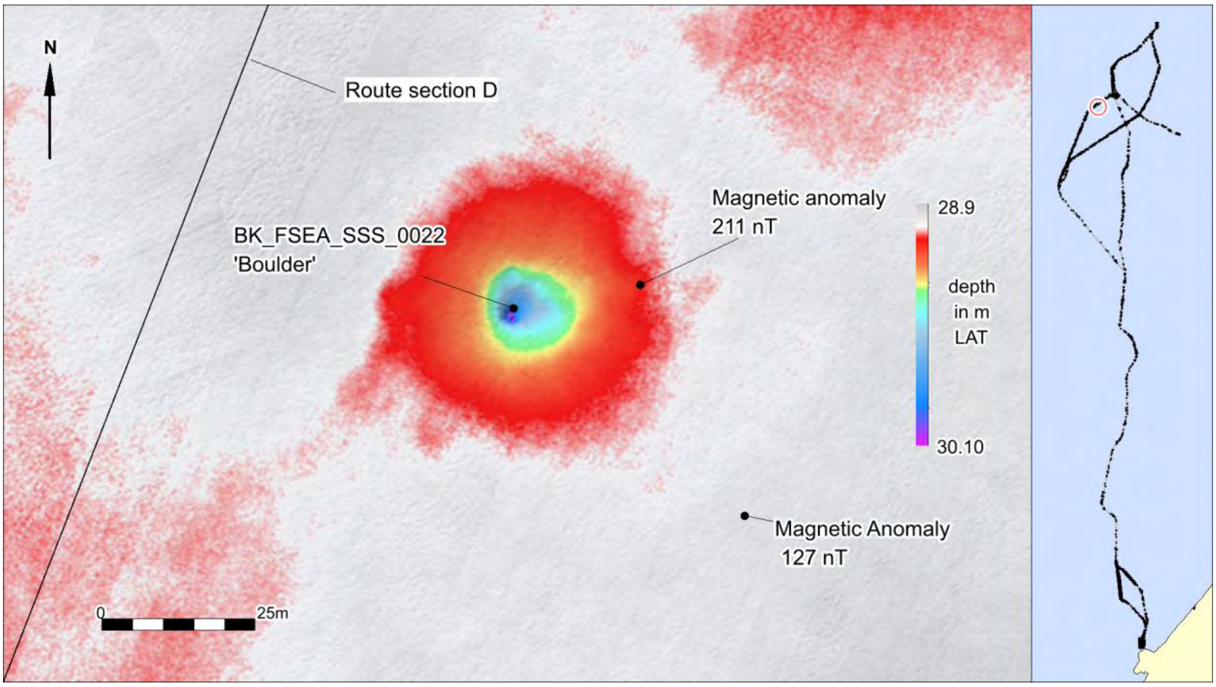

Figure 10. Multibeam image of survey contact BK-FSEA-SSS-022

Contact BK-FSEA-SSS-0022 was interpreted by Fugro as a '*boulder*'. The multibeam image shows an object surrounded by a round scour depression with a diameter of 30 meters and a relative depth of one meter.

Two large magnetic anomalies have been observed to the east of the contact. These might represent a buried structure; possibly unidentified wreck remains. The location lies 55 meters east of route section D.

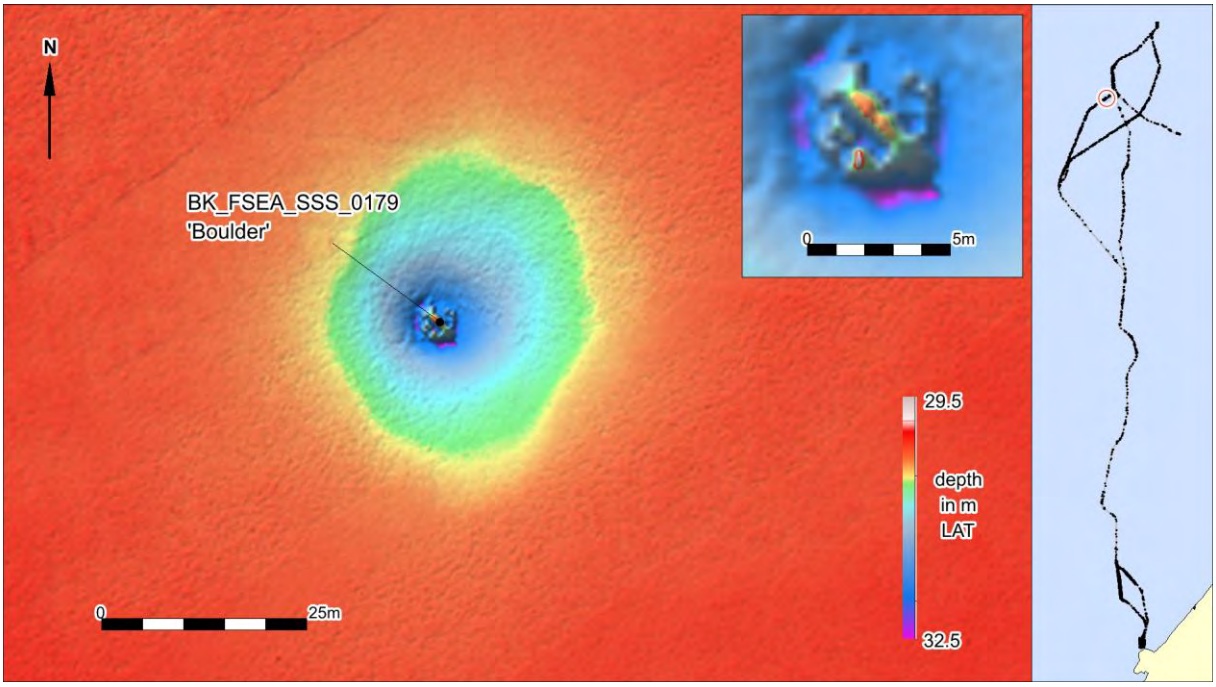

Figure 11. Multibeam image of survey contact BK-FSEA-SSS-0179

Contact BK-FSEA-SSS-0179 was interpreted by Fugro as a '*boulder*'. The multibeam image shows a triangular object surrounded by a round scour depression with a diameter of 20 meters and a relative depth of 1.5 meter. In more detail, the object resembles an anchor with a shaft length of 3.2 meters and arms of 2.1 meters. This might be an historical Admiralty Pattern anchor, or simply "Admiralty", commonly used in the 17th and 18th century. The location lies 240 meters west of route section D.

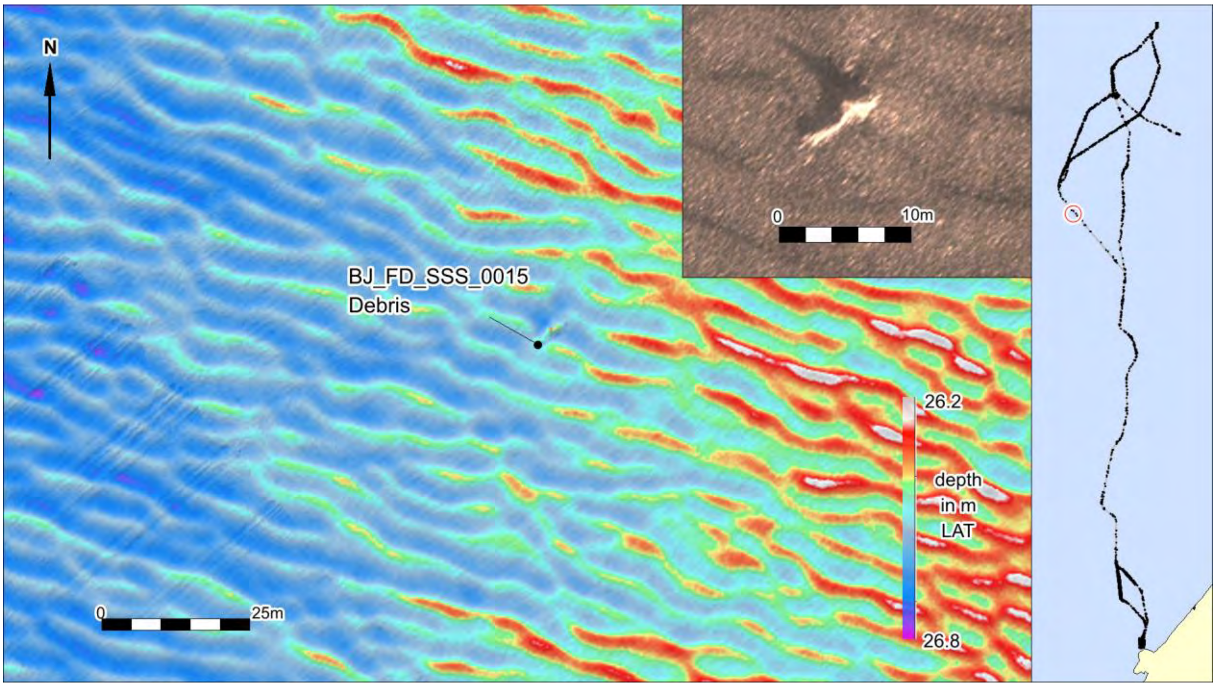

Figure 12. Sonar and multibeam image of survey contact BJ-FD-SSS-015

Contact BJ-FD-SSS-0015 was interpreted by Fugro as a '*debris*'. Both multibeam and side scan sonar images show an elongated irregular object of 5.6 x 1.5 x 1.0 meters perpendicular to the surrounding sand ripples. No magnetic anomalies have been observed in the surrounding area. The object might be the remains of a wreck. The location lies 232 meters east of route section F.

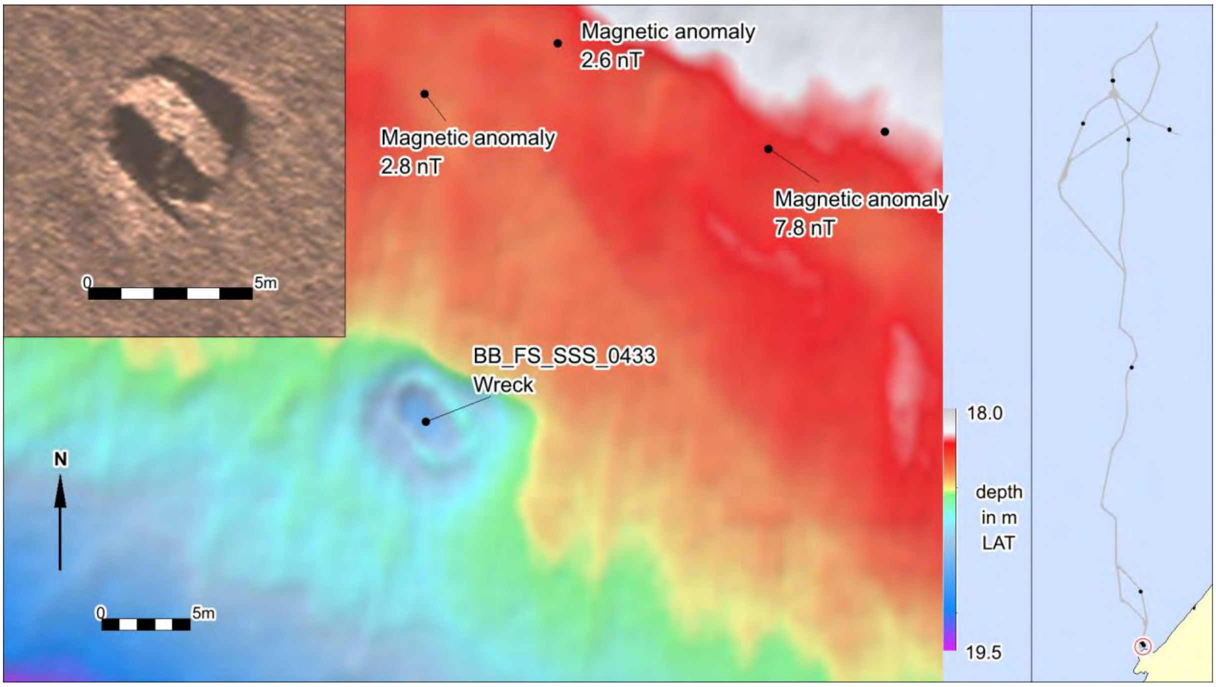

Figure 13. Multibeam image of survey contact BB-FS-SSS-0433

Contact BB-FS-SSS-0433 was interpreted by Fugro as a 'wreck'. Both multibeam and side scan sonar images show an oval object of 4.3 x 2.4 x 0.3 meters surrounded by (relatively small) magnetic anomalies. The object might be the remains of a wreck. The location lies 216 meters west of route section West.

Summary of side scan sonar / multibeam contacts

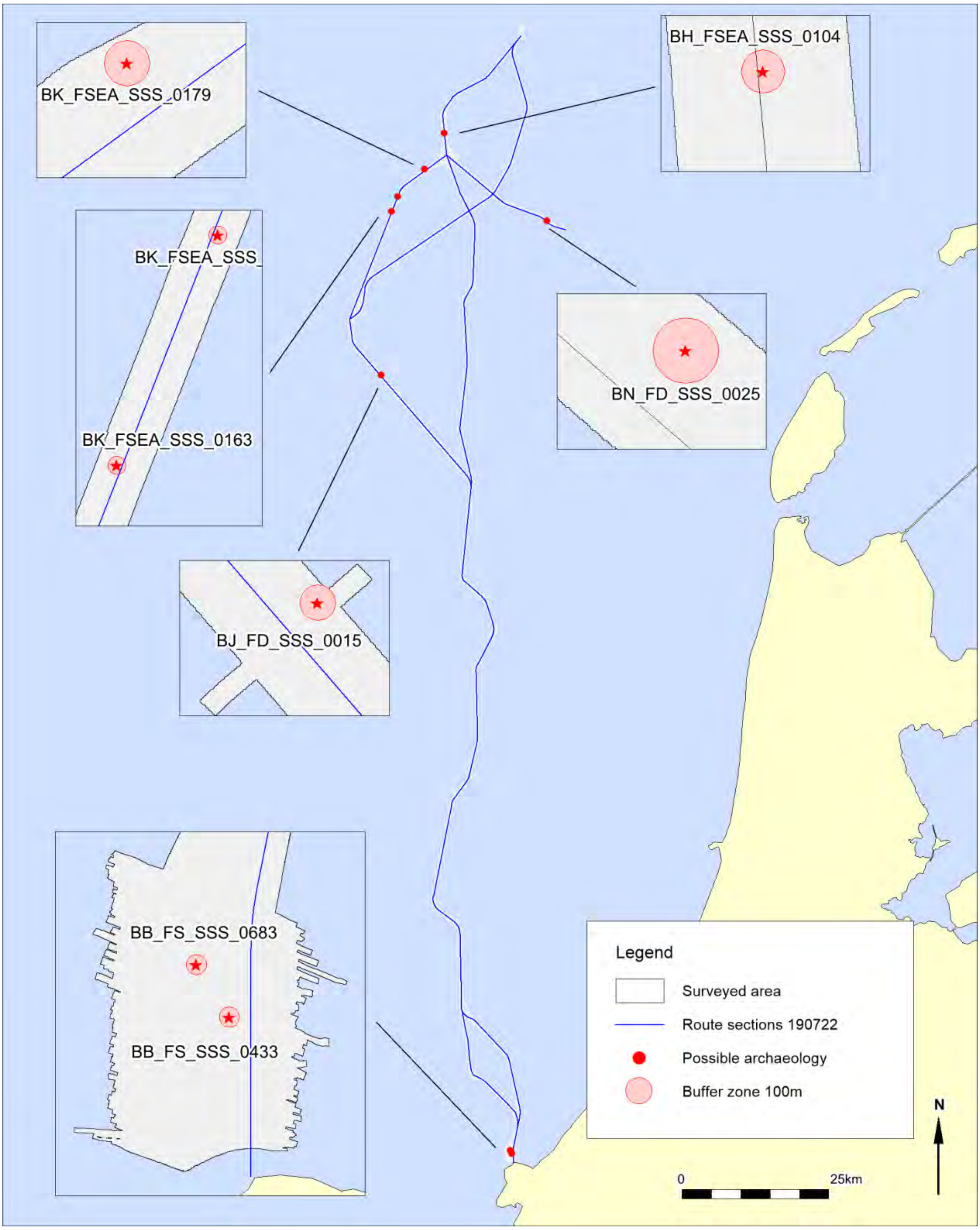

Figure 14. Overview of all side scan sonar / multibeam contacts with an archaeological expectation

3.4 Multibeam

Apart from the *multibeam* images discussed in the previous sections no *multibeam*-features have been observed outside the side scan sonar contacts which are interpreted to reflect the presence of archaeological objects or structures.

3.5 Magnetometer

A total of 2748 magnetic anomalies have been observed within the area of investigation. An overview is given in the next figure.

Figure 15. Spatial distribution of all magnetic anomalies

A number of these anomalies can be related to infrastructure (cables and pipelines), but the majority have an unknown origin. Although the nature of these objects is not known it is possible that the anomalies represent archaeological remains buried in the seabed, and therefore have to be taken into account within this assessment. The average line spacing for the magnetometer was 20 to 40 meters. A minimum value of 500 nT has been used to classify the objects as potentially archaeological targets.

Note on magnetic anomalies and value of 500 nT.
A magnetic anomaly is a local deviation from the natural magnetic field, expressed in nanoTesla. The measured value depends on the mass of the iron contained by an object, but also largely on the distance between magnetometer and the object. With a relatively large line spacing (>= 100m) chances are, that objects are missed or have an apparent lower reading on the magnetometer.

For example: a mass of 1000 kg iron results in a value of 50 nT at 12 meters, and 500 nt at 5 meters. The term 'large anomaly' is therefore subjective and depends mainly on the line spacing of the magnetometer survey.

For archaeological assessments, as a rule of thumb, the following minimum values for unidentified deviations are therefore considered to be of archeological interest:
Line spacing ~100 meters: 50 nT
Line spacing ~50 meters: 500 nT

According to Fugro, 212 anomalies with an unknown origin are larger than 500 nT. After re-examination, 202 anomalies can be associated with known present objects like pipelines and wellheads.

Association	Amount
Cable	1
Pipeline	194
Wellhead	2
Known NCN	5
Unknown	10
Total	**212**

Table 13. Magnetic anomalies over 500 nT

The remainder, a total of 10 magnetic anomalies, cannot be related to known pipelines and cables, or visible objects at the seabed surface. These anomalies are induced by unknown ferrous objects buried in the seabed, covered by sediments. These objects could consist of pieces of cable, chain, debris, lost anchors, UXO, iron parts of shipwrecks, et cetera. The 10 objects which induced anomalies of more than 500 nT are considered to be of potential archaeological interest, until proven differently.

An overview is presented in the figure below.

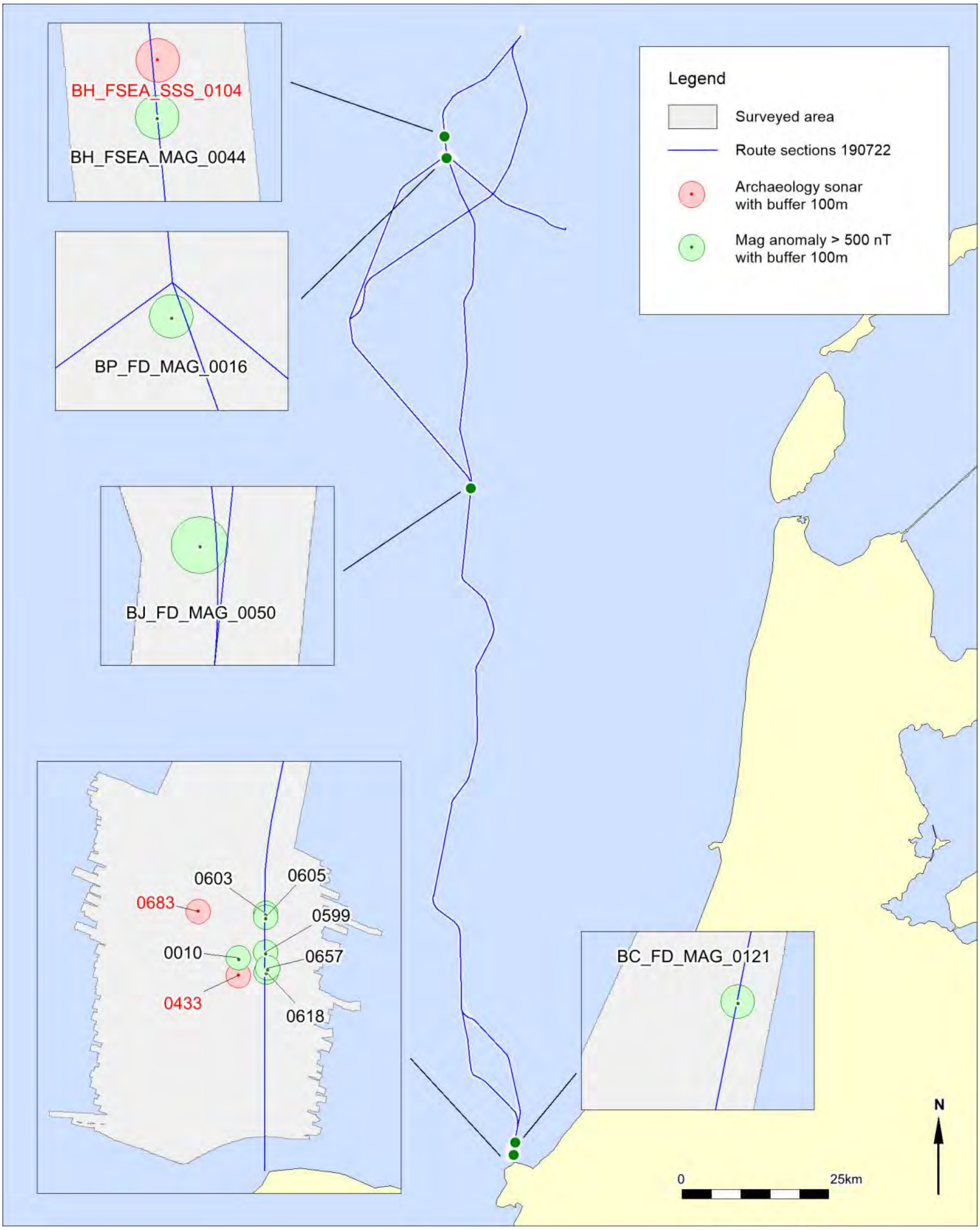

Figure 16. Magnetic anomalies larger than 500nT not related to known objects, infrastructure or objects found with side scan sonar.

3.6 Subbottom data

Desk study results

The archaeological desk study has indicated that the combined thickness of the *Holocene* sequence is expected to range from 0 to 30 meters in the area.

The variations in thickness are due to:

- lateral variations in water depth, mobility of the seabed, sediment supply and sedimentation rate from the onset of the Early Holocene till present day.
  general trend:
  a) near coastal shallow waters with high mobility of seabed in the southern part: high thickness of Holocene cover;
  b) distal parts of trajectories with deep waters and low mobility of seabed: thin Holocene cover;

- the morphology of the seabed
  a) in part of the trajectory sand ridges and sand waves occur (Pleistocene deep-seated), which alternate with:
  b) low-lying areas in between those ridges and sand waves (Pleistocene more roximate to seabed surface);

- the original morphology Pleistocene landscape which was present prior to the Holocene marine ingression in the area;

- the various extent to which the Pleistocene landscape has eroded during the Holocene marine ingression.

The *Holocene* units include the surface sediments of the Bligh Bank Member (south) and Terschellingerbank Member| Southern Bight Formation and the Urania Formation (north). Those units locally cover deposits of the Wormer Member | Velsen Bed | Naaldwijk Formation and/or the Basal Peat Bed | Nieuwkoop Formation.

Just north of the Maasgeul a more than one-meter-thick bed of stiff Early to Mid-Holocene river clay is present. This clay is part of the Echteld Formation and wedges out to the north. Stratigraphically this clay of the Echteld Formation is positioned in between the Basal Peat Bed and lagoonal and marine deposits of the Wormer Member | Naaldwijk formation. Further, in the Maasgeul area Early Holocene overbank deposits of the Rhine can be present. These stiff ripened clays and silts are classified as the Wijchen Bed | Kreftenheye Formation. On top of the Wijchen Member locally Early Holocene wind-blown deposits (river dunes) of the Delwijnen Member can be present. The flanks of these river dunes are covered by the Basal Peat bed and Echteld Formation.

The *Holocene* deposits cover *Pleistocene* units of:

- the Eem Formation (Eemian marine)
- the Brown Bank Member | Eem Formation (Early Weichselian lagoonal and shallow marine)
- the Kreftenheye Formation (Pleniglacial river), and
- the Boxtel Formation (Late Glacial terrestrial - stream deposits and aeolian).

To illustrate the variations in the subsurface geology we present in figure 17 the Top Pleistocene Map by TNO | Laban from 2004 and the Geological Map of the Netherlands produced by Geological Survey of The Netherlands in 2021. This image provides a reference framework for the interpretation of the subbottom profiler data.

In the left panel of figure 17 the 2004 Top Pleistocene map is displayed. This map shows the Pleistocene units that subcrop below a cover of Holocene deposits. Those Holocene deposits include the mobile sands of the Bligh Bank Member | Southern Bight Formation and towards the north the Terschellingerbank Member | Southern Bight Formation and Urania Formation which are exposed at the seabed over the full extent of the route. Locally these recent deposits cover Early Holocene deposits of the Basal Peat Bed | Naaldwijk Formation and Wormer Member | Naaldwijk Formation.

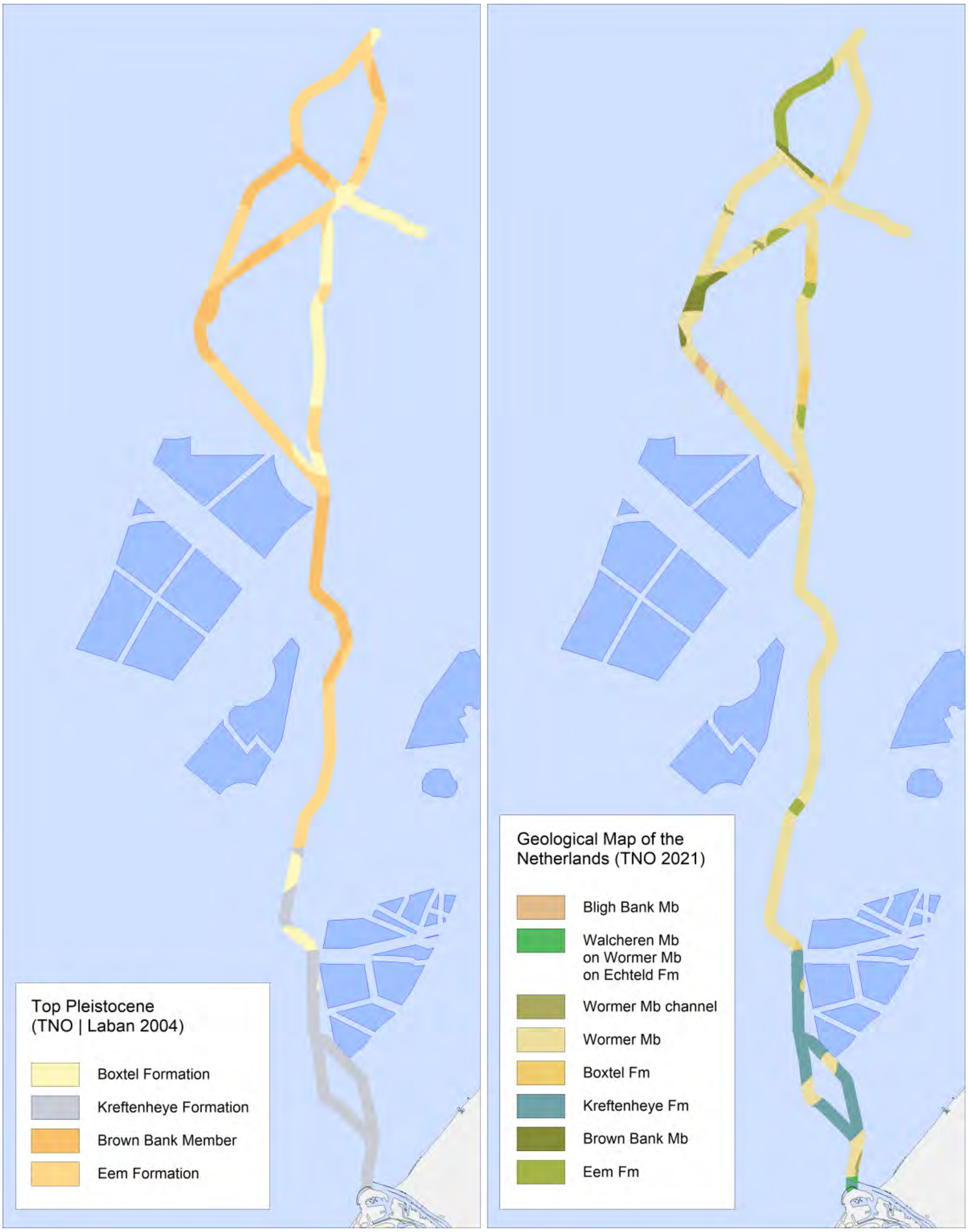

Figure 17. Subcropping Pleistocene units within 2000-meter corridor along the optional Aramis routes according to the 2004 Top Pleistocene Map and 2021 Geological map of the Netherlands; wind farm sites displayed to provide some spatial context.

As described above, in the Maasmond area Early to Middle Holocene fluvial clays of the Echteld Formation are present. Also, local occurrences of Early Holocene river dunes of the Delwijnen Member | Boxtel Formation and repined overbank clays of the Wijchen Member | Kreftenheye Formation could be encountered.

The Geological Map of the Netherlands is shown in the right panel of figure 17. This image shows the units that are subcropping below the Southern Bight Formation and Urania Formation. Contrary to TNO | Labans' map those subcropping deposits also include Holocene units.

In the online explanatory document that comes along with the Geological map the following is stated: '*Coversand (BX4: Boxtel Fm, Wierden Mb) and loess (BX5: Boxtel Fm, Schimmert Mb) are only shown if more than 2 m thick. The ubiquitous layer of actively transported open-marine sand (SB2: Bligh Bank Mb) is only shown if it is more than 7 m thick. Anthropogenic deposits are not shown on the map.*'

Occurrences of the Boxtel Formation are very often less than 2 meter thick. It should therefore be borne in mind that in areas where other units such as the Brown Bank Member are mapped the Boxtel Formation can still be present as a thin bed topping this unit.

Another important note is that recent research in the IJmuiden Ver Wind Farm Zone and personal communication with Cees Laban indicates that offshore deposits that in the past - based on seismic data - were classified as the Wormer Member[12] also include small-scale fluvial and aeolian deposits of the Late Glacial Boxtel Formation. The Boxtel Formation is often found offshore in stream valleys. Stream valleys were low-lying parts of the paleo-landscape. Because of this relative low-lying position and the presence of firm beds of the Early Holocene Basal Peat Bed and clayey Velsen Bed the Boxtel Formation was better protected against erosion in the stream valleys than in the surrounding landscape.[13]

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[12] In the 20th Century the units that currently are classified as the Wormer Member and Basal peat Bed were mapped as the 'Elbow Formation'.

[13] Pers. Comm. F. Busschers 2023.

Assessment of seismic data

Table 14 shows the shallow seismic units which have been identified by Fugro along the Aramis route trajectories. The table contains an interpretation of the lithostratigraphic units that according to Fugro could be part of the identified seismic units.

Dataset	Unit	Horizon Top	Horizon Base	Seismic Signature and Character of the Base	Distribution	Lithology[1]	Geological Formation / *Member*	Depositional Environment
SBP	DS	H00	H_DS	Semi-transparent and chaotic. The basal reflector marks the change from chaotic to acoustically transparent or structured seismic facies.	Present in nearshore part only (Maaskanaal)	Clayey sand to sandy clay	-	-
SBP	A	H00	H10	Acoustically transparent to chaotic, with locally high amplitude reflections. Base is marked by a medium to high amplitude, flat reflector.	Present across the entire route	Sand	Southern Bight	Marine
SBP, 2D-UHRS	B	H00, DS, H10	H15	Various; semi-transparent and structureless to locally bedded with low to medium amplitude parallel reflectors; locally, internal channels with high amplitude parallel reflectors observed; locally internal erosion surfaces observed. The base is locally channelised and the infill of these channels has typically chaotic or structured (layered) character with high amplitude reflections. The basal reflector has a medium to high amplitude; irregular to undulating. High amplitude (negative on the 2D-UHRS) reflectors may indicate layers/pockets of peat / organic clay frequently present in this unit.	Present basically across the entire route; locally absent in the southern part of the route	Sand, clay, locally laminated sand and clay, locally thin beds or laminae of peat	Naaldwijk Boxtel Kreftenheye	Coastal to tidal-flat, locally lagoonal; locally periglacial to fluvial
2D-UHRS	C	H15	H20	Mostly structured (layered) with low to medium-amplitude parallel reflectors. Locally, in the upper part of the unit, structureless, semi-transparent interval locally semi-transparent, structureless. In the north-eastern part of the route, the unit is characterised by overall semi-transparent seismic facies with local high amplitude negative reflectors of various extent. The high amplitude reflectors may indicate layers of pockets of peat and/or organic clay. Base forms a sub-horizontal erosional surface, locally forming broad channels/depressions.	Present in the central and large portion of the northern part of the route	Laminated sand and clay, locally sand, locally thin beds or laminae of peat	*Brown Bank*	Lagoonal, estuarine, tidal flat
2D-UHRS	D	H15, H20	H25	Acoustically transparent to semi-transparent, structureless. Locally, layered intervals, internal erosion surfaces marked by strong undulating or inclined reflectors. Internal channelling features are locally present. The infill of these channels is various from chaotic to structured (layered). Base forms a sub-horizontal erosional surface, locally forming channels.	Present almost across the entire route, except small area in the centre and in the most southern part of the route	Sand	Eem Kreftenheye (nearshore)	Marine
2D-UHRS	E	H25	H30	Acoustically transparent to semi-transparent, structureless; locally chaotic. Base forms a sub-horizontal erosional surface, locally forming channels.	Present in the northern part of the route	Sand	Egmond Ground	Marine
2D-UHRS	F	H25, H30	H35	Semi-transparent infill with occasional amplitude anomalies. locally discontinuous, wavy and steeply inclined medium-amplitude reflectors. Internal channels near the top. The basal reflector forms U-shaped channel / valley.	Present locally in the northern and central part of the route	Sand with clay interbeds	Peelo	Fluvio-glacial, glacio-lacustrine (subglacial valley infill)
2D-UHRS	G	H20, H25, H30, H35	H40 (internal) / BPD	Chaotic to acoustically semi-transparent, locally discontinuous, inclined medium-amplitude reflectors. Locally, internal erosion surfaces and internal channels / channelling features. Horizon H40 marks internal erosion surface, at which locally high amplitude negative reflectors are present, indicating a thin bed or laminae of peat /organic clay.	Present across the entire route	Sand with local clay interbeds	Yarmouth Roads	Fluvio-deltaic to marine

Notes:
DS = disturbed sediments
Hyphen = not applicable
BPD = below penetration depth of seismic reflection data
1) = predominant soil type; more detailed information will be provided in the Integrated Report (F197217-REP-007), which will include data of the geotechnical investigation

Table 14. Overview of seismostratigraphic units (source: Fugro survey report F197217-REP-001)

The result of the assessment of the prehistoric landscapes from the subbottom profiler and UHRS data is described below. A geological x-section from south to north along the sections nearshore east, A, B, and C is included as Appendix 3 in this report. Focus is put on the upper 5 meters below the seabed plane that marks the base of the mobile seabed sediments, because the As Planned pipeline installation foresees a burial depth of 1 m below the seabed after a pre-sweep of sand waves have been carried out. This does not mean that geological units that occur at greater depths are fully disregarded. Phenomena of interest for the evolution of prehistoric landscapes are looked into.

Section Nearshore East

This x-section covers:

- the landfall of the pipeline at the Maasvlakte 2,
- the pipeline crossing of the Maasgeul,
- the shallow parts of the seabed with depths less than 15 meters north of the Maasgeul between KP 1.5 and KP 8.5 in a section that can be described as a bulge, and
- the trajectory between KP8.5 and KP 30.6 with depths varying from 20 to 30 meters.

Both on the southern and northern edge of the Maasgeul Pleistocene en Holocene units are exposed at the intersection of these layers and beds with the Maasgeul. North of the Maasgeul the top of Unit B likely consists of Mid-Holocene fresh-water fluvial tidal deposits of firm to stiff clay with plant remains. This bed of clay is part of the Echteld Formation.

To illustrate the different sediment beds and lithostratigraphic units that are contained in Unit B in the Maasgeul area we projected the lithological column of DINO borehole B37A0952 onto the x-section of the Nearshore East section. The borehole lies 46 m west of the route trajectory. No lithostratigraphic interpretation is given in DINO.

We interpret the sequence from bottom to top as:

- medium coarse sand of the Kreftenheye Formation,
- peat and organic clay of the Basal Peat Bed,
- very coarse sand with clay bed of Wormer Member (?),
- clay of the Echteld Formation.

Between KP 1.5 and KP 6.5 the Echteld Formation is covered by tidal deposits of the Wormer Member and the Walcheren Member | Naaldwijk Formation, and mobile sands of the Bligh Bank Member | Southern Bight Formation (Unit A). Within this KP 1.5 to KP 6.5 section the Echteld Formation wedges out towards the north.

Further north, around KP 5.0 foresets are observed in the upper part of Unit B (see figure 18 below). We interpret the upper part of Unit B as estuarine deposits of the Naaldwijk Formation. At the base Fugro mapped acoustic blanking. It is not known if the blanking is related to occurrences of peat in the subsurface.

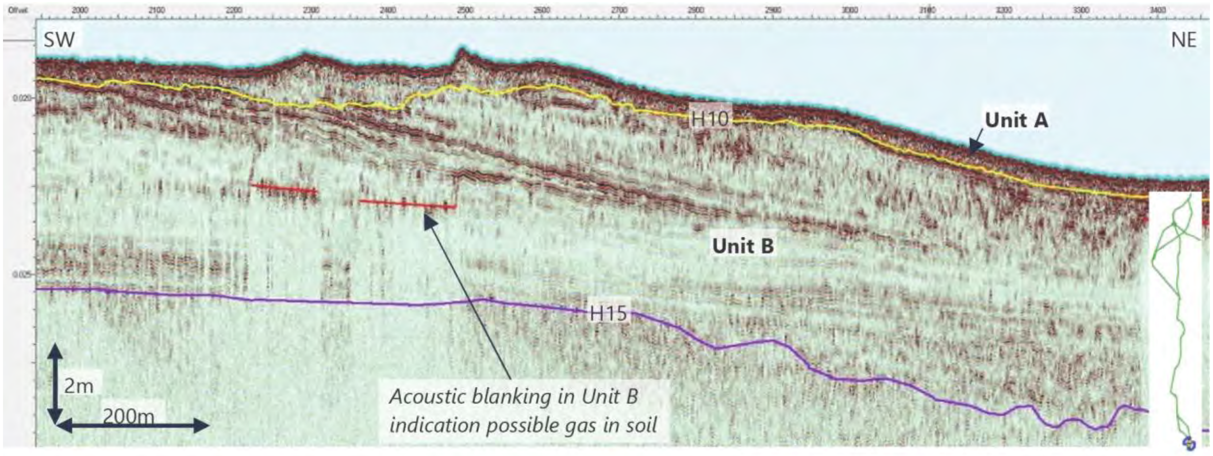

Figure 0.12: SBP data example of acoustic blanking in Unit B. (Line SBP_TA3C2020P1)

Figure 18. Wormer Member | Naaldwijk Formation in the upper part of Unit B around KP 5.0 of the Section Nearshore East

The section between KP 8.5 and the end of Section Nearshore East at KP 30.5 shows a gradual thickening of Unit A. The thickness of Unit B varies from 1 to 4 meters. Possibly Unit B represents tidal deposits of the Wormer Member. However, this is not certain. As can be seen in figure 19 Unit B has a (semi)transparent character, while the underlying Unit C has a more homogenous character with occasional anomalies. It might be possible that both Unit B and Unit C consist of Pleistocene deposits of the river Rhine that are classified as the Kreftenheye Formation, with H15 being an internal reflector.

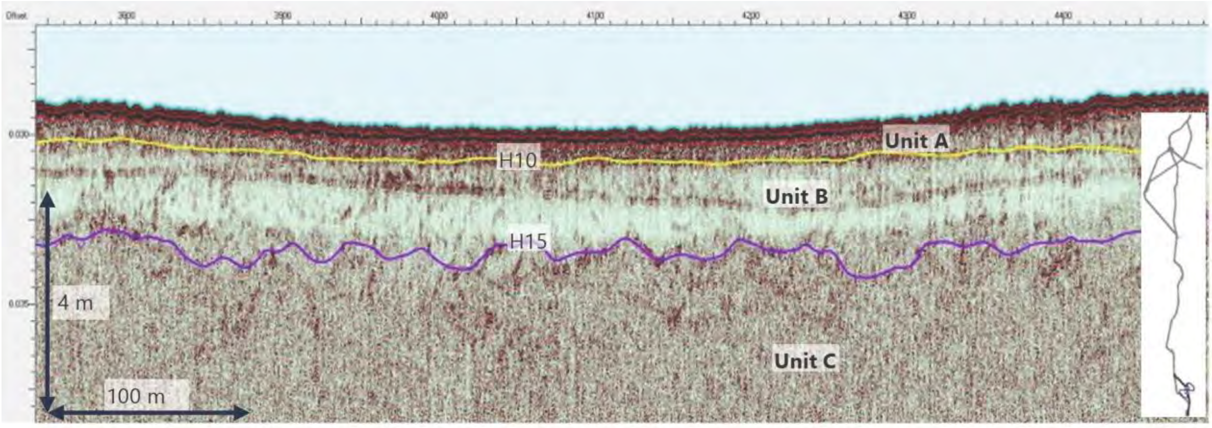

Figure 0.9: SBP data example of route section Export Route East MT. (Line SBP_TA3C2016P2)

Figure 19. River sands of the Kreftenheye Formation (Unit C). The interpretation of Unit B is uncertain. Unit B could also consist of the Kreftenheye Formation with H15 as an internal reflector or Unit B consists of Holocene tidal deposits of the Wormer Member.

Section A

In this section the seabed morphology is characterized by up sand dunes with elevations up to 5 meter relative to the surrounding seabed. The sand dune crests lie on average some 500 meters apart. The sands from which the dunes are built are classified as the Southern Bight Formation | Bligh Bank Member. The base of the Unit A (reflector H10) likely coincides with the base of the Bligh Bank Member. However, in places where the Bligh Bank Member covers sandy deposits of the Wormer Member, the layer boundary between those two lithostratigraphic units might not show as a reflector in the subbottom profile. Where a classic Early Holocene bottom to top sequence of the Nieuwkoop Formation | Basal Peat Bed, organic clay of the Naaldwijk Formation | Velsen Bed and coarsening upward fine sand of the Naaldwijk Formation | Wormer Member has been preserved intact, the transition from the generally thin layers of the Basal Peat Bed and Velsen Bed to underlying Pleistocene sands will show as a distinct reflector in the subbottom profile. Therefore, it is possible that Unit A also includes those Early Holocene organic and argillaceous deposits. Intermittent occurrences of peat and/or organic clay have been mapped at the transition from Unit A to Unit B. We interpret these occurrences of peat and organic clay as the Basal Peat Bed and Velsen Bed. An example is shown in figure 20.

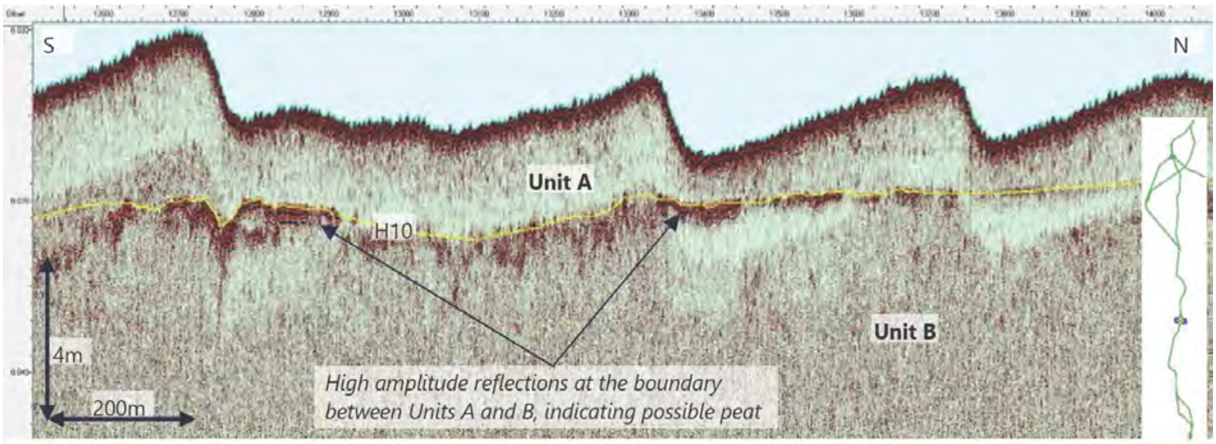

Figure 0.11: SBP data example of anomalies indicating possible peat in Unit B. (Line SBP_TA3E2134P1)

Figure 20. Possible peat the transition from Unit B to Unit A

As can be seen in x-section A in Appendix X, peat also occurs as beds covering the layered infills of channel features. Because of the stratigraphic position of the channels relative to the Basal Peat Bed we conclude that the channels are older than the Basal Peat Bed.[14] Because the channels incised the surrounding sediments that are part of the seismic Unit B, we also conclude that the channel infills are younger than the surrounding sediments. This age difference can be large or small. We interpret the channel features as Late Glacial (?) stream valleys that are infilled with fine sandy or loamy fluvial deposits of the Boxtel Formation | Singraven Member with possible intercalations or topping of fine well-sorted aeolian sand (cover sand) of the Boxtel Formation | Wierden Member. An example of a channel feature that incised Unit B is shown in figure 21. The seismic facies of Unit B in this part of the pipeline route trajectory is described as transparent and semi-transparent with rare high amplitude reflectors. This seismic facies points, together with the known geological constellation of the area, at the presence of fluvial deposits of the Kreftenheye Formation. These fluvial deposits consist of poorly sorted Early Pleniglacial river sands of the Rhine.

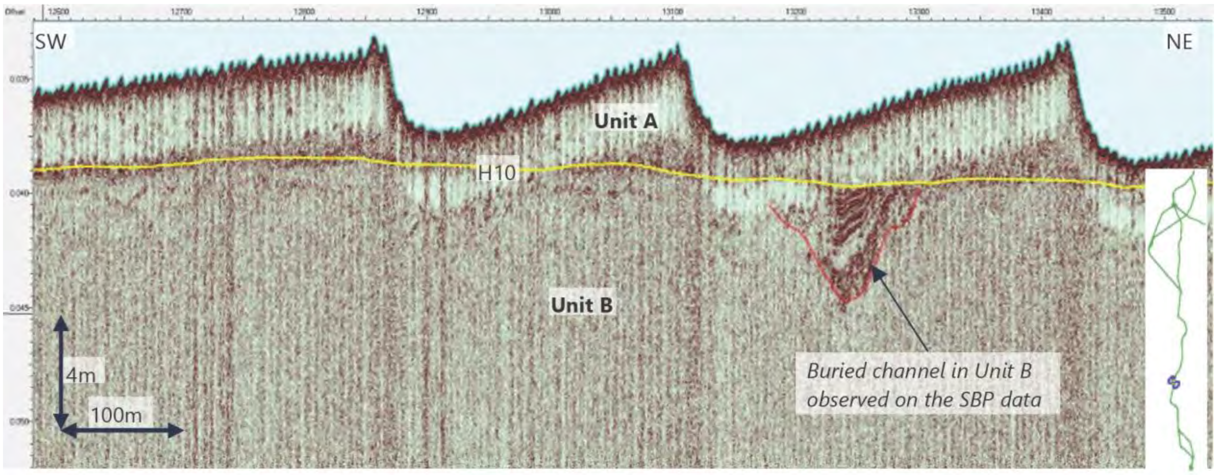

Figure 0.10: SBP data example of buried channels in Unit B. (Line SBP_TA3D2118P1)

Figure 21. Channel-like feature in top of Unit B (source: Fugro survey report F197217-REP-001)

At KP 63.2 a change in seabed morphology is observed. South of this point sand waves are present; north of this point the seabed is generally flat with few ridges. These ridges are elevated some 2.8 meters relative to the surrounding seabed. The fading sand dunes coincide with the appearance of high-amplitude parallel reflectors and high negative amplitude anomalies at relatively shallow depths in the seismic profile. For instance, at KP 67.9 the top of this sequence lies at approximately 1.3 m below the seabed. This coherent layered seismic facies is mapped as Unit C. We interpret Unit C as Early Weichselian layers and laminae of (organic) clay, silt, fine sand, and detritus of the Eem Formation | Brown Bank Member. The fine clastic layered sediments have been deposited in a brackish water lagoonal and shallow marine environment.

Between KP 67.5 and KP 81.0 the top of Unit C, the presumed Brown Bank Member, is found proximate to the seabed surface, and the overlying Unit B is very thin. According to the Geological Map of the Netherlands (2021) partly reworked Early Holocene tidal deposits of the Wormer Member | Naaldwijk Formation are present below the mobile deposits of the Bligh Bank Member. However, if a bed of peat and/or organic clay that was mapped by Fugro around KP 79.4 at the interface between Unit A and Unit B indeed is there, this bed of peat and/or organic clay likely comprise the Basal Peat Bed and/or Velsen Bed. This implies that - at this location - the deposits of Unit B cannot be part of the Wormer Member but shall

[14] In other words: the channel infill is covered by a layer of peat.

be classified as Late Glacial deposits of the Boxtel Formation or a veneer of Early Pleniglacial river deposits of the Kreftenheye Formation.

Between KP 80.7 and KP 87.3 the base of Unit B has a basin-like shape and reaches a thickness of 5 meters. The lithostratigraphic interpretation is uncertain. In this interval Unit C, that is the Brown Bank Member | Eem Formation, has eroded during the deposition of the sediments that are now contained in Unit B. Possibly, sedimentation took place during the Early Pleniglacial, when the catchment area of the Rhine reached far into North Sea area. At KP 87.3 a peat bed has been identified in the upper section of Unit B that probably is part of the Basal Peat Bed.

Between KP 80.7 and the end of section A around KP 94.0 the seabed surface is flat with minor decimeter high current ripples. Unit A has a very consistent thickness of 2.8 meters. If the pipeline is installed at 1 meter below the seabed, the seabed disturbance will be limited to the Holocene top layer. The underlying Pleistocene landscapes will not be affected.

Section B

Between KP 0.0 and KP 12.5 Unit A is 2.5 meters thick. The seabed morphology and thickness of Unit A form a continuation of what is observed in Section A.

Between KP 0.0 and KP 45.0 Unit B is present throughout. The thickness of Unit B varies from a few decimeters to nearly 3 meters. Between KP 30.0 and KP45.0 Unit A is thinner than in other parts of Section B. The interpretation of Unit B is not straightforward. According to the TNO | Laban 2004 Top Pleistocene map the Boxtel Formation occurs as subcropping unit in major part of Section B. On the 2021 Geological Map of the Netherlands the Wormer Member | Naaldwijk Formation is mapped as subcropping unit below the Bligh Bank Member. From KP 45.0 northward Unit B thickens to 8 meters around KP 50.0. Along with Unit B, Unit A also thickens to some 2.5 meters.

Fugro has mapped occurrences of peat at the top of Unit B, (around KP 42.2), as intraformational beds within Unit B (between KP 44.0 and 48.0), and at the base of Unit B (between KP 51.0 and 58.0). The peat that was identified at the base of Unit B lies around -37 m LAT. The seismostratigraphic position of this peat bed (base of Unit B) is different from the stratigraphic position of the peat in Section A (top of Unit B). The interpretation is therefore not straightforward. Possibly the peat bed is again the Basal Peat Bed, but now covered by a thick sequence of tidal deposits of the Wormer Member. Another, possibly more likely option, is that the peat bed was deposited during an interstadial period of the latest ice age, the Weichselian. The peat could be part of the Boxtel Formation or the Early Weichselian Woudenberg Formation.

Section C

The general trend in Section C is an overall deepening of the seabed surface from 31 meters in the south (KP 0.0) to 39 meters in the northern part of this section (KP 26.2). The combined thickness of Unit A and Unit B is less than 2 meters between KP 12.8 and the end of Section C.

Intermittent peat is found at the base of Unit B. As mentioned above the timing of deposition and the lithostratigraphic unit where these peat layers are part of is uncertain. The base of Unit B (= top of Unit C) is a straight plane that very gently dips from -39 m LAT at KP 0.0 to -41 m LAT at KP 26.2.

Distinct channel features have been mapped at the base of Unit B. The incision depth of these channels ranges from 2 to 4 meters. The intermittent peat beds at the base of Unit B cover the channel infills. The development of the channels and the later deposition of peat represent different phases in the development of the landscape. These phases could either be separated by a time hiatus or have followed shortly after each other.

Figure 22 shows a subbottom data example of section C including a channel feature and intermittent occurrences of peat at the base of the well-bedded sequence of Unit B (source: Fugro survey report F197217-REP-001). Clearly visible is the thinning of Unit B from south (left side of the image) to north (right side of the image. Figure 23 shows a subbottom data example of section K14-L4A in which channel features are visible that are also encountered in section C.

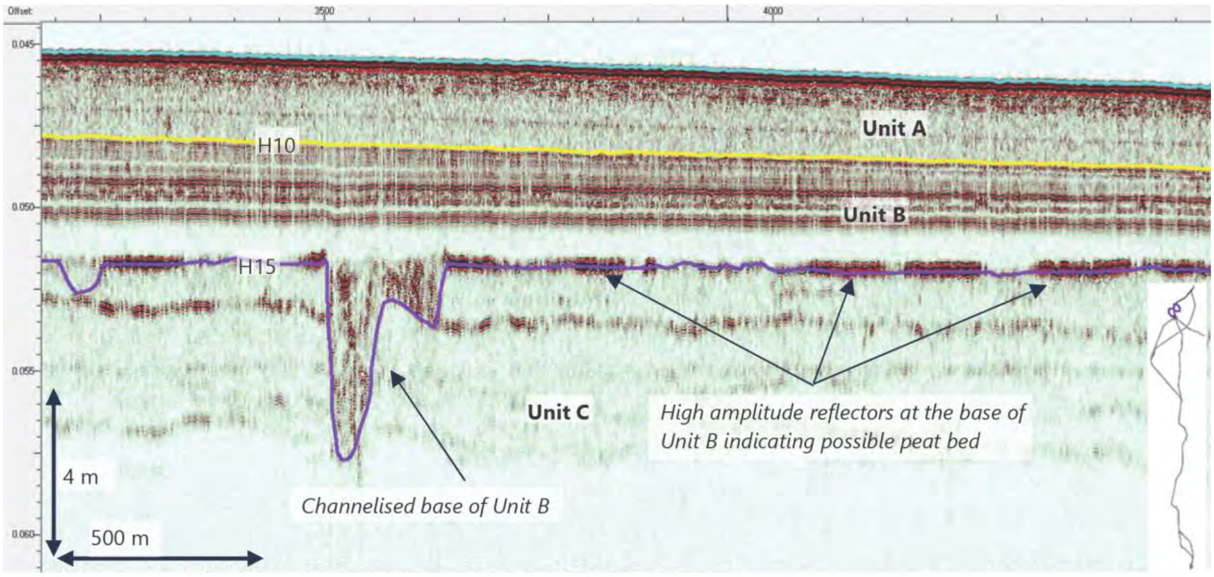

Figure 0.8: SBP data example of route section C. (Line SBP_TA3H23321P1_1)

Figure 22. Channel feature and intermittent occurrences of peat at the base of the parallel bedded sequence of Unit B (source: Fugro survey report F197217-REP-001)

The upper part of Unit C has a (semi)transparent character with a faint plan-parallel sub-horizontal bedding. Although the deposits within Unit C appear to be bedded, this bedding does not show as clear reflectors in the subbottom profile. The top of Unit C probably consists of sandy deposits with little difference and/or gradual changes in grain-size and composition. We interpret the top of Unit C as Eemian marine deposits of the Eem Formation.

The channels that incised Unit C have been infilled with sediments that, at least in figure 23, have not resulted in clear reflectors in the subbottom profile. Probably the absence of clear reflectors is due to limited variation in the lithological composition of the channel infills, which could point to an infill with predominantly (fine) sandy sediments.

The channel infills are truncated by discrete sub-horizontal plan-parallel reflectors at the base of Unit B. These clear reflectors relate to alternating beds with different acoustic impedances. Likely, these differences in acoustic impedance are caused by lithological variations such as alternating beds of fine sand, silt, clay, and peat.

If Unit B consists of Early Holocene tidal deposits of the Wormer Member | Naaldwijk Formation, the peat bed at the base is of Unit B is the Early Holocene Basal Peat Bed. The layered to laminated character of Unit B would fit an Early Holocene tidal setting. The truncated channel features could then represent Late Glacial stream valleys that are infilled with fine sandy or loamy sediment. However, it should be noted that the plan-parallel alternations of fine sand, silt, clay, and detritus also are characteristic of the Early Weichselian Brown Bank Member | Eem Formation. The option that Unit B represents the Brown Bank Member can therefore not be excluded.

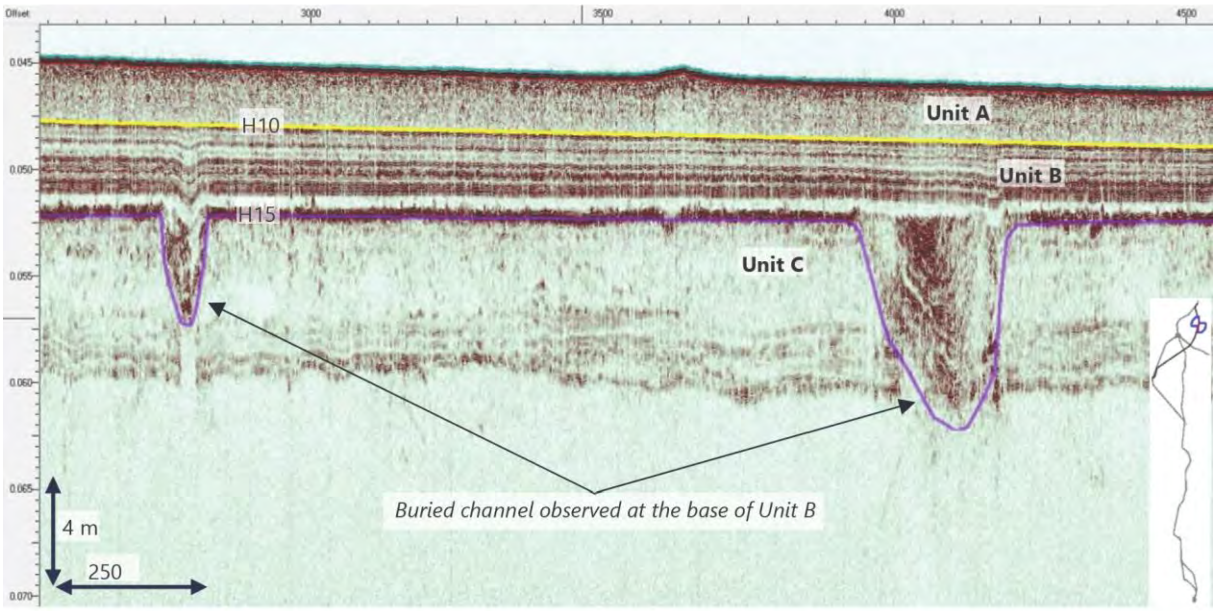

Figure 13.7: SBP data example of route section K14-L4A. (Line SBP_TA3M2321P1_1)

Figure 23. Channel features that are truncated by parallel beds of Unit B (source: Fugro survey report F197217-REP-001)

4 Synthesis

For this investigation different research questions are defined in the Program of Requirements[15]. Based on the results of de data analysis the research questions are answered.

Primary Question : Are any archaeological remains present within the Area of Interest and to what extent are these remains traceable?

Yes. At 19 locations objects have been found with a possible archaeological value. Eight of these objects are related to visible contacts at the seabed and may represent shipwreck remains. At 10 locations magnetic anomalies with a peak-to peak value over 500 nT have been mapped which cannot be related to known objects like pipelines or cables and may be of potential archaeological interest. The objects that cause these anomalies are not visible on side scan sonar or multibeam images and are therefore considered to be buried in the seabed. These objects could, apart from archaeological objects, include debris, UXO, lost anchors, et cetera. As long as the character of these objects has not been determined, the objects are considered to be of potential archaeological interest.

With respect to side scan sonar, magnetometer and multibeam survey:
Are there any phenomena visible on the seabed?
Yes. With side scan sonar and multibeam a total of 3806 contacts have been mapped. With magnetometer, a total of 2748 magnetic anomalies have been observed within the area of investigation.

If so: What is the description of these phenomena?
Fugro has identified 3806 *side scan sonar* contacts within the surveyed corridor. The classification of the contacts is listed below.

Classification	**Amount**
Boulder	3010
Debris	159
Depression Pockmark	5
Fishing Gear	7
Mattress	2
Pipeline	4
Seabed Mound	98
Suspected Debris	517
Wreck	4
Total	**3806**

Do these phenomena have a man-made or natural origin?
The majority of the contacts have been classified as man-made.

If these phenomena can be designated to be man-made: What classification can be attached?
See the table above.

[15] Van Lil and van den Brenk, 2022

If these phenomena can be classified as archaeological: Is it possible to interpret the nature of the archaeological objects?
Eight of these objects are related to visible contacts at the seabed and may represent shipwreck remains.
At 10 locations magnetic anomalies with a peak-to peak value over 500 nT have been mapped which cannot be related to known objects like pipelines or cables and may be of potential archaeological interest. The objects that cause these anomalies are not visible on side scan sonar or multibeam images and are therefore considered to be buried in the seabed. These objects could, apart from archaeological objects, include debris, UXO, lost anchors, et cetera. As long as the character of these objects has not been determined, the objects are considered to be of potential archaeological interest.

If these phenomena can be identified as natural: What is the nature of these natural phenomena?
Over 3000 contacts are classified as 'boulder'. These probably also include clay boulders, because known stone boulders in the North Sea only occur north of the city of Den Helder.

Based on the acoustic image is it possible to designate zones of high, middle or low marine activity on the seabed?
Along the route sand waves have been mapped which are known to migrate a few meters per year northwards. Sand ripples originated by tidal currents are present along the entire route.

General:
What is the relation between the observed objects and the topography of the seabed? Based on this relationship can risk-prone areas be marked selectively?
Larger objects like the shipwrecks show scouring but are largely embedded in the seabed sediments. This appears to be the case throughout the area. Therefore, it is not possible to mark risk-prone areas selectively.

If no acoustic phenomena can be observed, are there any clues that this is a consequence of either natural erosion, sedimentation or human interference?
This question is given the results of the investigation not applicable.

With respect to the seismic data: What is the depth of the top of the Pleistocene and Holocene landscape(s) relative to a) LAT and b) the present seabed?
The depth of the Pleistocene landscapes relative to both LAT and the present seabed could not always be determined, because the boundaries of the identified seismic units do not always coincide with those of the lithostratigraphic units. The lithostratigraphic sequences along the routes cannot always be deduced from the seismic data. The presence of peat found by Fugro does help in determining the top of the Pleistocene. The Basal Peat Bed is a bed of peat that has been deposited throughout the North Sea area when groundwater levels rose in response to the rising of the sea level from the beginning of the Holocene to present. The timing of the deposition of the Basal Peat Bed differs with the elevation of the landscape at the moment of inundation.

We produced a south to north x-section utilizing the seismic data delivered by Fugro to provide a context of the geological constellation in the area. The x-section includes the sections Nearshore East, A, B and C. The findings for these sections are also applicable for the other route options.

Section Nearshore East

In the nearshore section, no occurrences of peat were reported. Based on the known geological constellation in this part of the route trajectory we expect the top of the Pleistocene landscape to be buried by tidal deposits of the Naaldwijk Formation, at multiple meters below the seabed. An exception is the Maasgeul where the top of the Pleistocene sequence is expected to intersect with edge of the Maasgeul at or below -20 m LAT.

Section A

In section A occasional peat has been mapped at the base of Unit A | top of Unit B. We interpret these beds of peat as the Basal Peat Bed that covers Pleistocene deposits that are contained in Unit B. The Basal Peat Bed has an intermittent character. The reason for this can be two-fold: 1) peat has never been deposited, and 2) peat has initially been deposited, but has eroded at a later stage. Yet, in between the peat occurrences we expect the top of the Pleistocene landscape in Section A to be located at the same stratigraphic level, that is the top of the seismic Unit B (= H10), albeit that the change that the top of these deposits has eroded is significantly larger than in areas where peat has been found. Along with the occurrence of peat, the top of the Pleistocene sequence has been found at 25 to 30 meters relative to LAT in Section A. The depth of the Pleistocene sequence relative to the seabed varies with the thickness of Unit A. This means that in between sand waves the top of the Pleistocene can be close to being exposed at the seabed or solely covered by a veneer of sand. At the locations of sand wave crests the top of the Pleistocene can be located up to 7 meters below the seabed.

Section B

Given the seismic character of Unit C, including clear subhorizontal subparallel reflectors we interpret Unit C as the Eem Formation, including the Brown Bank Member. The interpretation of Unit B is uncertain. Unit B can include Late Glacial terrestrial deposits of the Boxtel Formation, Early Holocene deposits of the Naaldwijk Formation and even also shallow marine deposits of the Eem Formation and Brown Bank Member. Beds of peat or organic clay are also identified in Section B. The amount and continuity of the peat increases from south to north. Most peat occurs at a different stratigraphic level than in Section A. In Section B peat is often found at the base of the seismic Unit B. This peat could either be the Basal Peat Bed or peat from a deeper stratigraphic level such as the Boxtel Formation or Woudenberg Formation. If the Pleistocene landscape coincides with the base of Unit A, the top of the Pleistocene lies -26.5 m to -34 m LAT and 1 to 3 meters below the seabed. If the Pleistocene landscape coincides with the base of Unit B, the top of the Pleistocene lies -28 m to -40 m LAT and 2.5 to 11 meters below the seabed. Ground truthing is necessary to make a better judgement.

Section C

The very flat seabed in Section C deepens to the north from -32 m LAT to -39 m LAT. Towards the north the combined thickness of Unit A and Unit B decreases to less than 2 meters. The base of Unit B gently dips towards the north from -39 m LAT in the south to -41 m LAT in the north. Intermittent peat is found in many locations at the base of Unit B. Discrete channel features have been mapped that incise Unit C. The peat beds cover these channel features. If the Pleistocene landscape coincides with the base of Unit A, the top of the Pleistocene lies -34 m to -40 m LAT and 0.7 to 3 meters below the seabed. If the Pleistocene landscape coincides with the base of Unit B, the top of the Pleistocene lies -39 m to -41 m LAT and 1.3 to 7.5 meters below the seabed. Ground truthing is necessary to make a better judgement.

What lithostratigraphic units can be distinguished along the pipeline routes?
It is not possible to distinguish lithostratigraphic units based on the seismic data alone. The dominant lithostratigraphic units that are expected to be present are listed in the table below.

Classification	Occurrence Section	Lithology	Age	Environment	Layer boundary
Naaldwijk Fm	Nearshore	sand and clay	holocene	tidal, estuarine	erosive
Basal Peat Bed Nieuwkoop Fm	Nearshore A, B and C	peat	holocene	Marsh, swamp	conformable
Boxtel Fm	Nearshore A, B and C	Homogeneous fine sand loam, peat, clay	Late Glacial	polar desert, small stream	erosive
Kreftenheye Fm	Nearshore A, poss. B	poorly sorted sand	Pleniglacial	braided river	erosive
Brown Bank Mb	A, B and C	layered and laminated fine sand, silt, clay, and detritus	Early Weichselian	lagoon, lake	conformable
Eem Fm	A, B and C	sand and clay	Eemian	marine	erosive

Table 15. Lithostratigraphic units along the pipeline routes

Have channel-like features been observed?
Yes.

If so: What are the characteristics of the channel-like features in terms of spatial distribution (width, depth, shape, extent), channel infill composition, stratigraphic position and age.
Channel features are observed at two seismostratigraphic levels:

1- As incisions into the top of Unit B
2- As incisions into the top of Unit C

The depth of incision is limited to a few meters or less. At both stratigraphic levels the channel features are covered by peat. From this we conclude that the channel infills are older than the peat depositions. We interpret the channels that incised the top of Unit B as Late Glacial stream valleys that are filled-in with fine sand or loam and later covered by Early Holocene peat of the Basal Peat Bed.

The channel features that incised Unit C could also be Late Glacial with a cover of the Basal Peat Bed, but the interpretation of the peat at this stratigraphic level is uncertain (possible Boxtel Fm or Woudenberg Fm?).

Are occurrences of peat and/or organic clay observed?
Yes.

If so: What is the spatial distribution (depth, extent) stratigraphic position and age of these deposits.
Please refer to the answers to the previous questions.

The Basal Peat Bed is expected to occur at the base of Unit A in Section A. The peat beds that are found at the base of Unit B could be the Basal Peat Bed, but older peat from the Boxtel Formation or Woudenberg Formation cannot be excluded.

Are intact prehistoric landscapes affected by the installation of the pipeline based on their vertical position related to the seabed?
Yes, even if the trenching depth is limited to one meter below the seabed intact prehistoric landscapes could be affected by the installation of the pipeline. Risk-prone areas are sections where peat beds occur proximate to the seabed surface. Those areas have been identified in Section A in where peat occurs in low-lying areas in between sand dunes and in the northern parts where peat occurrences a wide-spread and the combined thickness of Unit A and Unit B is less than two meters.

Are there any indications observed on the seismic profiles for the presence of buried (man-made) objects?
No.

If so: Based on the presence of buried objects and its correlation with side scan sonar, magnetometer en multibeam data can something be said about the nature of these buried objects?
This question is not applicable.

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5 Summary and recommendations

A large quantity of survey data (*side scan sonar, magnetometer, multibeam echosounder* and *subbottom profiling*) covering a total area of 243 km^2 have been analyzed to conduct an archaeological assessment.

The current analysis of geophysical survey results is the second and step in the AMZ-cycle, following the desk study. The purpose of this assessment is to test the desk study-based expectancy for archaeological remains in the area. The expectancy covers remains of shipping related objects (wrecks), airplanes from World War II and prehistoric settlements.

Side scan sonar and multibeam contacts

Within the surveyed area, an archaeological expectation was assigned to a total of 8 contacts. In accordance with Dutch Law and Legislation no seabed disturbances should be carried out within 100 meters of each of the marked locations. If any activities will take place within 100 meters of a potential archaeological location, it will be examined on a case-by-case basis whether the 100 meters should be maintained in consultation with the Cultural Heritage Agency of the Netherlands (RCE).

Feature	NCN	Easting	Northing	Route section	Distance
BK_FSEA_SSS_0022	-	551288	5924521	D	**+50**
BK_FSEA_SSS_0179	-	555839	5929168	D	-240
BJ_FD_SSS_0015	-	548443	5894128	F	+230
BB_FS_SSS_0683	219	570384	5762003	East	-540
BH_FSEA_SSS_0104	531	559172	5935317	C	**+25**
BK_FSEA_SSS_0163	967	550165	5921956	D	**-56**
BN_FD_SSS_0025	945	576689	5920367	E Neptune	+220
BB_FS_SSS_0433	-	570711	5761481	East	-210

Table 16. Objects with an archaeological expectation.

Three of the eight contacts fall within 100 meters of the proposed route.

Magnetic anomalies

A total of 2748 magnetic anomalies have been observed. At 10 locations magnetic anomalies with a peak-to peak value over 500 nT have been mapped which cannot be related to known objects like pipelines or cables and may be of potential archaeological interest. The objects that cause these anomalies are not visible on side scan sonar or multibeam images and are therefore considered to be buried in the seabed. These objects could, apart from archaeological objects, include debris, UXO, lost anchors, et cetera. As long as the character of these objects has not been determined, the objects are considered to be of potential archaeological interest.

Target	E	N	nT	Section	Distance
BAB_FS_UXO_0010	570711	5761625	808	East	-210
BAB_FS_UXO_0599	570931	5761671	514	East	**+5**
BAB_FS_UXO_0603	570932	5761987	2312	East	**+8**
BAB_FS_UXO_0605	570933	5761957	1158	East	**+8**
BAB_FS_UXO_0618	570936	5761510	729	East	**+11**
BAB_FS_UXO_0657	570948	5761543	1348	East	**+22**
BC_FD_MAG_0121	571170	5763666	666	East	**+4**
BH_FSEA_MAG_0044	559169	5935057	578	C	**-2**
BJ_FD_MAG_0050	563642	5875159	2089	F	**-59**
BP_FD_MAG_0016	559490	5931390	591	B	**-60**

Table 17. Magnetic anomalies over 500 nT with an archaeological expectation.

Nine of the eleven contacts fall within 100 meters of the proposed route.

In accordance with Dutch Law and Legislation no seabed disturbances should be carried out within 100 meters of each of the marked locations. If any activities will take place within 100 meters of a potential archaeological location, it will be examined on a case-by-case basis whether the 100 meters should be maintained in consultation with the Cultural Heritage Agency of the Netherlands (RCE). All locations of potential archaeological interest within 100 meters of the proposed route are shown in the next figure.

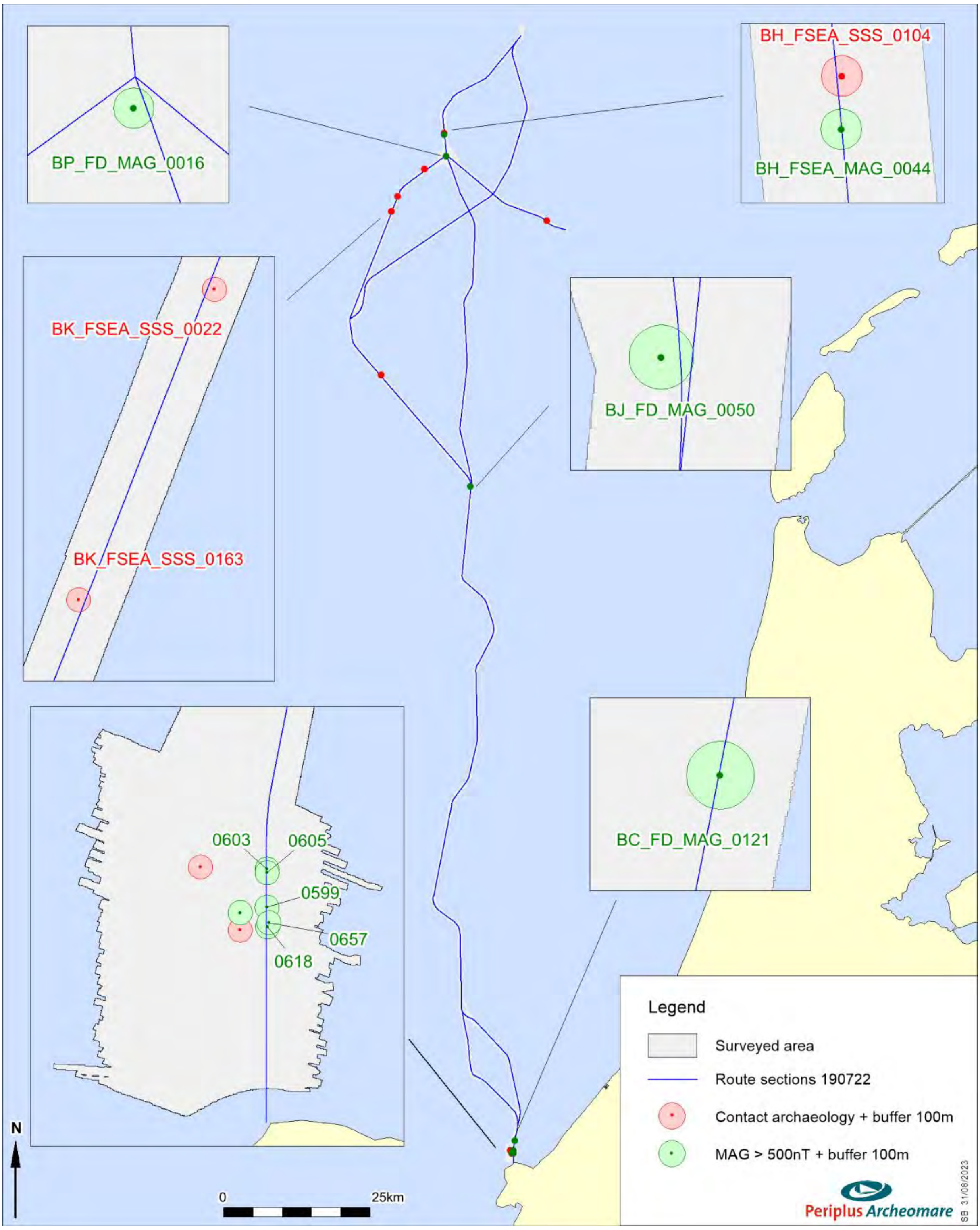

Figure 24. Overview of the potential archaeological targets within 100 meters of the proposed route

Prehistoric remains

Areas of potential archaeological interest listed below.

Depositional environment Areas of potential archaeological interest	**Lithostratigraphic Unit**	**Time of deposition**	**Archaeological period**
Peat-covered aeolian and small scale fluvial deposits	Boxtel Formation	*Late Glacial* and Early *Holocene*	Late Paleolithic and Early Mesolithic
Catchment of the Rhine	Kreftenheye Formation	Pleniglacial	Middle Paleolithic
Shores of lakes and lagoons	Brown Bank Member	Early *Weichselian*	Middle Paleolithic to Early Mesolithic

Table 18. Areas of potential archaeological interest

The physical quality, that is, the integrity and preservation of prehistoric remains is highly dependent on the extent to which prehistoric landscapes and archaeological levels herein have been affected by erosion. The seismic data indicate that part of the *Pleistocene* landscape has eroded during the Early *Holocene* marine ingression, thus affecting the integrity of possible prehistoric settlements. Locally the geological units defined as potential containers of prehistoric remains may have been preserved intact, especially in areas where peat has been found. The interpretation of lithostratigraphic units and the character of the layer boundaries (erosive versus non-erosive) from the seismic data is based on the geological data available and expert judgement. The seismic interpretation shall be ground-truthed by vibrocore sampling. The actual geological sequences present in the area and the integrity of layer boundaries will be verified, thus offering a tool for further analysis of the prehistoric landscapes and specify and test the archaeological potential.

Recommendation

Prehistory

Periplus Archeomare recommends conducting further archaeological research that focuses on the genesis and integrity of paleo-landscapes along the Aramis route trajectories for general archaeological research purposes. This research comprises an inventory of field research by means vibrocore sampling in accordance with the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1). A geotechnical campaign is carried out to generate a geological model of the subsurface of the pipeline corridor and to determine the physical properties of the sediment layers present. We recommend designating a number of vibrocore locations where sediment samples are collected that can be used for geo-archaeological research.

The intact samples must be examined by a (senior) prospector and described in accordance with the *Standaard Boorbeschrijvingsmethode* (SBB). Samples are selected and stabilized to be analyzed by specialists in the field of OSL and radiocarbon age dating, sediment petrography, palynology, micropaleontology (foraminifera, ostracods, diatoms, et cetera), macro-remains of plants and animals and molluscs to gain insight into the development of landscapes over time and the extent to which these paleolandscapes have been preserved.

In accordance with the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1), a Program of Requirements (PvE) and / or Plan of Action (PvA) must be drawn up. The PvE/PvA includes the objective, the research strategy and methodology, the frameworks and the practical implementation of the research, so that the process runs smoothly, and multiple use of the data acquired in a uniform manner is achieved. It is advised to submit this PvE / PvA for approval to the Competent Authorities and the RCE. After completion of the inventory field research, during the construction of the pipeline, data can be collected that - from an archaeological point of view - provide valuable information at a detailed level. It can be very useful to investigate this information further from an archaeological point of view. It is advised to investigate the possibilities for this in consultation with the RCE, once the plans have been worked out.

During the installation of the pipeline, archaeological objects may be discovered which were completely buried or not recognized as an archaeological object during the geophysical survey. We recommend passive archaeological supervision based on an approved Program of Requirements. Passive archaeological supervision means that an archaeologist is not present during the execution of the work but always available on call. Following this recommendation would prevent delays during the work when unexpectedly archaeological remains are found. In accordance with the Erfgoedwet, it is required to report those findings to the enforcing authority (Minister of OCW). This notification must also be included in the scope of work.

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Glossary and abbreviations

Terminology	**Description**
AMZ	Archeologische Monumenten Zorg, a description of procedures to ensure the protection of National archaeological Cultural Heritage
Allerød	Warm period (*interstadial*) within the *Late Glacial*, 13,900 to 12,900 cal years BP
Bioturbation	Disturbance of sediment layers by burrowing animals
Bølling	Warm period (*interstadial*) within the *Late Glacial*, 14,700 to 14,000 cal years BP
CPT	Cone penetration test
Cryoturbation	Disturbance of sediment layers due to freezing and thawing
Diffraction Hyperbola	Isolated point reflectors induced by e.g. boulders or pipelines show as hyperbola in a seismic profile, because the reflections of these objects are not only registered during the crossing of the object (top of hyperbola), but also before and after the crossing (arms of hyperbola)
Eemian	Warm period (*interglacial*) between *Saalian* and *Weichselian* from 130,000 to 115,000 years ago
Erratic	An (glacial) erratic is a piece of rock that differs from the size and type of rock native to the area in which it rests. These rocks are carried by glacial ice, often over distances of hundreds of kilometres. Erratics can range in size from pebbles to large boulders.
Ferrous	Material, which is magnetic or can be magnetized, and well-known types are iron and nickel
Glacial	Ice-age
Holocene	Youngest geological epoch (from the last Ice Age, around 10,000 BC. to the present)
In situ	At the original location in the original condition
Interglacial	Warm period in between two ice-ages
Interstadial	Warm period within an ice-age
Late Glacial	Last part of the Weichselian, 15,000 to 12,000 years ago
ka	Kiloanus or kiloyear, a period of 1,000 years
Magnetometer	Methodology to measure deviations from the earth's magnetic field (caused by the presence of ferro-magnetic = ferrous objects)
Multibeam	Acoustic instrument that uses different bundles or beams to measure the depth in order to create a detailed topographic model
Odderade	Warm period (*interstadial*) within the Early *Weichselian*, 85,000 to 75,000 years ago
Pleistocene	Geological era that began about 2 million years ago. The era of the ice ages but also moderately warm periods. The *Pleistocene* ends with the beginning of the *Holocene*
Pleniglacial	Coldest part of the *Weichselian*, 75,000 ka to 15,000 years ago
PvE	Program of Requirements (Dutch: Programma van Eisen)
RCE	Ministry of Cultural Heritage (Dutch: Rijksdienst voor het Cultureel Erfgoed)
ROV	Remotely Operated Vehicle
Saalian	Second last Ice age (glacial), 240,000 to 130,000 years ago
Sandr	Fan shaped outwash plain in front of a glacier

Terminology	Description
Side scan sonar	Acoustic instrument that registers the amplitude of reflections of the seabed. The resulting images are similar to a black / white photograph. The technique is used to detect objects and to classify the morphology and type of soil
Current ripples	Asymmetrical wave pattern at the seabed caused by currents. The steep sides of the ripples are always on the downstream side
Subbottom profiler	Acoustic system used to create seismic profiles of the subsurface
Trenching	Construction of a trench for the purpose of burying a cable or pipeline
Vibrocore	Vibrocore bore is a special drilling technique where a core tube is driven by means of vibration energy in the seabed. In addition, the core tube is provided with a piston so that the bottom material in the core tube remains in place
Weichselian	Last Ice Age (glacial) from 115,000 to 12,000 years ago

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Appendix 1. Listing of selected side scan sonar contacts

The table below contains a selection of 117 *side scan sonar* contacts with a possible archaeological expectation, based on the comparison with known objects (NCN), their size (larger than four meters) and characteristics.

After reviewing, an archaeological expectation has been assigned to 9 contacts marked with a light green colour, presented in the table below.

Feature_name	Easting	Northing	Feature description Fugro	L	W	H	Z	Description PPA
BH_FSEA_SSS_0036	572394	5953350	Mattress	18.7	2.3	0.0	-32.8	Mattress
BH_FSEA_SSS_0003	572516	5953431	Depression Pockmark	7.7	6.6	0.0	-39.6	Spudcan depression
BH_FSEA_SSS_0007	572470	5953396	Depression Pockmark	8.2	6.2	0.0	-39.6	Spudcan depression
BH_FSEA_SSS_0004	572548	5953407	Depression Pockmark	6.1	5.9	0.0	-39.5	Spudcan depression
BH_FSEA_SSS_0005	572529	5953379	Depression Pockmark	7.0	6.1	0.0	-39.5	Spudcan depression
BH_FSEA_SSS_0016	572402	5952674	Depression Pockmark	4.3	4.1	0.0	-39.4	oval contact
BH_FSEA_SSS_0001	572373	5953287	Mattress	16.0	0.8	0.1	-39.3	mattress
BM_FSEA_SSS_0354	571321	5945854	Suspected Debris	4.4	0.3	0.0	-38.1	Elongated contact
BM_FSEA_SSS_0042	572235	5942929	Suspected Debris	4.3	0.9	0.2	-36.8	Oval contact, clustered with other oval contacts
BH_FSEA_SSS_0245	558780	5937355	Suspected Debris	12.7	3.1	0.0	-35.1	irregular contact, possibly a seabed disturbance
BM_FSEA_SSS_0030	573164	5939530	Seabed Mound	5.6	1.5	0.0	-34.7	Elongated thin contact, possible cable or chain
BH_FSEA_SSS_0117	558891	5936096	Suspected Debris	4.0	1.3	0.4	-34.2	Irregular contact in depression.
BM_FSEA_SSS_0078	572899	5938204	Suspected Debris	11.5	7.2	0.0	-33.8	Matrasses Pipeline Total L7-A to L7-P
BH_FSEA_SSS_0107	559378	5933267	Suspected Debris	4.3	0.3	0.4	-32.3	Elongated straight contact
BP_FD_SSS_0003	560054	5931344	Debris	5.7	1.0	0.0	-31	Seabed disturbance
BP_FD_SSS_0010	559575	5930614	Debris	7.5	3.2	0.0	-30.6	no contact visible
BK_FSEA_SSS_0290	543796	5905721	Boulder	4.3	4.7	0.0	-29.6	Seabed disturbance
BK_FSEA_SSS_0108	551298	5924649	Boulder	28.8	1.2	0.2	-29.4	buoy anchor with cable
BK_FSEA_SSS_0174	544378	5904424	Boulder	4.3	2.4	0.0	-29.4	elongated contact
BK_FSEA_SSS_0154	546697	5913055	Boulder	9.8	0.6	0.2	-29.3	Patch of shells
BK_FSEA_SSS_0044	547294	5914807	Boulder	4.5	2.2	0.0	-29.2	Nothing Visible on SSS and MBES
BK_FSEA_SSS_0120	547879	5915829	Boulder	6.8	0.8	0.0	-29.2	Nothing Visible on SSS and MBES
BK_FSEA_SSS_0196	545707	5909928	Boulder	4.3	3.1	0.0	-29.2	oval contact
BK_FSEA_SSS_0260	545890	5910411	Boulder	4.2	1.1	0.0	-29.2	oval contact
BK_FSEA_SSS_0274	547617	5914888	Boulder	5.2	5.6	0.0	-29.2	oval contact

Feature_name	Easting	Northing	Feature description Fugro	L	W	H	Z	Description PPA
BK_FSEA_SSS_0075	549384	5919899	Boulder	6.0	3.3	0.0	-29.1	Elongated straight contact
BK_FSEA_SSS_0175	545656	5908303	Boulder	4.3	1.0	0.1	-29.1	oval contact
BM_FSEA_SSS_0086	570587	5931442	Suspected Debris	4.0	0.5	0.0	-29.1	Seabed disturbance
BE_FD_SSS_0003	561690	5822980	Suspected Debris	5.7	2.7	0.1	-28.9	oval contact
BN_FD_SSS_0039	562547	5929173	Debris	4.1	1.0	0.0	-28.9	no contact visible
BE_FD_SSS_0002	560603	5821138	Suspected Debris	8.3	4.3	0.4	-28.8	oval contact in depression
BM_FSEA_SSS_0292	546644	5910321	Suspected Debris	7.8	0.2	0.1	-28.8	Elongated contact
BK_FSEA_SSS_0286	542892	5903521	Boulder	9.8	0.5	0.0	-28.7	thin straight contact, possibly depression
BM_FSEA_SSS_0377	547318	5911315	Suspected Debris	6.4	0.3	0.0	-28.7	Elongated contact, cable or chain
BM_FSEA_SSS_0098	570182	5930164	Suspected Debris	4.6	0.6	0.0	-28.3	Elongated contact
BG_FD_SSS_0014	561067	5926853	Pipeline	25.1	0.8	0.1	-28.2	Pipeline
BG_FD_SSS_0021	561279	5926721	Pipeline	53.6	0.5	0.0	-28.1	Pipeline
BG_FD_SSS_0010	561476	5926599	Pipeline	87.8	0.6	0.0	-27.8	Pipeline
BG_FD_SSS_0017	561489	5926592	Pipeline	53.9	0.5	0.3	-27.6	Pipeline
BG_FD_SSS_0009	561534	5926360	Suspected Debris	5.7	3.4	0.0	-27.3	Nothing Visible on SSS and MBES
BN_FD_SSS_0025	576689	5920367	Wreck	17.5	5.2	1.5	-27	See NCN 945 / Contact bn_fd_sss_0025
BE_FD_SSS_0035	562830	5824316	Suspected Debris	24.6	1.0	0.0	-26.9	Elongated contact, possibly cable or chain
BJ_FD_SSS_0004	545175	5897731	Debris	4.5	2.3	0.0	-26.9	Nothing Visible on SSS and MBES
BE_FD_SSS_0015	561724	5823492	Suspected Debris	15.9	0.7	0.0	-26.8	Elongated contact, possibly cable or chain
BE_FD_SSS_0031	564689	5840888	Suspected Debris	6.0	1.1	0.0	-26.8	Elongated contact, possibly cable or chain
BM_FSEA_SSS_0082	567876	5925957	Suspected Debris	4.0	0.4	0.0	-26.6	Elongated contact
BG_FD_SSS_0020	562256	5924505	Suspected Debris	13.2	0.4	0.0	-26.4	Long Small Bended Contact, Nothing on Mbes, Possible Rope or Chain
BN_FD_SSS_0010	566548	5925589	Debris	5.7	3.1	0.0	-26.4	no contact visible
BM_FSEA_SSS_0014	566988	5924284	Suspected Debris	4.6	0.4	0.1	-26.3	no contact visible
BF_FD_SSS_0026	563257	5896796	Seabed Mound	6.6	3.2	0.7	-26.2	oval contact, possibly a stone
BM_FSEA_SSS_0130	559140	5919286	Suspected Debris	4.9	0.4	0.0	-26.2	cable/chain
BM_FSEA_SSS_0283	566066	5924076	Suspected Debris	4.3	0.7	0.0	-26.2	Elongated contact
BM_FSEA_SSS_0279	565452	5923640	Suspected Debris	10.1	0.8	0.0	-26.1	Elongated contact

Feature_name	Easting	Northing	Feature description Fugro	L	W	H	Z	Description PPA
BN_FD_SSS_0017	571919	5922297	Debris	4.1	0.8	0.0	-26.1	elongated curved contact
BM_FSEA_SSS_0263	560640	5920327	Suspected Debris	5.7	0.6	0.0	-26	Elongated contact
BM_FSEA_SSS_0277	561266	5920672	Suspected Debris	4.7	0.8	0.0	-26	Elongated contact
BM_FSEA_SSS_0333	561394	5920909	Suspected Debris	5.3	0.7	0.0	-26	Elongated contact
BM_FSEA_SSS_0367	564897	5923160	Suspected Debris	4.9	0.6	0.0	-26	Elongated contact
BG_FD_SSS_0023	563609	5921710	Debris	5.7	0.5	0.0	-25.9	Cluster of small oval contacts
BM_FSEA_SSS_0221	562349	5921382	Suspected Debris	4.2	0.4	0.0	-25.9	Elongated contact
BM_FSEA_SSS_0256	562509	5921591	Suspected Debris	6.1	0.4	0.0	-25.9	Elongated contact
BM_FSEA_SSS_0273	562187	5921340	Suspected Debris	5.7	0.7	0.0	-25.9	Elongated contact
BM_FSEA_SSS_0317	563598	5922366	Suspected Debris	8.0	0.9	0.0	-25.9	Elongated contact
BN_FD_SSS_0034	574301	5921805	Debris	6.7	2.5	0.0	-25.9	Seabed disturbance
BF_FD_SSS_0002	562271	5906303	Seabed Mound	6.5	4.0	0.2	-25.8	oval contact
BF_FD_SSS_0004	562337	5906463	Debris	4.8	1.4	0.1	-25.8	oval contact
BF_FD_SSS_0005	562372	5906435	Seabed Mound	4.1	1.3	0.1	-25.8	oval contact
BF_FD_SSS_0009	562478	5906537	Seabed Mound	5.1	1.0	0.0	-25.8	oval contact
BE_FD_SSS_0033	564696	5841065	Suspected Debris	6.7	0.4	0.0	-25.7	Elongated contact, possibly cable or chain
BF_FD_SSS_0007	562431	5905891	Seabed Mound	11.9	3.3	0.3	-25.7	Elongated triangular contact, with a grinding channel
BF_FD_SSS_0008	562436	5905902	Seabed Mound	6.8	3.0	0.2	-25.7	oval contact, with a depression
BF_FD_SSS_0015	562631	5906896	Seabed Mound	4.3	2.2	0.1	-25.7	Oval contact in a cluster of smaller oval contacts
BF_FD_SSS_0021	562712	5906802	Seabed Mound	5.6	1.4	0.1	-25.7	oval contact
BF_FD_SSS_0027	563122	5908014	Suspected Debris	13.3	2.4	0.2	-25.7	Elongated contact
BG_FD_SSS_0008	564555	5919314	Suspected Debris	5.3	0.5	0.0	-25.7	Elongated contact
BF_FD_SSS_0006	562395	5905025	Debris	4.7	1.2	0.2	-25.6	Two oval contacts, possibly stones
BF_FD_SSS_0013	562585	5906295	Seabed Mound	12.9	2.5	0.1	-25.6	Elongated, curved contact, possibly a depression
BF_FD_SSS_0023	562758	5906789	Seabed Mound	6.3	1.5	0.0	-25.6	Nothing Visible on SSS and MBES
BG_FD_SSS_0030	564078	5914876	Debris	16.5	5.2	0.0	-25.6	Nothing Visible on SSS and MBES

Feature_name	Easting	Northing	Feature description Fugro	L	W	H	Z	Description PPA
BF_FD_SSS_0030	563476	5908191	Seabed Mound	13.6	2.8	0.1	-25.5	Elongated contact
BF_FD_SSS_0032	563600	5908415	Seabed Mound	5.3	1.9	0.1	-25.5	Oval contact in a cluster of smaller oval contacts
BF_FD_SSS_0034	563664	5908420	Seabed Mound	4.0	2.6	0.0	-25.5	Oval contact in a cluster of smaller oval contacts
BF_FD_SSS_0035	563664	5908843	Seabed Mound	7.9	1.2	0.1	-25.5	Elongated contact
BF_FD_SSS_0038	563778	5908537	Seabed Mound	12.4	3.1	0.1	-25.5	Elongated, curved contact, possibly a depression
BF_FD_SSS_0041	563849	5908905	Seabed Mound	11.2	3.1	0.1	-25.5	Elongated contact in a cluster of smaller oval contacts
BF_FD_SSS_0042	563897	5908744	Seabed Mound	8.3	2.8	0.1	-25.5	Elongated contact
BF_FD_SSS_0049	564270	5910802	Seabed Mound	4.2	0.8	0.0	-25.5	no contact visible
BG_FD_SSS_0004	564261	5911517	Debris	8.2	1.4	0.0	-25.5	Nothing Visible on SSS and MBES
BJ_FD_SSS_0010	553035	5888675	Debris	4.3	0.7	0.0	-25.4	elongated curved contact
BF_FD_SSS_0025	562976	5899476	Fishing Gear	84.9	0.6	0.0	-25.3	Elongated contact, cable or chain
BJ_FD_SSS_0008	549409	5892980	Debris	4.0	1.6	0.0	-25	oval contact in depression
BE_FD_SSS_0026	564436	5829719	Suspected Debris	5.0	0.6	0.0	-24.2	Seabed disturbance
BB_FS_SSS_0147	569907	5761041	Suspected Debris	6.5	0.9	0.4	-24	Seabed disturbance
BE_FD_SSS_0009	564748	5833956	Suspected Debris	4.2	2.0	0.1	-23.9	oval contact lying on a sand wave
BE_FD_SSS_0028	564355	5830266	Suspected Debris	4.5	3.2	0.0	-23.9	Oval contact, possibly stone
BD_FD_SSS_0642	563132	5781065	Debris	5.1	0.8	0.1	-23.7	Nothing Visible on SSS and MBES
BB_FS_SSS_0481	570154	5761583	Suspected Debris	6.0	2.2	0.1	-23.2	Nothing Visible on SSS and MBES
BE_FD_SSS_0020	563657	5826463	Suspected Debris	11.0	2.7	0.0	-23.2	Seabed disturbance
BD_FD_SSS_0224	557171	5805022	Debris	4.1	1.0	0.0	-23.1	No contact on the SSS, in the Mbes an elongated contact parallel to the sand golf
BB_FS_SSS_0419	570165	5761433	Suspected Debris	8.9	0.6	0.4	-22.6	Elongated straighht contact, partially cut off by the mosaic
BE_FD_SSS_0008	564243	5829215	Suspected Debris	5.9	1.1	0.3	-20.7	No contact on the SSS, in the Mbes an elongated contact parallel to the sand golf
BB_FS_SSS_0433	570711	5761481	Wreck	4.3	2.4	0.3	-18.9	oval contact

Feature_name	Easting	Northing	Feature description Fugro	L	W	H	Z	Description PPA
BB_FS_SSS_0444	570947	5761501	Suspected Debris	4.4	0.5	0.1	-18.4	Natural Ridge
BB_FS_SSS_0025	570853	5760453	Suspected Debris	7.9	1.1	0.2	-18.1	Seabed disturbance
BB_FS_SSS_0705	569990	5762046	Suspected Debris	7.3	0.9	0.2	-17	Elongated contact, possibly cable or chain
BB_FS_SSS_0835	569874	5762289	Suspected Debris	4.1	1.2	0.3	-17	irregularly formed contact
BB_FS_SSS_0937	569719	5762832	Suspected Debris	7.2	0.6	0.2	-16.4	oval contacts, possibly stones
BB_FS_SSS_0019	570760	5760382	Suspected Debris	4.9	1.2	0.5	-14.9	NCN 20283, Seabed disturvance
BA_FS_SSS_0035	570150	5760234	Suspected Debris	4.8	0.5	0.3	-11.5	Elongated contact
BB_FS_SSS_0620	570364	5761961	Suspected Debris	4.1	0.4	0.3	-17	See Wreck NCN 219
BB_FS_SSS_0678	570397	5761996	Wreck	31.9	20.5	1.6	-17	See Wreck NCN 219
BB_FS_SSS_0684	570389	5762001	Suspected Debris	4.3	0.6	0.4	-17	See Wreck NCN 219
BH_FSEA_SSS_0187	559117	5935318	Wreck	17.1	3.9	1.7	-34	See Wreck NCN 531
BJ_FD_SSS_0015	548443	5894128	Debris	5.6	1.8	0.0	-26.4	Elongated object 5.6 perpendicular to sand waves
BK_FSEA_SSS_0022	551288	5924521	Boulder	5.6	2.9	5.2	-29.8	Buried Remains with Magnetic Anomalies
BK_FSEA_SSS_0163	550142	5921916	Boulder	0.0	2.5	2.5	-29	See NCN 967
BK_FSEA_SSS_0179	555839	5929168	Boulder	6.7	5.7	1.0	-30.3	Large Anchor Shaft 3.2 M Arms 2.1m With Scouring

Appendix 2. Phases of maritime archaeological research

The Dutch Quality Standard for Archaeology (KNA Waterbodems, version 4.1) describes all procedures and requirements for the archaeological research process. Below a brief description of the steps involved:

1. **Desk study**
   The purpose of a desk study is to collect and report all available historical data, geological information, and information about disturbances in the past. The result is an archaeological expectation map or model.
   The desk study may be expanded with an analysis of sonar and multibeam data, if available.

   IF the outcome of the desk study shows that there is a risk of occurrence of archaeology, then the next phase must be carried out:

2. **Exploratory field research (opwaterfase)**

   a. Geophysical survey
   In order to test the archaeological expectation, a geophysical survey is carried out. The type of survey depends on the type of expected objects, local geology and expected depth of the objects below the seafloor. In practice, the research usually consists of a side scan sonar survey, if necessary, supplemented with multibeam echo sounder recordings, subbottom profiling and magnetometer measurements. The requirements of the survey are based on the desk study and should be included in a program of requirements which must be approved by the competent authorities.

   IF potential archaeological objects are found, then the next phase (**3**) must be carried out.

   b. Geotechnical survey
   In order to reconstruct prehistoric landscapes and refine and test the archaeological expectation related to those landscapes a geotechnical survey can be carried out. A geotechnical survey comprises penetration tests (CPT's) and/or bottom sampling (*vibrocore*, Acqualock, Begemann, grab sampling, etcetera). The sample strategy and sample locations are based on the geological constellation of the area and interpreted subbottom profiling data. The requirements of the survey shall be listed in a program of requirements which must be approved by the competent authorities.

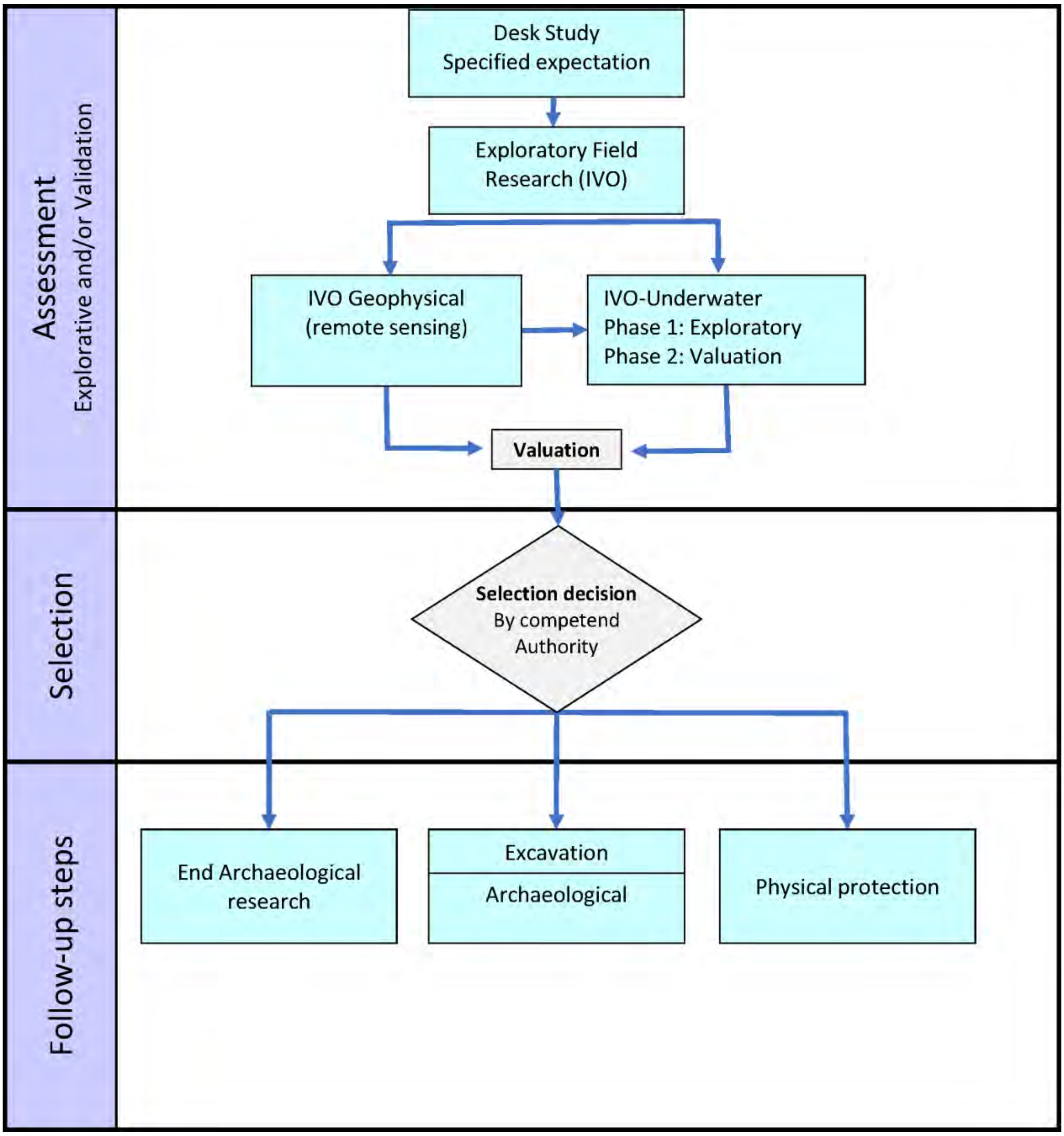
3. **Exploratory field research (onderwaterfase verkennend)**
   The suspected sites are investigated by specialized divers in order to identify the objects. The requirements of the underwater research are included in a program of requirements which must be approved by the competent authorities.

   IF as site is identified as an archaeological object or structure then the next phase must be carried out:

4. **Appreciative field research (onderwaterfase waarderend)**
   The archaeological remains at the site are thoroughly investigated and mapped by a specialized archaeological diving team and samples are collected for additional research. Then a decision will be made whether the archaeological remains are worth preserving. If the latter is the case, then there are two possibilities: either the remains can be preserved in situ (adjustment of plans), or the next phase will be conducted:

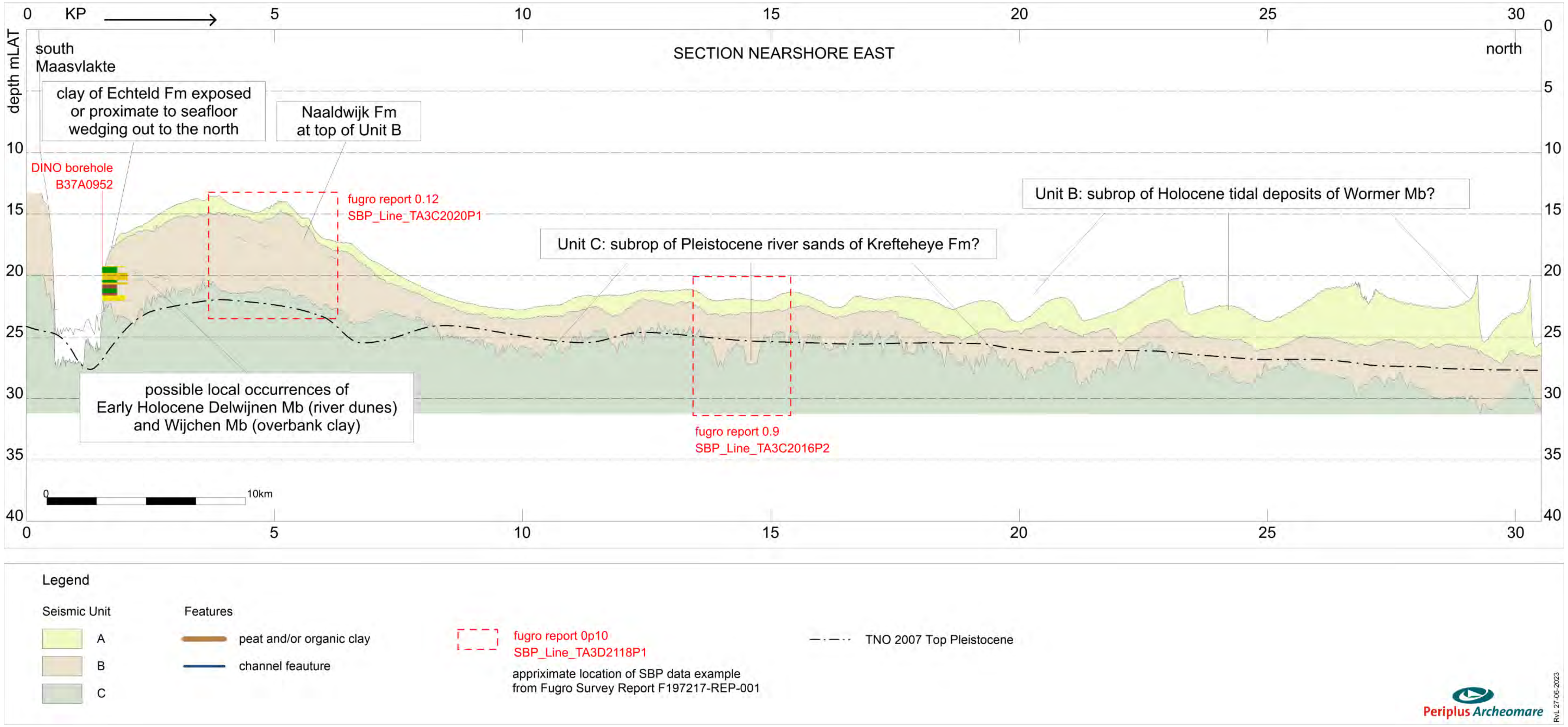
5. **Archaeological excavation**
   The archaeological remains are excavated under supervision of a senior maritime archaeologist. All remains need to be documented, registered, and conserved. The requirements of the underwater research are included in a program of requirements which must be approved by the competent authorities.

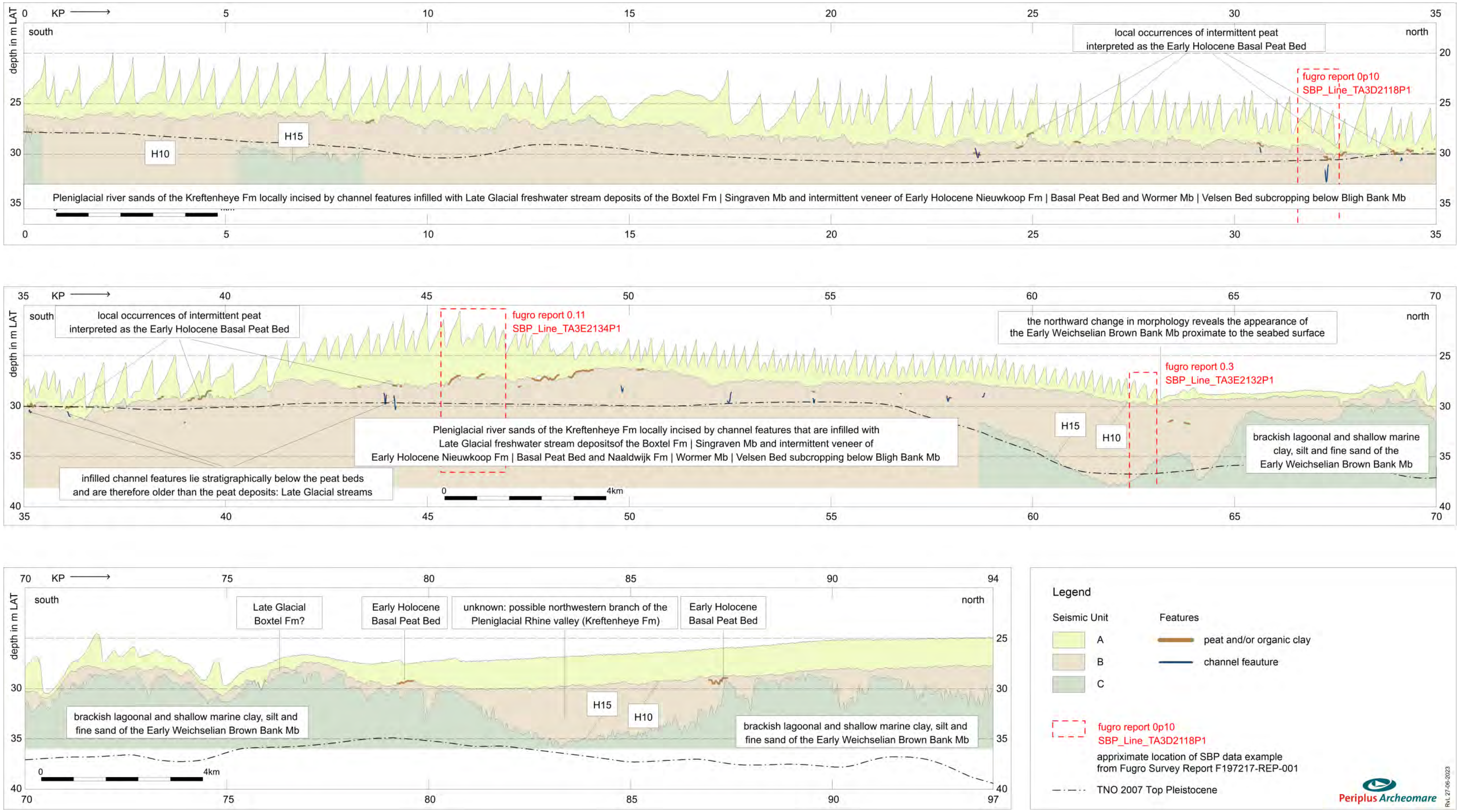
The phases described above contain a number of decision points that are dependent on the detected archaeological objects. The figure below shows these moments schematically.

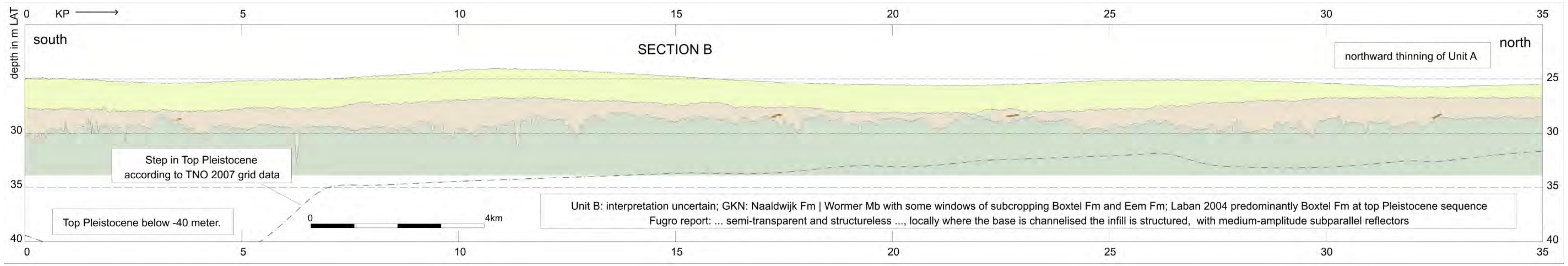


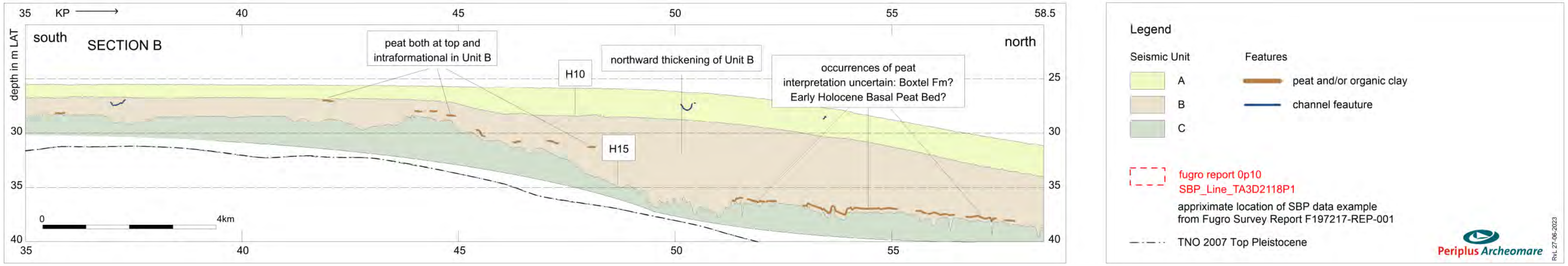
Appendix 3. X-sections

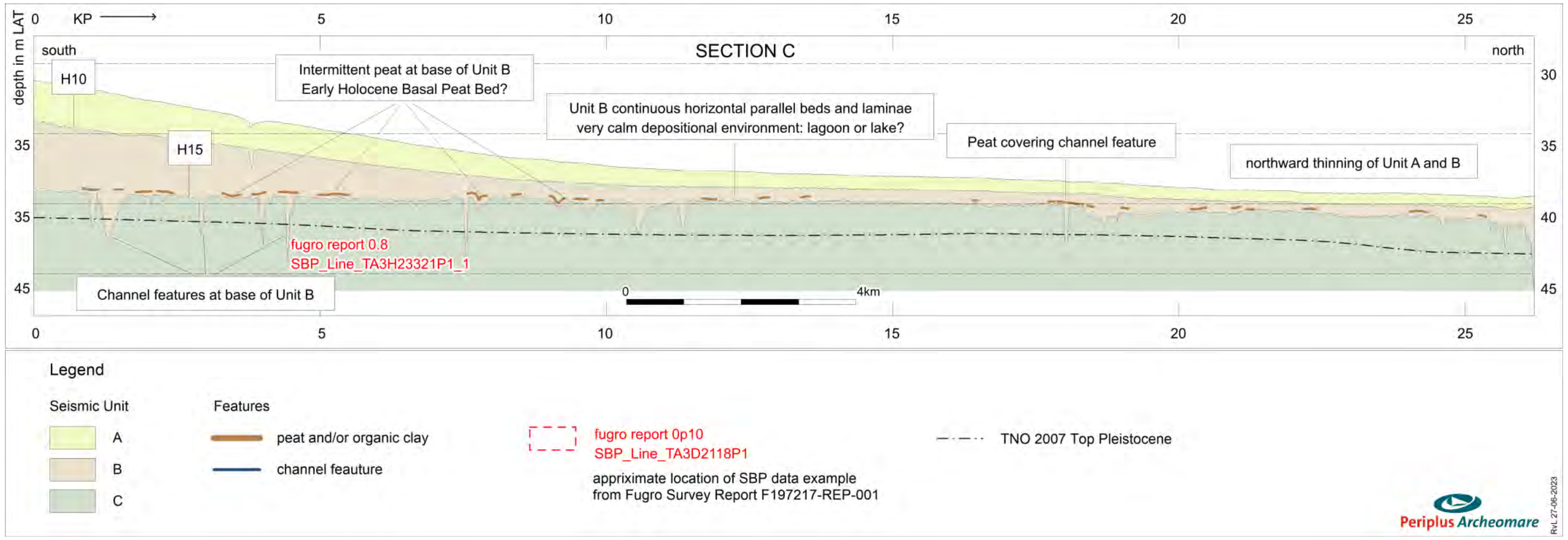
Section Nearshore East, A, B and C


KP
depth mLAT
south
Maasvlakte
SECTION NEARSHORE EAST
north
clay of Echteld Fm exposed or proximate to seafloor wedging out to the north
Naaldwijk Fm at top of Unit B
DINO borehole B37A0952
fugro report 0.12
SBP_Line_TA3C2020P1
Unit B: subrop of Holocene tidal deposits of Wormer Mb?
Unit C: subrop of Pleistocene river sands of Krefteheye Fm?
possible local occurrences of Early Holocene Delwijnen Mb (river dunes) and Wijchen Mb (overbank clay)
fugro report 0.9
SBP_Line_TA3C2016P2
10km
Legend
Seismic Unit
A
B
C
Features
peat and/or organic clay
channel feauture
fugro report 0p10
SBP_Line_TA3D2118P1
appriximate location of SBP data example
from Fugro Survey Report F197217-REP-001
TNO 2007 Top Pleistocene
Periplus Archeomare
RvL 27-06-2023


KP
depth in m LAT
south
north
local occurrences of intermittent peat interpreted as the Early Holocene Basal Peat Bed
fugro report 0p10
SBP_Line_TA3D2118P1
H15
H10
Pleniglacial river sands of the Kreftenheye Fm locally incised by channel features infilled with Late Glacial freshwater stream deposits of the Boxtel Fm | Singraven Mb and intermittent veneer of Early Holocene Nieuwkoop Fm | Basal Peat Bed and Wormer Mb | Velsen Bed subcropping below Bligh Bank Mb
local occurrences of intermittent peat interpreted as the Early Holocene Basal Peat Bed
fugro report 0.11
SBP_Line_TA3E2134P1
the northward change in morphology reveals the appearance of the Early Weichselian Brown Bank Mb proximate to the seabed surface
fugro report 0.3
SBP_Line_TA3E2132P1
Pleniglacial river sands of the Kreftenheye Fm locally incised by channel features that are infilled with Late Glacial freshwater stream depositsof the Boxtel Fm | Singraven Mb and intermittent veneer of Early Holocene Nieuwkoop Fm | Basal Peat Bed and Naaldwijk Fm | Wormer Mb | Velsen Bed subcropping below Bligh Bank Mb
brackish lagoonal and shallow marine clay, silt and fine sand of the Early Weichselian Brown Bank Mb
infilled channel features lie stratigraphically below the peat beds and are therefore older than the peat deposits: Late Glacial streams
0 4km
Late Glacial Boxtel Fm?
Early Holocene Basal Peat Bed
unknown: possible northwestern branch of the Pleniglacial Rhine valley (Kreftenheye Fm)
Early Holocene Basal Peat Bed
brackish lagoonal and shallow marine clay, silt and fine sand of the Early Weichselian Brown Bank Mb
brackish lagoonal and shallow marine clay, silt and fine sand of the Early Weichselian Brown Bank Mb
Legend
Seismic Unit
A
B
C
Features
peat and/or organic clay
channel feauture
fugro report 0p10
SBP_Line_TA3D2118P1
appriximate location of SBP data example from Fugro Survey Report F197217-REP-001
TNO 2007 Top Pleistocene
Periplus Archeomare


depth in m LAT
KP
SECTION B
south
north
northward thinning of Unit A
Step in Top Pleistocene according to TNO 2007 grid data
Top Pleistocene below -40 meter.
0
4km
Unit B: interpretation uncertain; GKN: Naaldwijk Fm | Wormer Mb with some windows of subcropping Boxtel Fm and Eem Fm; Laban 2004 predominantly Boxtel Fm at top Pleistocene sequence
Fugro report: ... semi-transparent and structureless ..., locally where the base is channelised the infill is structured, with medium-amplitude subparallel reflectors


depth in m LAT
KP
south
SECTION B
north
58.5
peat both at top and intraformational in Unit B
H10
northward thickening of Unit B
occurrences of peat interpretation uncertain: Boxtel Fm? Early Holocene Basal Peat Bed?
H15
0
4km
Legend
Seismic Unit
Features
A
B
C
peat and/or organic clay
channel feauture
fugro report 0p10
SBP_Line_TA3D2118P1
apprixmate location of SBP data example from Fugro Survey Report F197217-REP-001
TNO 2007 Top Pleistocene
Periplus Archeomare
Rvl. 27-06-2023


depth in m LAT
KP
SECTION C
south
north
H10
H15
Intermittent peat at base of Unit B Early Holocene Basal Peat Bed?
Unit B continuous horizontal parallel beds and laminae very calm depositional environment: lagoon or lake?
Peat covering channel feature
northward thinning of Unit A and B
fugro report 0.8
SBP_Line_TA3H23321P1_1
Channel features at base of Unit B
0
4km
Legend
Seismic Unit
Features
A
B
C
peat and/or organic clay
channel feauture
fugro report 0p10
SBP_Line_TA3D2118P1
apprixmate location of SBP data example from Fugro Survey Report F197217-REP-001
TNO 2007 Top Pleistocene
Periplus Archeomare
Rvl. 27-06-2023

Appendix 4. Integrated Geophysical and Geotechnical reports

F197217-REP-001_(01) Geophysical Results Report.pdf

By Fugro

Gemeente Rotterdam

Onderwerp:
A2023301 Gemeente Rotterdam, Aramis project, 2 tunnelschachten

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Van: dhr. drs. B.A. Corver
Telefoon: 06 – 289 19 034
E-mail: ba.corver@rotterdam.nl

Ons kenmerk: AS23/11267-23/0022317

Datum: 30 november 2023

Retouradres: Ceintuurbaan 213b, 3051 KC Rotterdam
Royal HaskoningDHV
t.a.v. de heer E. Holleman
Postbus 1132
3800 BC AMERSFOORT

Geachte heer Holleman,

De afdeling Archeologie van de gemeente Rotterdam (BOOR) heeft op uw verzoek de noodzaak van het uitvoeren van een archeologisch (voor)onderzoek in het kader van de voorgenomen grondwerkzaamheden ter behoeve van Aramis project, 2 tunnelschachten (nabij Prinses Maximaweg), te Rotterdam beoordeeld.

Beoordeling
De plannen geven geen aanleiding tot archeologisch vooronderzoek (bureauonderzoek en/of inventariserend veldonderzoek) op de planlocatie. De locatie kan voor de voorgenomen ontwikkeling worden vrijgegeven zonder archeologische bemoeienis.
Er dient wel altijd rekening gehouden te worden met zogenaamde toevalsvondsten, bijvoorbeeld scheepswrakken of -resten. Hiervan dient men op basis van de Erfgoedwet 2016, art. 5.10 melding te maken bij Onze Minister van Onderwijs, Cultuur en Wetenschap c.q. de Rijksdienst voor het Cultureel Erfgoed. In de praktijk is het eenvoudiger om dit bij de bevoegde overheid, de gemeente Rotterdam, voor deze Archeologie Rotterdam, te doen.

Onderbouwing
Het plangebied maakt deel uit van een archeologisch kansrijk gebied. In het bestemmingsplan ‘Maasvlakte 1’ is voor de locatie een bouwregeling en een omgevingsvergunning opgenomen voor bouw- en graafwerkzaamheden die dieper reiken dan 3 m - NAP en die tevens een oppervlakte beslaan van meer dan 200 vierkante meter.

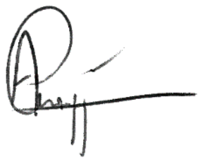
De grondroerende werkzaamheden bestaan uit het graven van een tunnel. In het kader van CO_2-opslag zal transport plaatsvinden onder de zeewering en Maasgeul door naar een in de Noordzee gelegen distributieplatform, met een diameter van 32”. Om de kruising met de Maasgeul te realiseren wordt een microtunnel voorzien. Voor de aanleg van deze microtunnel zijn momenteel twee opties: een diepe schacht ten noorden van de Maasvlakteweg weg (314 m^2, tot 19,2 m diep, uiteindelijk 35-40 m - mv, diameter 20 m) of een minder diepe schacht ten zuiden van de Maasvlakteweg (800 m^2, tot 11,7 m - mv, lxb = 80x10 m). Voor beide opties is deze plantoets uitgevoerd.

De werkzaamheden overschrijden de toegestane verstoringsmarges van het bestemmingsplan, echter op basis van Vos 2019[1] blijkt dat de kans op de aanwezigheid van archeologische resten klein is. In verband hiermee wordt een archeologisch vooronderzoek op de planlocatie niet noodzakelijk geacht.

Bij eventuele wijzigingen in het aanlegplan kan een archeologisch vooronderzoek alsnog nodig zijn en dient het opnieuw aan Archeologie Rotterdam te worden voorgelegd.

Met vriendelijke groet,

DIRECTEUR STADSBEHEER OPENBARE WERKEN
(voor deze)



dr. A. Carmiggelt
Hoofd Archeologie Rotterdam (BOOR)

[1] Vos, P. 2019: Toelichting op de kaart van het oppervlak van de Pleistocene ondergrond en de Vroeg Holocene paleo-landschapskaarten van het Maasvlakte gebied - Port of Rotterdam, Deltares.

Aramis Pipeline Routing Desktop Study - Expected Site Conditions

Consultancy Report | Dutch Sector of the North Sea

R201644 03 | 10 February 2022

TotalEnergies

Document Control

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03	10 February 2022	Final	Update of cables	ABL	SPO	SPO

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Nanterre, 10 February 2022

Dear Mr. Contet,

Please find attached the final version of the Desktop Study performed as part of the ARAMIS Pipeline Routing project.

This report, referenced R201644 (03), was prepared by the joint efforts of Dr. Arthur Blouin, Engineering Geologist, Peter Schilder, Geologist, Bogusia Klosowska, Principal Geologist. It was reviewed by Wessel van Kesteren, Principal Geologist, under the supervision of Stanislas Po.

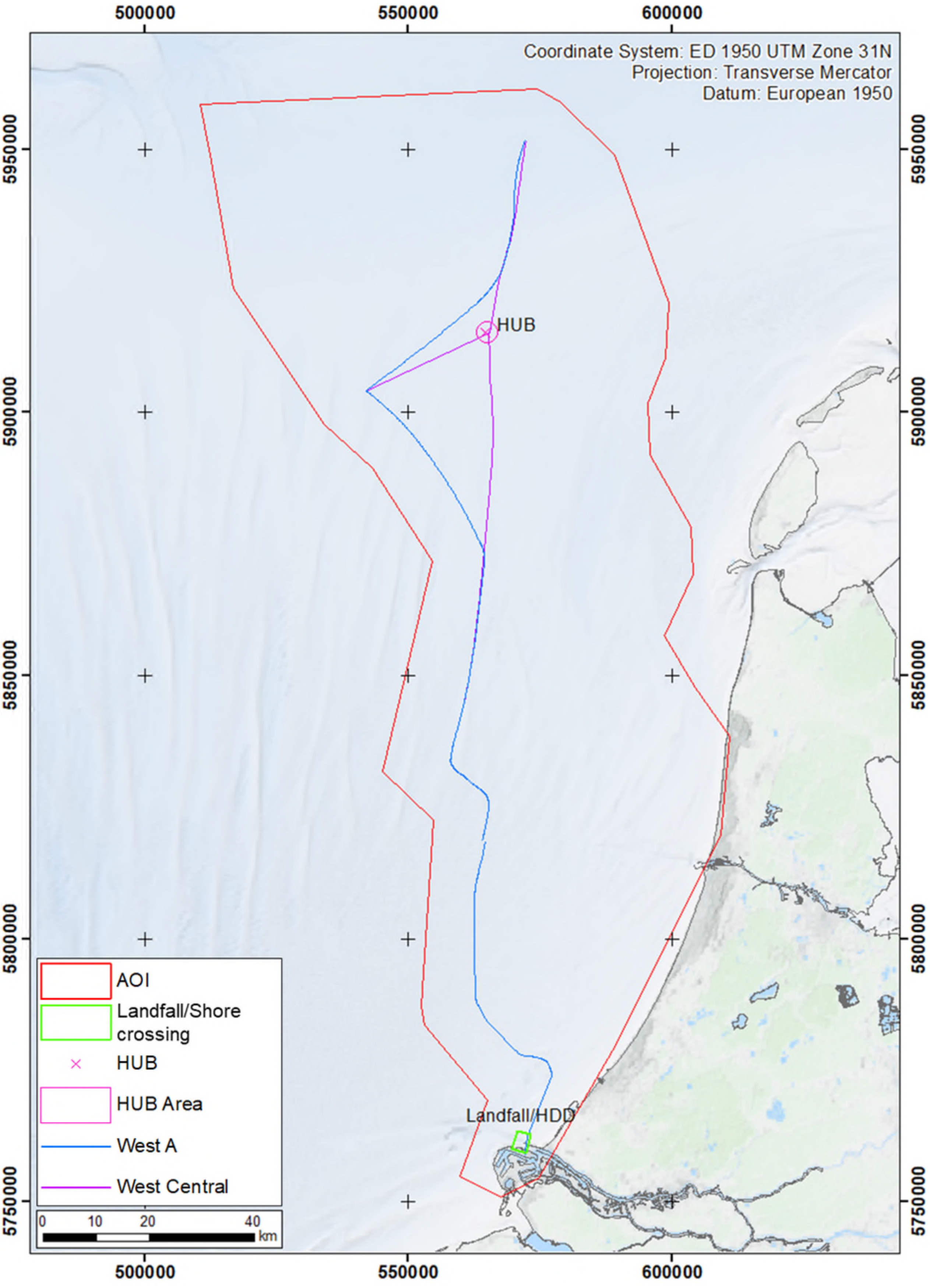
Thank you for giving us the opportunity to work for you.

Please do not hesitate to contact us should you have any queries.

Yours faithfully,

Dr Arthur BLOUIN
Engineering Geologist

Frontispiece



Executive Summary

TotalEnergies requested Fugro to perform a desktop study (DTS) aimed at characterising soil conditions and site use based on publicly available data and Fugro experience over an area of 11,355 km^2 within the Dutch sector of the North Sea. Two areas of particular attention were differentiated within the general area of interest (AOI). These are the Landfall/Shore crossing Area and the Offshore Distribution HUB Area.

The main results of the DTS are summarised as follows:

- Information relating to site use, restricted areas, past or present activities, and any seafloor objects that may affect and constrain development of the proposed pipeline infrastructure was gathered and presented in the report in the form of text and maps;
- Water depths range from 0 m to a maximum of approximately 46 m relative to lowest astronomical tide (LAT). Seafloor gradients are generally less than 1°, but may be locally up to 30° and are related to anthropogenic features and crests of bedforms;
- Three zones with a distinct seafloor morphology were identified within the AOI: a coastal zone, a shallow continental shelf with low-angle topography covered by a complex compound of rhythmic bedforms, and a relatively deep low-energy zone with low-angle seafloor gradient;
- Three types of bedforms were observed within the AOI: sand banks, sand waves and megaripples;
- Sand waves are mobile over the lifetime of a pipeline and are considered to have a significant impact on pipeline foundation design and asset integrity;
- Six groups of surficial sediments were identified across the AOI: Sandy GRAVEL, (slightly) gravelly SAND, (slightly) gravelly muddy SAND, SAND, muddy SAND and sandy MUD. The main constituent is SAND;
- The AOI is characterised by variable soil conditions down to the depth of interest, which were grouped into geotechnical soil units based on the available data (geological, geophysical and geotechnical);
- Separate ground models are presented for the AOI, the Landfall/Shore crossing Area and the Offshore Distribution HUB Area. These ground models take into account the different depths of interest and site-specific site conditions;
- Eighteen soil profiles were generated to display the lateral and vertical variability across the AOI;
- In the Landfall/Shore crossing Area, the surficial sediments comprise predominantly sand to locally sandy gravel, and very soft clay in the Maasmond Kanaal. In the subsurface, the main units are the Naaldwijk Formation, comprising of interbedded sand and clay, with locally peat (laminae to thin beds), and the Kreftenheye, IJmuiden Ground and Winterton Shoal Formations, which comprise dense to very dense sand, with locally layers of silty sand and/or (laminated) clay in the lower part of the depth of interest.
- Three soil province maps were created to depict the spatial extent of each predicted soil profile within the AOI, Landfall/Shore crossing Area and Offshore Distribution HUB Area;
- A geohazards inventory list is provided, detailing (geo)hazards, soil and anthropogenic constraints and man-made obstructions identified across the AOI;

- Recommendations for site-specific geophysical and geotechnical surveys are detailed at the end of the report. These recommendations may aid in reducing uncertainties and aid decision making regarding the ARAMIS Pipeline routing.

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Abbreviations

AOI	Area of interest
BH	Borehole
bLAT	below Lowest Astronomical Tide
BP	Before Present
BSF	Below seafloor
CD	Chart datum
CM	Central meridian
CPT	Cone penetration test
DTM	Digital terrain model
DTS	Desktop study
ED	European Datum
Fm.	Geological formation
GIS	Geographic information system
ETRS	European terrestrial reference system
LAT	Lowest Astronomical Tide
ka	Period of thousand years
LGM	Last Glacial Maximum
Ma	Million years ago
Mb.	Geological formation member
MBES	Multibeam echosounder
MSL	Mean Sea Level
OWF	Offshore wind farm
SBP	Sub-bottom profiler
SHOM	Service Hydrographique et Océanographique de la Marine
SSS	Side Scan Sonar
UHR	Ultra High resolution
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
WFZ	Wind farm zone
WGS	World Geodetic System
WMS	Web Map Service

1. Introduction

1.1 Purpose

Fugro France SAS (Fugro) was contracted by TotalEnergies (client) to provide a desktop study to characterise the site conditions for the ARAMIS Pipeline Routing project.

This geological desktop study (DTS) aims to better understand the ground conditions along the future ARAMIS Pipeline located in the Dutch sector of the North Sea.

The final purpose is to provide the client with a geological and geotechnical model across area of interest (AOI), providing the necessary information to help decision making for the pipeline routing.

1.2 Study Areas

The AOI comprises an area of 11355 km² and is located in the southern North Sea, north-west off the coast of the Netherlands, within the Dutch administrative zone (Figure 1.1). Along the coastline, the AOI extends from Maasvlakte within the Port of Rotterdam in the south, to Egmond aan Zee in the north. The AOI extends over approximately 210 km in a north–south direction and 90 km in a west–east direction.

Within the AOI, two areas of particular attention were differentiated. These are:

- Landfall/Shore crossing Area: the first 3 km of the planned pipeline routing for horizontal directional drilling (HDD) and trenching at Maasvlakte;
- Offshore Distribution HUB Area: a 2 km radius area around the planned Offshore Distribution HUB location. This area is mentioned as HUB Area in maps throughout the report.

The depth of interest is 20 m below seafloor (BSF) for the entire AOI, except for the Landfall/Shore crossing Area, where it is 40 m to 50 m BSF and the Offshore Distribution HUB Area, where it is 100 m BSF.

Client provided preliminary offshore rigid pipeline routing (two options: West A and West Central). At this point the final pipeline routing is not defined.

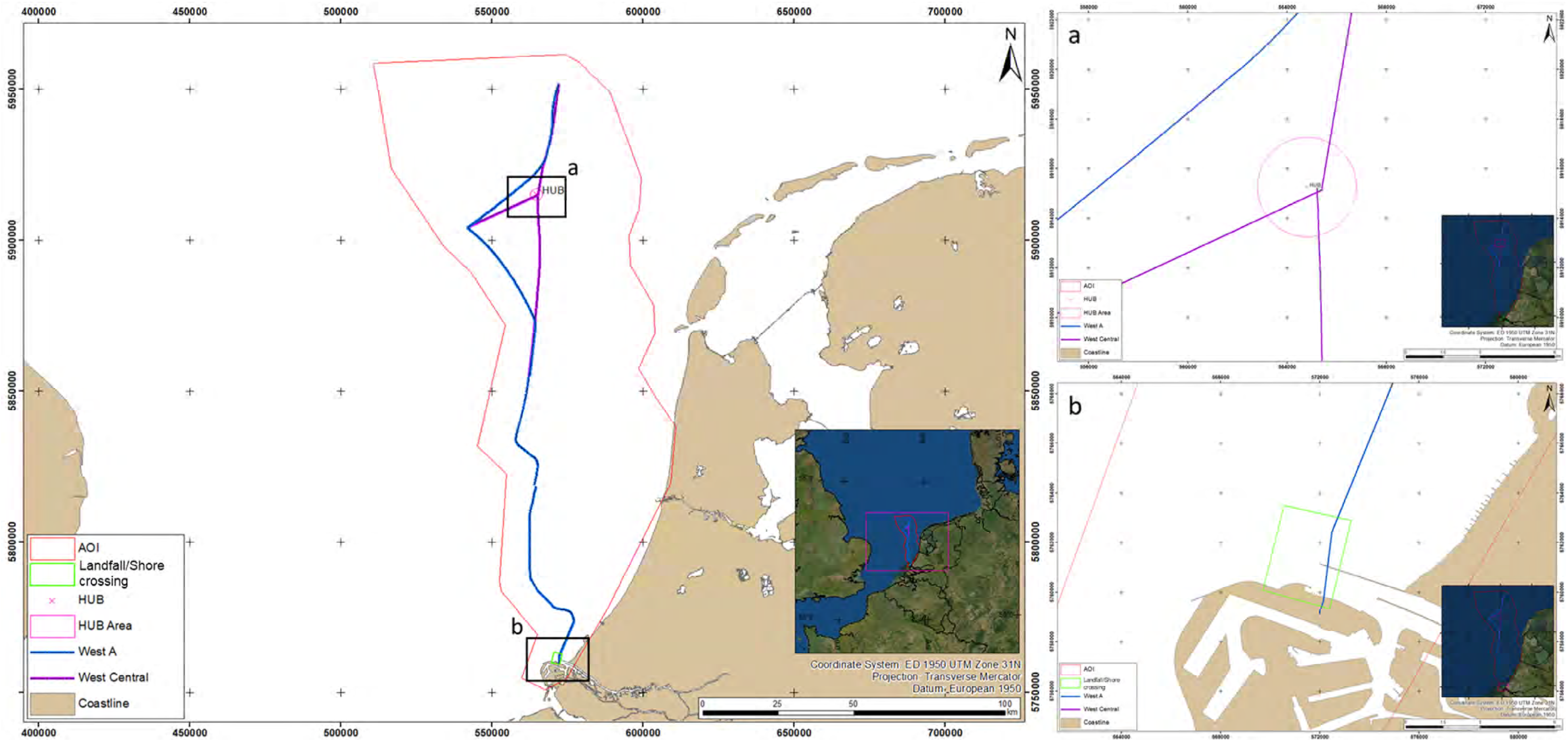


Figure 1.1: Extent of the AOI and definition of the Landfall/Shore crossing and Offshore Distribution HUB Areas

1.3 Scope of Work

The report presents the site-specific seafloor and sub-seafloor conditions derived from available data and the present understanding of the regional geology. These elements will be described across the AOI, Landfall/Shore crossing and Offshore Distribution HUB Areas.

This study includes comments on the site suitability considering a list of potential site-specific (geo)hazards, as well as soil and anthropogenic constraints across the AOI.

The UXO historical desktop study and archaeological desktop study were sub-contracted. Reports from sub-contractors are provided as Appendix B and Appendix C.

1.4 Study Limitations

This report does not cover the following topics:

- Metocean conditions;
- Environmental impact of foundations, if any;
- UXO risk assessment at the AOI.

The results of this study are dependent on the origin, quality, and quantity of available data. The presented ground model is preliminary and should only be used to help decision making during the bidding process.

Geotechnical parameters presented in this report are estimates, derived from Fugro experience over analogous representative areas within the AOI (e.g. planned wind farm sites). Future site-specific in situ measurements are required to confirm or adjust the presented geotechnical parameter ranges before any installation

1.5 Geodetic Parameters

Table 1.1 presents the coordinate reference system for this project. All illustrations in the report as well as the A3 maps are prepared using the ED50 datum and UTM Zone 31N projection.

Table 1.1: Geodetics parameters

Geodetic Datum	
Datum	International_1924
Spheroid	D_European_1950
Semi major axis	a = 6 378 137.0 m
Semi minor axis	b = 6 356 911.946127946 m
Inverse flattening	$^1/_f$ = 297.0
Map Projection	
Projection system	Transverse Mercator (UTM Zone 31N)
Central meridian	3°
Latitude of origin	0°

False easting	500 000 m
False northing	0 m
Linear unit	Metre

1.6 Data Use

Fugro understands that this report will be used for the purposes described in the 'Introduction' section. These purposes are a key factor in defining the scope and level of services offered.

It should also be noted that the geological and geotechnical data presented in this report are based on interpretations, correlations, and extrapolations, which implies a certain degree of uncertainty to be considered. This study will emphasise the level of confidence in the geological model and will detail the uncertainties related to stratigraphic conditions, the nature and thickness of the geological formations and geotechnical parameters.

However, the results of this report should not be used for purposes other than those for which this report was prepared, or if the original development or activity is modified by the client without prior control of their suitability.

1.7 Guidelines on Use of Report

Appendix A outlines the limitations of this report, in terms of a range of considerations including, but not limited to, its purpose, its scope, the data on which it is based, its use by third parties, possible future changes in design procedures and possible changes in the conditions at the site with time. It represents a clear description and explanation of the constraints which apply to all reports issued by Fugro. It should be noted that the Guidelines do not in any way supersede the terms and conditions of the contract between Fugro and TotalEnergies.

2. Approach and Data Review

2.1 Desktop Study Approach

The first step for the desktop study was to gather any relevant data, both public and internal, related to geological, geophysical and geotechnical features within the AOI but also covering a wider area. Based on these, the regional geological background was determined. This allowed for a better understanding and identification of potential or identified geological features or processes that may be expected across the AOI.

In addition, information relating to site use, restricted areas, past or present activities, and any seafloor objects that may affect and constrain development of the proposed pipeline infrastructure was gathered and presented in a number of maps.

These data were then reviewed and studied to characterise the different geological features, stratigraphic units, geotechnical parameters and constraints (geological and site-use) across the AOI, with a particular focus on the Landfall/Shore crossing Area and the Offshore Distribution HUB Area. Geotechnical parameters were derived mainly based on public information and Fugro experience. Note that no project names or locations are shared for confidentiality reasons. The data that were used are introduced in Section 2.2.

Attention is given to the identification of possible missing data or areas of uncertainties to establish recommendations for future geophysical and geotechnical site-specific surveys.

The ultimate result of the DTS is to provide a geotechnical ground model allowing to describe the soil variability, both vertically (soil profiles) and laterally (soil provinces), in the AOI (including Landfall/Shore crossing and Offshore Distribution HUB Areas).

The available data used for this study were compiled in a GIS (Geographic Information System) geodatabase. The maps were created using ArcGIS® software by Esri (version 10.8).

The final GIS project is delivered along with the final revision of the report.

2.2 Available Data

The main sources of information used in this study include:

- Client-supplied information (Table 2.1);
- Fugro internal databases;
- Digital public domain data (Table 2.2);
  - WMS
  - Freely downloadable GIS-compatible data
- Published literature.

For those sources that are not included in the GIS database deliverable, URL links are given to allow TotalEnergies to retrieve the relevant information.

2.2.1 Client-Supplied Information

Table 2.1: Project information

Data	Data Format	Date Provided
Boundaries of Area of Interest (AOI)	Shapefile	06 December 2021
WEST A and WEST CENTRAL Routings	Shapefile	07 December 2021
Offshore Distribution Area	Shapefile	04 November 2021
Outline of Landfall/Shore crossing Area	Coordinates	15 December 2021

2.2.2 Fugro Database

This report uses and summarises Fugro-held information:

- Information about regional geology;
- General geotechnical data;
- Previous geotechnical and geophysical investigation data applicable to development sites within the AOI.

2.2.3 Public Domain

Data from public sources have been gathered and reviewed. These data are accessible for consultation online, to download or using WMS servers. Table 2.2 presents the data sources used.

Table 2.2: Public domain data sources

Type	Source	Link
SITE USE		
Landing stations	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Telecommunication cables	EMODnet, SHOM, Rijkswaterstaat	https://www.emodnet-humanactivities.eu/view-data.php https://www.rijkswaterstaat.nl/en
Power cables	Rijkswaterstaat	https://www.rijkswaterstaat.nl/en
Buoys	Rijkswaterstaat	https://www.rijkswaterstaat.nl/en
Offshore facilities	NLOG	https://www.nlog.nl/index.php/en/files-interactive-map
Wells	NLOG	https://www.nlog.nl/index.php/en/files-interactive-map
Pipelines	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Active HC licenses	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Navigation channels	Noordzeeloket	https://www.noordzeeloket.nl/en/up-date-atlas/

Type	Source	Link
Anchoring areas	Noordzeeloket	https://www.noordzeeloket.nl/en/up-date-atlas/
Harbour approach areas	Noordzeeloket	https://www.noordzeeloket.nl/en/up-date-atlas/
Wind farm active areas	Noordzeeloket	https://www.noordzeeloket.nl/en/up-date-atlas/
Wind farm development areas	Noordzeeloket	https://www.noordzeeloket.nl/en/up-date-atlas/
Dredging areas	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Military areas	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Environment Natura 2000 areas	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
Dredging areas	Rijkswaterstaat	https://geo.rijkswaterstaat.nl/services/ogc/gdr/stort_loswal/ows?
Fishing and shipping activities	EMODnet	https://www.emodnet-humanactivities.eu/view-data.php
BATHYMETRY		
AOI	EMODnet (2020)	https://portal.emodnet-bathymetry.eu/
Rotterdam approach area	EMODnet (2020)	https://portal.emodnet-bathymetry.eu/
Landfall/Shore crossing Area	EMODnet (2018)	https://portal.emodnet-bathymetry.eu/
Hollandse Kust WFZs	RVO	https://offshorewind.rvo.nl/
SOIL		
Substrate type	EMODnet	https://www.emodnet-geology.eu/map-viewer/?p=seabed_substrate
Grab samples, vibrocores and boreholes	DINOloket	https://www.dinoloket.nl/en/subsurface-data
Hollandse Kust WFZs	RVO	https://offshorewind.rvo.nl/
GEOLOGICAL INFORMATION		
Southern Bight Fm.	Balson et al. (1991), NITG–TNO (2004b)	-
Urania Fm.	NITG–TNO (2004b)	-
Naaldwijk Fm.	Cameron et al. (1984), Harrison et al. (1987), Balson et al. (1991)	-
Boxtel (Twente) Fm.	NITG–TNO (2004d)	-
Eem Fm / Brown Bank Mb.	NITG–TNO (2004d)	-
Kreftenheye Fm.	NITG–TNO (2004d)	-
Eem Fm.	Cameron et al. (1984, 1986)	-
Drente (Borkum Riff) Fm.	Laban (1995)	-
Drente (Cleaver Bank) Fm.	Laban (1995), NITG–TNO (2004d)	-
Tea Kettle Hole Fm.	Laban (1995)	-

Type	Source	Link
Egmond Ground Fm.	Cameron et al. (1984, 1986), Laban (1995)	-
Peelo (Swarte Bank) Fm.	Cameron et al. (1986), Laban (1995), Laban & van der Meer (2011)	-
Yarmouth Roads Fm.	Cameron et al. (1984, 1986)	-
Ice sheet extents	Laban (1995)	-
Notes: Data was accessed between December 2021 and January 2022		

3. Regional Geology

3.1 Regional Geodynamics and Geological History

The large-scale tectonic setting of the Netherlands and adjacent areas is driven by the north–south collision of Gondwana and Laurussia during the Late Carboniferous to form Pangaea, and the subsequent rifting during the Triassic in the Arctic–North Atlantic and western Tethys domains. This formed, in conjunction with the anisotropic and thickened crust of the Variscan fold belt, a complex system of basins and rifts in Northwest Europe (Geluk, 2005). Alpine inversion of these basins took place during the Late Cretaceous and early Paleogene as a result of the collision of Iberia and Europe. This was followed by multiple phases of subsidence from the Eocene up to recent times (Wong et al., 2007).

3.2 Pre-Quaternary Geology

From the late Miocene onwards, a complex fan delta system developed, which gradually evolved into an alluvial plain prograding from the east. Until the end of the Neogene, deposition in the North Sea was dominated by sediment input from the Eridanos (Baltic) river system (Overeem, 2002; Knox et al., 2010; Rasmussen & Dybkjaer, 2014; Thöle et al., 2014).

3.3 Quaternary Geology

During the Pleistocene, the depositional evolution of the North Sea basin was strongly influenced by climatic variations, glaciations and associated sea level fluctuations (Funnell, 1996; Overeem et al., 2001; Kuhlmann & Wong, 2008; Thöle et al., 2014). This resulted in a complex interplay of glacial, glaciolacustrine, glaciofluvial, fluvial, aeolian, deltaic and (shallow) marine environments and deposits (Laban, 1995; Laban & Rijswijk, 2002; Joon et al., 1990; Peeters et al., 2015).

By the mid-Pleistocene (~1 Ma), the Rhine, Meuse and Scheldt rivers had become important contributors of sediment influx to the North Sea basin, as a result of uplift of highland areas in Germany (Laban and Rijsdijk, 2002). Subsidence decreased during this time and the basin had become largely filled with deltaic deposits.

The AOI has been affected by an alternating series of glacial and interglacial periods that has occurred since the Pleistocene and continues to the present day. Below follows a more detailed description of the three glacial and three interglacial periods that took place.

3.3.1 Elsterian Glaciation (Middle Pleistocene)

During the Elsterian glaciation (475 ka to 410 ka BP), the Scandinavian and British ice masses coalesced and spread in southern direction to cover the northern part of the Netherlands and the southern North Sea (Ehlers, 1990; De Gans, 2007). The northern half of the AOI has been affected by the Elsterian ice sheet, while the southern half was influenced by the Rhine and Meuse river systems (Figure 3.1a). The Aramis area was also influenced by the Eridanos river system, which was deflected south of the ice limit. Deposition of predominantly low energy open marine deltaic sediments consisting of siliceous sands and clays ensued, which are thought to belong to the Yarmouth Roads Formation (Laban, 1995; Laban & Rijsdijk, 2002; Rijsdijk et al., 2005). Elsterian tunnel valleys occur within the Yarmouth Roads Formation. The infill of these tunnel valleys comprises glaciofluvial, glaciolacustrine and proglacial clays and sands of the former Swarte Bank Formation (now part of the Peelo Formation; Praeg, 1996; Rijsdijk et al., 2005; Graham et al., 2011; Moreau et al., 2012).

3.3.2 Holsteinian Interglacial (Middle Pleistocene)

During the subsequent Holsteinian interglacial (410 ka to 370 ka BP), sea level rose because of climate amelioration and melting ice masses. This resulted in a transgression phase in the AOI.

Fluvial and marine deposits were prevalent in this period. The fluvial deposits have been defined as the onshore Urk Formation (Bosch et al., 2003), while the offshore equivalent comprises marine deposits belonging to the Egmond Ground Formation (Bosch et al., 2003; Rijsdijk et al., 2005). Laterally, the Urk Formation grades into the Egmond Ground Formation (Bosch et al., 2003). The Urk Formation can contain clay interbeds, while the Egmond Ground Formation can contain marine shells. The Urk Formation and Egmond Ground Formation may locally incise into the underlying Yarmouth Roads Formation.

3.3.3 Saalian Glaciation (Middle to Late Pleistocene)

During the Saalian glaciation (370 ka to 130 ka BP), the eastern half of the AOI was probably covered by the Saalian ice sheet while the western half was located in close proximity to the Saalian Ice Margin (Figure 3.1b). However, the exact limit of the ice sheet advance offshore remains uncertain.

Ice masses formed glacially scoured basins and several ice-pushed ridges (moraines). The ice-pushed ridges were recognised directly south of the Hollandse Kust (noord) wind farm zone (WFZ) (Laban & van der Meer, 2011; Peeters et al., 2015; Cartelle et al., 2021).

Numerous tunnel valleys were created during the Saalian in subglacial and proglacial settings. A major tunnel valley is present in the centre of the site, and more tunnel valleys may be present near the north-eastern boundary of the Aramis area (Cameron et al., 1984a; Joon et al., 1990; Laban, 1995; Stouthamer et al., 2015).

Fluvial erosion of underlying formations occurred. During the Saalian glaciation, the Rhine–Meuse river system merged with a proglacial river system south of the ice margin (Peeters et al, 2015). This setting implies variable soil conditions dominated by extensive areas of glaciofluvial sands and gravels (outwash plains/sandurs) deposited in front of the ice sheet, with clays deposited in glaciolacustrine environments. Local aeolian deposition took place near the Saalian Ice Margin. The glaciofluvial and aeolian sediments belong to the Drachten Formation (formerly Tea Kettle Hole Formation), while the glaciolacustrine sediments belong to the Uitdam Member of the Drenthe Formation (formerly Cleaver Bank Formation). The latter is mainly confined to the Saalian tunnel valleys (Laban, 1995).

Between the coast of the island of Texel to a position about 14 km to the west, a till plateau is present.

TILL is unsorted glacial sediment. Within the AOI the TILL is expected to comprise silty, sandy CLAY, with matrix-supported gravel to boulder-sized grains. It is present in the north-east of the AOI and belongs to the Drenthe Formation (Gieten Member). Glacial TILL may pose a risk to the installation of offshore structures due to its heterogenic grain size composition and overconsolidated nature.

The Saalian glaciation is associated with widespread glacial deformation both onshore and offshore. Large deformation structures have been reported within the AOI (Joon et al., 1990; Laban, 1995). Some indications of glacial deformation have been identified in the Hollandse Kust WFZs.

Saalian sediments in the southern North Sea have been largely eroded by the subsequent Eemian transgression but are still present in Saalian channels and valleys.

3.3.4 Eemian Interglacial (Late Pleistocene)

A major marine transgression affected AOI during the Eemian interglacial (130 ka to 115 ka BP). The AOI became part of the delta plain of the river Rhine. Shallow marine sands (Eem Formation), lagoonal and estuarine clays and sands, and fluvial sands (Kreftenheye Formation) were laid down in a complex depositional setting (Peeters et al., 2015). Existing glacial valleys and channels were inundated by the marine transgression (Figure 3.1c).

With the onset of the marine regression at the end of the Eemian and beginning of the Weichselian glaciation, brackish marine clays and lagoonal or lacustrine silty laminated clays, identified as the Brown Bank Member (part of Eem Formation), were deposited in a low-energy environment in the (north-)western part of the AOI (Figure 3.1d; Cameron et al., 1984a; Peeters et al., 2015; GDN, 2018).

3.3.5 Weichselian Glaciation (Late Pleistocene)

During the youngest glacial period, the Weichselian (115 ka to 18 ka BP), the limit of the ice sheet extent was just north-west of the AOI. At the time, deposition in the southern North Sea was dominated by periglacial conditions with temporary fluvial influences of the Rhine–Meuse river system (Figure 3.1e).

The periglacial deposits comprise sand, sandy loam, peat, thaw-lake deposits and aeolian sediments belonging to the Boxtel Formation. The aeolian deposits are considered to have little preservation potential in a dominantly (glacio)fluvial environment (NITG–TNO, 2004). The glaciofluvial deposits comprise sand, gravelly sand and clay of the Kreftenheye Formation. Erosion of underlying formations probably occurred.

3.3.6 Holocene (Recent)

With the transition from late glacial to early Holocene (11.6 ka BP to present), climatic amelioration resulted in sea level rise, and the North Sea basin became flooded. Deposition took place in a terrestrial periglacial environment, transitioning into tidal and lagoonal as the sea level rose. Sediments from this period belong to the Naaldwijk Formation and are preserved as (scattered) sands and clays that often infill channels. Locally, peat beds were deposited in shallow marsh settings (Nieuwkoop Formation). As transgression progressed, the AOI was overlain by sands of the Southern Bight Formation and muddy sands of the Urania Formation.

The North Sea Basin has remained essentially sediment starved since the start of the Holocene (Jacobs & De Batist, 1996), and deposits occur mainly in the form of sand banks and sand waves (Liu et al., 1993). Surficial sediments in the AOI mainly consist of sand with shell and shell fragments typical of a high energy, open marine environment. These sands are partially derived from reworking of the sediments from the underlying fluvial deposits. Sands with a higher mud fraction are present in a bathymetric depression in the northern part of the AOI. These sediments belong to the Urania Formation and are indicative of a low energy open marine environment.

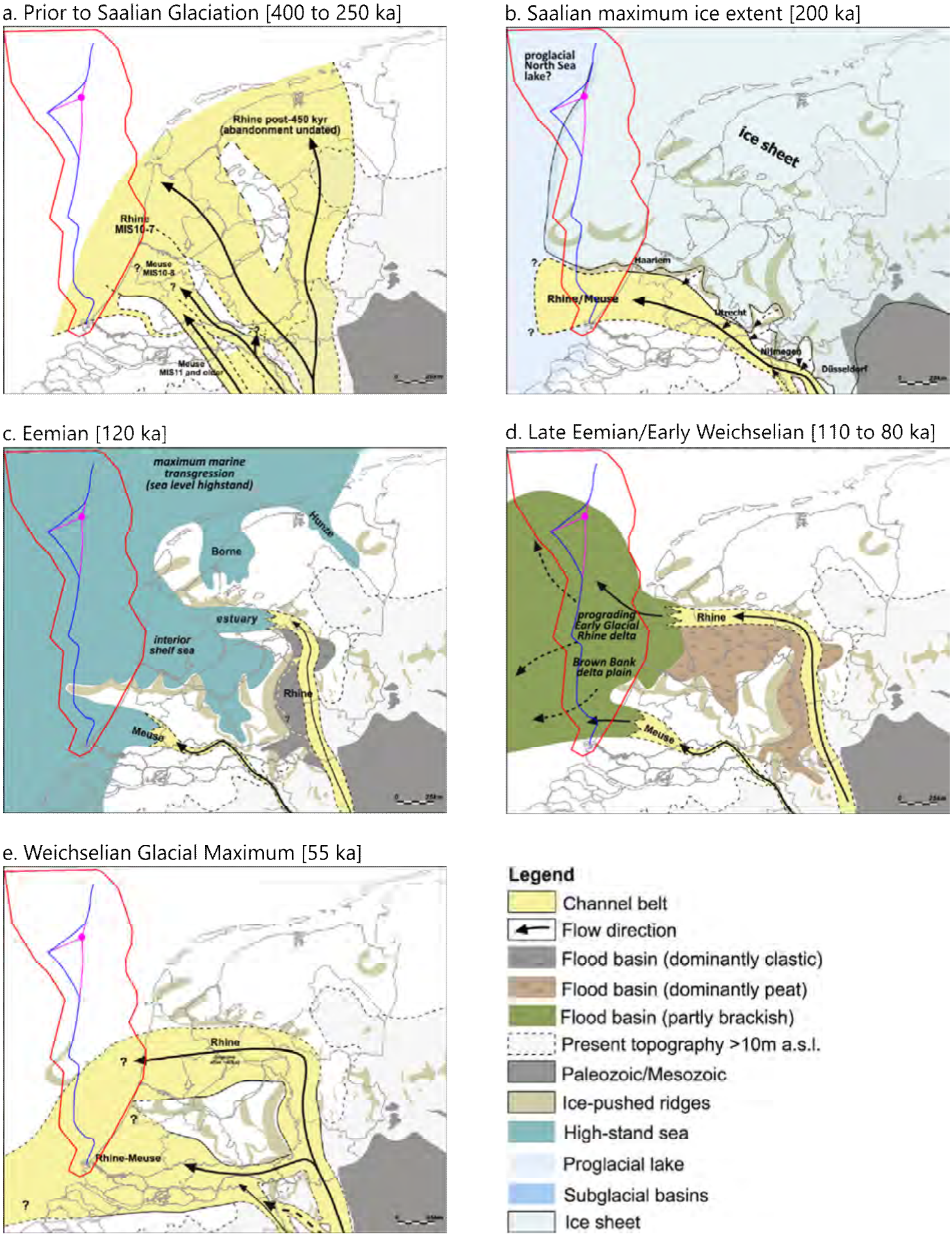


Figure 3.1: Paleo-geographical reconstructions of the Netherlands during the Middle to Late Pleistocene illustrated by five successive time frames. a) Rhine–Meuse drainage configuration prior to Saalian Glaciation. b) Maximum Saalian ice extent. c) Eemian interglacial maximum transgression during sea level highstand. d) Rhine delta prograding into lower-deltaic flood basin environment. e) Configuration of the Rhine and Meuse during the Weichselian glacial maximum (modified after Peeters et al., 2015).

3.4 Maximum Ice Sheet Extent and Subglacial Valleys

Three Pleistocene glaciations resulted in ice sheets covering large parts of the Dutch sector of the North Sea. From the oldest to the youngest, these glaciations are named Elsterian, Saalian and Weichselian. Figure 3.2 presents the maximum extent of the Pleistocene ice sheets and the location of the associated subglacial valleys.

The Elsterian valleys form a complex system of anastomosing, but mainly NNE–SSW trending, broad (approximately 1 km to 10 km wide) and deep (up to 400 m BSF) erosional features. They are present in the northern half of the AOI. These subglacial valleys were mainly filled with glaciofluvial SAND near the base and glaciolacustrine CLAY near the top, belonging to the Peelo Formation (Cameron et al., 1986; Laban, 1995).

A major Saalian subglacial valley runs in a N–S direction, along the margin of the maximum extent of the Saalian ice sheet, located in the centre of the AOI. It is approximately 10 km wide and up to 80 m deep. The infill consists locally of glaciolacustrine CLAY (Uitdam Member) near the base, covered with marine SAND of the Eem Formation (Laban, 1995, Fugro, 2020).

Weichselian subglacial valleys occur as close as 6 km north of the AOI (Laban, 1995).

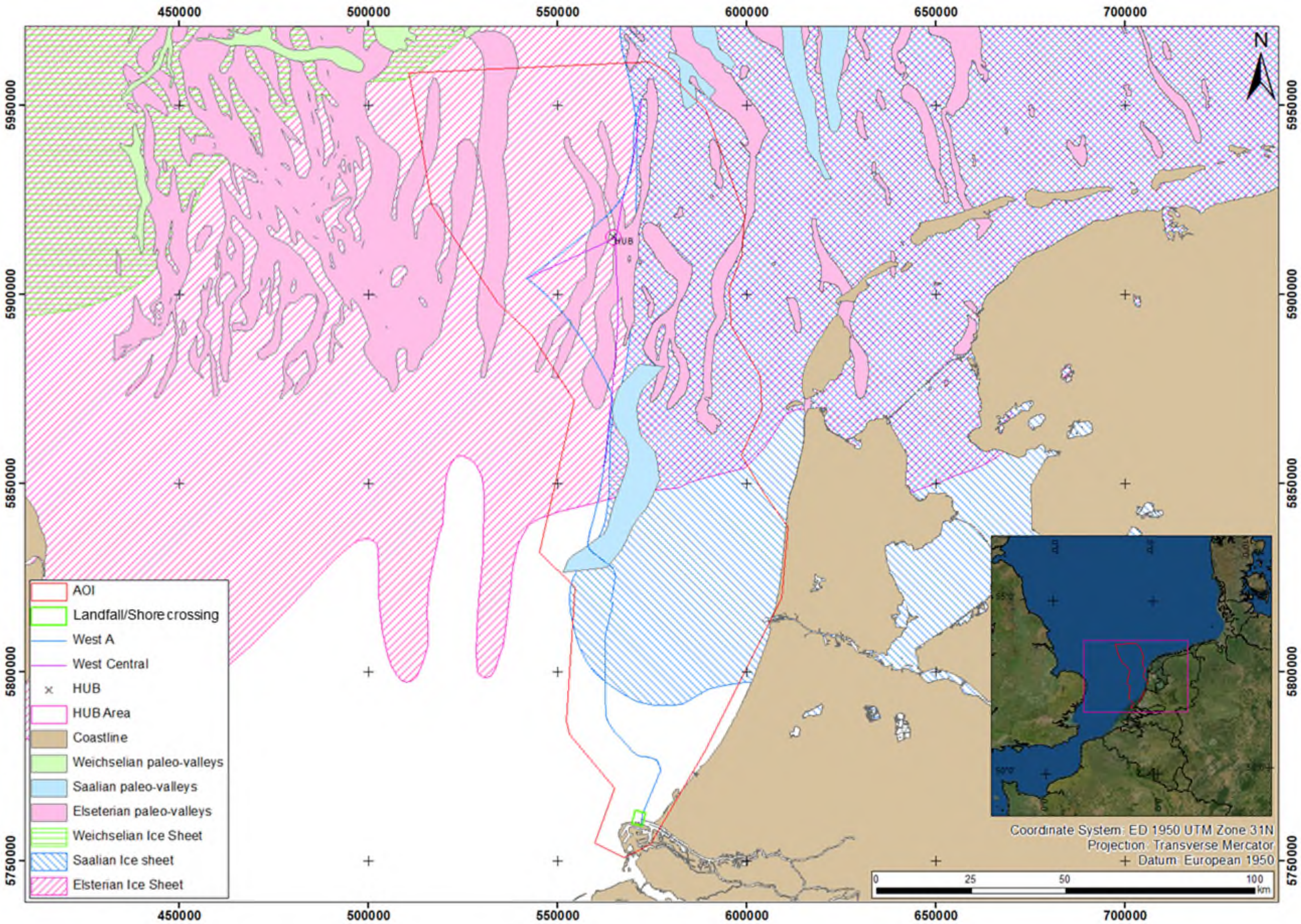


Figure 3.2: Maximum ice extent of the Pleistocene glaciations and associated paleo-valleys (Laban, 1995)

4. Site-Specific Conditions

4.1 Site Use

4.1.1 AOI

Past and/or present activities in the AOI can affect and constrain development of the pipeline infrastructure. Evidence of human activity and seafloor objects are documented in the Archaeological Desktop Study (Appendix B) and in the UXO Desktop Study (Appendix C).

Figure 4.1 presents navigation areas or infrastructure identified within the AOI:

- 197 navigation buoys;
- 7 navigation channels;
- 6 anchoring areas;
- 4 harbour approach areas.

Figure 4.2 presents restricted areas identified within the AOI:

- 7 navigation channels;
- 6 anchoring areas;
- 4 harbour approach areas;
- 3 wind farms in operation;
- 4 wind farms under development;
- 121 dredging areas;
- 11 dredge spoil areas;
- 4 military exercise areas;
- 7 natural protected areas.

Figure 4.3 presents seafloor oil and gas infrastructure identified within the AOI:

- 149 offshore facilities;
- 1153 wells;
- 227 pipelines.

Figure 4.4 presents seafloor cable and wind energy related infrastructure identified within the AOI:

- 1 cable landing station;
- 8 telecommunication cables;
- 139 wind turbine generators;
- 23 power cables.

Based on the currently available information, 36 cables and 35 pipeline crossings are to be expected in the AOI considering the current proposed pipeline routes.

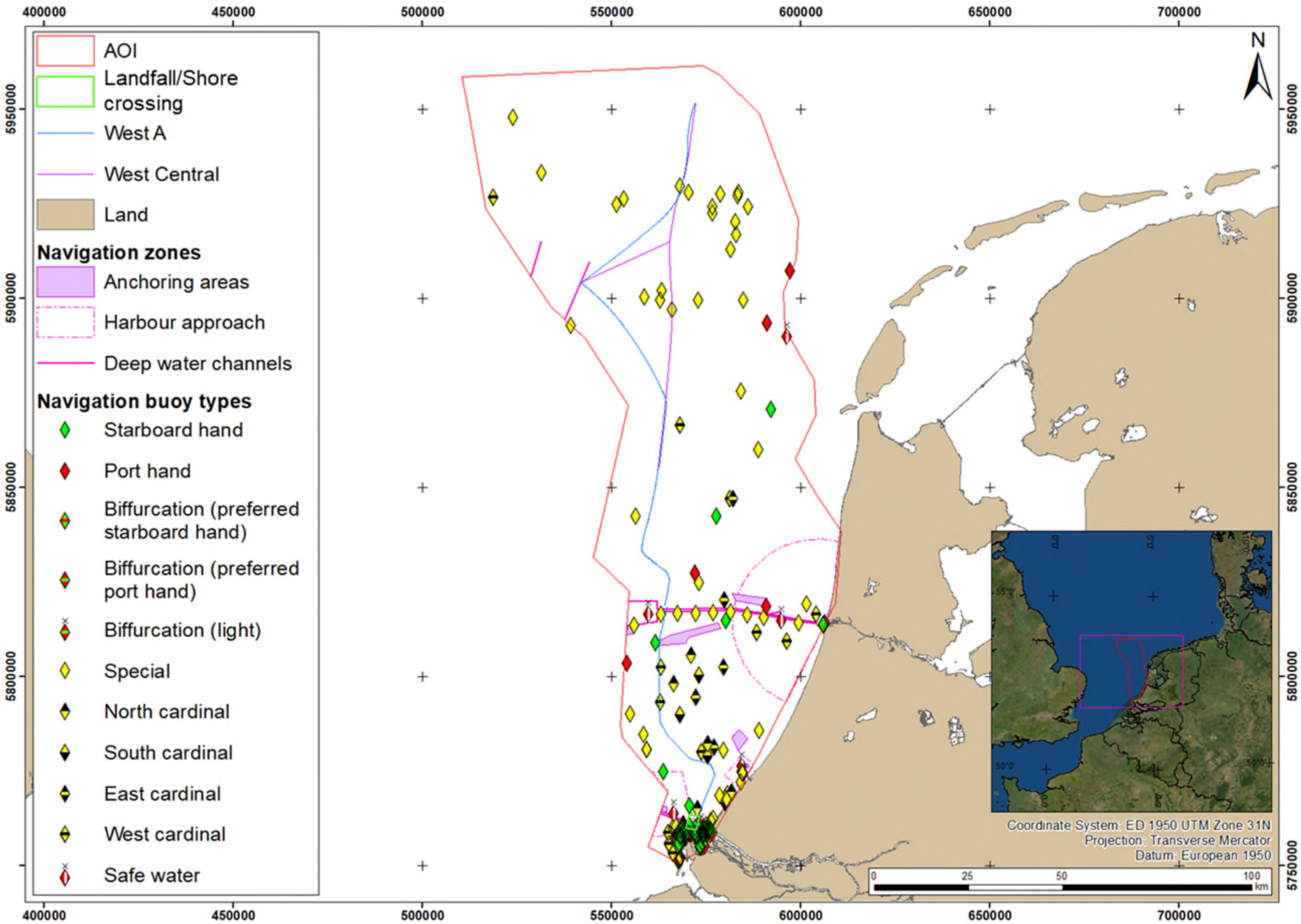


Figure 4.1: Navigation areas or infrastructures identified within the AOI

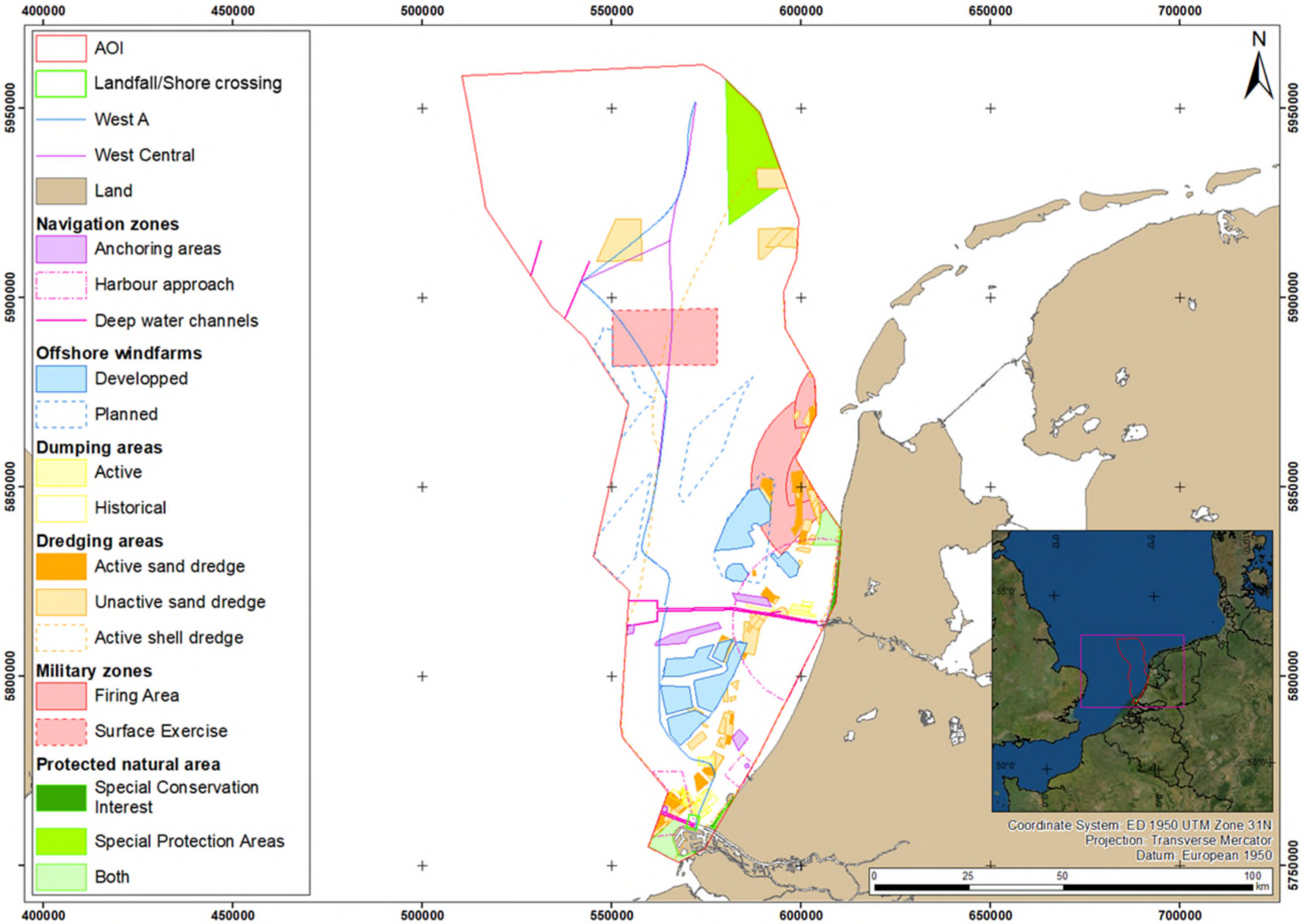


Figure 4.2: Restricted areas identified within the AOI

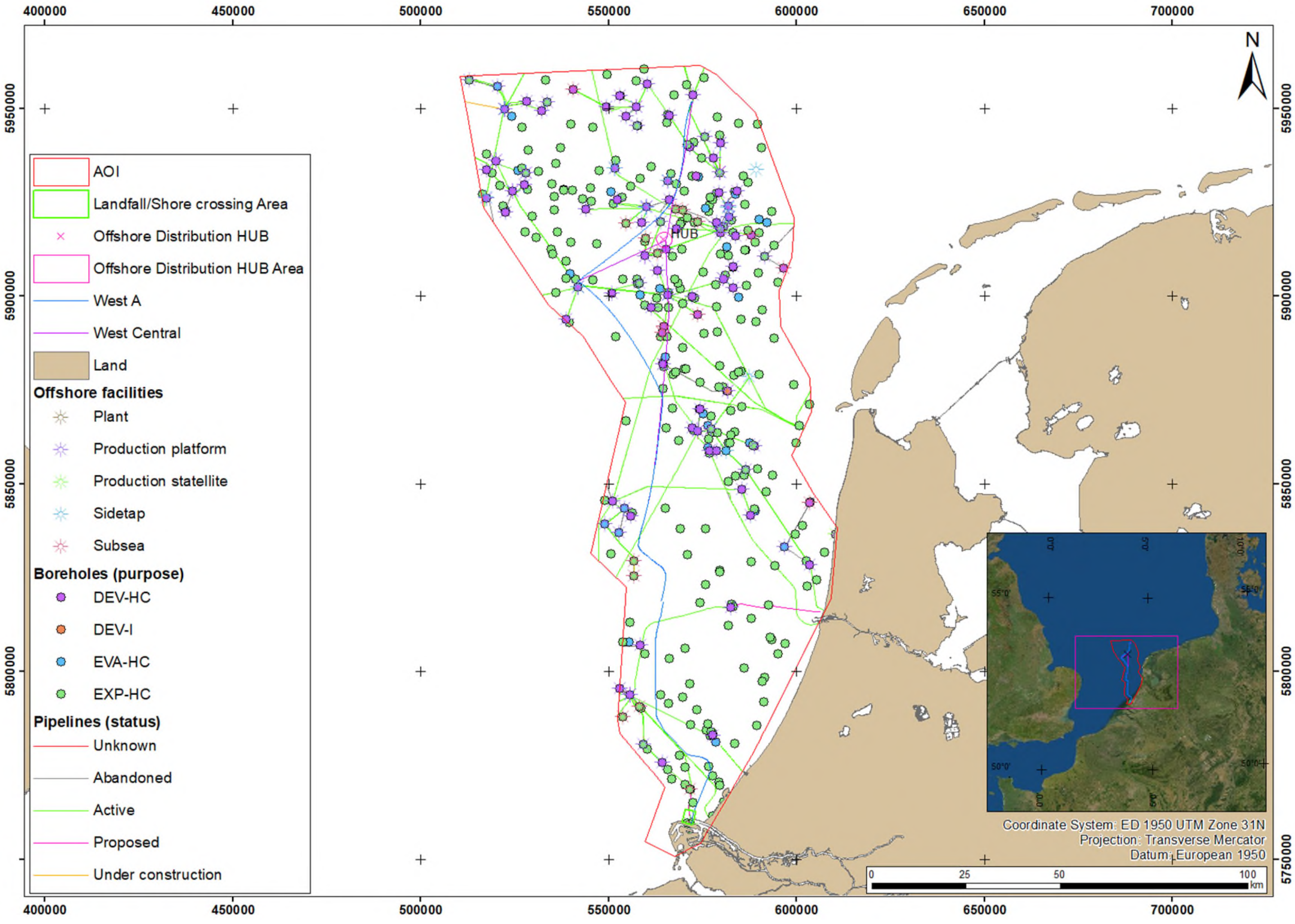


Figure 4.3: Oil and gas seafloor infrastructures identified within the AOI

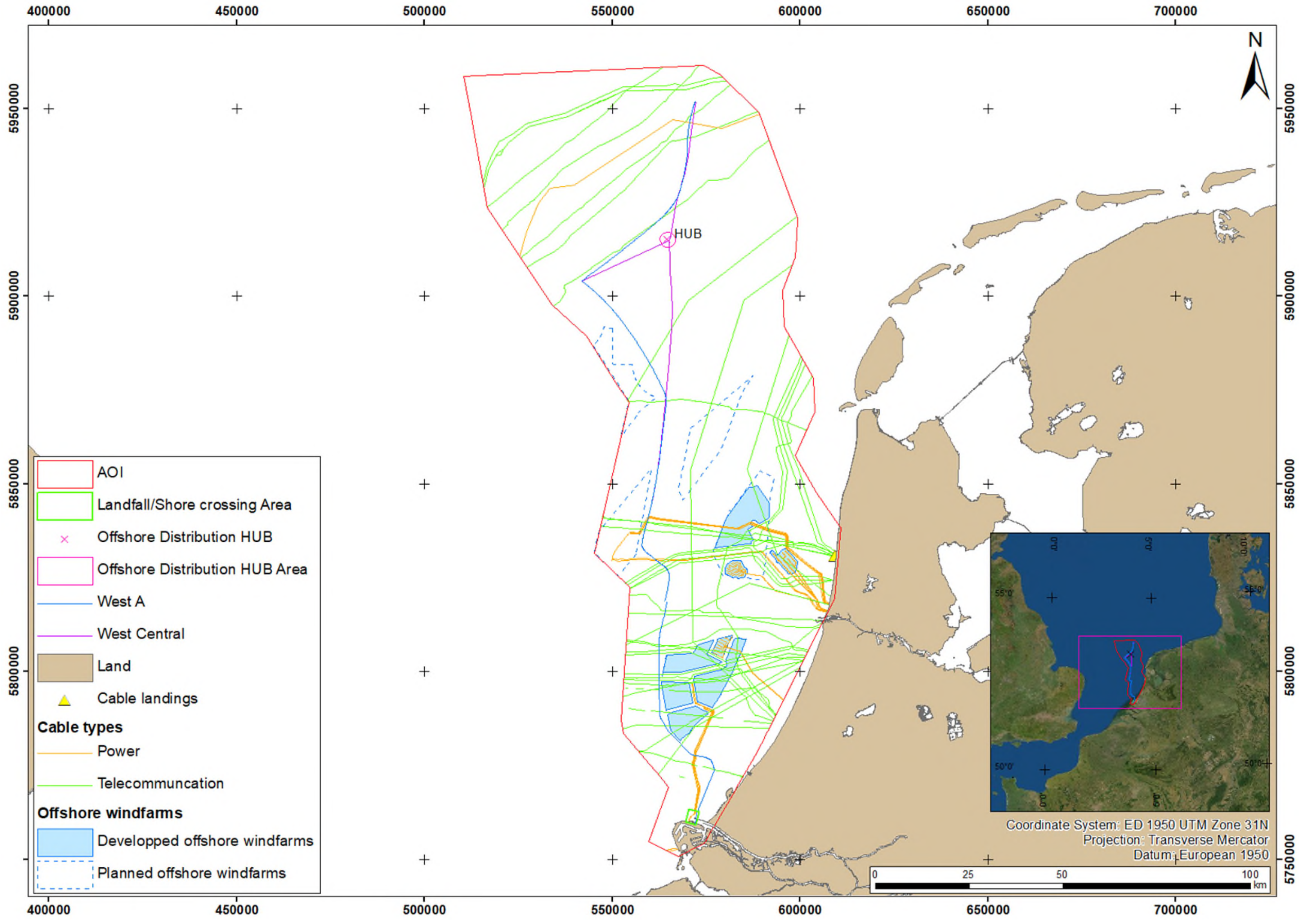


Figure 4.4: Cable and wind-energy related infrastructures identified within the AOI

Vessel route densities per type of vessels as well as vessel density per activity for 2020 were extracted from EMODnet.

Figure 4.5 present the total vessel route density for 2020 within and around the AOI, regardless of the types of boats. The main commercial routes are clearly visible as red lines, connecting the North Sea, Baltic Sea and English Channel as well as joining the main harbours (such as Rotterdam and IJmuiden). The present pipeline layout crosses three of the highest density routes. The Offshore Distribution HUB Area is within an area with medium density routes, probably corresponding mainly to small cargos, fishing, or leisure vessels.

Figure 4.6 presents the average fishing activity for 2020 within and around the AOI. Fishing activity is medium in the southern half of the AOI, and low within the northern half (and close to the Offshore Distribution HUB Area). Fishing activity is high within 20 km from the shore. However, within the Maasmond Kanaal, it is expected that fishing activity is low due to the presence of dense shipping traffic.

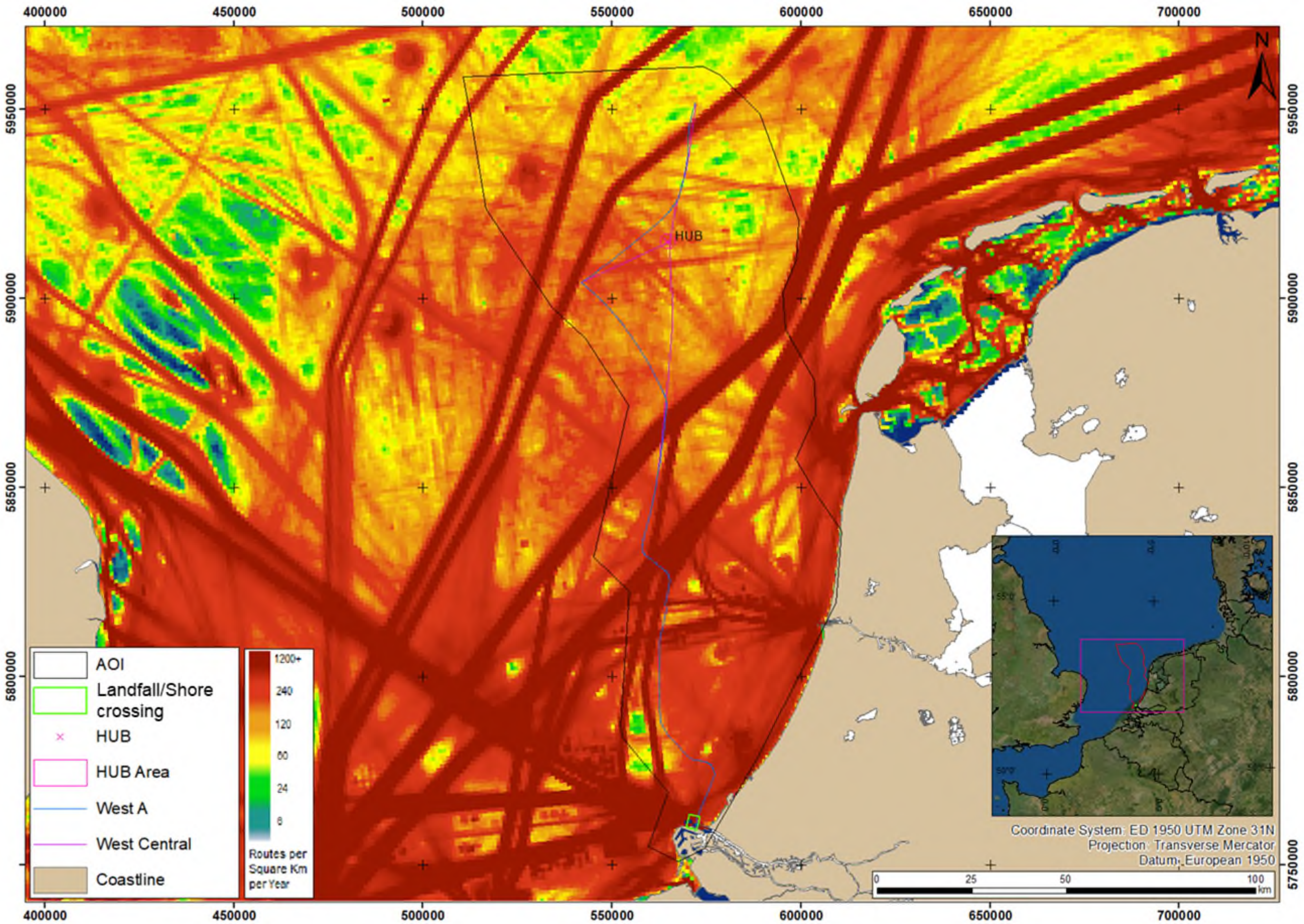


Figure 4.5: Total vessel routes density given as routes per km^2 per year for 2020 (EMODnet, 2022)

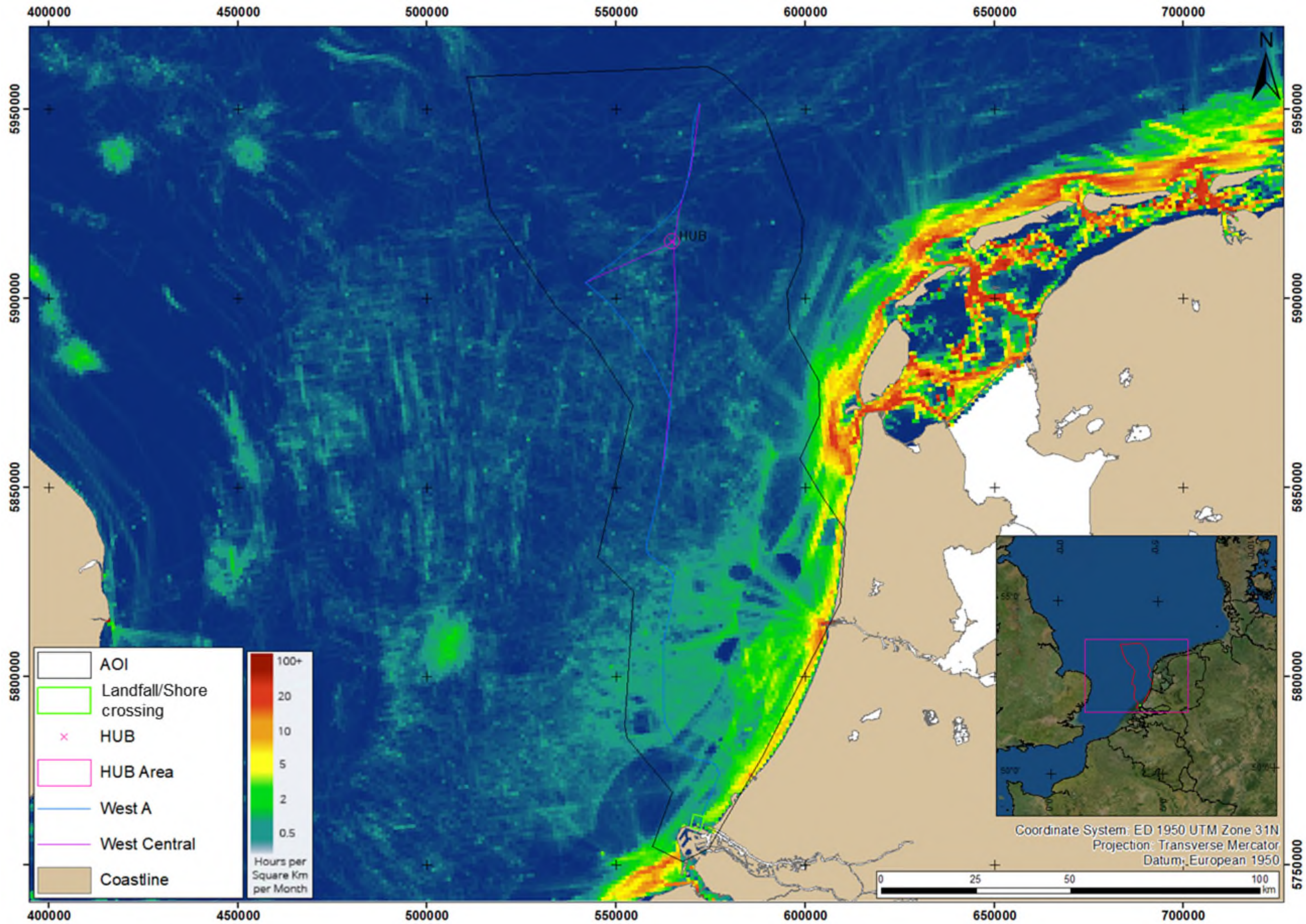


Figure 4.6: Average fishing activity density given in hours per km² per month for 2020 (EMODnet, 2022)

4.1.2 Landfall/Shore Crossing Area

Within the Landfall/Shore Crossing Area a number of restricted areas and infrastructure was identified.

Figure 4.7 presents the following:

- restricted areas and navigation infrastructures identified within the AOI:
  - 2 navigation buoys;
  - 1 (deep water) navigation channel;
  - 1 harbour approach area;
  - 1 dredge spoil area;
  - 1 natural protected area.
- seafloor oil and gas infrastructure identified within the AOI:
  - 1 production facility;
  - 4 wells;
  - 3 pipelines.
- power cables, related to wind energy infrastructure, identified within the AOI:
  - 4 power cables.

4.1.3 Offshore Distribution HUB Area

No specific site use or seafloor obstructions of any type are expected within the Offshore Distribution HUB Area, except for fishing activities and vessels crossing the area.

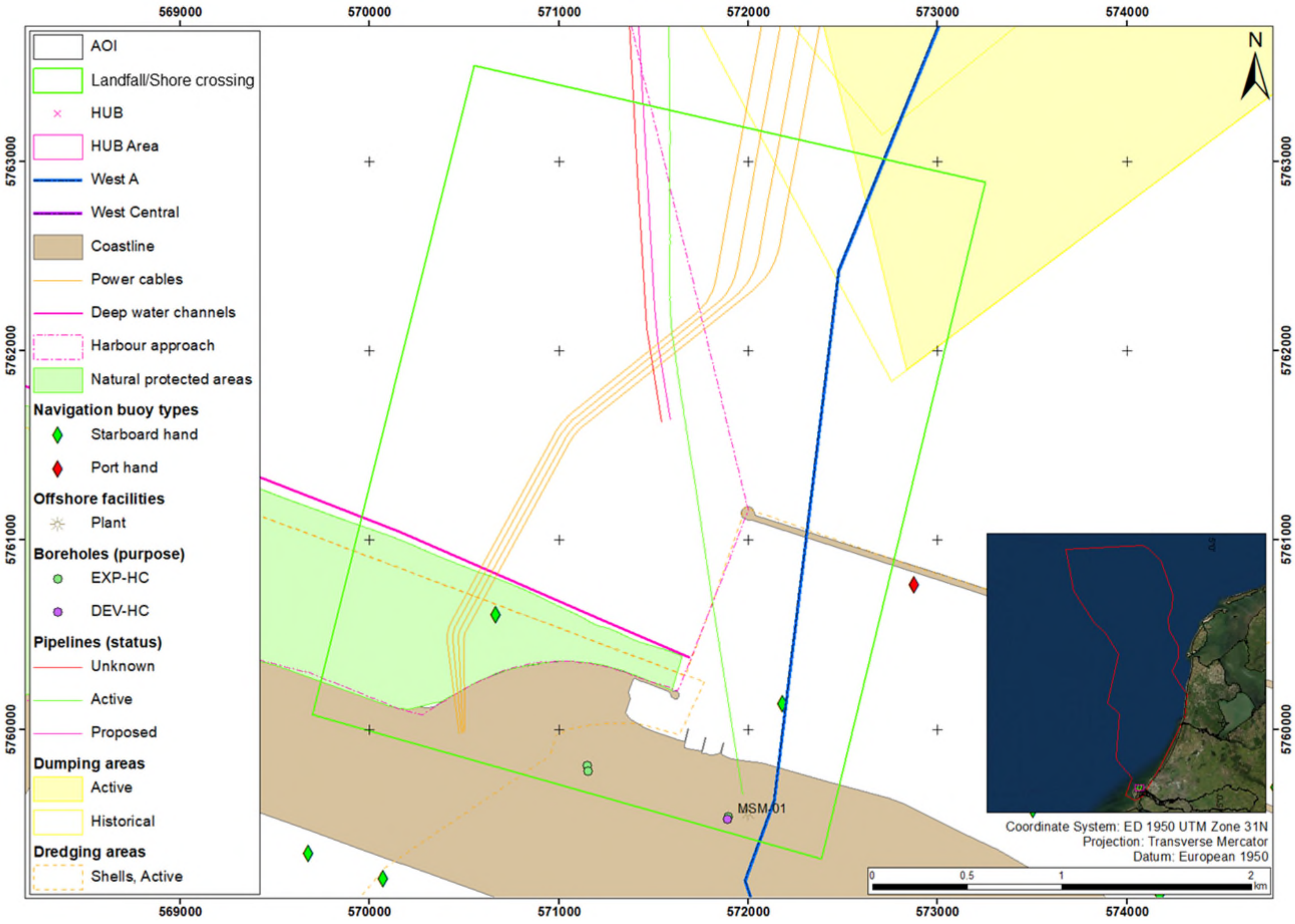


Figure 4.7: Site use across the Landfall/Shore crossing Area

4.2 Seafloor Conditions

4.2.1 Bathymetry and Seafloor Gradient

4.2.1.1 AOI

The Dutch offshore sector has been extensively surveyed by the Dutch Hydrographic Office, and historical data have been acquired and interpolated since 1979 (Deltares, 2016, 2020). This includes bathymetric data, which is publicly available on EMODnet.

Table 4.1 summarises the water depth and slope gradient values as observed in the individual bathymetry datasets available for the AOI. Included in the table is the resolution of the respective bathymetry datasets. Bathymetry and seafloor gradients of the AOI are presented in Figure 4.8. Close-ups for the Rotterdam approach, northern coastal, southern coastal, Hollandse Kust (noord), Hollandse Kust (west) and Hollandse Kust (zuid) WFZs are given in Figure 4.9 to Figure 4.14, respectively.

In general, the seafloor is gently dipping towards the west to west-north-west, perpendicular to the coast. The water depth in the AOI averages approximately 25 m below lowest astronomical tide (bLAT). Approximately 15 km north of the Offshore Distribution HUB Area, the seafloor deepens in a northern direction from approximately 20 m to 39 m bLAT over a distance of 20 km.

Most of the AOI is characterised by low seafloor gradients of less than 5°. Locally, higher seafloor gradients were observed and can have either a hydrodynamic (natural) or man-made origin.

The highest seafloor gradients associated with bedforms were observed on the lee side of sand waves (up to 30°). In the coastal area seafloor gradients up to approximately 19° were observed.

Man-made seafloor features resulting in higher seafloor gradients in the AOI include navigation channels, dredging areas, dumping areas, wrecks and other seafloor obstructions.

However, it should be noted that slope gradients are computed from bathymetry maps and therefore dependant on the data resolution. Where multibeam echosounder (MBES) data were acquired (WFZs), the calculated slope gradients are considered reliable and allow to visualise slope breaks linked to features as small as 2 m to 5 m. Outside of the wind farm sites, the grid resolution is either 30 m or 100 m and therefore smaller features cannot be imaged, and slope gradients are likely to be underestimated or overestimated locally.

Since the AOI covers a large area, Fugro does not recommend acquiring higher-resolution data at this stage. However, acquisition of MBES data along the final pipeline route will be paramount in order to assess and mitigate any seafloor hazards.

Table 4.1: Summary of water depths and seafloor gradients as observed in the different bathymetry datasets

Area	Maximum Water Depth [m LAT]	Minimum Water Depth [m LAT]	Average Slope Angle [°]	Maximum Slope Angle [°]	Minimum Slope Angle [°]	Bathymetry Grid Resolution [m]
AOI	-46.3	0	0.1	8	0	100
Hollandse Kust (noord) WFZ	-28.1	-14.9	1.7	29.9	0	2
Hollandse Kust (west) WFZ	-33.1	-22.5	2.2	20.6	0	2
Hollandse Kust (zuid) WFZ	-27.8	-16.1	0.6	14.9	0	5
Rotterdam approach area	-41.5	-13.5	0.3	9.5	0	30
Coastal area	-15.2	36.4	1.0	18.8	0	30

Notes:
m LAT = metres relative to Lowest Astronomical Tide

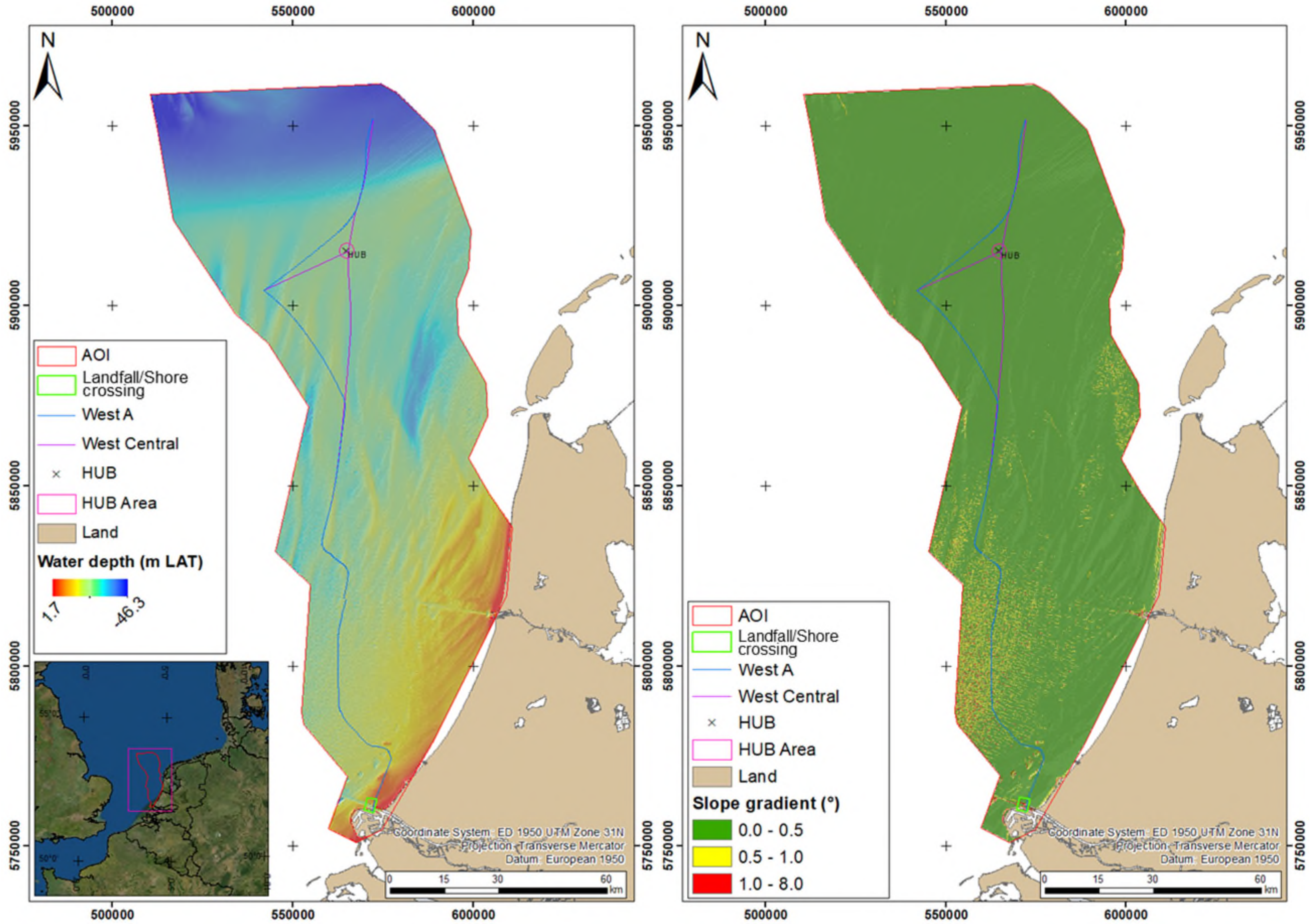


Figure 4.8: Left: bathymetric map and Right: slope gradient map of the entire AOI based on EMODnet 2020 data

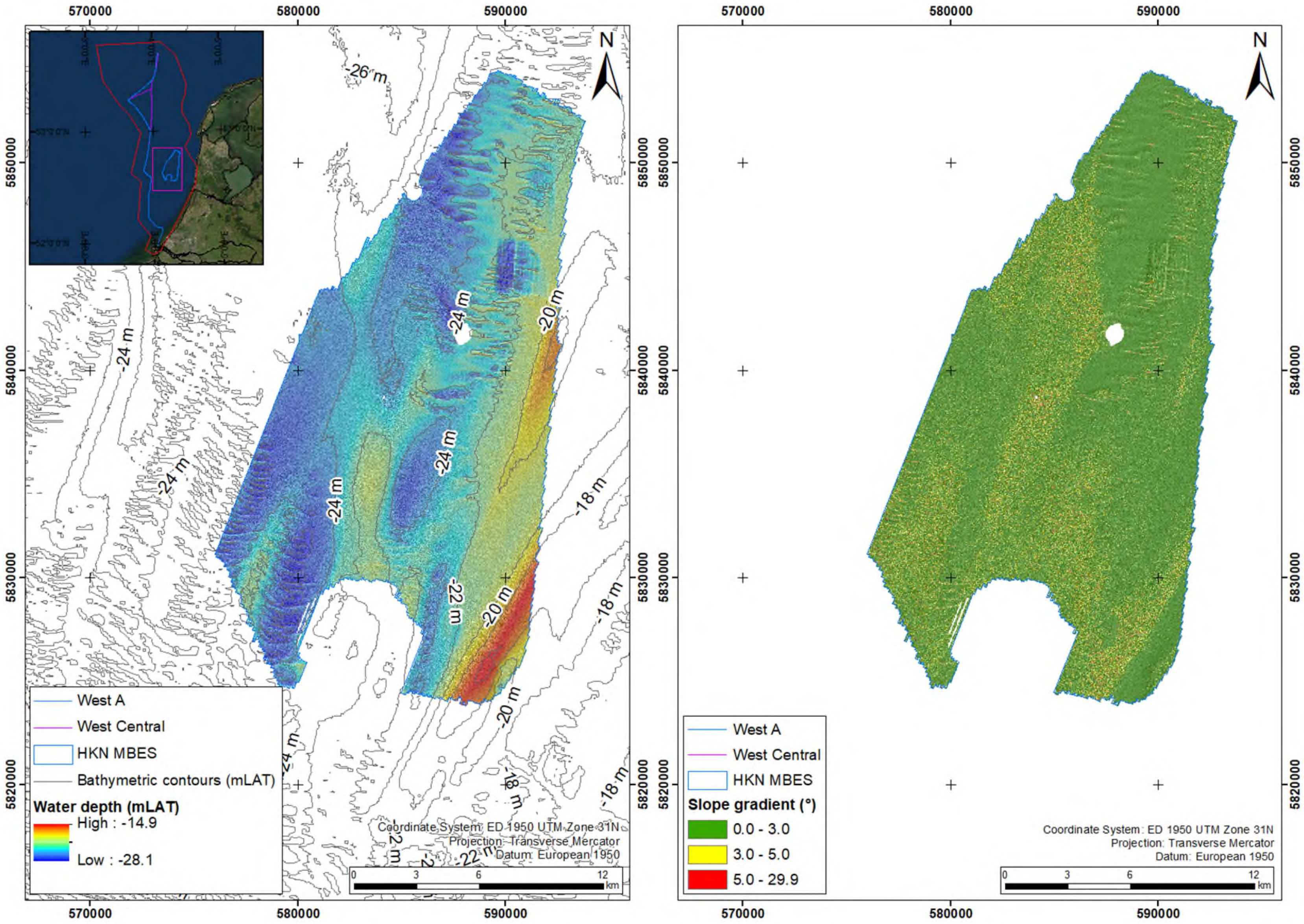
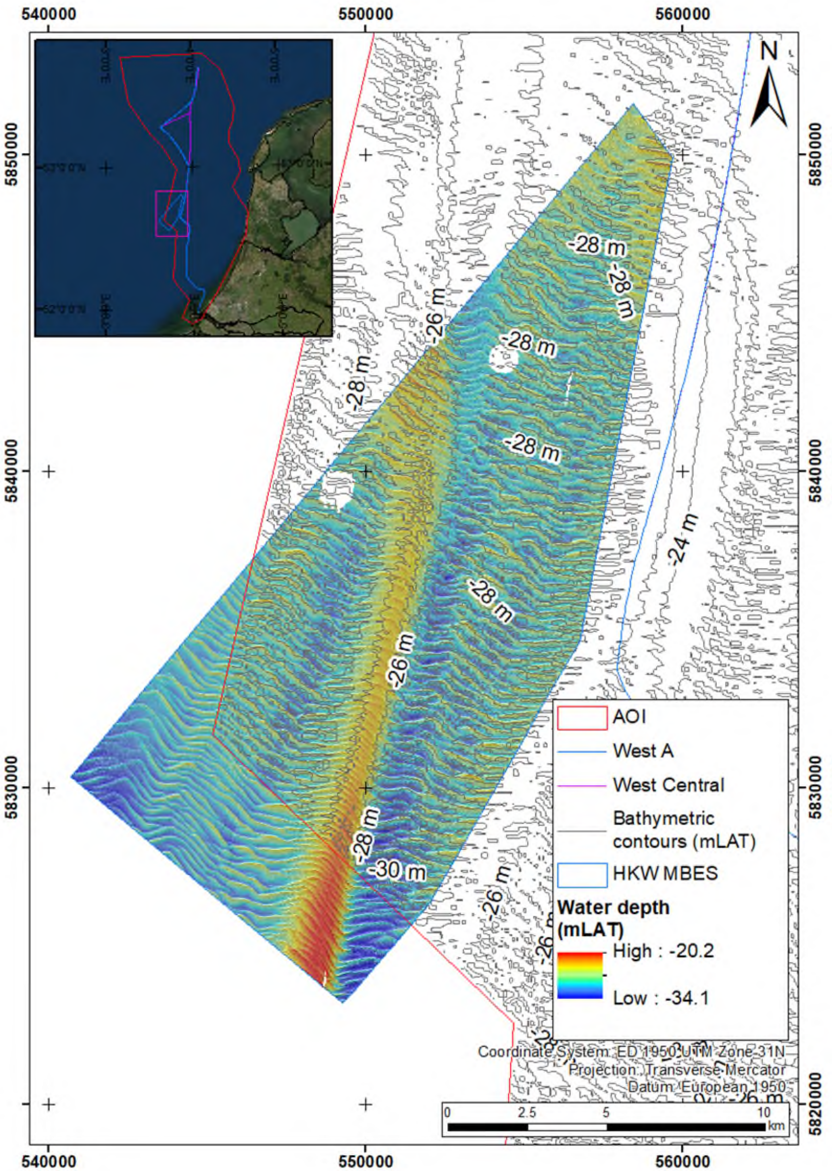


Figure 4.9: Left: bathymetric map and Right: slope gradient map of the Hollandse Kust (noord) WFZ area based on Fugro 2018 MBES data



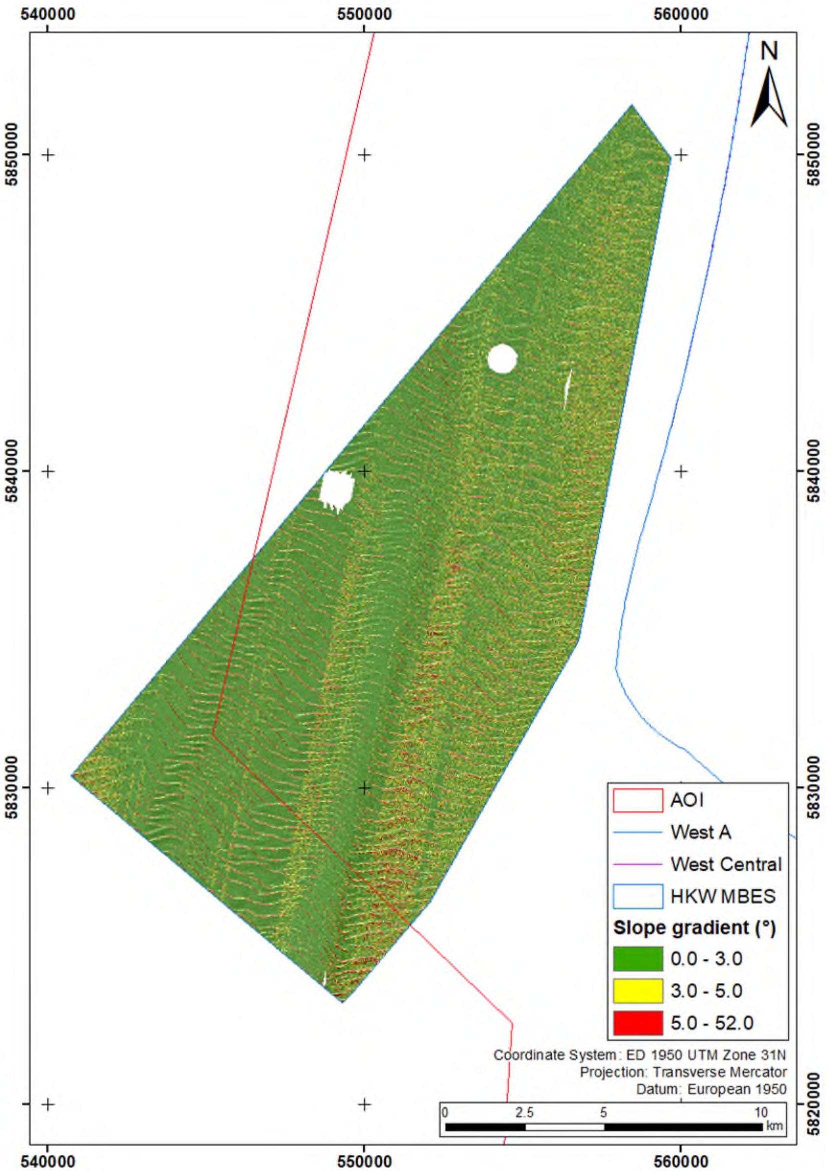
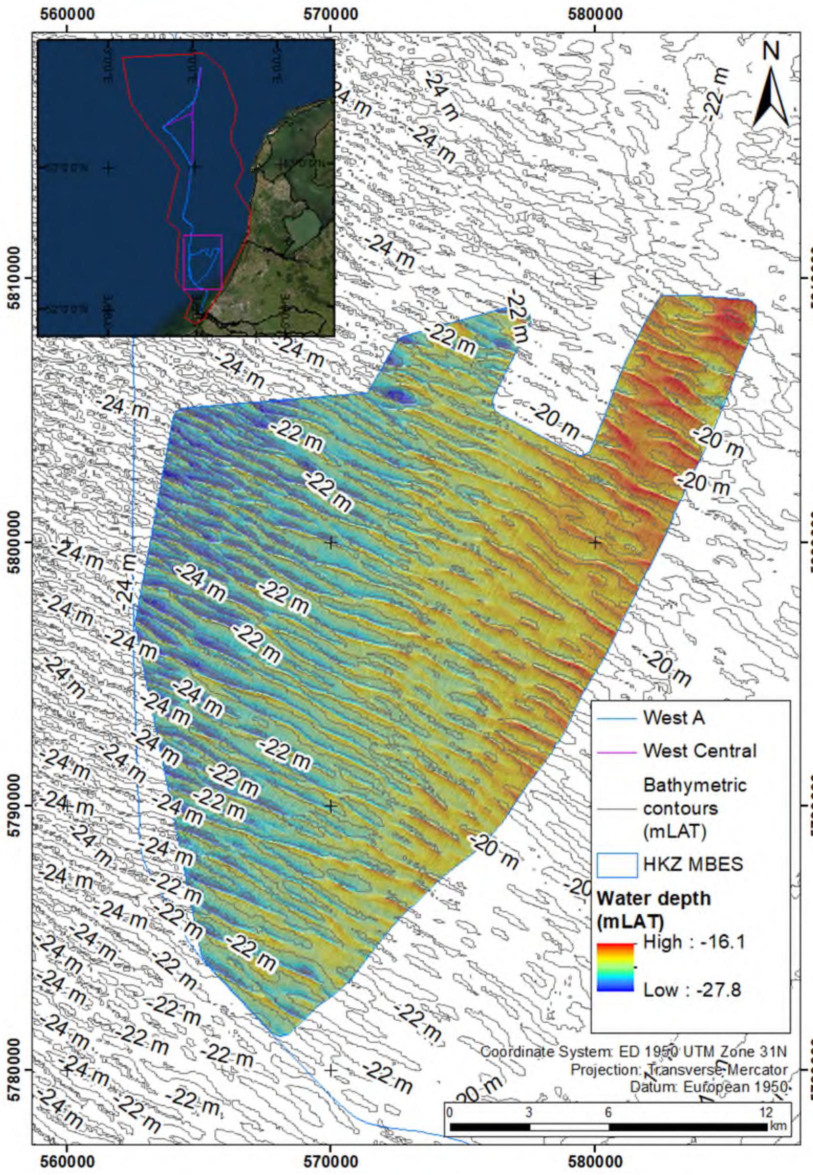


Figure 4.10: Left: bathymetric map and Right: slope gradient map of the Hollandse Kust (west) WFZ area based on Fugro 2019 MBES data



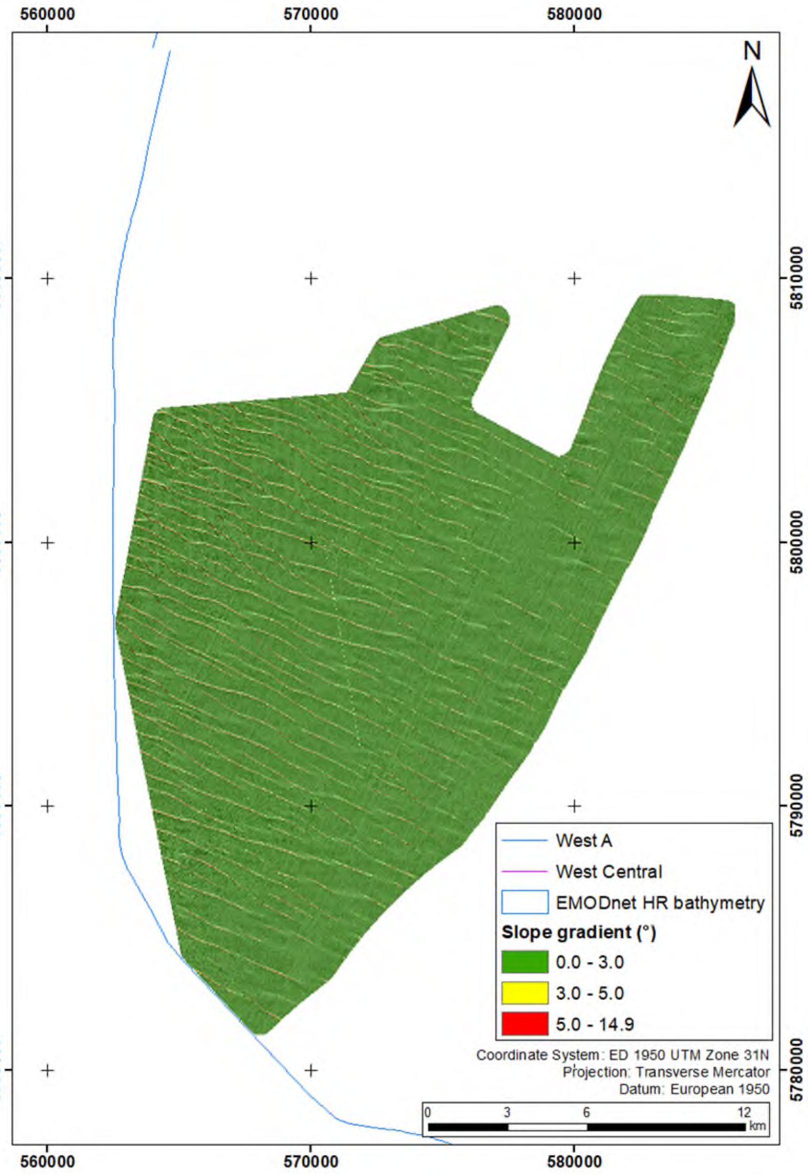


Figure 4.11: Left: bathymetric map and Right: slope gradient map of the Hollandse Kust (zuid) WFZ area based on Fugro 2016 MBES data

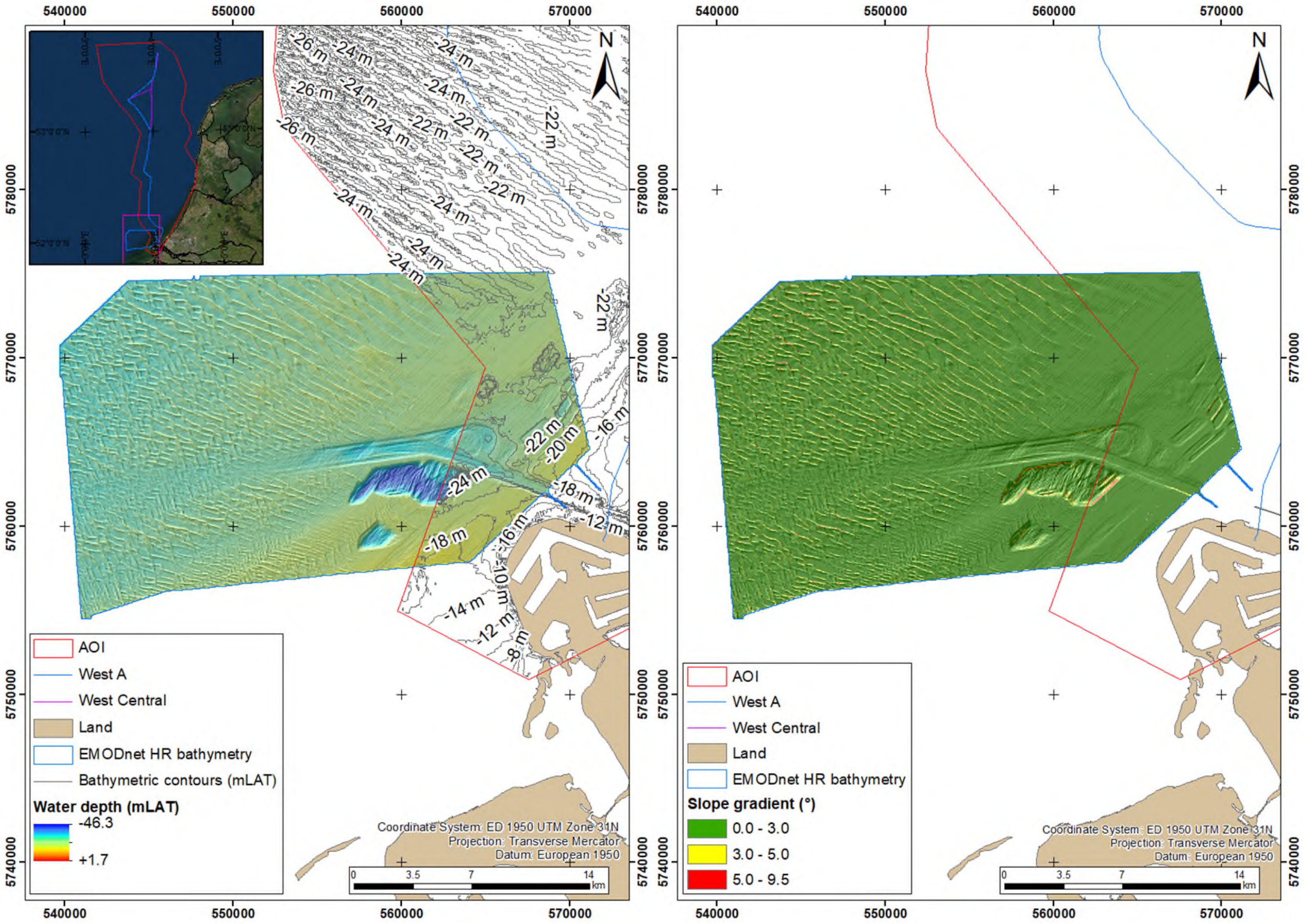


Figure 4.12: Left: bathymetric map and Right: slope gradient map of the Rotterdam approach area based on EMODnet 2020 high-resolution data

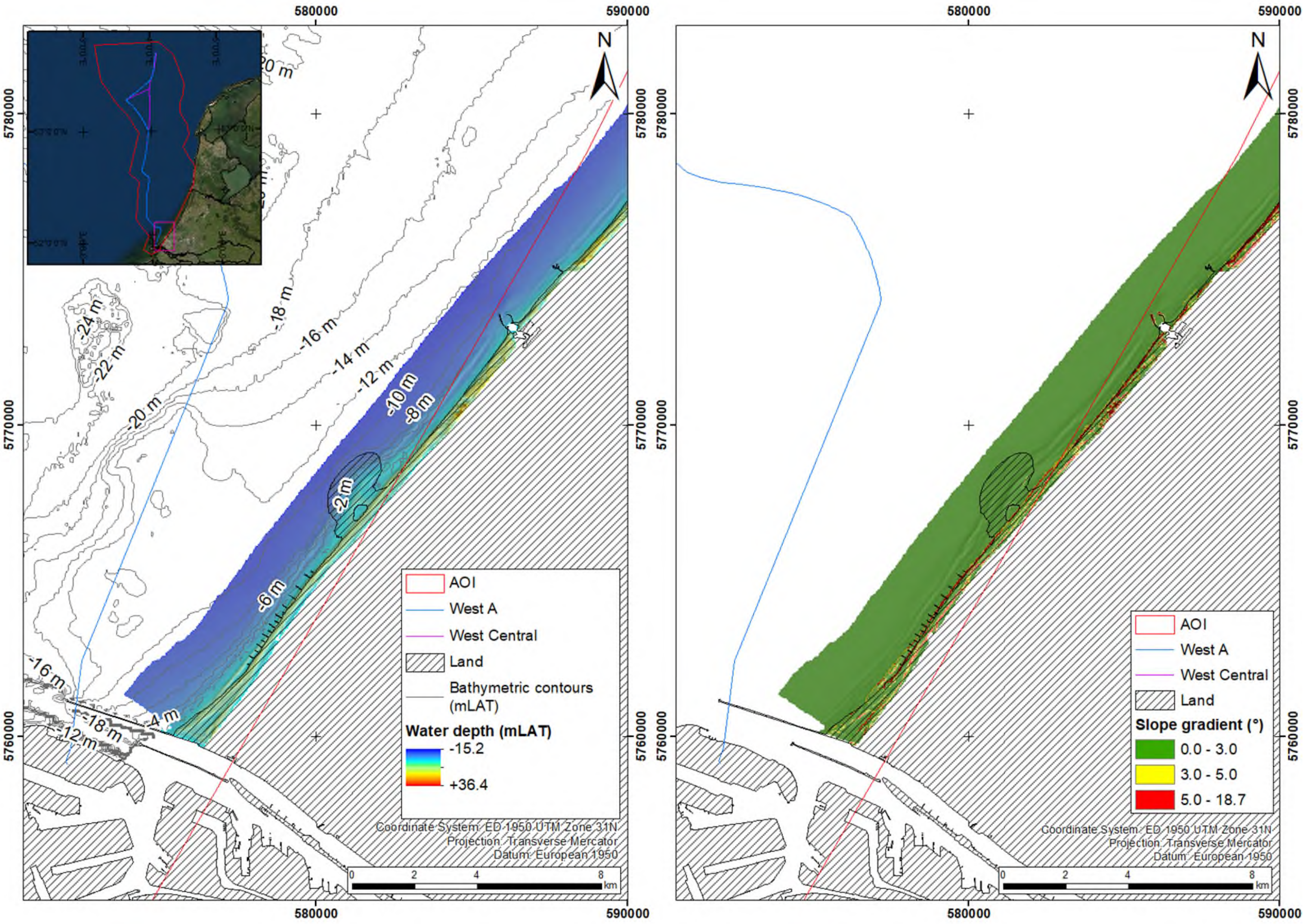


Figure 4.13: Left: bathymetric map and Right: slope gradient map of the southern coastal area based on EMODnet 2018 high-resolution data

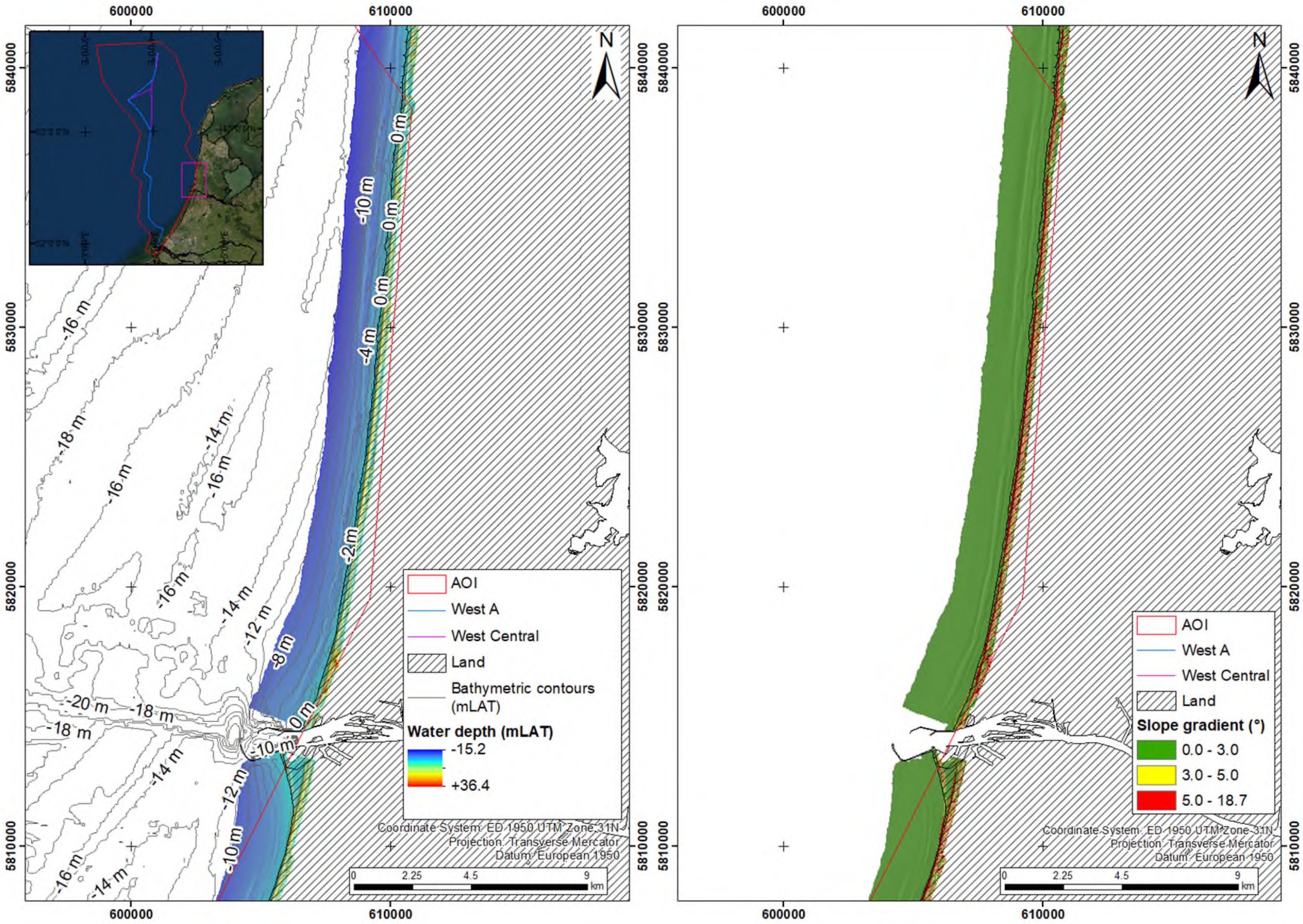


Figure 4.14: Left: bathymetric map and Right: slope gradient map of the northern coastal area based on EMODnet 2018 high-resolution data

4.2.1.2 Landfall/Shore Crossing Area

The Landfall/Shore crossing Area is covered by the EMODnet 2020 tile having a 100 m grid resolution.

Table 4.2 provides the water depth and slope gradient values for the Landfall/Shore crossing Area based on the available EMODnet data.

Table 4.2: Summary of water depths and seafloor gradients at the Landfall/Shore crossing Area

Area	Maximum Water Depth [m LAT]	Minimum Water Depth [m LAT]	Average Slope Angle [°]	Maximum Slope Angle [°]	Minimum Slope Angle [°]
Landfall/Shore crossing	-31.1	0	0.7	6.8	0
Notes: m LAT = metres Lowest Astronomical Tide Values derived from publicly available EMODnet (2020) bathymetry data, DTM with 100 m of grid resolution					

The bathymetric map for the Landfall/Shore crossing Area is given in Figure 4.15.

Water depth within the Landfall/Shore crossing Area varies between 0 m and 31.1 m bLAT. The major bathymetric feature in this area is the relatively deep navigation channel (Maasmond Kanaal). The navigation channel is well imaged by the EMODnet bathymetry data, forming a WNW–ESE oriented depression. The water depth at the edges of the Maasmond Kanaal is approximately 15 m bLAT, whereas in the navigation channel it is ranging between approximately 20 m 25 m bLAT. In local depressions within the Maasmond Kanaal water depths may exceed 30 m bLAT.

North of the navigation channel, no seafloor features are visible, and the seafloor gently dips from SE to NW ranging between 11 m to 18 m bLAT.

The slope gradients range from 0° to 7° with an average value of 0.7°. Slope gradients up to 20° are expected at the flanks of the navigation channel.

The southern flank of the Maasmond Kanaal appears regular, steep and narrow in the south-east and widens towards the south-west. The northern flank of the Maasmond Kanaal has locally an irregular shape, possibly as a result of slumping observed in this area. Seafloor gradients of up to 34° are related to these slumped areas (Fugro database).

A site-specific MBES survey across the entire Landfall/Shore crossing Area would allow to increase the resolution of these maps and highlight any features smaller than 100 m (which cannot be imaged based on the present data resolution).

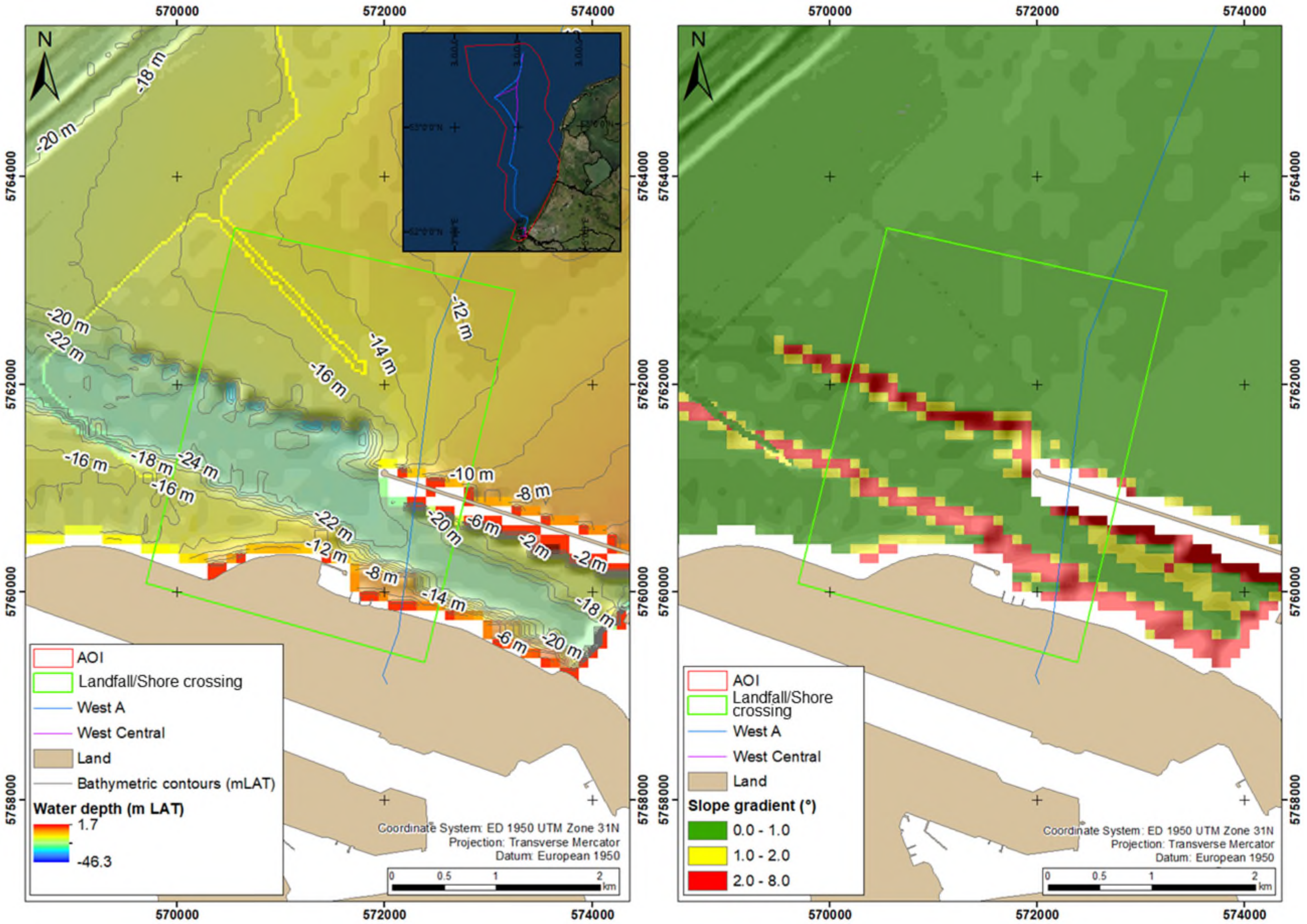


Figure 4.15: Left: bathymetric map and Right: Slope gradient map of the Landfall/Shore crossing Area based on the EMODnet 2020 data

4.2.1.3 Offshore Distribution HUB Area

The Offshore Distribution HUB Area is covered by the EMODnet 2020 tile having a 100 m grid resolution.

Table 4.3 provides the water depth and slope gradients values for the Offshore Distribution HUB Area based on the available EMODnet data.

Table 4.3: Summary of water depths and seafloor gradients at the Offshore Distribution HUB Area

Area	Maximum Water Depth [m LAT]	Minimum Water Depth [m LAT]	Average Slope Angle [°]	Maximum Slope Angle [°]	Minimum Slope Angle [°]
Offshore Distribution HUB Area	-26.2	-25.2	0.05	0.1	0

Notes:
m LAT = metres Lowest Astronomical Tide
Values derived from publicly available EMODnet (2020) bathymetry data, DTM with 100 m of grid resolution

Water depth within the Offshore Distribution HUB Area varies between 25.2 m and 26.2 m bLAT.

The bathymetric map for the Offshore Distribution HUB Area is given in Figure 4.16. The seafloor appears smooth, with a maximum water depth to the west of the Offshore Distribution HUB Area and minimum values to the north-east. No clear dipping trends can be noticed, except with bathymetric contours that tend to show that the Offshore Distribution HUB Area is crossed by a NE–SW oriented trough of less than 1 m deep (probably linked to a small seafloor bedform).

The slope gradients range from 0° to 0.1° confirming the presence of a flat and smooth seafloor. However, it has to be noted that slope gradients were computed based on the 100 m grid resolution bathymetry and that local features presenting higher seafloor gradients may occur.

A site-specific MBES survey across the entire Offshore Distribution HUB area would allow to increase the resolution of these maps and highlight any feature smaller than 100 m such as sand waves, megaripples and any other types of bedforms and seafloor obstructions that may occur.

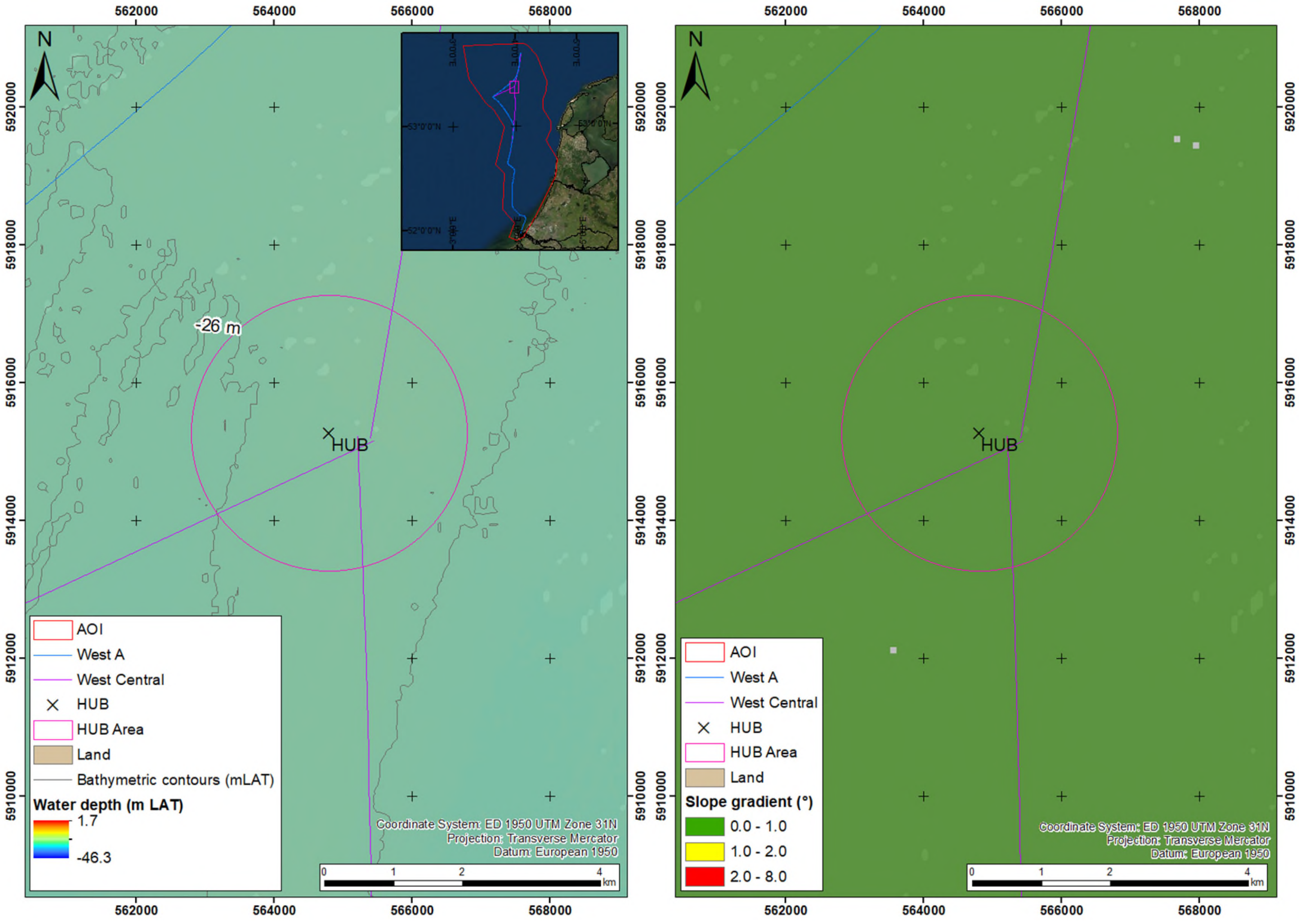


Figure 4.16: Left: bathymetric map and Right: slope gradient map of the Offshore Distribution HUB Area based on the EMODnet 2020 data

4.2.2 Seafloor Morphology

4.2.2.1 AOI

The seafloor morphology within the AOI can be divided into three distinct zones as illustrated in Figure 4.17: 1) a coastal zone covered by a complex compound of rhythmic bedforms, 2) a shallow continental shelf with low-angle topography covered by a complex compound of rhythmic bedforms, and 3) a relatively deep low-energy zone with low-angle topography (Figure 4.8).

The bedforms observed in Zones 1 and 2 include sand banks, sand waves, megaripples and ripples. These bedforms have been classified by Deltares (2016, 2019 and 2020), as part of morphodynamic desktop studies to aid development of the wind farms. The classification considers different parameters such as wavelength, wave height and mobility, which are the result of the complex interaction between hydrodynamics, sediment grain-size and character, sediment transport and morphology.

Below follows a more detailed description of the bedforms observed in the AOI. Table 4.4 summarises the characteristics of the different bedform types observed in the AOI.

Table 4.4: Bedform characteristics in the AOI

Type	Wavelength [m]	Wave Height [m]	Orientation
Sand bank	3000 to 10000	2.5 to 8	N–S to NNE–SSW
Sand wave	120 to 1750	0.5 to 6	NW–SE to WNW–ESE
Megaripple	4 to 20	0.1 to 0.4	NW–SE to WNW–ESE

Notes:
N: North | S: South
E: East | W: West

Bedforms across the AOI were mapped based on what is imaged on the EMODnet 100 m grid resolution data. Elements that were identified include sand banks, areas with sand waves as well as troughs and other depression features. Megaripples are below resolution of the EMODnet data. The resulting map is presented in Figure 4.8. The identified and expected bedforms across the AOI are further detailed hereafter.

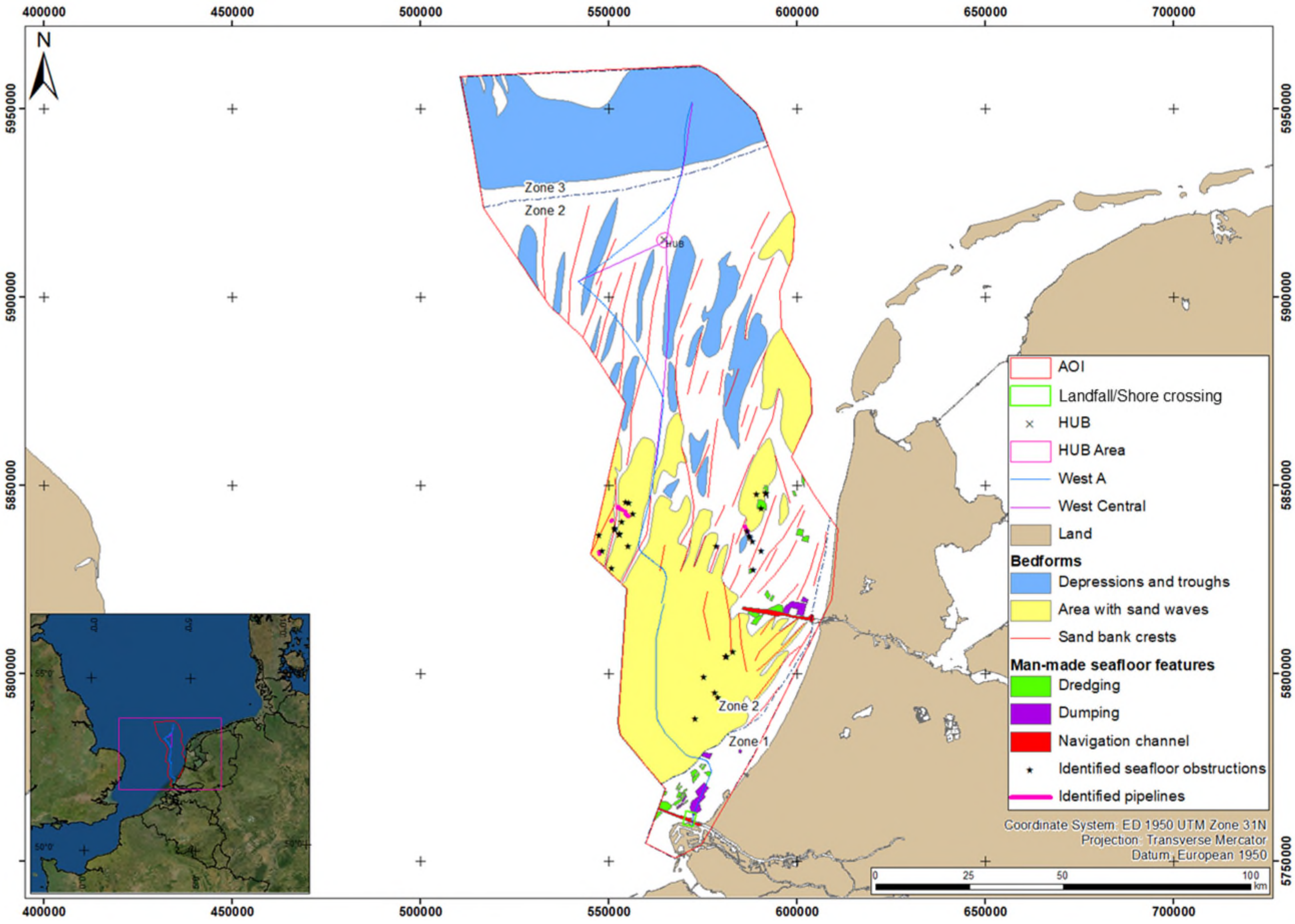


Figure 4.17: Map of the identified bedform and man-made seafloor features across the AOI

Sand Banks

The largest bedforms within the AOI are sand banks. They are present only in Zones 1 and 2 of the AOI (Figure 4.17). They form elongated ridges (sub-)parallel to the coast with a N–S to NNE–SSW orientation. The ridges are tens of kilometres long with a symmetric cross profile and lie several kilometres apart. They are on average 10 m high. An example of sand banks as imaged in Hollandse Kust (west) MBES data is given in Figure 4.18, with a bathymetric section perpendicular to the sand bank crest allowing to illustrate the morphology, height, and wavelength of sand banks in the AOI.

The sand banks are orientated roughly parallel to the main current direction (Hulscher et al., 1993). Near the coast they may be orientated more obliquely to the tidal current (Calvete et al., 2001). The sand banks closer to the shore are classified as tidal ridges (van Dijk et al., 2012). The formation of sand banks can broadly be divided into two categories (Dyer and Huntley, 1999):

- relict features, remaining after postglacial sea level rise;
- newly formed, in the present hydrodynamic regime.

The offshore sand banks may have formed during the early Holocene and the tidal ridges have been possibly formed more recently. Formation of tidal ridges is related to tidal currents in a tide-dominated coastal embayment (Ashley, 1990).

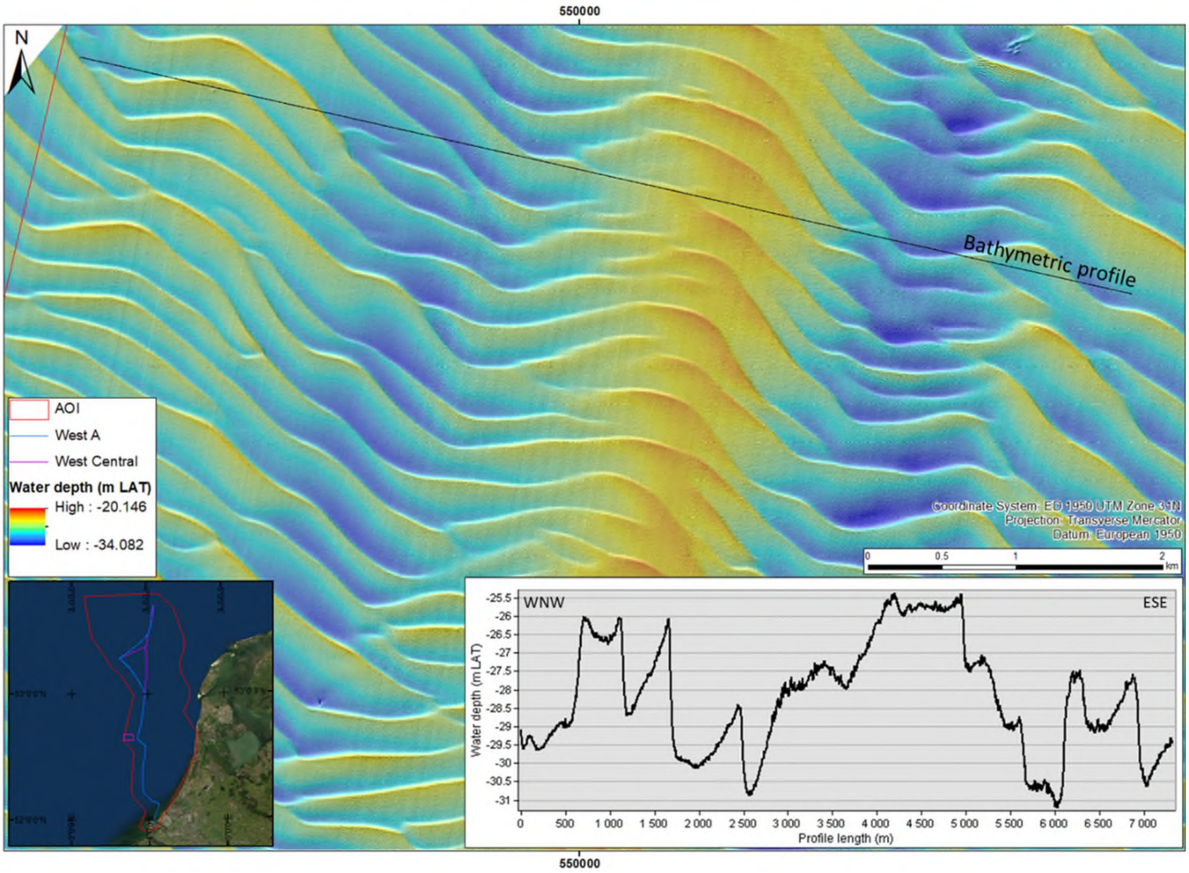


Figure 4.18: Example of sand banks with superimposed sand waves in the Hollandse Kust (west) WFZ as imaged on MBES bathymetry data. A bathymetric profile is given in a perpendicular direction to the sand banks.

Sand Waves

Sand waves are superimposed on the sand banks. They are observed in water depths of approximately 20 m to 28 m bLAT within Zones 1 and 2 of the AOI (Figure 4.17). The crests of the sand waves are orientated NW–SE to WNW–ESE, roughly perpendicular to the sand banks (see Figure 4.18). Their wavelength ranges between approximately 120 m and 1750 m, while wave height varies between 0.5 m and 4 m. The sand waves typically have an asymmetric profile with a lower angle stoss side and a steep lee side facing the direction of propagation. This morphology implies that the dominant migration direction is north to north-north-east (for sediment mobility refer to Section 4.3).

Sand waves are created due to tidal flow and may be as high as 25% of the water depth (McCave, 1971), and have wavelengths in the order of hundreds of metres (Ashley, 1990; van Dijk & Kleinhans, 2005; Deltares, 2016).

An example of sand waves as imaged in Hollandse Kust (west) MBES data is given in Figure 4.19, with a bathymetric section perpendicular to their direction, allowing to illustrate the morphology, height, and wavelength of sand waves in the AOI. Sand waves are also visible in Figure 4.18, perpendicular to the sand banks.

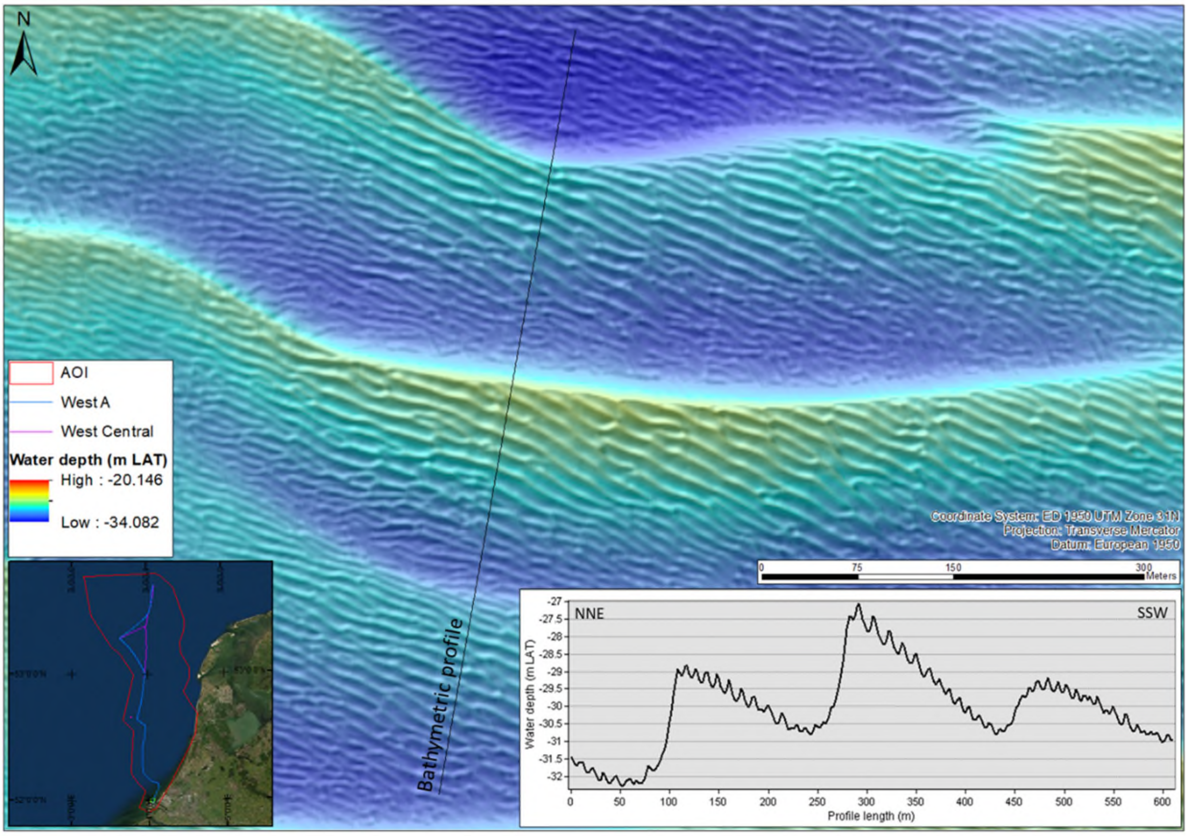


Figure 4.19: Example of sand waves with superimposed megaripples in the Hollandse Kust (west) WFZ as imaged on MBES bathymetry data. A bathymetric profile is given in a perpendicular direction to the sand waves.

Megaripples

High resolution bathymetry datasets for the wind farm sites located within the AOI allowed to capture the presence of megaripples. Megaripples are ubiquitous, superimposed on the stoss side of sand waves and are similarly orientated (Figure 4.19). They have wavelengths of approximately 4 m to 20 m, with heights between 0.1 m and 0.4 m.

An example of megaripples as imaged in Hollandse Kust (west) MBES data is given in Figure 4.19, with a bathymetric section perpendicular to their direction allowing to illustrate their morphology, height, and wavelength in the AOI.

Ripples

Ripples are the smallest bedforms, with dimensions in the order of centimetres. Because of their limited size, they cannot be observed in bathymetry data. They are superimposed on the megaripples and are similarly orientated. Because of their small size, ripples are not a concern for offshore pipeline design. They are, however, relevant for the seafloor roughness and sediment transport in the area (Deltares, 2020).

Troughs and Depressions

Troughs are linked to the presence of the sand banks in areas that are not affected by sand waves (deeper than 28 m bLAT). These troughs can be 4 m to 6 m deep and are elongated in a N–S direction (parallel to the sand banks). Where sand waves are present, these troughs were probably subsequently filled by sediments through the formation and evolution of the sand waves. Seafloor within the troughs appears to be smooth and regular on the EMODnet bathymetry. Troughs are only found in Zone 2 of the AOI as mapped in Figure 4.17.

Moreover, the northern depression (Zone 3) is characterised by a smooth seafloor and no bedform is imaged at the resolution of the EMODnet bathymetry. This is probably linked to the sudden increase of water depth (from 30 m bLAT to 42 m bLAT).

4.2.2.2 Landfall/Shore crossing Area

No bedforms were imaged at the EMODnet 2020 grid resolution of 100 m in the Landfall/Shore crossing Area. A site-specific MBES survey will provide a higher resolution, potentially imaging small-scale bedforms such as megaripples or ripples.

4.2.2.3 Offshore Distribution HUB Area

No bedforms were imaged at the EMODnet 2020 grid resolution of 100 m in the Offshore Distribution HUB Area. However, the Offshore Distribution HUB Area is located within an area containing sand banks (Zone 2), to the north of a trough (Figure 4.17). As the sand banks are the largest expected bedforms in the AOI (Table 4.4), it is likely that the Offshore Distribution HUB Area is too small to capture the typical sand bank morphology entirely. A site-specific MBES survey will provide a higher resolution, potentially imaging small-scale bedforms such as sand waves and/or megaripples.

4.2.3 Seafloor Sediments

4.2.3.1 AOI

An overview of the substrate type classification (Folk, 1954) is presented in Figure 4.20 (EMODnet). The seafloor sediments map is corroborated by information contained in the DINOloket (2021) database, which includes grab sample data, vibrocore data and sampling borehole data. In addition, seafloor sediments were mapped in high detail at the Hollandse Kust (noord), Hollandse kust (west) and Hollandse Kust (zuid) WFZs.

The following seafloor sediments are present in the AOI:

- Sandy GRAVEL
- (Slightly) gravelly SAND
- (Slightly) gravelly muddy SAND
- SAND
- Muddy SAND
- Sandy MUD

MUD is defined in the geological maps as the fraction composed of clay-sized to silt-sized sediments.

The AOI is covered by predominantly SAND with numerous patches of (slightly) gravelly SAND. North of the Offshore Distribution HUB Area, the seafloor comprises mainly muddy SAND with some patches of (slightly) gravelly muddy SAND and sandy MUD. This area with a higher MUD fraction coincides with the deeper low-energy marine environment as described in Section 4.2.2.1. Areas of (slightly) gravelly SAND correspond to areas where sand banks and sand waves are expected based on Figure 4.17 and Figure 4.20.

In terms of expected stratigraphy at the seafloor, three main Holocene units were mapped (Figure 4.21):

- Southern Bight Formation, deposited in a high-energy open-marine environment, mainly composed of SAND to (slightly) gravelly SAND, distributed in Zone 2 of the AOI;
- Urania Formation, deposited in a low-energy open-marine environment mainly composed of sandy MUD to muddy SAND, covering Zone 3 entirely;
- Naaldwijk Formation, deposited in a coastal to tidal-dominated environment and is mainly composed of (slightly) gravelly SAND, covering Zone 1 (not completely mapped).

Fugro recommends acquiring site-specific geotechnical data along the final pipeline layout prior to pipe installation in order to verify and refine the seafloor sediment types.

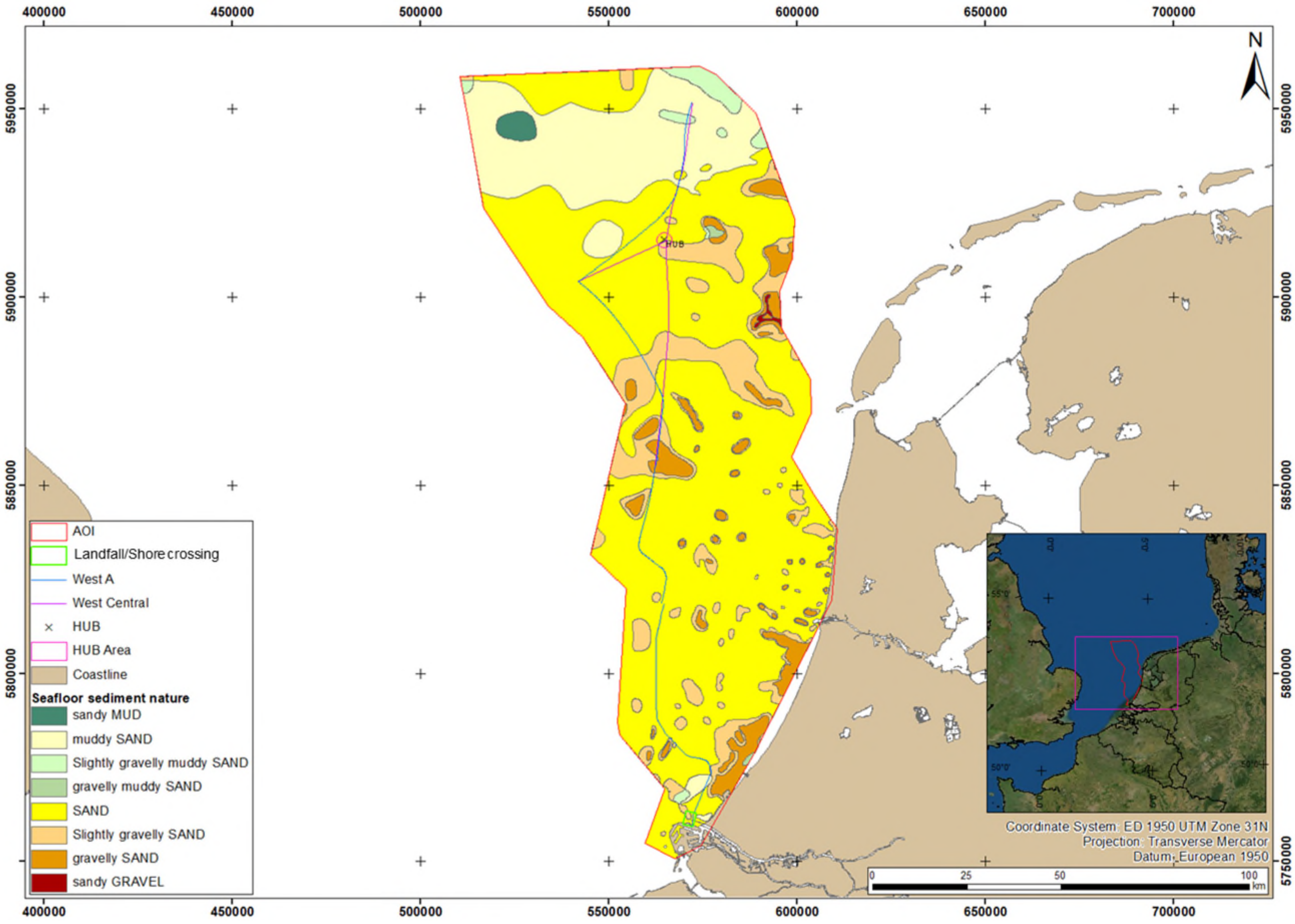


Figure 4.20: Surficial sediments across the AOI

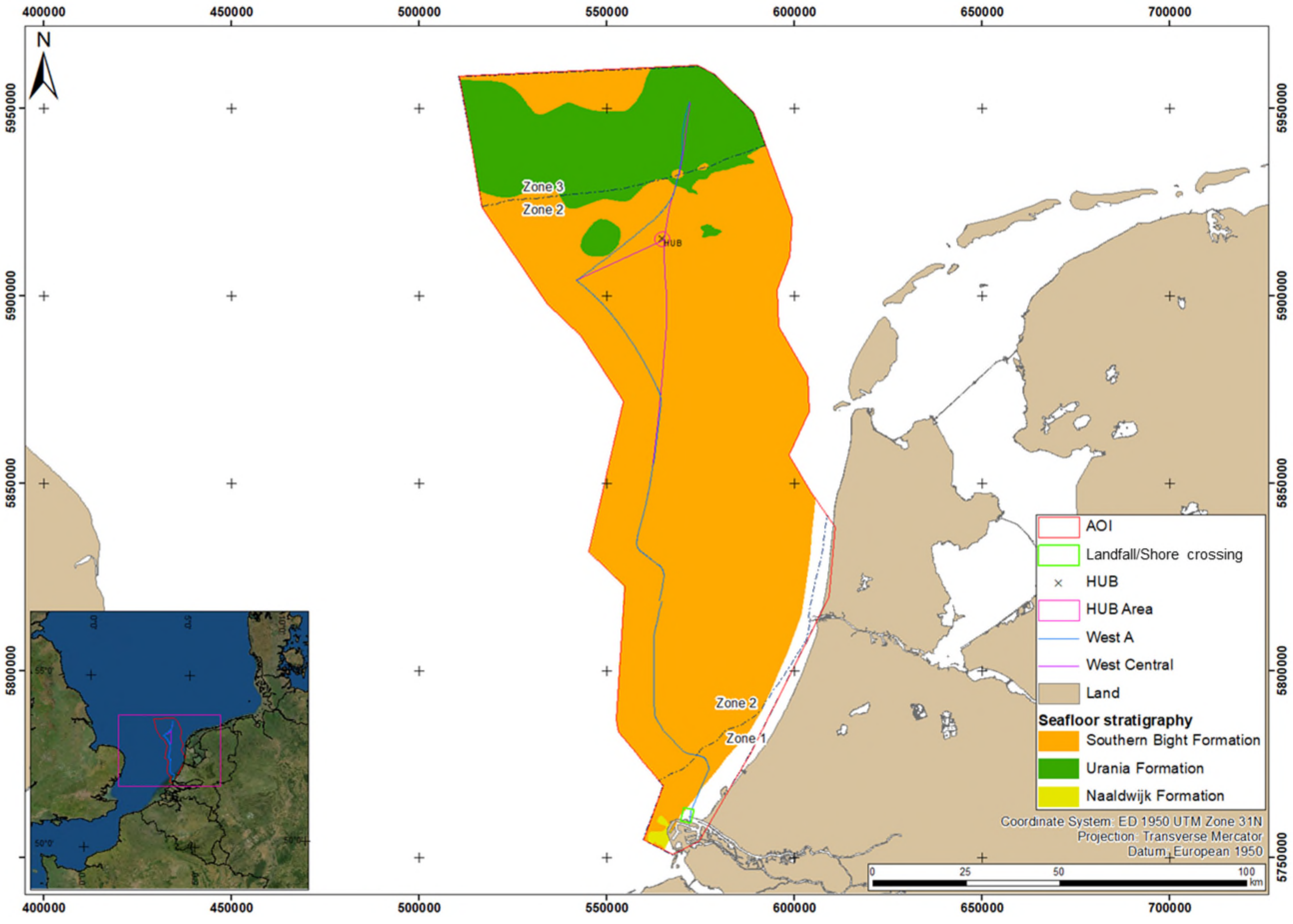


Figure 4.21: Surficial sediment stratigraphy across the AOI. Coverage is missing along the coastal area. In this area the Naaldwijk Formation is expected

4.2.3.2 Landfall/Shore Crossing Area

Two main seafloor sediment types are to be expected in the Landfall/Shore crossing Area (Figure 4.22):

- SAND;
- Slightly gravelly SAND, in the north-west corner.

Based on Fugro experience, clayey or silty SAND, locally slightly gravelly dominates at seafloor in areas outside the Maasmond Kanaal. In the Maasmond Kanaal very soft to soft CLAY dominates, with localised patches of clayey SAND.

Site-specific geotechnical surveys would allow to refine the sediment nature within the Landfall/Shore crossing Area.

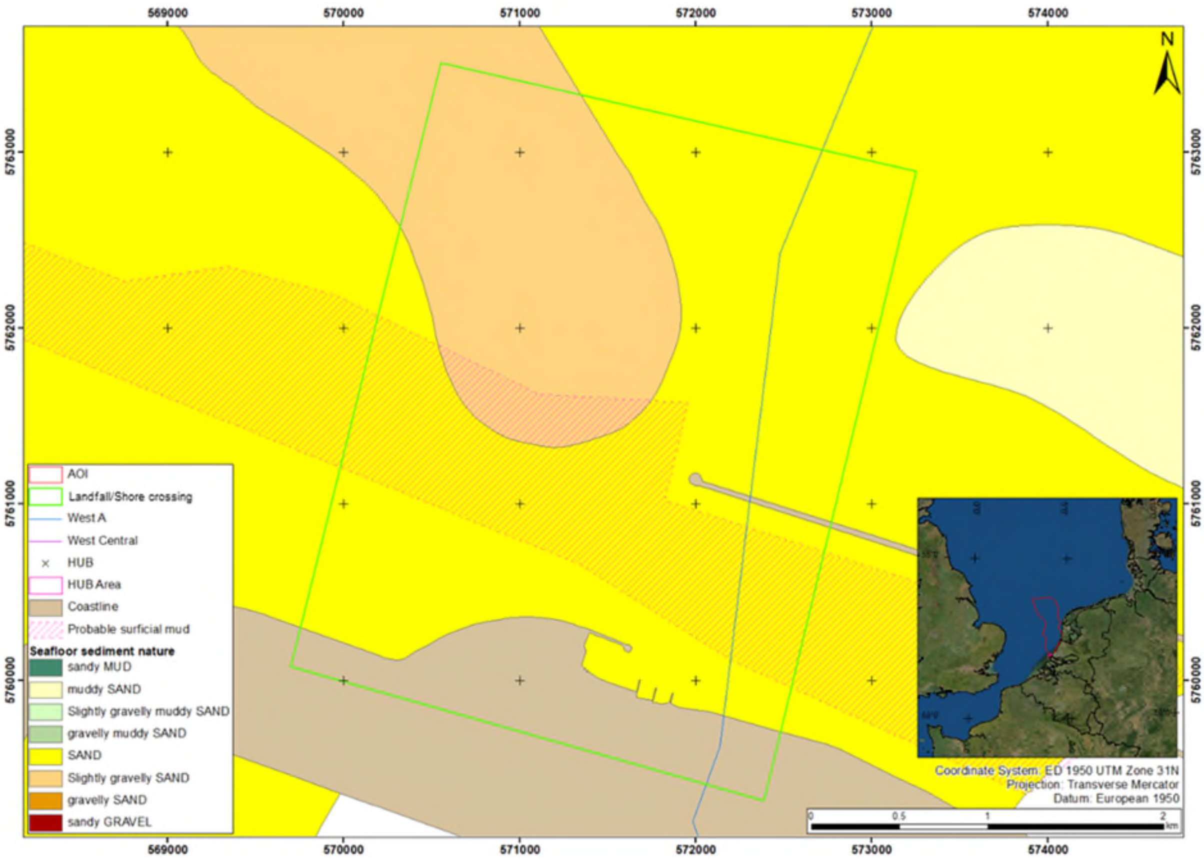


Figure 4.22: Surficial sediment nature across the Landfall/Shore crossing Area

4.2.3.3 Offshore Distribution HUB Area

The Offshore Distribution HUB Area comprises two main seafloor sediment types that are presented in Figure 4.23:

- SAND;
- Slightly gravelly SAND, in the south.

Site-specific geotechnical surveys would allow to refine the sediment nature within the Offshore Distribution HUB Area.

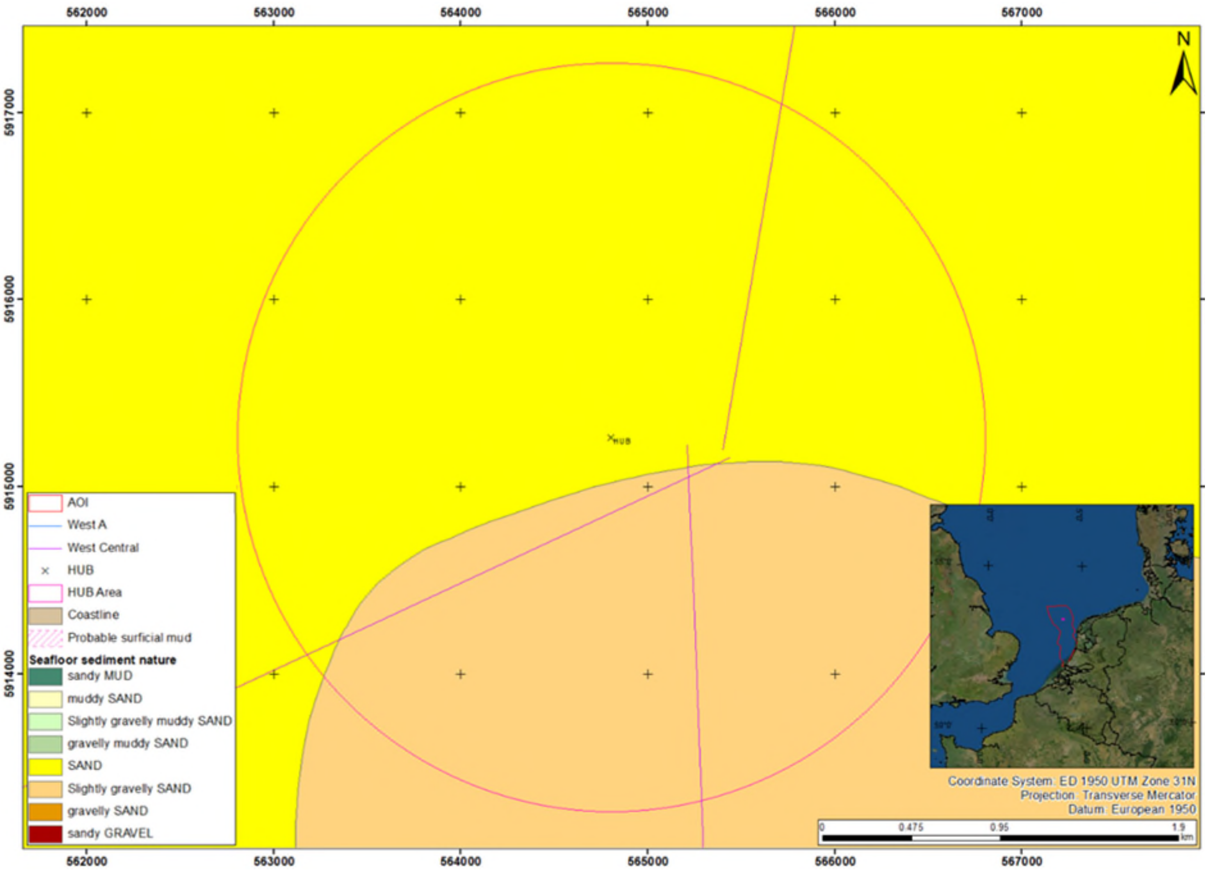


Figure 4.23: Surficial sediment nature across the Offshore Distribution HUB Area

4.2.4 Man-Made Seafloor Features

4.2.4.1 AOI

Man-made seafloor features were identified in the different bathymetric data. These features include:

- Unidentified seafloor obstructions (including probably several wrecks and wellheads);
- Pipelines;
- Dredged areas;
- Dumped material;
- Navigation channels.

These elements were mapped and are displayed in Figure 4.17. The man-made obstructions could only be mapped on the high-resolution MBES data. More details on the man-made obstructions are provided in the UXO and Archaeological DTS reports (Appendix C and Appendix B).

4.2.4.2 Landfall/Shore Crossing Area

The Maasmond Kanaal navigation channel and a dumping area were recognised within the Landfall/Shore crossing Area as mapped in Figure 4.24. In addition, ROCK dumps related to coastal defence structures are present on the shores of the Maasmond Kanaal as well as numerous seafloor scars related to dredging operations (Fugro database).

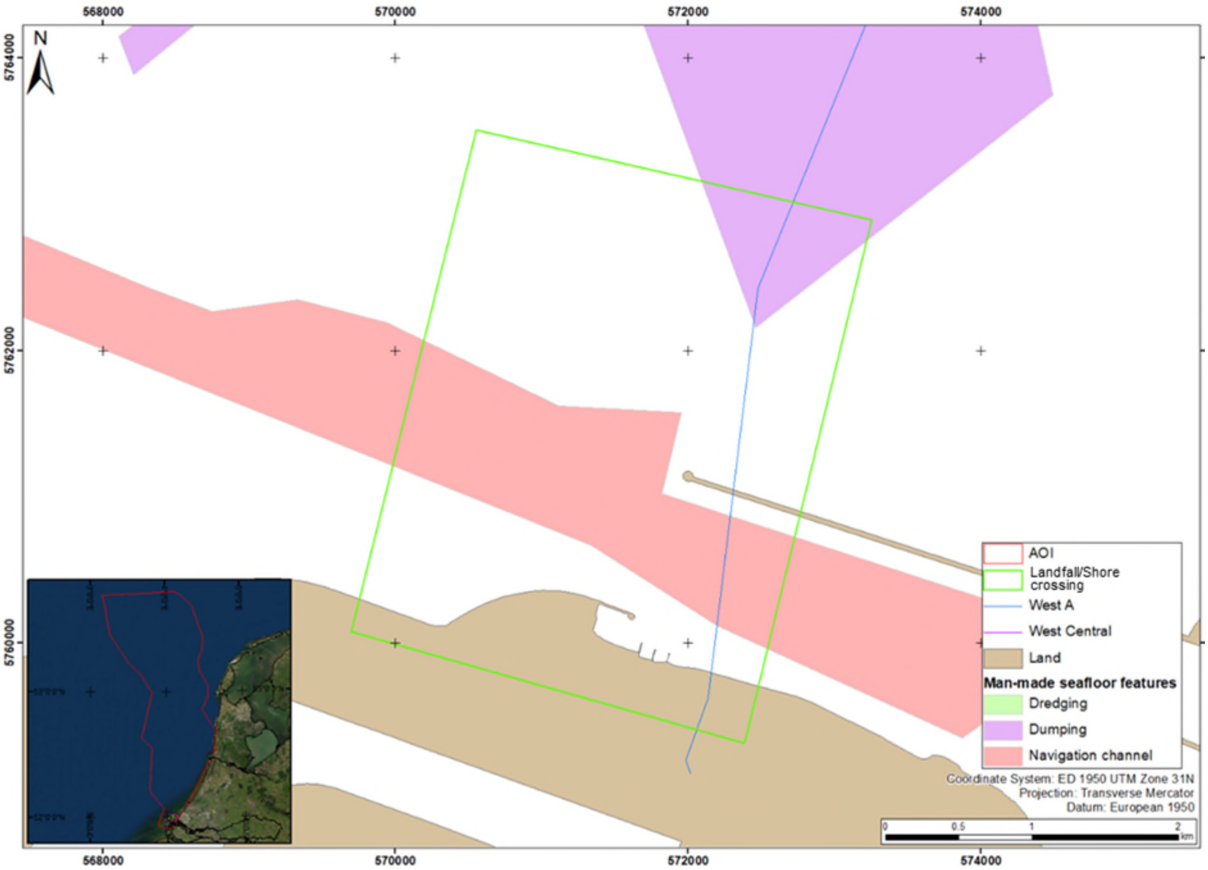


Figure 4.24: Surficial sediment nature across the Landfall/Shore crossing Area

4.2.4.3 Offshore Distribution HUB Area

No man-made seafloor features were recognised within the Offshore Distribution HUB Area.

4.3 Seafloor Mobility

The high availability of sand at seafloor facilitates the formation of dynamic bedforms (refer to Section 4.2.2 for description of bedforms), which are mobile in response to (tidal) currents.

Sand waves and sand banks have dimensions that are significant for pipeline foundation design, while megaripples and ripples are perceived as not having a significant impact. The sand banks are considered stationary over the lifetime of a pipeline, whereas the sand waves may migrate at a speed up to tens of metres per year (van Dijk & Kleinhans, 2005; Dorst et al., 2009; van Santen et al., 2011) and cause metres-scale vertical seafloor variations over the lifetime of a pipeline.

If sand waves are removed by dredging, they may regenerate within a period of years (Knaapen and Hulscher, 2002). This is illustrated in Figure 4.25, where sand waves appear to be building back within a former dredging area.

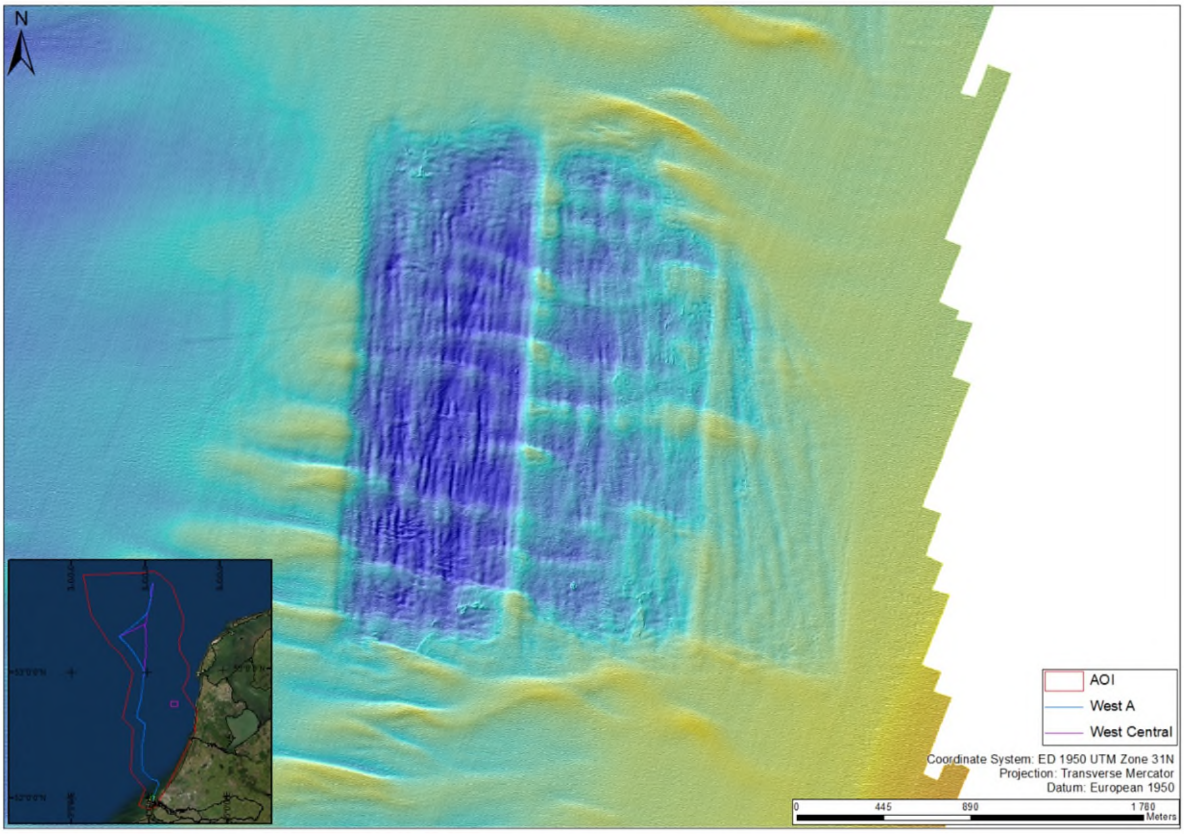


Figure 4.25: Former dredging area where sand waves are building back , as imaged in Hollandse Kust (noord) MBES bathymetry

Table 4.5 provides a summary of sand wave migration rates based on a selection of studies performed in the southern North Sea.

Table 4.5: Sand wave migration rates in the southern North Sea

Location	Average Migration Rate [m/year]	Source
Hollandse Kust (noord) WFZ	1.9 to 5.4	Deltares (2019)
Hollandse Kust (west) WFZ	1 to 3.9	Deltares (2020)
Hollandse Kust (zuid) WFZ	1 to 2.6	Deltares (2016)
Prinses Amalia OWF	4	Deltares (2017)
Luchterduinen OWF	2 to 3	Deltares (2017)
Texel	> 20	Van der Meulen et al. (2004)
Rotterdam Harbour	0	Van der Meulen et al. (2004)
Belgian Sector	1 to 4	Fugro database
UK Sector – east of Norfolk Banks	0 to 4	Fugro database

Typical sand wave migration rates in the southern North Sea are between 1 m/year to 10 m/year and in exceptional cases, as for example coastal zones, up to 20 m/year (Deltares, 2020). The sand wave morphology indicates that the dominant migration direction in the North Sea is to the north-north-east.

The migration rates of sand waves vary spatially and over time. In general sand waves in shallower water depths, e.g., on top of the sand banks migrate faster than in the deeper parts and locally migration speeds as high as 9.0 m/year are observed (Deltares, 2019).

The migration distance may increase in the event of storms or exceptional weather surge. Winter storm events can change the morphology of sand waves. For example, sediment can be transported from crest to trough, decreasing the height of bedforms. Additionally, megaripples and ripples may be smoothened. These small-scale bedforms will reappear once the rhythmic currents' regime is re-established (Deltares, 2016).

Van der Meulen et al. (2004) reported a migration rate of over 20 m/year near the island of Texel, with typical migration rates decreasing southwards to a stationary (0 m/year) field near the Rotterdam harbour. Migration rates in the Prinses Amalia offshore wind farm (OWF) and Luchterduinen OWF, located in the centre of the AOI, were assessed to be in the order of 4 m/year and 2 m to 3 m per year, respectively.

Fugro performed several seafloor mobility studies in the North Sea, which included comparison of MBES data between different years. For example, in the Belgian sector, MBES data acquired 3 years apart revealed sand wave migration rates in the order of 1 m to 4 m per year. In the UK sector, east of Norfolk Banks, the MBES data between consecutive years revealed sand waves migration rates from 0 m to 4 m per year.

4.4 Sub-seafloor Conditions

Section 3 provides background information on the regional geological setting. The following sections provide project-specific results on sub-seafloor conditions. The Stratigraphic

Nomenclature by TNO – the Geological Survey of the Netherlands is used and is available on the DINOloket website (TNO-GDN, 2022).

4.4.1 AOI

The expected geological formations that occur in the AOI and description of the lithologies associated with these formations are summarised in Table 4.6. Included are the expected thickness ranges and distribution of the formations across the AOI. The expected thickness values are based on Cameron et al. (1984; 1986), Laban et al. (1992), Laban (1995), Fugro (2019a, 2020) and DINOloket (2022). The distribution of the geological formations was compiled from maps by Cameron et al. (1984, 1986), Harrison et al. (1987), Balson et al. (1991), Laban (1995), NITG–TNO (2004b, 2004d) and Laban & van der Meer (2011), which are stored in the GIS database for easy access.

To illustrate the subsurface stratigraphy a schematic profile from northern part of the AOI is provided on Figure 4.27. Figure 4.26 shows a detailed interpreted seismic profile taken from the Hollandse Kust (west) WFZ (Fugro, 2020) situated in the central-west part of the AOI.

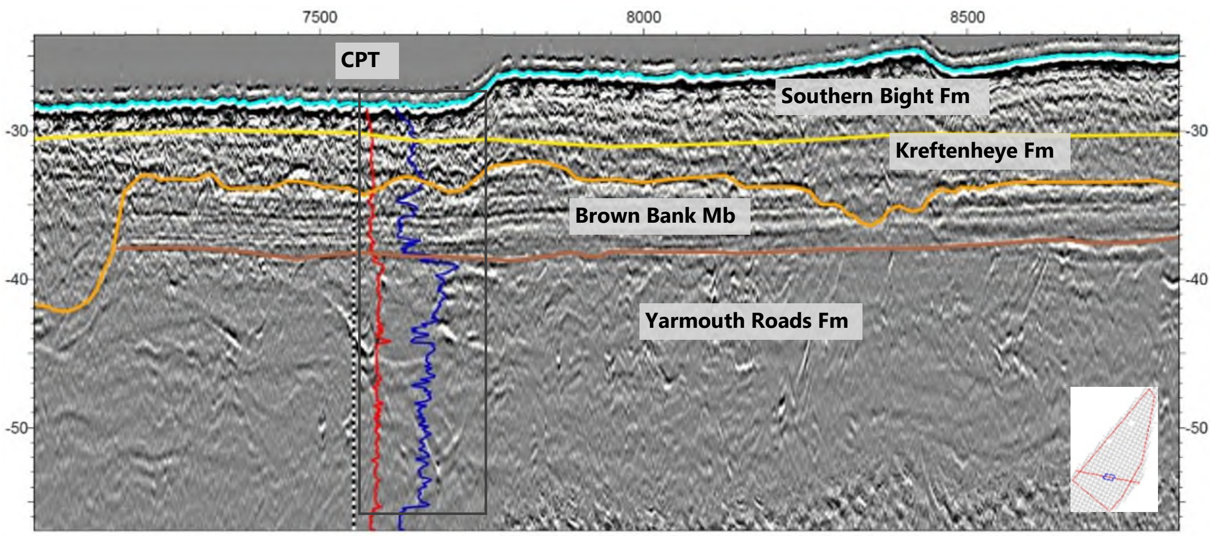


Figure 4.26: Example seismic reflection (2DUHR) cross section within the Hollandse Kust (west) WFZ (modified from Fugro, 2020). *Vertical scale is in metres reduced to LAT. The horizontal scale shows relative distance in metres along the seismic line. Width of the Cone Penetration Test (CPT) box shows cone resistance values (blue curve) within range of 0 to 60 MPa and sleeve friction values (red curve) from 0 to 1 MPa*

Maps showing distribution of the geological formations are provided in the following figures:

- Figure 4.21 shows the geological formations occurring at the seafloor;
- Figure 4.28 shows the thickness of the Holocene;
- Figure 4.29 shows distribution of the Late Pleistocene formations (directly below Holocene sediments);
- Figure 4.30 shows distribution of the Early to Middle Pleistocene formations, from the Drente Formation (Gieten Member) down to the Yarmouth Roads Formation;
- Figure 4.31 shows the distribution of the Early Pleistocene formations, comprising the Peelo Formation and the Yarmouth Roads Formation.

Note that the formations may have a larger extent than indicated on these figures (display effect—younger formation may partially cover the older formation). Refer to the GIS database for their full extents.

Table 4.6: Overview of the stratigraphy in the AOI specifying the geological units present

Age	Geological Formation / *Member**	Expected Thickness Range [m]	Soil Type†	Depositional Environment	Distribution and Comments
Holocene	Southern Bight	0 to 25	Very loose to very dense, fine to coarse SAND with shells and shell fragments, locally silty	High energy open marine	Present across the entire AOI, except the depression in the north and locally in the south The unit is thicker at the crests of the sand waves and thinner in the troughs between them. The maximum thickness is approximately 10 m. The extreme values are reached locally in the coastal area
Holocene	Urania	0 to 7	Very soft to soft (sandy) CLAY or very loose to medium dense (clayey) SAND	Low energy open marine	Present in the depression in the north
Early Holocene	Naaldwijk	0 to 15	Medium dense to very dense fine to medium (clayey) SAND and/or loose to medium dense (sandy) SILT or soft (low strength) CLAY, locally with beds of PEAT, locally thin beds of gravelly sand	Coastal to tidal	Present locally across the entire AOI, mostly as infill in shallow paleo-channels, which are highly variable in lateral and vertical extent. In general, the unit is more extensive and increase in thickness towards the coastline.
Weichselian	Boxtel (Twente)	0 to 5	Medium dense to very dense fine SAND, with minor intercalations of clay, silt, gravel and/or peat	Periglacial, aeolian	Patchy distribution across the AOI
Weichselian	Kreftenheye	0 to 25	Dense to very dense fine to medium SAND, with locally beds of gravelly sand, silty clay, clayey peat	Glaciofluvial to fluvial	Mainly present in the southern half of the AOI. Reaches maximum thickness in the southern part (Landfall/Shore crossing Area) and is absent in the northern part of the AOI
Late Eemian to Early Weichselian	Eem / *Brown Bank* (Brown Bank)	0 to 20	Firm to very stiff calcareous CLAY or SILT, with extremely closely to very closely spaced laminae to thick beds of sand	Brackish marine lagoonal to lacustrine	Present in the north-western part of the AOI. The unit reaches largest thickness (>10 m) very locally, where it forms infill of channelling features
Eemian	Eem	0 to 15	Medium dense to very dense fine SAND with shells and shell fragments; locally clay and silt beds	Shallow to open marine, locally glaciofluvial	Present in the most of the AOI, can be locally absent. Absent in the southernmost part of the AOI
Saalian	Drente / *Gieten* (Borkum Riff)[2)]	0 to 5	Very stiff to hard silty sandy gravelly CLAY (glacial TILL)	Glacial	Locally present only in the north-eastern part of the AOI
Saalian	Drente / *Uitdam* (Cleaver Bank)[2)]	0 to 25	Stiff to hard CLAY, locally with silt, sand, and gravel beds	Periglacial, glaciolacustrine	Mainly confined to Saalian tunnel valleys in the northern half of the AOI. The unit thickness is typically <10 m, larger thickness observed only very locally
Saalian	Drachten (Tea Kettle Hole)	0 to 10	Medium dense to dense, fine to medium SAND, with locally laminae of silt or/and clay	Periglacial, glaciofluvial, aeolian	Present locally in the northern half of the AOI
Holsteinian	Egmond Ground	0 to 40	Medium dense to very dense fine SAND with shells and shell fragments, with thin clay and silt interbeds	Open marine	Present across the northern half of the AOI
Elsterian	Peelo (Swarte Bank)	0 to > 100	Interbedded medium dense to very dense (silty) SAND and very stiff to hard (sandy) CLAY	Glacial, glaciofluvial (infill of valleys) to glaciolacustrine	Present across northern half of AOI, thickness significantly increases in (deep) tunnel valleys
Early to Middle Pleistocene	Yarmouth Roads	0 to > 100	Interbedded medium dense to very dense, slightly silty to very silty, fine to medium SAND, and stiff to very stiff CLAY or SILT with laminae of sand; locally laminae to thin beds of PEAT	Fluvio-deltaic to marine	Present across the AOI, except in the most south-eastern part
Early Pleistocene	Winterton Shoal / IJmuiden Ground	0 to > 100	Interbedded medium dense to very dense, silty, fine to medium SAND, with laminae to thick beds of (organic) clay and stiff to hard CLAY or SILT with laminae of sand; locally laminae of PEAT	Fluvio-deltaic to marine	Present in the south-eastern part of the AOI (Landfall/Shore crossing Area)

Notes:

Information is presented for depth range of interest (to 100 m BSF)
'Greater than' sign ('>') indicates minimum observed thickness

* = BGS naming convention between brackets
† = May contain boulders

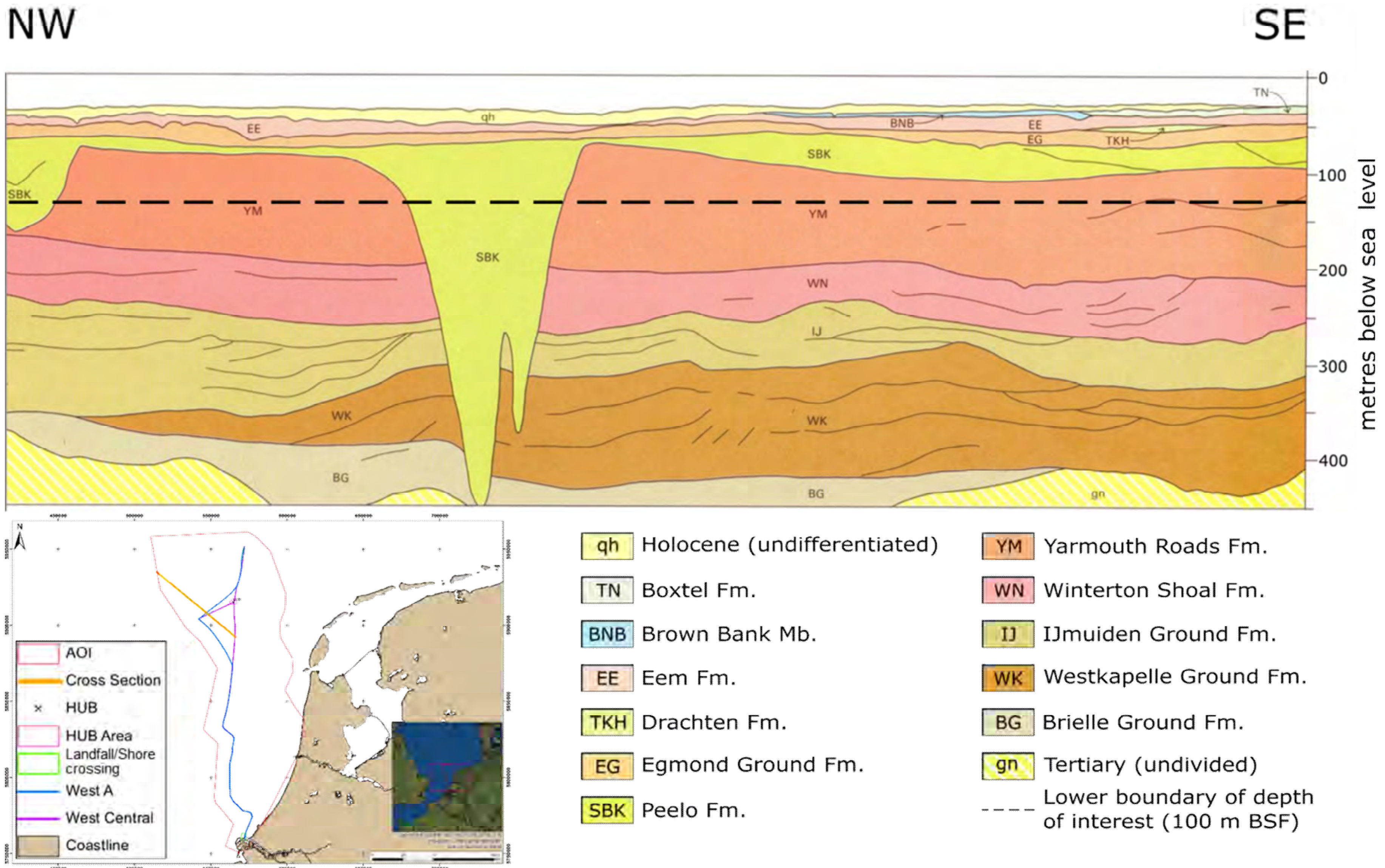


Figure 4.27: Schematic profile (with 50x vertical exaggeration) of the north-west part of the AOI. See the inset in the bottom left-hand corner for the location of the cross section (in orange). Modified after Cameron et al. (1986)

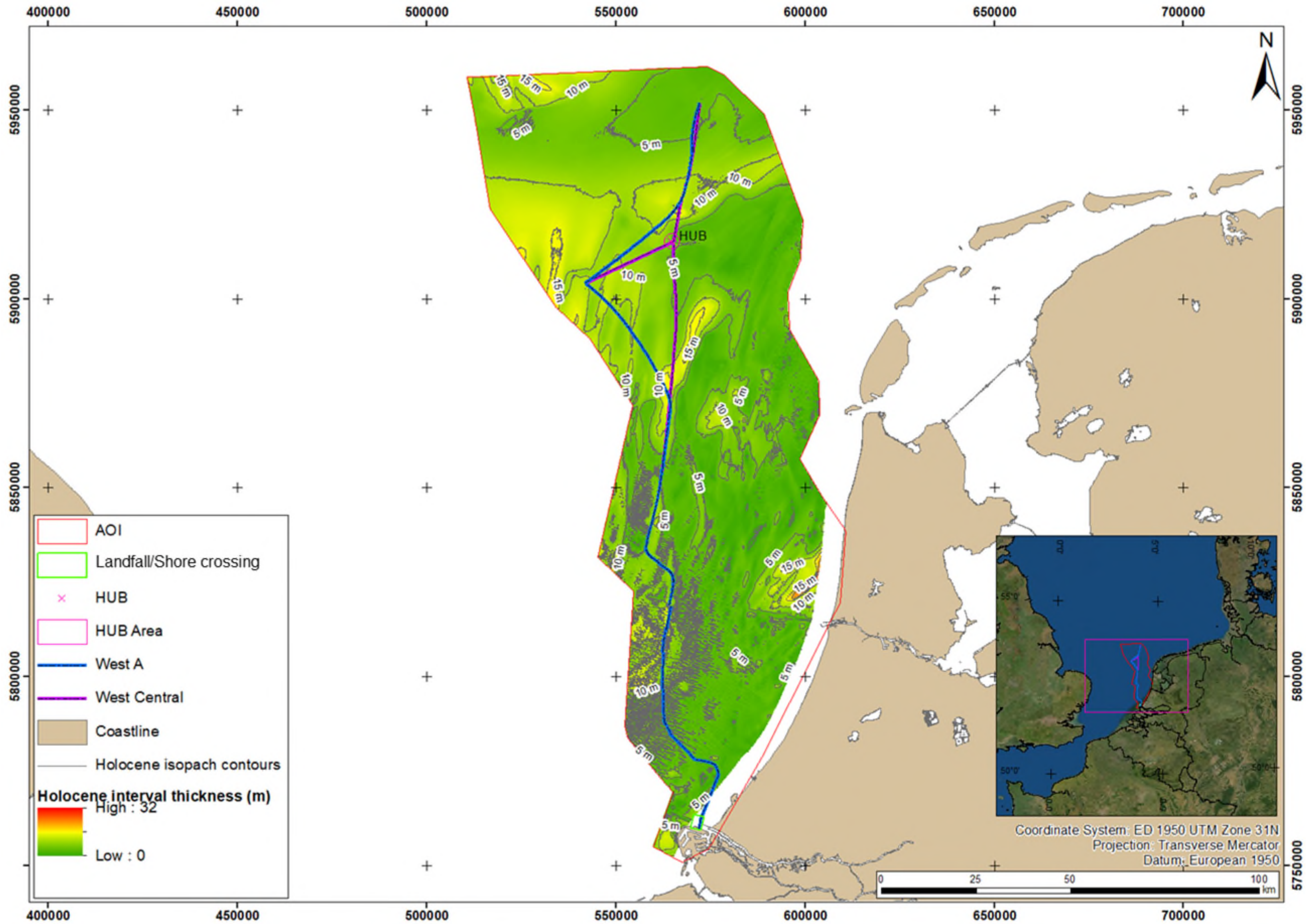


Figure 4.28: Expected thickness of the Holocene in the AOI

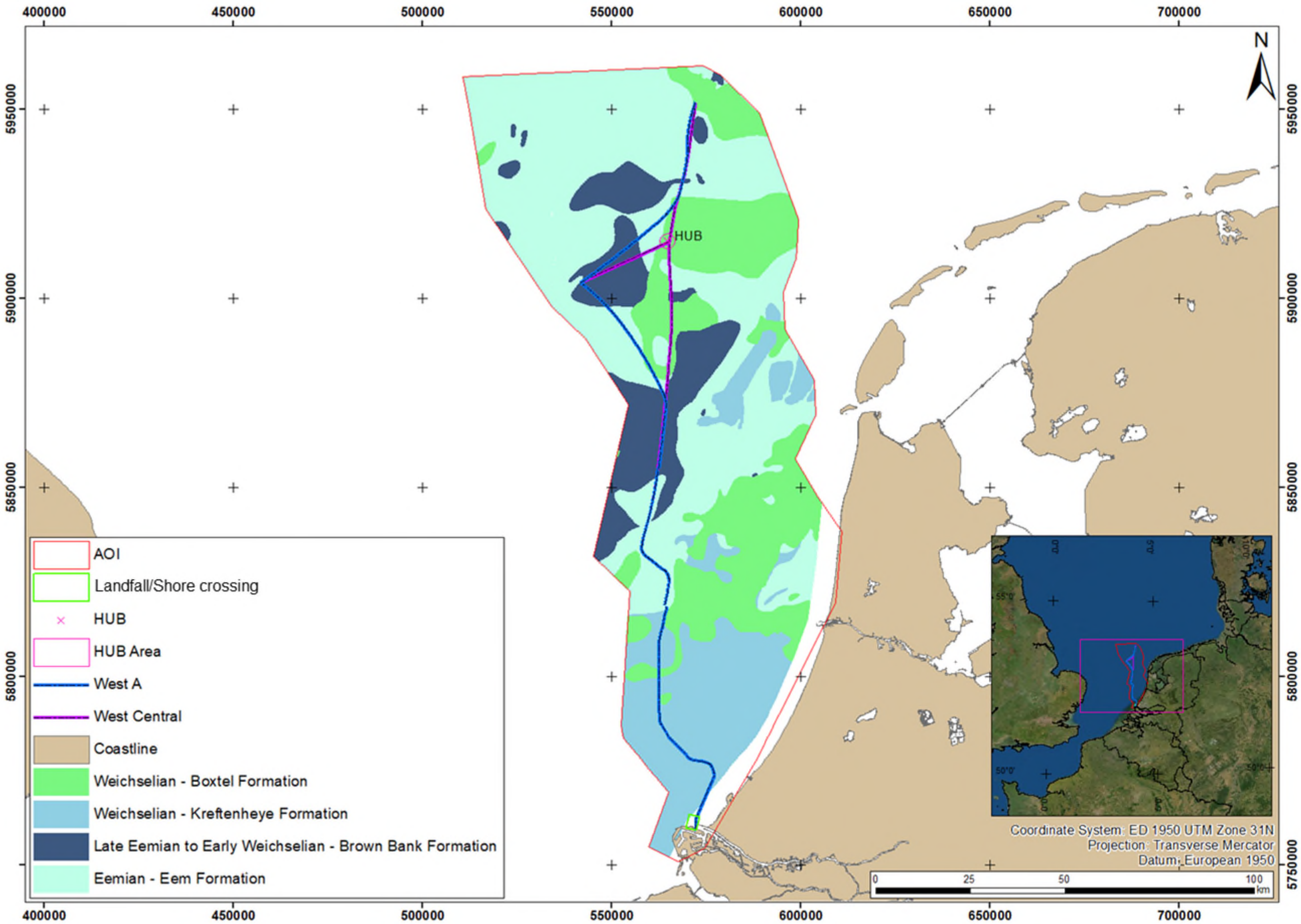


Figure 4.29: Distribution of the Late Pleistocene formations and members

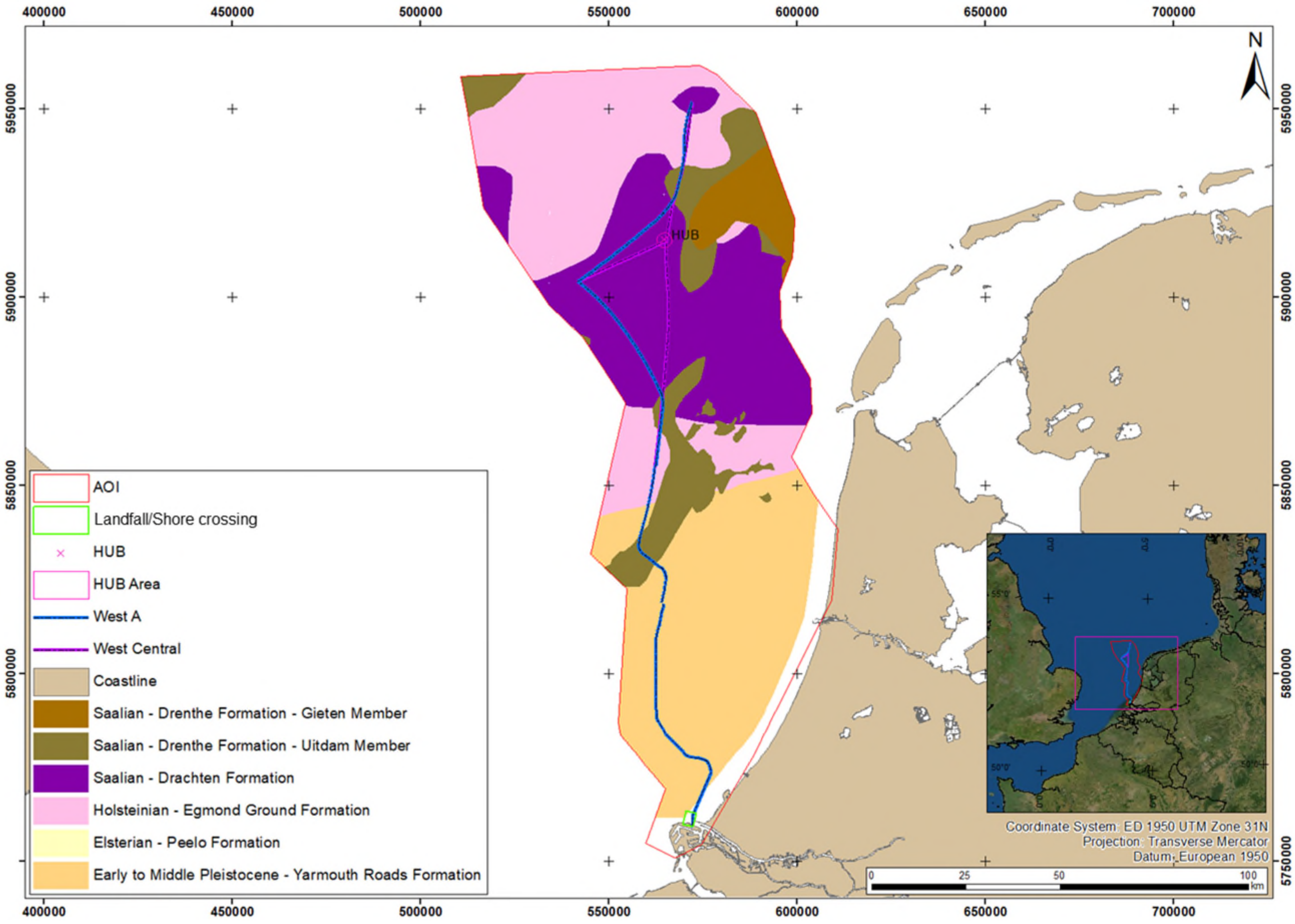


Figure 4.30: Distribution of the Early to Middle Pleistocene formations and members

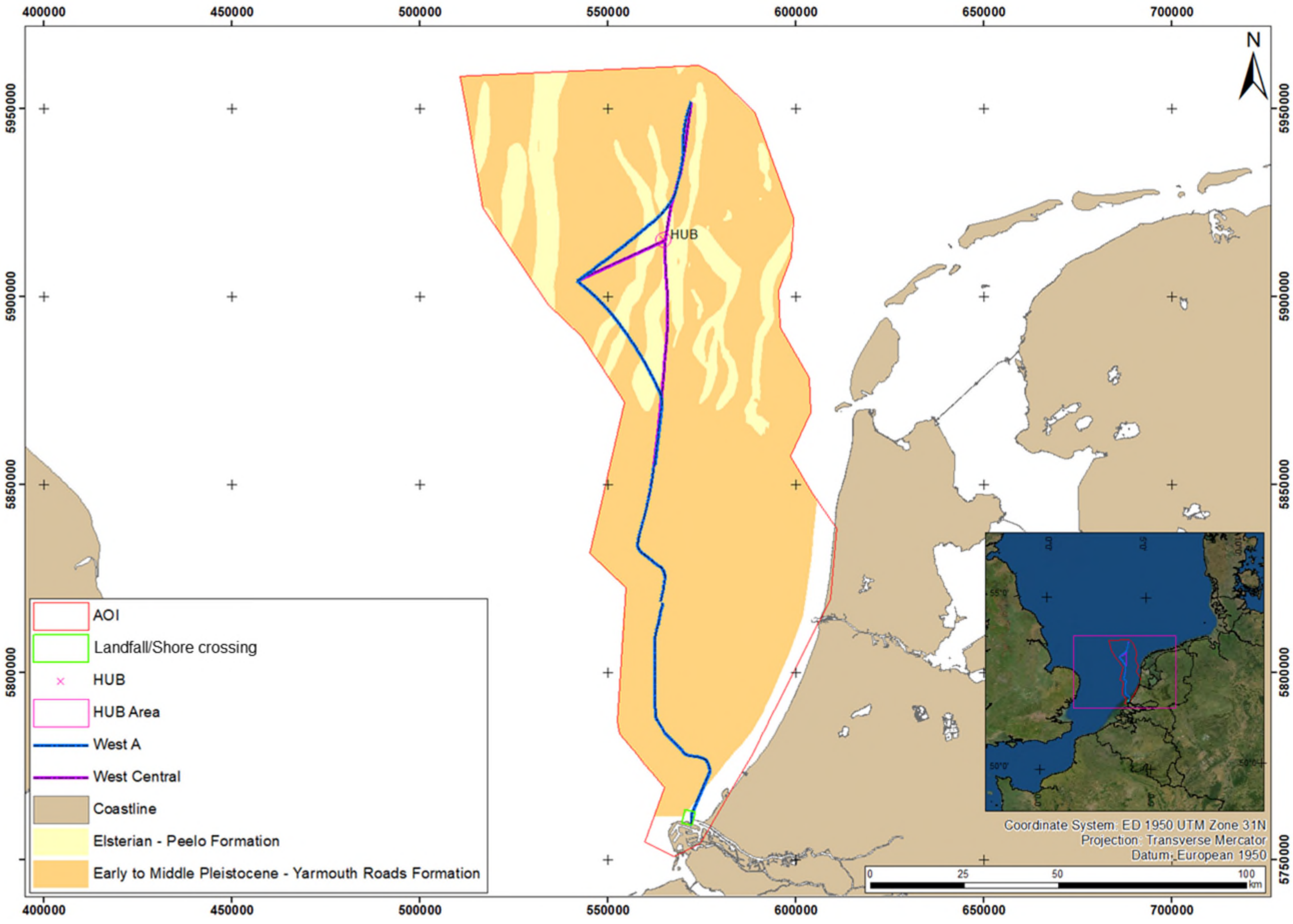


Figure 4.31: Distribution of the Early Pleistocene formations

4.4.2 Landfall/Shore Crossing Area

The expected stratigraphy and lithologies in the Landfall/Shore crossing Area, based on the information from DINOloket is presented in Figure 4.32.

There are three main units/geological formations to be expected, from top: Naaldwijk, Kreftenheye and Early Pleistocene formations, which comprise the Winterton Shoal and/or IJmuiden Ground Formations. The Naaldwijk Formation is internally very variable with dominant clay and locally some inclusions of peat. Kreftenhaye Formation is dominated by SAND and the Early Pleistocene deposits by SAND mixed with CLAY.

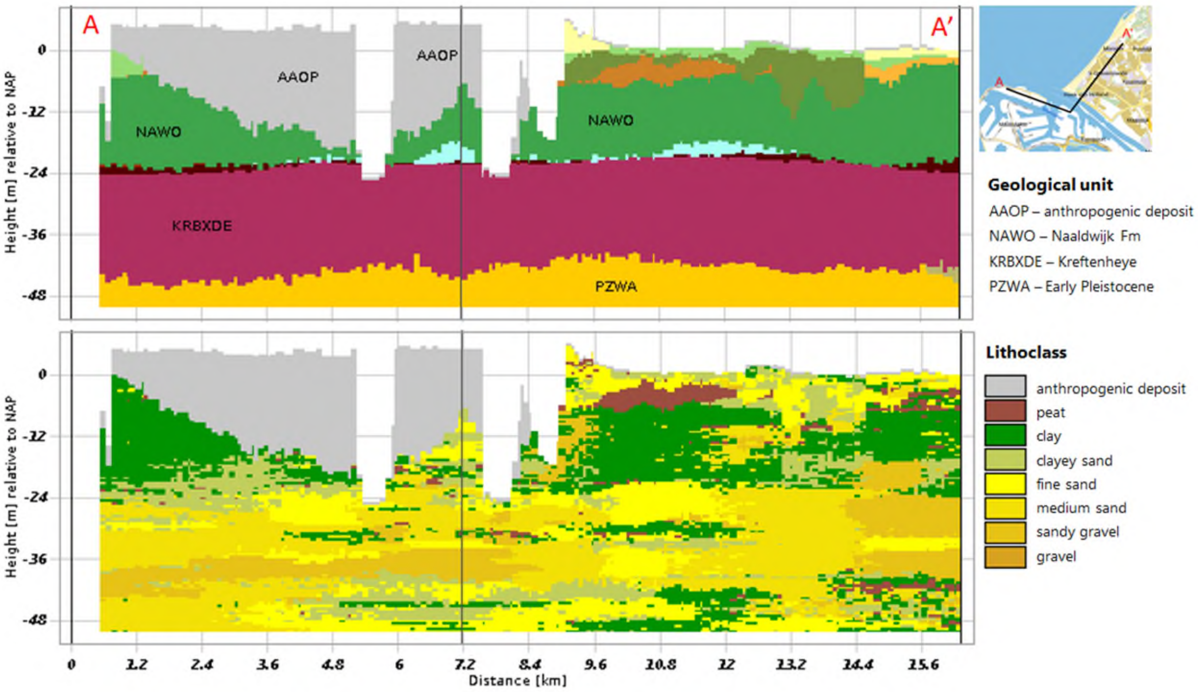


Figure 4.32: Synthetic ground models showing geological units (top image) and most probable lithologies (bottom image) in the vicinity of the Landfall/Shore crossing Area (source: DINOloket)

Table 4.7 presents the expected stratigraphy and spatial soil variability at the Landfall/Shore crossing Area. The information presented is based on (1) three geotechnical boreholes with penetration depth from approximately 17 m to 35 m BSF (Fugro, 2019c); (2) numerous geotechnical sampling and CPT testing locations from Fugro database, with various penetration depths from a few metres to approximately 40 m BSF. The geotechnical borehole data are within the boundaries of the Landfall/Shore crossing Area, located mainly in the western part.

Particularly, the presented depth and thickness values for the identified stratigraphic units/geological formations, as well as the spatial soil variability are based on previous geotechnical and geophysical investigation data performed by Fugro in the area. Figure 4.33 presents a schematic cross section along the first 3 km of the proposed pipeline route based on the interpretation of these data.

Table 4.7: Expected stratigraphy for the Landfall/Shore crossing Area

Geological Formation	Depositional Environment	Expected Thickness [m]	Soil Type	Distribution and Spatial Variability*
Disturbed Soil (DS)	Recent accumulation	0 to 5	Very soft to soft CLAY, locally sandy, locally gravelly	Present in the Maasmond Kanaal
Southern Bight	Marine	0 to 1	Very loose to dense, medium SAND with frequent shells and shell fragments	Locally present as a thin cover or in form of possible localised small-scale bedforms; can be present especially in the northern part of the area
Naaldwijk	Coastal, tidal channel and tidal flat	0 to 13	Medium dense to very dense, fine and medium SAND and soft to firm (sandy) CLAY, locally PEAT interlayers	Present across the entire area. Locally this unit might be removed due to dredging activities (i.e., in the Maasmond Kanaal) The unit is characterised by very high spatial soil variability. The unit locally forms infill of paleo-channels, where it reaches maximum thickness. More extensive paleo-channels are expected in the northern part of the area (Figure 4.34)
Kreftenheye	Fluvial	10 to 25	Very dense fine to medium SAND, locally slightly gravelly to gravelly, locally with traces to few gravels; locally with laminae to thin beds of clay	Present across the entire area. Relatively homogenous unit, with minor localised laminae to thin beds of clay
IJmuiden Ground/ Winterton Shoal	Deltaic to fluvial	> 20	Medium dense to very dense (slightly) silty SAND, locally beds of laminated CLAY, locally with thin to thick beds of very stiff to hard CLAY	The entire area; high variability in relative density of sand or an alternation of sand and clay; beds of laminated sandy clay can be (locally) present

Notes:
Information is presented for depth range of interest (to 40 m BSF)
'Greater than' sign ('>') indicates minimum observed thickness
* = refer to Figure 4.33 for schematic cross section

Comments are as follows:

- The base of the Maasmond Kanaal has been dredged up to 10 m depth. As a result, the upper strata (i.e., the Naaldwijk Formation) were likely removed or reduced to thickness of occasionally less than 1 m.
- In the Maasmond Kanaal the top comprises very soft to soft clay or medium dense (clayey or silty) sand laminated with clay. This top relatively weak layer can be a recent deposit in the channel and/or partly a remnant or of the Naaldwijk Formation. Thickness of this layer is on average between 1 m and 3 m, but locally can be up to 6 m.

- Peat/organic clay layers (laminae to thin beds) can be present locally within the Naaldwijk Formation outside of the Maasmond Kanaal, and within the top layer in the Maasmond Kanaal. On seismic reflection data, localised areas of acoustic blanking were observed in and outside of the Maasmond Kanaal, which can be related to the peat and/or possible accumulations of gas as a result of decomposition of the organic material.
- Localised gravel beds may be present in the subsurface. A thick bed of very sandy gravel was encountered at a depth of approximately 5 m BSF at a single location south of the Maasmond Kanaal.
- Rock dumps made of gravel, cobbles and boulders (as part of the flood-defence structure) are present in the coastal zones. Side scan sonar (SSS) data indicated that submerged rock dump extent from several metres to tens of metres from the shoreline. No information on the thickness of this layer is available. In boreholes located onshore 2 m to 6 m-thick layers of gravel/cobbles were encountered.
- Seafloor depressions associated with objects interpreted as possible boulders were observed sporadically on the MBES data in the Landfall/Shore crossing Area. Boulders were not encountered or reported in the subsurface, based on the available information.

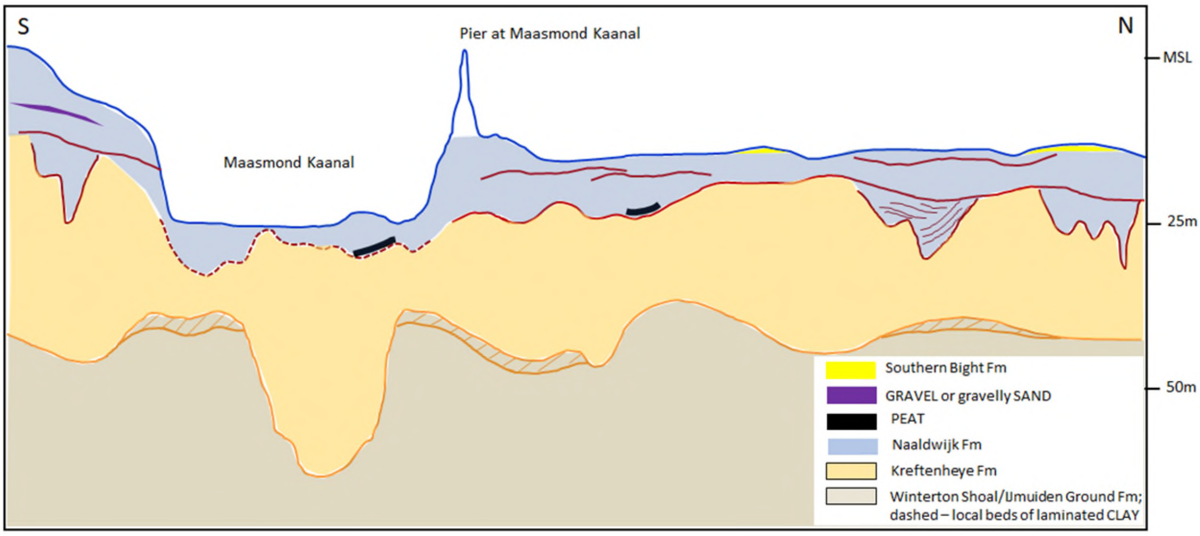


Figure 4.33: Schematic simplified cross section across the Maasmond Kanaal (based on geotechnical Fugro experience). Refer to Table 4.7 for detailed description of the units/geological formations

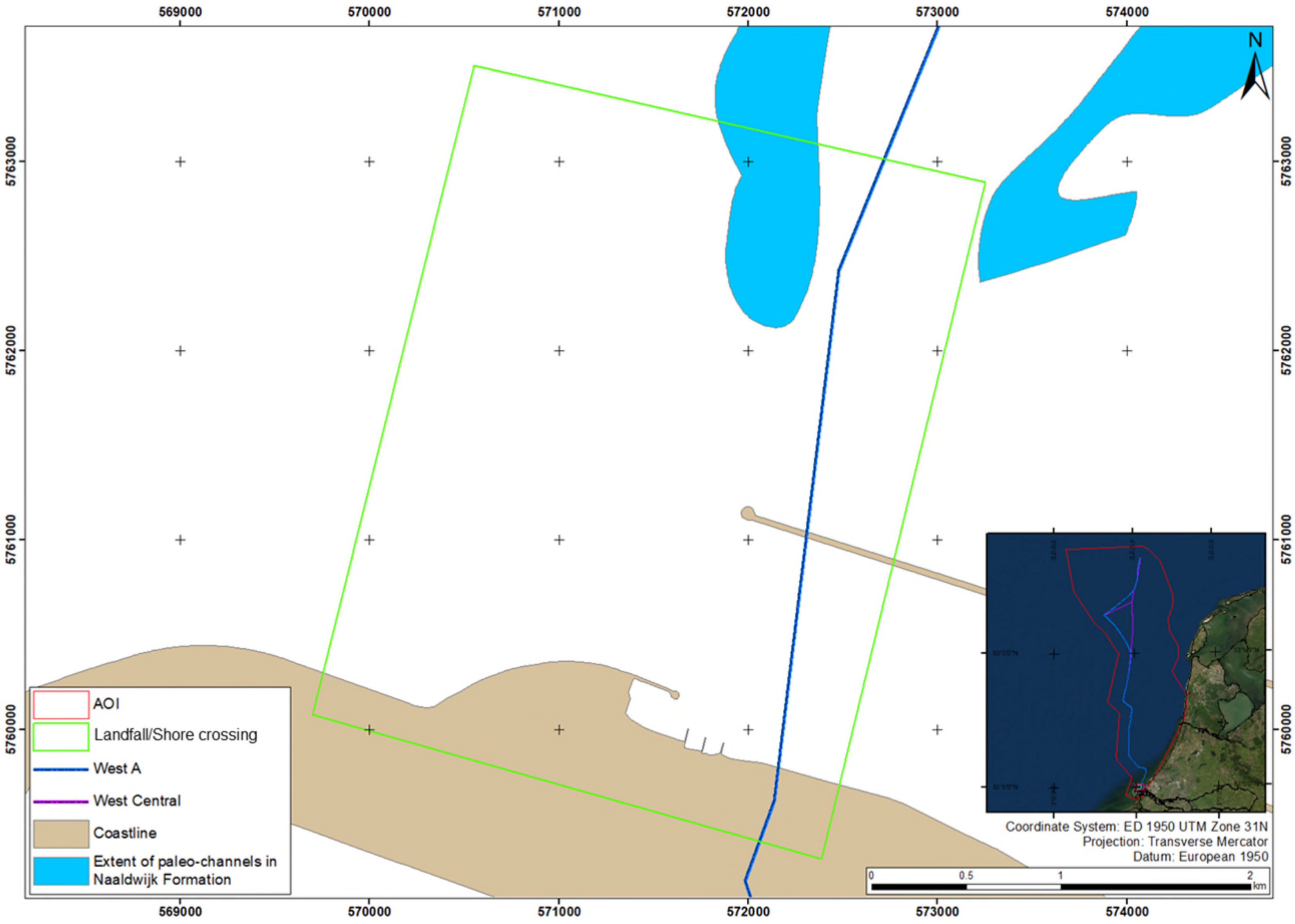


Figure 4.34: Distribution of the early Holocene (Naaldwijk Formation) paleo-channels in the Landfall/Shore crossing Area

4.4.3 Offshore Distribution HUB Area

Table 4.8 presents the general stratigraphy and spatial soil variability at the Offshore Distribution HUB Area. The information presented is based on geological maps and three geotechnical boreholes located approximately 3 km from the Offshore Distribution HUB Area boundary (Fugro confidential experience). No borehole information is available within the Offshore Distribution HUB Area.

Table 4.8: Expected stratigraphy for the Offshore Distribution HUB Area

Geological Formation / *Member*	Depositional Environment	Expected Thickness [m]	Soil Type	Distribution and Spatial Variability
Southern Bight	Marine	2 to 10	Very loose to very dense SAND with shells and shell fragments, locally silty	Present across the entire area
Naaldwijk	Coastal to tidal	0 to 5	Highly variable; generally soft CLAY, with silt, sand and peat beds	May be present (locally)
Boxtel	Periglacial, aeolian	0 to 5	Medium dense to very dense fine SAND	May be present (locally)
Eem / *Brown Bank*	Brackish marine lagoonal to lacustrine	0 to 10	Firm to very stiff calcareous CLAY or SILT, with extremely closely to very closely spaced laminae to thick beds of sand	May be present (locally)
Eem	Marine	5 to 15	Medium dense to very dense SAND with shells and shell fragments, locally silty and with peat beds	Expected to be present
Drente / *Uitdam*	Periglacial, glaciolacustrine	0 to 5	Stiff to hard CLAY, locally with silt, sand, and gravel beds	May be present (locally)
Drachten	Periglacial, aeolian	0 to 5	Medium dense to dense, fine to medium silty SAND	Expected to be present
Egmond Ground	Marine	10 to 40	Medium dense to very dense SAND with shells and shell fragments and beds of clay and silt	Expected to be present
Peelo	Glacial, glaciofluvial to glaciolacustrine	> 20	Interbedded medium dense to very dense SAND and very stiff to hard sandy CLAY	Expected to be present, although thickness may vary within the area
Yarmouth Roads	Fluvio-deltaic to marine	> 40	Dense to very dense SAND with shells and shell fragments, locally slightly silty	Expected to be present, although thickness may vary within the area

Notes:
Information is presented for depth range of interest (to 100 m BSF)
'Greater than' sign ('>') indicates minimum observed thickness

Comments are as follows:

- Based on the available geological maps, the Naaldwijk Formation and the Brown Bank Member may be (partly) present in the Offshore Distribution HUB Area. Based on information from the nearby boreholes it is not possible to distinguish between these formations and member. However, CLAY with a thickness of 0.5 m to 5 m between the Southern Bight Formation and the Eem Formation was observed. Therefore, either Naaldwijk or Brown Bank is expected to be (locally) present.

- Beds of PEAT may be present locally and belong to either the Naaldwijk, or the Brown Bank Member.
- Stratigraphy descriptions for the nearby geotechnical boreholes incorporated the Drachten Formation and Uitdam Member into the Eem Formation and/or Egmond Ground Formation. Therefore, it is not possible to confirm the presence of these strata. The geological maps suggest that the Drachten Formation should be present, while the Uitdam Member might be (locally) present. The expected thickness of each of these formations is up to 5 m.
- The thickness of the Peelo Formation as observed in the nearby boreholes is approximately 22 m and 29 m. Regional geophysical and geotechnical information suggests that the formation is present throughout the area (Figure 4.27; Cameron et al., 1986; Laban, 1995).
- The base of the Yarmouth Roads Formation was not encountered in the nearby geotechnical boreholes. However, regional geophysical and geotechnical information suggests the formation is present throughout the wider area and has a thickness of at least 40 m (Figure 4.27; Cameron et al., 1986; Laban, 1995).

4.5 Ground Models

One ground model per study area is presented in this report, allowing to capture site-specific details and the different depth of interest for each site.

4.5.1 AOI

4.5.1.1 Predicted Soil Units and Geotechnical Parameters

To predict soil units across the AOI, the seafloor and sub-seafloor features identified in the available geological, geophysical and geotechnical data and literature were reviewed and summarised (Sections 4.2 and 4.4). Predicting soil units enables soil profiles and associated soil province map(s) to be generated.

Soil units were defined by grouping together stratigraphic formations expected to have similar lithologies (e.g., principal soil type). A geotechnical description is given allowing to encompass the possible variability and change in lithology within each of the soil units.

Eight soil units were predicted to be present across the AOI and within the depth of interest. Table 4.9 presents the predicted soil units and the associated preliminary geotechnical parameters defined for each unit.

The geotechnical description of soil units, detailed below, are applicable for the complete AOI as well as on the specific Landfall/Shore crossing and Offshore Distribution HUB Areas:

- Soil unit i, comprising the Holocene surficial sediments:
    - ia: sandy very soft MUD to muddy loose SAND;
    - ib: very loose to very dense SAND;
    - ic: slightly gravelly loose SAND to sandy GRAVEL;
- Soil unit ii, comprising tidal and coastal deposits of Early Holocene: interbedded very thin to thick beds of CLAY and SAND;
- Soil unit iii, grouping the Pleistocene formations dominated by SAND: SAND, locally (slightly) silty, with locally (and minor) beds of CLAY, SILT, GRAVEL and PEAT;
- Soil unit iv, grouping the Pleistocene formations dominated by CLAY, subdivided based on age (strength):
    - iva: overconsolidated (firm to stiff) CLAY with SAND laminae/thin beds;
    - ivb: overconsolidated (stiff to hard) CLAY, with beds of SILT to SAND;
- Soil unit v, corresponding to glacial TILL: very stiff to hard silty sandy gravelly CLAY.

Geotechnical parameters are derived from Fugro experience comprising numerous geotechnical sampling and CPT boreholes across the AOI. Thicknesses given are based on the same experience as well as on geological maps used in this report. The AOI being very large, the geotechnical parameters values cannot be detailed precisely, and ranges given in Table 4.9 allow to encompass potential range of values across the AOI.

Fugro recommends geotechnical sample data and CPTs along the final pipeline route to refine parameter ranges, and precise the expected thicknesses of the different units along the pipeline route. It is also recommended that the siting of the sampling and CPT locations is performed once geophysical data has been acquired to ensure areas of variability are sufficiently characterised and consistent areas only collect the required information. Based on these future geophysical and geotechnical surveys, the soil units may be discriminated further along the pipeline route.

Table 4.9: Predicted preliminary geotechnical parameters for the AOI

Stratigraphic Unit (Geological Formation)	Soil Unit	Description	Soil Type	Thickness [m]	γ′ [kN/m³]	D_r [%]	s_u [kPa]	S_t [-]	Φ′ [°]	q_c [MPa]
Surficial Sediments (Southern Bight and Urania)	**ia**	sandy very soft MUD to muddy loose SAND	CLAY	0 to 5	18 to 19	N/A	5 to 50	-	N/A	<2
	ib	very loose to very dense SAND	SAND	0 to 10	18 to 19.5	<35 to >100		N/A	25 to 45	2 to 20
	ic	slightly gravelly loose SAND to sandy GRAVEL	SAND	0 to 5	19 to 20	<35		N/A	25 to 30	4 to 20
Naaldwijk	**ii**	interbedded very thin to thick beds of CLAY and SAND	CLAY	0 to 15	18 to 19.5	N/A	20 to 100	1 to 3	N/A	1 to 3
			SAND			25 to 85		N/A	25 to 35	2 to 10
Boxtel (Twente) Kreftenheye, Eem Drachten (Tea Kettle Hole) Egmond Ground Yarmouth Roads	**iii**	SAND, locally slightly silty, with locally beds of CLAY, SILT, GRAVEL and PEAT	CLAY	0 to >20	18.5 to 20.5	N/A	100 to 200	~1 to 3	N/A	2 to 4
			SAND			65 to >100		N/A	30 to 45	15 to 90
Brown Bank	**iva**	overconsolidated firm to stiff CLAY with SAND laminae/thin beds	CLAY	0 to 10	18.5 to 19.5	N/A	50 to 200	1 to 3	N/A	1 to 4
			SAND			25 to 75		N/A	30 to 40	2 to 10
Drenthe (Cleaver Bank) Peelo (Swarte Bank)	**ivb**	overconsolidated stiff to hard CLAY, with beds of SILT to SAND	CLAY	0 to >20	19.5 to 21	N/A	200 to 400	~1 to 2	N/A	4 to 8
			SAND			65 to >100		N/A	35 to 45	15 to 90
Drenthe (Borkum Riff)	**v**	sandy, gravelly CLAY (glacial TILL)	CLAY	0 to 5	20 to 22	N/A	200 to 600	~1 to 2	N/A	4 to 12

Notes:
N/A = not applicable
- = no information available
γ′ = total unit weight
s_u = undrained shear strength
S_t = sensitivity
Dr = relative density
Φ′ = drained peak effective friction angle
q_c = CPT cone resistance

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4.5.1.2 Geotechnical Profiles

Nine soil profiles were generated for the AOI based on available data. These soil profiles describe the possible lateral and vertical variability of soil units predicted to be present to 20 m BSF across the AOI. Soil profiles are presented in Figure 4.35. They were designed to discriminate areas with presence of:

- glacial TILL (profiles numbered 2);
- firm to stiff CLAY from the Brown Bank Formation (profiles numbered 3);
- neither glacial TILL or Brown Bank CLAY (soil profiles numbered 1).

The other criteria differentiating between the soil profiles are the types of surficial sediments: (a) mud-rich, (b) sand and (c) gravel-rich.

Bedforms were considered as positive features relatively to the mean seafloor level and are shown as positive triangles at the top of the profiles.

4.5.1.3 Soil Provinces

A soil province map, presented in Figure 4.36, was generated for entire AOI to depict the spatial extent of each predicted soil profile (Figure 4.35). The soil province map allows the lateral variability in soil units to be better understood and pictured.

Areas covered by each soil province are given in Table 4.10 along with the percentage of the total AOI surface area they represent. From this table, it appears that over 84 % of the AOI is characterised by the normal soil profiles (profiles numbered 1 in Figure 4.35). Less than 4% of the AOI is likely to present glacial TILL (unit v) within the depth of interest (profiles numbered 2), while 12% of the AOI present firm to stiff CLAY of the Brown Bank Formation (unit iva) within the depth of interest (profiles numbered 3). 65% of the area is covered by SAND rich surficial sediments (profiles numbered 'b'), less than 19% is covered by MUD-rich sediments (profiles numbered 'a') and 16% is covered by GRAVEL-rich surficial sediments (profiles numbered 'c').

Table 4.10: Area covered by each soil province

Soil Province	Area (km^2)	% of AOI
AOI - 1a	1920.2	16
AOI - 1b	6455.9	56
AOI - 1c	1395.2	12
AOI - 2a	18.6	<1
AOI - 2b	321.7	2
AOI - 2c	123.8	1
AOI - 3a	235.3	2
AOI - 3b	807.3	7
AOI - 3c	347.1	3

Figure 4.36 presents the maximum extent of units consisting of stiff to hard CLAY (unit ivb) as hatched areas. However, the stiff to hard CLAY is in general likely to occur below the depth of interest of the AOI.

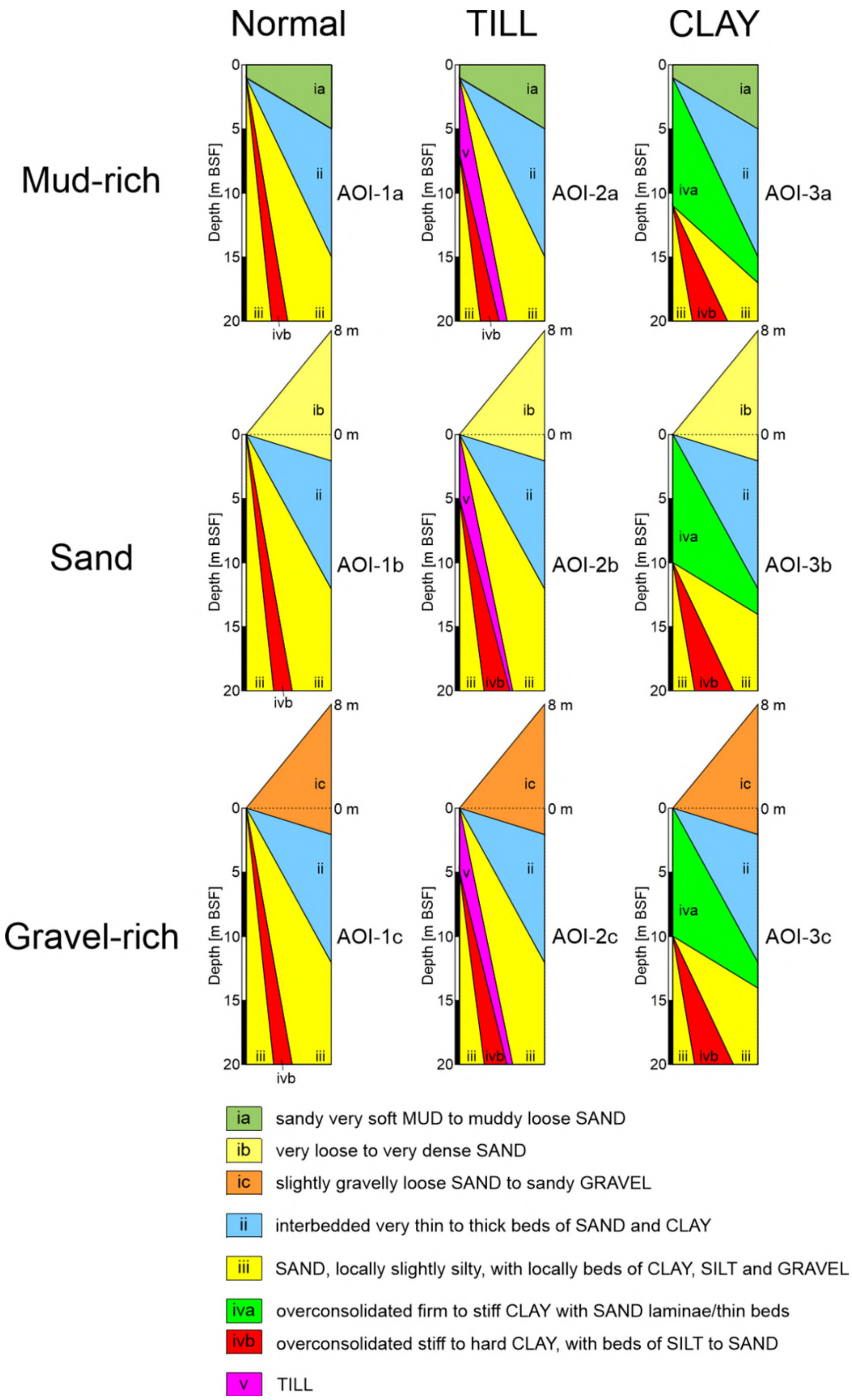

Figure 4.35: Predicted soil profiles across the AOI

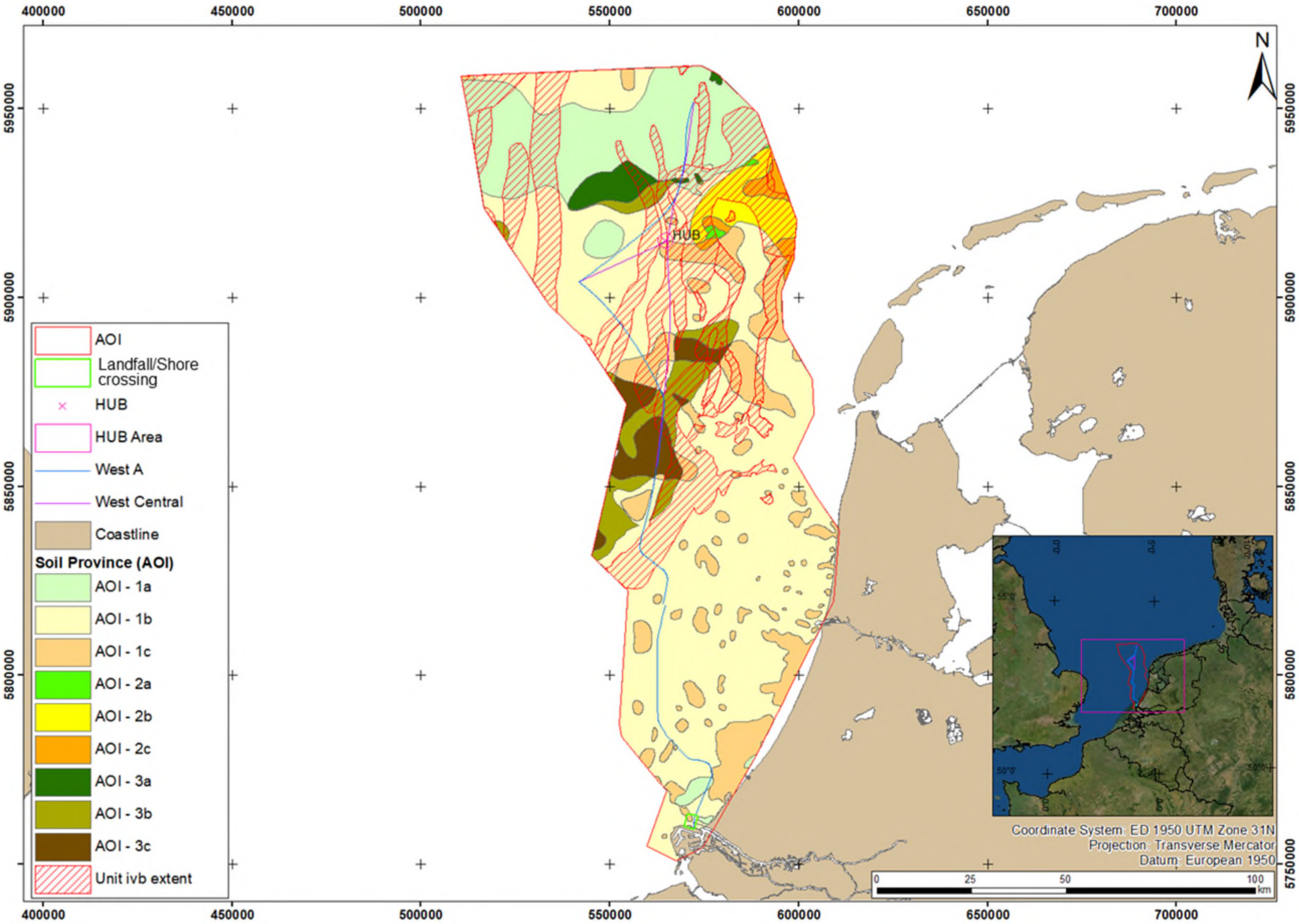

Figure 4.36: Soil province map across the AOI

4.5.2 Landfall/Shore Crossing Area

4.5.2.1 Predicted Soil Units and Geotechnical Parameters

Five soil units were predicted to be present in the Landfall/Shore crossing Area and within the depth of interest (40 m to 50 m BSF). Table 4.11 presents the predicted soil units and the associated preliminary geotechnical parameters defined for each unit.

Geotechnical descriptions and soil units are the same as those defined for the AOI (Section 4.5.1.1), with the addition of unit ‘ds’ corresponding to disturbed soil/recent accumulation consisting of very soft CLAY or very loose to medium dense SAND. This unit is limited to the Maasmond Kanaal and probably comprises residues of dredging operations.

Unit iii also includes the Early Pleistocene Winterton Shoal/IJmuiden Ground Formations, which are lateral equivalents of the Yarmouth Road Formation.

GRAVEL beds may be present locally in the subsurface. In the coastal zones there are gravel/cobbles/boulders accumulations (as part of rock dumps of the flood-defence structure). These deposits extent laterally from metres to several tens of metres from the shoreline. The thickness is unknown but may be up to several metres. No boulders were encountered in the subsurface, however presence of boulders cannot be entirely excluded (see also Section 4.4.2).

Geotechnical parameter values and thickness ranges are specific to the Landfall/Shore crossing Area and were derived from geotechnical Fugro experience in the Landfall/Shore crossing Area.

Fugro recommends acquisition and interpretation of site-specific geophysical data (sub-bottom profiler (SBP), MBES and SSS) across the Landfall/Shore crossing Area in order to confirm or refine the pipeline routing. Once the final routing is agreed, a site-specific survey should be planned depending on the expected soil variability. This would then allow to confirm and further refine geotechnical parameters and soil unit vertical and lateral variability. An update of the ground model may be subsequently considered based on any new findings.

Table 4.11: Predicted preliminary geotechnical parameters for the Landfall/Shore crossing Area

Stratigraphic Unit (Geological Formation)	Soil Unit	Description	Soil Type	Thickness [m]	γ' [kN/m^3]	D_r [%]	s_u [kPa]	S_t [-]	Φ' [°]	q_c [MPa]
Disturbed Soil	**ds**	very soft CLAY	CLAY	0 to 5	15 to 19	N/A	< 2	-	N/A	< 2
		very loose to medium dense SAND	SAND			<35 to 65		N/A	25 to 35	2 to 10
Surficial Sediments (Southern Bight and Urania)	**ib**	very loose to very dense SAND	SAND	0 to 5	18 to 19.5	<35 to 100		N/A	25 to 35	2 to 20
	ic	slightly gravelly loose SAND to sandy GRAVEL	SAND	0 to 5	18 to 19	<35		N/A	25 to 35	4 to 10
Naaldwijk	**ii**	interbedded very thin to thick beds of CLAY, SAND and locally PEAT	CLAY	0 to 13	18 to 19.5	N/A	2 to 100	1 to 3	N/A	1 to 4
			SAND			25 to 100		N/A	25 to 45	2 to 20
Kreftenheye,	**iii**	Dense to very dense SAND	SAND	10-25	18.5 to 20.5	80 to >100		N/A	25 to 45	20 to 60
Winterton Shoal / IJmuiden Ver		SAND, silty, with locally beds of CLAY and/or SILT	CLAY	>40		N/A	100 to 300	~1 to 3	N/A	2 to 6
			SAND			35 to >100		N/A	25 to 45	15 to 90

Notes:
N/A = not applicable
- = no information available
γ' = total unit weight
s_u = undrained shear strength
S_t = sensitivity
Dr = relative density
Φ' = drained peak effective friction angle
q_c = CPT cone resistance

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4.5.2.2 Geotechnical Profiles

Four soil profiles were drawn for the Landfall/Shore crossing Area based on available data. These soil profiles describe the possible lateral and vertical variability of soil units predicted to be present to 40 m BSF across the Landfall/Shore crossing Area.

Soil profiles are presented in Figure 4.37. They were designed to discriminate areas with different surficial sediment types (GRAVEL and MUD above SAND), as well as areas with anthropogenic reworked material. Profile 1 was subdivided to discriminate areas where unit ii may be thicker (up to 14 m) due to the presence of paleo-channels from the Early Holocene.

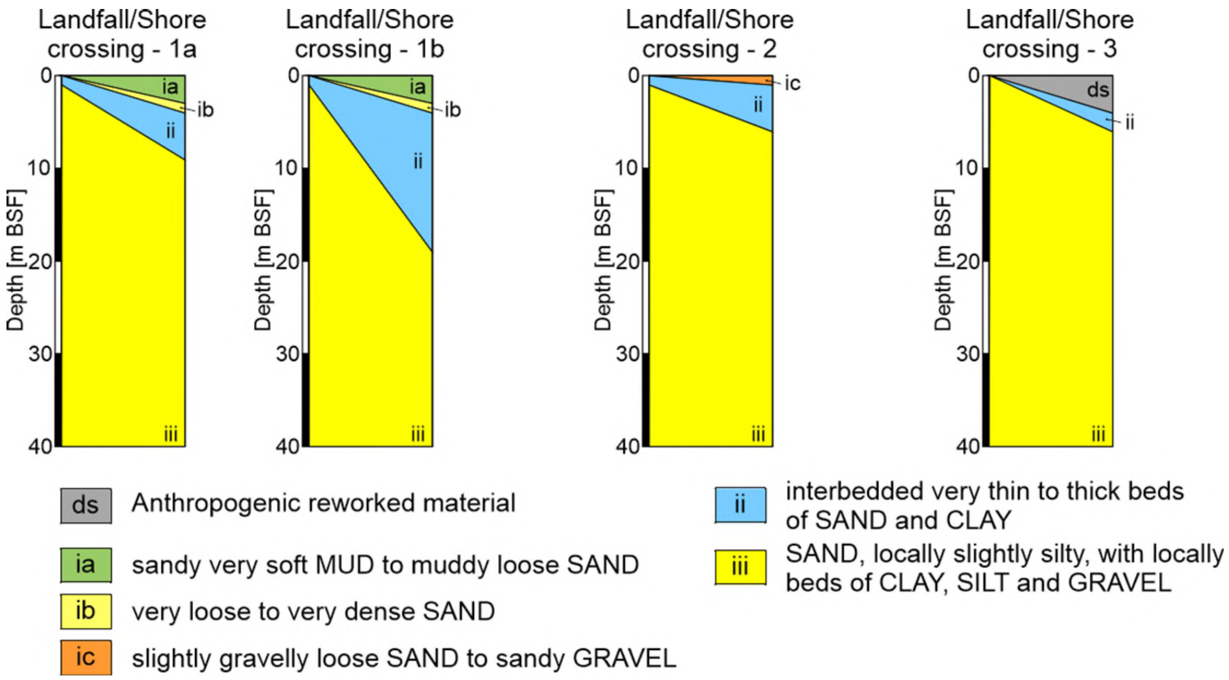

Figure 4.37: Predicted soil profiles across the Landfall/Shore crossing Area

4.5.2.3 Soil Provinces

A soil province map presented in Figure 4.38 was generated for the entire Landfall/Shore crossing Area to depict the spatial extent of each predicted soil profile (Figure 4.37). The soil province map allows the lateral variability in soil units to be better understood and pictured.

Areas covered by each soil province are given in Table 4.12 along with the percentage of the total Landfall/Shore crossing Area they represent. From this table, it appears that 38% of the area is characterised by mud-rich and muddy SAND surficial sediments (units ia and ib) with thin unit ii. 25% of the area, to the north-eastern corner, is expected to be covered by GRAVEL-rich sediments (unit ic). 21% of the area corresponds to the Maasmond Kanaal, potentially covered by disturbed/reworked deposits. Finally, only 4% of the area corresponds to the potential extent of paleo-channels (Naaldwijk Formation) based on geological maps (Figure 4.34).

About 12% of the Landfall/Shore crossing Area is covered by land and is not covered by any soil province.

Table 4.12: Area covered by each soil province across the Landfall/Shore crossing Area

Soil Province	Area (km^2)	% of AOI
Landfall/Shore crossing - 1a	3.8	38.3
Landfall/Shore crossing - 1b	0.4	4.4
Landfall/Shore crossing - 2	2.5	24.9
Landfall/Shore crossing - 3	2.1	20.8
Notes: 11.6% of the Landfall/Shore crossing Area is covered by land		

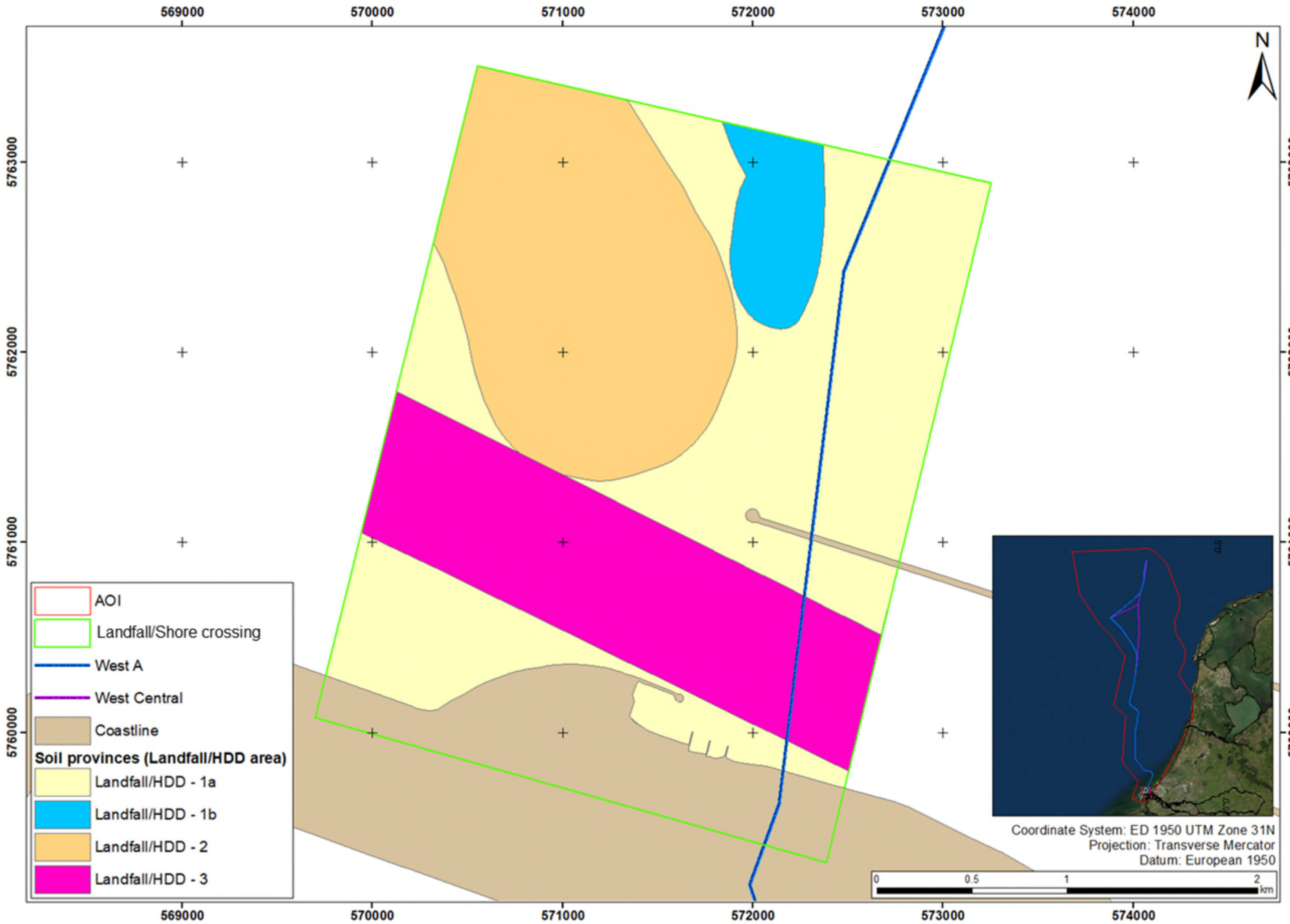

Figure 4.38: Soil province map across the Landfall/Shore crossing Area

4.5.3 Offshore Distribution HUB Area

4.5.3.1 Predicted Soil Units and Geotechnical Parameters

Five soil units were predicted to be present across the Offshore Distribution HUB Area and within the depth of interest (e.g., 100 m BSF). Table 4.13 presents the predicted soil units and the associated preliminary geotechnical parameters defined for each unit.

Geotechnical descriptions and soil units are the same as those defined for the AOI (Section 4.5.1.1).

Geotechnical parameters are the same as those presented for the entire AOI (Section 4.5.1.1). Fugro experience does not cover the Offshore Distribution HUB Area specifically, but the geotechnical parameter ranges for the AOI are likely to apply for the Offshore Distribution HUB Area to a depth of 100 m BSF. Expected thicknesses were adapted based on information from publicly available data and three geotechnical boreholes (Fugro experience) within 3 km of the Offshore Distribution HUB Area boundary.

Fugro recommends acquisition and interpretation of site-specific geophysical data (SBP, MBES and SSS) across the Offshore Distribution HUB Area to confirm or refine the pipeline routing. Once the final routing is agreed, a site-specific survey should be planned depending on the expected soil variability. This would then allow to confirm and further refine geotechnical parameters and soil unit vertical and lateral variability. An update of the ground model may be subsequently considered based on any new findings.

Table 4.13: Predicted preliminary geotechnical parameters for the Offshore Distribution HUB Area

Stratigraphic Unit (Geological Formation)	Soil Unit	Description	Soil Type	Thickness [m]	γ′ [kN/m³]	D_r [%]	s_u [kPa]	S_t [-]	Φ′ [°]	q_c [MPa]
Surficial Sediments (Southern Bight and Urania)	**ib**	very loose to very dense SAND	SAND	4 to 9	18 to 19.5	<35 to >100		N/A	25 to 45	2 to 20
	ic	slightly gravelly loose SAND to sandy GRAVEL	SAND	4 to 9	19 to 20	<35		N/A	25 to 30	4 to 20
Naaldwijk	**ii**	interbedded very thin to thick beds of CLAY and SAND	CLAY	0 to 1	18 to 19.5	N/A	20 to 100	1 to 3	N/A	1 to 3
			SAND			25 to 85		N/A	25 to 35	2 to 10
Boxtel (Twente) Kreftenheye, Eem Drachten (Tea Kettle Hole) Egmond Ground Yarmouth Roads	**iii**	SAND, locally slightly silty, with locally beds of CLAY, SILT, GRAVEL and PEAT	CLAY	40 to >100	18.5 to 20.5	N/A	100 to 200	~1 to 3	N/A	2 to 4
			SAND			65 to >100		N/A	30 to 45	15 to 90
Drenthe (Cleaver Bank) Peelo (Swarte Bank)	**ivb**	overconsolidated stiff to hard CLAY, with beds of SILT to SAND	CLAY	0 to 30	19.5 to 21	N/A	200 to 400	~1 to 2	N/A	4 to 8
			SAND			65 to >100		N/A	35 to 45	15 to 90

Notes:
N/A = not applicable
- = no information available
γ′ = total unit weight
s_u = undrained shear strength
S_t = sensitivity
Dr = relative density
Φ′ = drained peak effective friction angle
q_c = CPT cone resistance

4.5.3.2 Geotechnical Profiles

Four soil profiles were drawn for the Offshore Distribution HUB Area based on available data. These soil profiles describe the possible lateral and vertical variability of soil units predicted to be present to 100 m BSF across the Offshore Distribution HUB Area.

Soil profiles are presented in Figure 4.39. They were designed to discriminate areas with overconsolidated stiff to hard CLAY (unit ivb) at depth from the Peelo Formation. A subdivision was made to differentiate areas where SAND (ib) is expected at the seafloor from areas where GRAVEL-rich sediments (unit ic) are mapped.

The Offshore Distribution HUB Area is localised in-between two sand banks and therefore positive features of 1 m have been drawn to encompass the presence of the flanks of these bedforms.

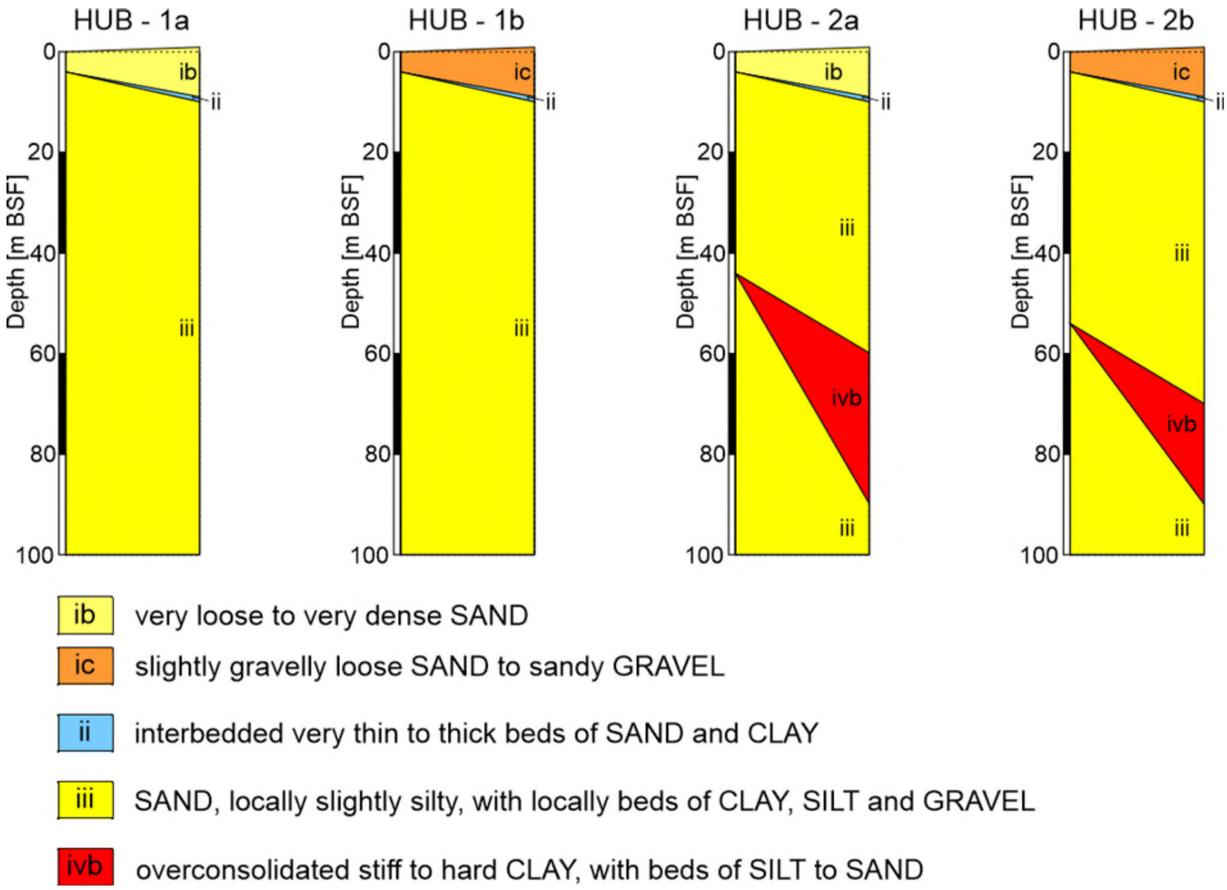

Figure 4.39: Predicted soil profiles across the Offshore Distribution HUB Area

4.5.3.3 Soil Provinces

A soil province map presented in Figure 4.40 was generated for the entire Offshore Distribution HUB Area to depict the spatial extent of each predicted soil profiles (Figure 4.37). The soil province map allows the lateral variability in soil units to be better understood and pictured.

Areas covered by each soil province are given in Table 4.14 along with the percentage of the total Offshore Distribution HUB Area they represent. From this table, it appears that 54% of the area is characterised by the potential presence of stiff to hard CLAY (unit ivb) within the depth of interest. This surface is divided within two distinct areas covering the western and eastern sides of the Offshore Distribution HUB Area. The areas correspond to two distinct paleo-channels from the Peelo Formation orientated north–south. More than 60% of the area is expected to be covered by SAND, while the southern part (40%) is expected to be composed of GRAVEL-rich material.

Table 4.14: Area covered by each soil province across the Offshore Distribution HUB Area

Soil Province	Area (km^2)	% of AOI
HUB - 1a	3.6	28
HUB - 1b	2.3	18
HUB – 2a	4.4	35
HUB – 2b	2.3	19

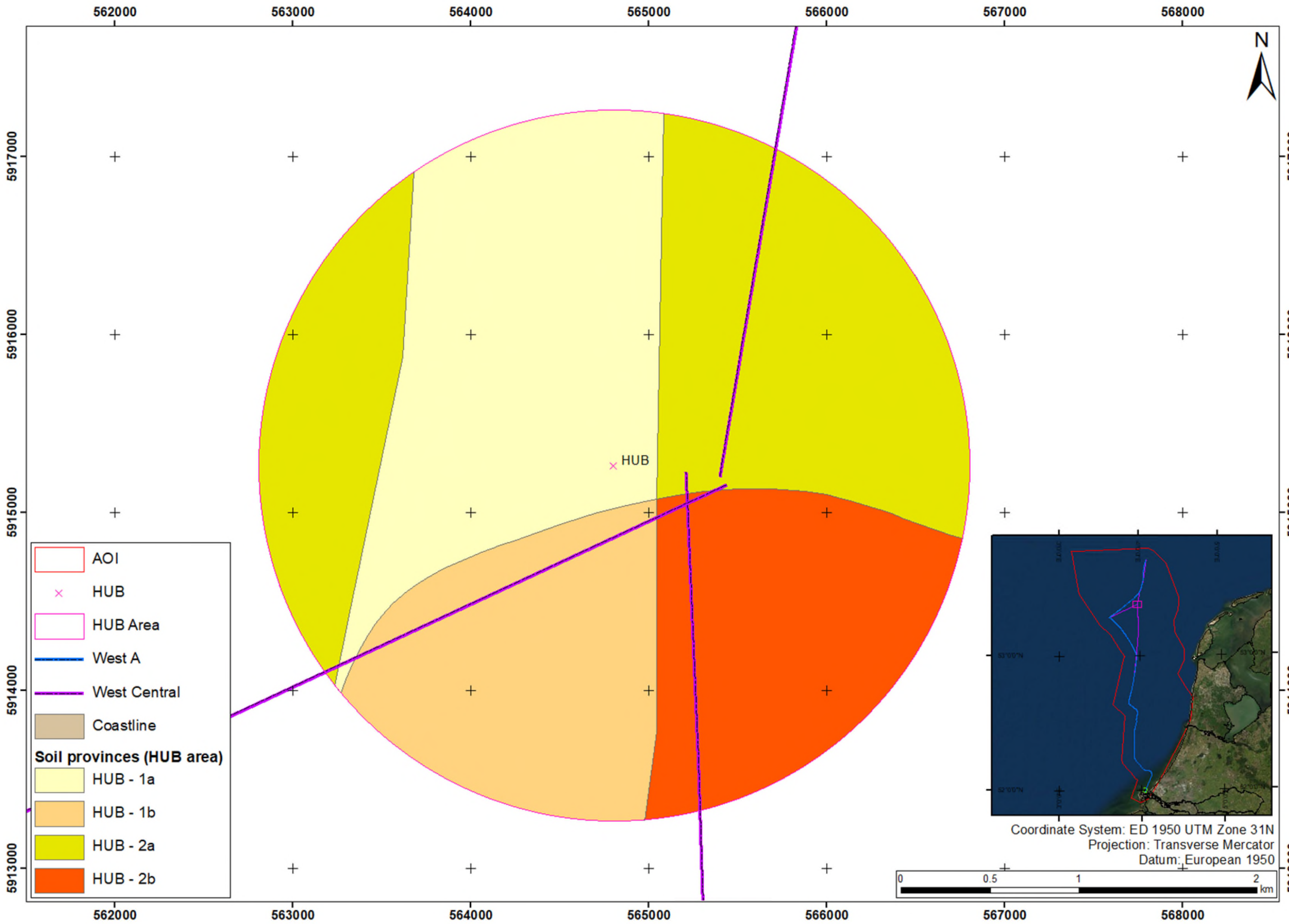

Figure 4.40: Soil province map across the Offshore Distribution HUB Area

5. Geohazards, Hazards and Site Constraints

5.1 General

Table 5.1 presents potential and identified geohazards and soil constraints for pipeline and other offshore infrastructures as well as for their installation. The information provides screening-level hazard characterisation (i.e. indicative) and may not be complete or comprehensive. Mitigation measures are proposed to reduce associated risks.

Table 5.2 presents potential and identified man-made related hazards, obstructions and site constraints for a pipeline and other offshore infrastructures. The information provides screening-level hazard characterisation (i.e. indicative) and may not be complete or comprehensive. Mitigation measures are proposed to reduce associated risks.

Table 5.1: Summary of potential and identified geohazards and soil constraints across the AOI

Constraint / Geohazard	Location / Distribution	Impact on Structure	Possible Mitigation
(Migrating) bedforms	Entire AOI, except northern part (Zone 3)	• Exposure or burial of structure; leading to snagging from trawling or anchoring, scour affecting structure stability • Spanning leading to uneven support of structure, critical stresses on structure • Temperature variations may lead to expansion / contraction of pipeline (increased susceptibility to walking in areas of exposure)	• Detailed mapping of bedforms through MBES data acquisition along pipeline route and within specific areas (Landfall/Shore crossing, Offshore Distribution HUB Areas) • Sediment mobility assessment, morphodynamic assessment and specific site survey works in areas of high risk • Meteocean site-specific desktop study to precisely assess migration/stability of bedforms • Avoid where possible areas with sand waves • Trenching to a certain depth (depending on bedform amplitude)
Storm events / wave action	Entire AOI. Probably lower impact within the areas deeper than 30 m LAT (northern AOI)	• Dynamic and cyclic loading • Burial or exposure, leading to loss of support, instability and damage	• Meteocean site-specific desktop study • Scouring site-specific study • Trenching to a certain depth (depending on estimated wave action depth)
Steep slopes / irregular topography	Flanks of Maasmond Kanaal Steep slopes also associated with bedforms, seafloor objects and dredging areas	• Uneven support of structure • Critical stresses on structure • Non-uniform penetration	• Avoidance • Trenching within bedforms

Constraint / Geohazard	Location / Distribution	Impact on Structure	Possible Mitigation
		• Slope failure • Lateral displacement of structure • Trenching difficulties	
Slumping	Northern flank of Maasmond Kanaal	• Slope instability and failure • Critical stresses • Scour and spanning or burial and loading • Rupture or failure of pipeline	HDD solution
Very soft clays	In Maasmond Kanaal and locally across the entire AOI, especially in paleo-channels	• Potential plough sinkage • Non-uniform penetration	• Jetting to install pipeline in soft sediments • Geophysical survey data to perform precise mapping of paleo-channels using UHR seismic or SBP data
Interbedded sand and clay sediments	Offshore Distribution HUB Area	Punch-through risk for foundation	Geotechnical survey at Offshore Distribution HUB location to refine geotechnical unitisation and parameters
Very dense sand	Entire AOI	• Trenching difficulties • Early refusal/limited penetration with plough	Selection of tools for pipeline emplacement suitable to deal with geotechnical properties
Gravel, cobbles and / or boulders	Localised areas across the AOI, particularly close to shore in the Landfall/Shore Crossing Area (in rock dumps of the flood-defence structure) and in deposits of Drente Formation	• Obstruction, trenching difficulties, possible early refusal or damage to structure • Gravel layers may impact HDD operations	• Detailed mapping of seafloor sediments along pipeline routing and across Offshore Distribution HUB area (MBES, SSS) • Detailed mapping of boulders expected at depth in UHR seismic and SBP data • Avoid areas with boulders
Peat / organic material	Locally present across AOI	• High compressibility, non-uniform support • chemical reaction between soil and steel • shallow gas	Geophysical and geotechnical survey in order to map and avoid areas where peat is expected
Pockmarks / shallow gas (peat)	Locally present in the Landfall/Shore crossing Area. Can be locally present in the AOI	• Laterally variable soil strength, steel corrosion, spanning of pipeline • Masking of acoustic signal • Risk of blowout and gas release during drilling and piling operations	• Geophysical survey data to detect shallow gas accumulations within seismic data • Map related seafloor features (pockmarks) • Avoid areas with shallow gas or identified markers (pockmarks)

Constraint / Geohazard	Location / Distribution	Impact on Structure	Possible Mitigation
Glacial TILL / boulder clay	Present locally in NE of AOI (Gieten Member)	• Spatially variable soil conditions • Heterogenous soil • Cobbles and boulders leading to challenging installation conditions	• Geophysical survey data to perform precise mapping and identification of these type of deposits using UHR seismic or SBP data • Geotechnical data collection to characterise conditions • Selection of pipeline emplacement method that can cope with variable soil conditions
Glaciotectonic deformation features	Present locally in NE and centre of AOI, related to the Gieten Member and Drachten Formation	• Variable soil conditions • Lower lateral resistance	• Geophysical survey data to perform precise mapping and identification of these type of deposits using UHR seismic or SBP data • Geotechnical data collection to characterise conditions
Regional subsidence / (historic) oil and gas extraction	Entire AOI	• Time-dependent reduction of freeboard of pipeline • Damage to structure	Monitoring during ongoing pipeline inspection surveys

Table 5.2: Summary of identified man-made obstructions and constraints across the AOI

Constraint / hazard	Location / Distribution	Impact on Structure	Possible Mitigation
Existing and planned future structures	Across AOI	• Obstruction • Potentially disturbed ground • Potential interruption in hydraulic flow regime affecting scour and soil deposition processes	• Relocation • Design pipeline/cable crossing • Collection of specific geophysical survey data at crossing locations
Rock dump / fill	Shorelines in the Landfall/Shore crossing Area related to coastal defence structures	• Disturbed soil / variable soil conditions • Potential interruption in hydraulic flow regime affecting scour and soil deposition processes • Pipeline abrasion • Installation problems	• Identify and map • Avoidance and relocation
Artificial soil / contaminated soil	Landfall/Shore crossing Area and dumping areas	• Variable soil conditions • Contamination	Avoidance and relocation
Wellheads	Across AOI	• Obstruction • Potentially pressurised shallow gas in soil	Avoidance and relocation

Unexploded ordnance (UXO)	See Appendix C	• Obstruction • Damage to structures • Uneven seafloor, disturbed soil	• UXO precise identification along pipeline route via magnetometer survey • UXO hazard risk assessment • Relocation • UXO clearance processes
Shipwrecks / dropped objects	See Appendix B and Appendix C	Obstruction	• Archaeological study and identification along pipeline route • Relocation • Investigate and remove if required
Potential archaeological targets	See Appendix B	• No / limited access • Project delay	• Archaeological study and identification along pipeline route • Relocation • Investigate and remove if required
Restricted areas (nature reserve, military exercise)	Across AOI	No / limited access	• Relocation • Permission requirements
Dredging and dumping areas	Across AOI	• Uneven seafloor • Disturbed soil • Variable soil conditions • Lateral displacement • No / limited access	• Damage to structures • Relocation • Permission requirements
Fishing activity (anchor and / or trawl scars)	Throughout most of AOI	• Disturbed soil / variable soil conditions • Entanglement of fishing gear • Damage to structure and offshore equipment • Lateral displacement	• Clearance operations before any site surveys, fishing liaison officer during survey works • Trenching to avoid damage from anchors or trawls
High level of shipping activity and anchorage areas	• Near Rotterdam and IJmuiden harbours • Navigation Channels	• Entanglement of anchor(line) • Damage to structure • Lateral displacement	• Clearance operations before any site surveys • Trenching to avoid damage from anchors or trawls

Figure 5.1 displays the extent of some mapped and identified soil constraints and geohazards. These includes:

- Glacial TILL;
- Areas with expected boulders;
- Areas with very soft surficial sediments;
- Expected paleo-channels;
- Extent of unit ivb, composed of stiff to hard CLAY.

Bedforms are mapped and highlighted as part of Figure 4.17, while steep slopes are highlighted in Figure 4.8 to Figure 4.16.

Most of the identified man-made seafloor obstructions and constraints are listed and mapped within Sections 4.1 and 4.2.4 of the report. More details on UXO and archaeological related features are provided within specific reports (see Appendix B and Appendix C).

Soils containing the mineral glauconite and/or carbonate soils are not expected to be present in the AOI (including the Landfall/Shore crossing Area) within the depth of interest based on available data.

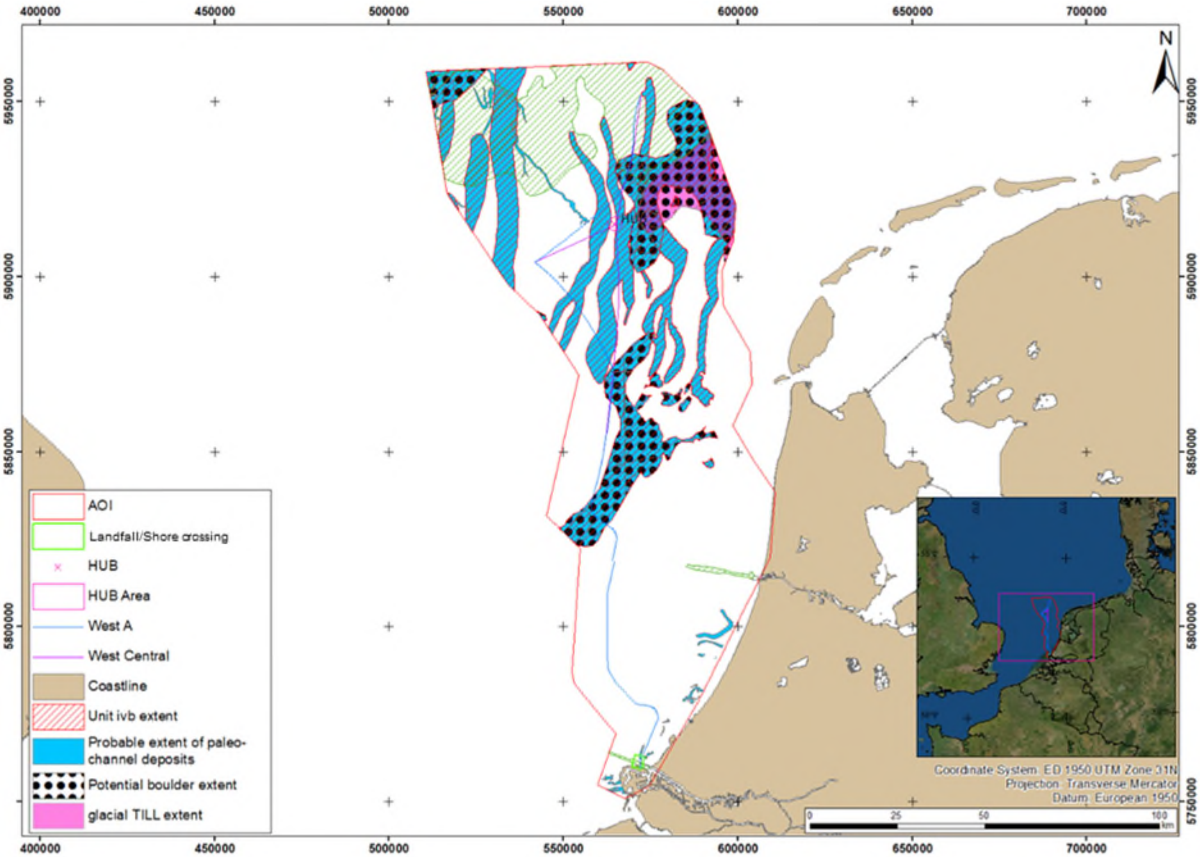

Figure 5.1: Map of identified soil constraints and potential geohazards across the AOI

5.2 Seismicity

Natural seismicity is mainly restricted to the southern (onshore) part of the Netherlands, where earthquakes with magnitudes of 2.5 to 6.0 are possible. The AOI lies within a tectonic region known as the West Netherlands Basin, which has been seismically quiet since the Neogene (Deltares, 2017).

The extraction of natural gas is known to produce induced seismicity. A total of 186 oil and gas fields are located in the AOI. Several induced seismic events related to these fields were recorded. These earthquakes had a magnitude between 2 and 4 (Deltares, 2017; Arcadis, 2018).

It is recommended that a probabilistic seismic hazard assessment is performed for the gas fields that are within a 5 km radius of the Landfall/Shore crossing Area and Offshore Distribution HUB Area to confirm the actual seismic hazard.

6. Conclusions and Recommendations

6.1 Conclusions

This desktop study aimed at characterising the soil conditions based on available public data and Fugro experience over an area of 11355 km² within the southern North Sea, Dutch sector. The ultimate purpose of the report is to provide information to help TotalEnergies in decision making regarding the ARAMIS Pipeline routing and provide recommendations regarding future site-specific surveys.

Based on available data, three preliminary geotechnical ground models focusing on three different areas are provided. These allow to picture the soil conditions and vertical and lateral variability to depth of interest. Geotechnical parameters were derived based on Fugro experience across the southern North Sea. The data review and analysis also allowed to list potential (geo)hazards, soil and anthropogenic constraints and man-made obstructions within the AOI.

The results provided within this desktop study are dependent on the available data and on data quality. Due to the large surface covered by the AOI, approximations and simplifications were made to create a comprehensive ground model allowing to capture the expected range of soil conditions. Variability within the defined soil units is expected, arising from varying depositional environments captured within independent units.

Site-specific data acquisition should be considered to refine and confirm the findings of the present study, once a more precise pipeline routing has been decided. Some recommendations are provided hereafter to help reducing uncertainties and mitigate identified (geo)hazards in the AOI.

6.2 Recommendations

Possible mitigation of identified or potential (geo)hazards and anthropogenic or soil constraints, including relocation of pipeline, engineering solutions or avoidance of certain features are already detailed in Table 5.1 and Table 5.2. These elements should help TotalEnergies in the decision making for the final pipeline route.

To better capture site conditions and soil variability along the future pipeline route and at specific areas (Offshore Distribution HUB and Landfall/Shore crossing Areas), several recommendations on further specific studies, geophysical and geotechnical site surveys are listed in this section. Most of these recommendations, in particular geophysical and geotechnical surveys will have to be considered once the pipeline route is decided.

6.2.1 Further Specific Studies

To better characterise some elements that are highlighted or identified within the present DTS, Fugro recommends performing specific studies including, but not limited to:

- Metocean site-specific desktop study to better understand mobility of bedforms and sediments due to currents, waves and tides;
- A sediment mobility assessment and study based on bathymetric data acquired at different dates across the area. This could be accompanied by specific site surveys in areas of identified high risks;
- UXO risk assessment study as defined in the conclusions of the UXO historical DTS (Appendix C) allowing to set fitting mitigation strategies.

6.2.2 Geophysical Site Surveys

Once the pipeline route corridor is agreed on, a number of geophysical methods should be considered to refine the mapping and identification of seafloor features and better define the variability of sub-seafloor soil units. They will in turn allow to better mitigate soil constraints and (geo)hazard-relatedrisks. Data acquired during these geophysical site surveys may include:

- MBES data to be acquired along the pipeline route with a typical corridor of 2 km allowing any re-routing if avoidance of any identified feature is required. MBES data will provide a high-resolution bathymetry along the route allowing to compute precise slope maps. Reflectivity may also be acquired during MBES operations giving a detailed representation of the seafloor rugosity. MBES should also be acquired around the planned Offshore Distribution HUB Area;
- SSS data to be acquired along the pipeline corridor with a typical corridor of 2 km and around the Offshore Distribution HUB location. SSS data helps identifying seafloor features and sediment types;
- SBP data to be acquired along the pipeline corridor. This will better characterise the sub-seafloor variability at the pipeline location, helping in the planning of the geotechnical site survey. At the Offshore Distribution HUB location and along the planned Landfall/Shore crossing Area, SBP grids should be acquired before any operations to identify potential sub-seafloor soil constraints and estimate soil variability. SBP can also provide valuable information when identifying preserved paleo-landscapes and potential prehistorical archaeological sites (Appendix B);
- UHR seismic data can be planned locally where specific designs are needed (such as HDD, piling at the Offshore Distribution HUB Area, trenching, tunnelling). UHR seismic data will provide a better penetration within deeper dense/hard units;
- A magnetometer survey must be performed along the entire pipeline corridor to identify any wrecks and UXOs at or close to the seafloor.

6.2.3 Geotechnical Site Surveys

Soil sampling and in situ testing (CPTs) are paramount to refine the geotechnical soil conditions and variability with depth. A geotechnical survey should be designed after geophysical data are acquired and interpreted to optimise the sampling and locations (both distribution and quantities). Where variable conditions or specific risks are identified, more locations may be required to better constrain them. Where more homogeneous conditions are expected, less locations could be planned. Geotechnical surveys should include:

- Sediment sampling to identify, log and test soil types. Sampling methods include gravity corers, box corers, grab samples and vibrocorers. A variety of laboratory testing can be considered, including geological testing (Multi-Sensor Core Logging, mineralogy, or dating) or geotechnical testing (water content, P-wave velocity, electrical resistivity, thermal conductivity, shear vane and oedometer tests). Specific geotechnical testing could be considered in order to measure the clay sensitivity;
- CPT allows to capture the site-specific soil conditions through a variety of measurements such as cone resistance and sleeve friction. It allows to identify soil units at depth and measure in situ mechanical properties such as sediment undrained shear strength (s_u) for clay or relative density for sand.

Along the pipeline route the depth of geotechnical locations can be limited to the first 5 m to 6 m BSF, while geotechnical locations within the Landfall/Shore crossing Area and at the Offshore Distribution HUB location should have greater penetration depths. For these deeper locations Fugro recommends downhole sampling and testing from a dedicated drilling platform (e.g. geotechnical drilling vessel or jack-up platform).

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Appendix A

Guidelines on Use of Report

FUGRO

A.1 Guidelines on Use of Report

This report (the “Report”) was prepared as part of the services (the “Services”) provided by Fugro France SAS (“Fugro”) for its client (the “Client”) under the terms of the relevant contract between the two parties (the “Contract”). The Services were performed by Fugro based on requirements of the Client set out in the Contract or otherwise made known by the Client to Fugro at the time. Fugro’s obligations and liabilities to the Client or any other party in respect of the Services and this Report are limited in time and value as defined in Contract (or in the absence of any express provision in the Contract as implied by the law of the Contract) and Fugro provides no other representation or warranty whether express or implied, in relation to the Services or for the use of this Report for any other purpose. Furthermore, Fugro has no obligation to update or revise this Report based on changes in conditions or information which emerge following issue of this Report unless expressly required by the Contract.
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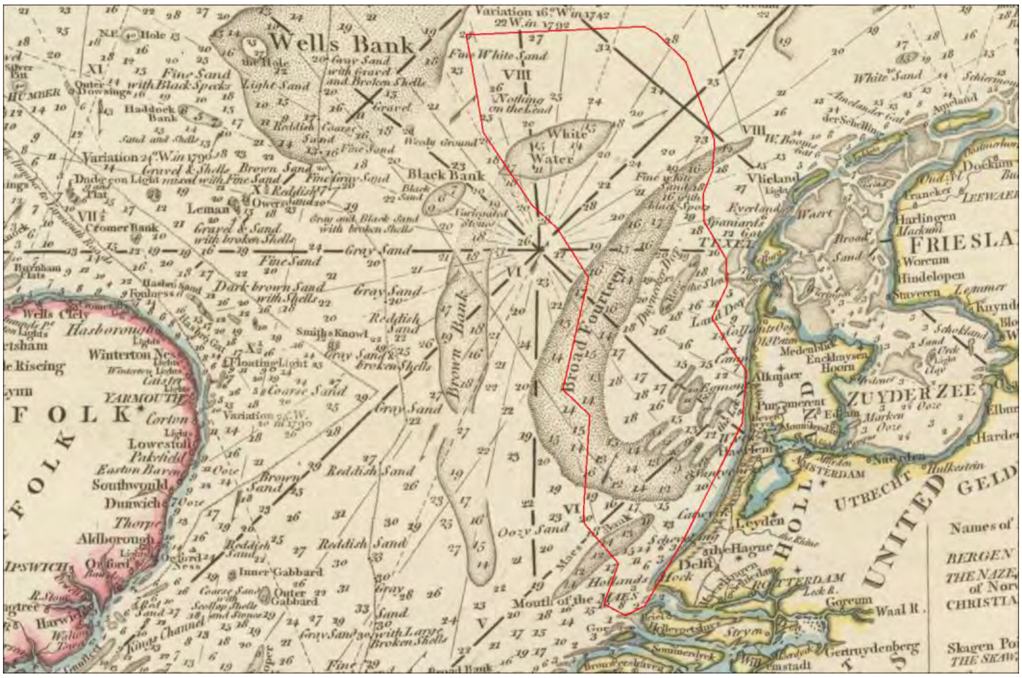
Appendix B

Archaeological Desktop Study

Archaeological Desk Study
Area of interests
Aramis pipelines



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Contents

Table 1. Dutch archaeological periods

Period	Time in Years				
Post-medieval / Modern Times	1500	A.D.	-	Present	
Late medieval period	1050	A.D.	-	1500	A.D.
Early medieval period	450	A.D.	-	1050	A.D.
Roman Times	12	B.C.	-	450	A.D.
Iron Age	800	B.C.	-	12	B.C.
Bronze Age	2000	B.C.	-	800	B.C.
Neolithic (New Stone Age)	5300	B.C.	-	2000	B.C.
Mesolithic (Stone Age)	8800	B.C.	-	4900	B.C.
Palaeolithic (Early Stone Age)	300.000	B.C.	-	8800	B.C.

Table 2. Administrative details

Location:	North Sea		
Toponym:	Aramis pipelines		
Chart:	1801-01		
Coordinates Geodetic datum: ED50 Projection: UTM31N	Centre:	E 560722	N 5856233
	NW	E 510577	N 5961562
	NE	E 610866	N 5961562
	SW	E 510577	N 5750904
	SE	E 610866	N 5750904
Depth (LAT):	0 to 46.1 meter, average 26.7 meter		
Surface investigation area	11,355 km^2		
Environment:	Tidal currents, salt water		
Area use:	Shipping , fishing, wind farm zones		
Area administrator:	Rijkswaterstaat Zee en Delta Municipality of Rotterdam		
ARCHIS number:	5144645100		
Periplus-project reference:	21A036-01		
Period of execution	January 2022		

Samenvatting (in Dutch)

Periplus Archeomare heeft in opdracht van Fugro een archeologisch bureauonderzoek uitgevoerd naar het plangebied voor de Aramis-leidingroutes. Het gebied van 11.355 km2 ligt in de Noordzee, voor de kust van Nederland.

Door de aanleg van de leidingen kunnen eventueel aanwezige archeologische resten in het gebied worden bedreigd. Volgens de Erfgoedwet (2016) is een wettelijke verplichting om archeologisch onderzoek te doen om archeologische resten te beschermen. Dit archeologische bureauonderzoek is de eerste stap in het archeologisch proces om vast te stellen of archeologische resten aanwezig zijn en of deze resten kunnen worden aangetast door de aanleg van de geplande pijpleidingen. De resultaten zijn hieronder samengevat.

Het gebied heeft hoge verwachtingen voor de aanwezigheid van (overblijfselen van) scheepswrakken en vliegtuigwrakken uit de Tweede Wereldoorlog. Intacte prehistorische landschappen en verwante in situ overblijfselen van paleolithische en vroeg-mesolithische campings en opgravingen kunnen op bepaalde plaatsen bewaard zijn gebleven. De voorlopige pijpleidingroutes zijn nog niet onderzocht door gedetailleerde geofysische onderzoeken. Deze gebieden bevatten mogelijk meer onontdekte scheepswrakken of overblijfselen van scheepswrakken dan nu bekend is.

Op dit moment is er nog weinig bekend over de integriteit van het Pleistoceen landschap. Door middel van seismiek kunnen hierin de voorkomende geologische eenheden (zowel horizontaal als verticaal) en archeologische niveaus in kaart worden gebracht. Het karakter van laaggrenzen (erosief of niet-erosief) kan worden geïnterpreteerd. Het is echter onwaarschijnlijk dat archeologische overblijfselen van paleolithische en mesolithische nederzettingsresten op basis van geofysisch en geotechnisch onderzoek met voldoende zekerheid kunnen worden geïdentificeerd om beperkingen op te leggen aan de aanleg van pijpleidingen. In dit stadium moet daarom niet worden geconcentreerd op het opsporen van prehistorische nederzettingsresten, maar op een pragmatische inzet geofysische technieken inzetten om een beter inzicht te krijgen in (de integriteit van) het Pleistoceen landschap. De verkregen inzichten zullen worden gebruikt om a) het archeologische verwachtingsmodel te verfijnen en b) gebieden met een hoge verwachting voor in situ prehistorische overblijfselen toe te wijzen.

Conform de AMZ-cyclus wordt geadviseerd om een inventariserend veldonderzoek uit te voeren om de archeologische verwachting. In het algemeen bestaan vergelijkbare onderzoeken uit een geofysisch onderzoek met side scan sonar, magnetometer en subbottom profiler en een geotechnisch onderzoek. De resulterende gegevens moeten worden geanalyseerd nadat de algemene verwerking, interpretatie en rapportage door de onderzoeksaannemer is uitgevoerd.

De archeologische beoordeling van de gegevens dient te worden uitgevoerd door een geofysisch specialist (KNA prospector Waterbodems). De datakwaliteit van de onderzoeken moet aansluiten bij de eisen voor deze archeologische beoordeling. Om de afstemming tussen het geofysisch onderzoek en de vereiste kwaliteit voor deze beoordeling te waarborgen, dient een Programma van Eisen opgesteld te worden conform de KNA (Kwaliteitsnorm Nederlandse Archeologie 4.1) dat door de bevoegde autoriteit wordt beoordeeld en goedgekeurd.

Summary

Periplus Archeomare was assigned by Fugro to conduct an archaeological desk study of the area of interest for the Aramis pipeline routes. The area of interest of 11.355 km^2 is located in the North Sea, off the coast of the Netherlands.

The installation of the pipelines may affect archaeological remains in the area, if present. According to the Law on Archaeological Heritage (Dutch: Erfgoedwet 2016) there is a statutory obligation to conduct archaeological research in order to protect the remains. This archaeological desk study is the first step in the archaeological process aiming to establish whether archaeological remains are, or are likely to be, present, and whether these remains could be effected by the development of the planned pipelines. The results are summarized below.

The area of interest has a high expectation for the presence of (remains of) ship wrecks and WWII plane wrecks. Intact prehistoric landscapes and related *in situ* remains of Palaeolithic and Early Mesolithic camp sites and inhumations are expected to have been preserved in places.

The proposed pipeline routes have not been investigated by detailed geophysical surveys yet. These areas may contain more undiscovered shipwrecks or remains of shipwrecks than currently known.

At this stage little is known about the integrity of the *Pleistocene* landscape. By means of subbottom profiling the occurrence geological units (both horizontal as vertical) and archaeological levels herein can be mapped. The character of layer boundaries (erosive or non-erosive) can be interpreted. It is unlikely however that archaeological remains of Palaeolithic and Mesolithic camp sites can be identified with sufficient certainty (based on the geophysical and geotechnical surveys) to impose restrictions on pipeline development. At this stage focus should therefore not be put on tracing prehistoric camp sites but on a pragmatic employment of geophysical techniques in order to obtain a better insight in (the integrity of) the *Pleistocene* landscape. The insights gained shall be used to a) refine the archaeological expectancy model and b) allocate areas with a high expectancy for *in situ* prehistoric remains.

In accordance with the AMZ cycle it is advised to conduct a field investigation (in Dutch '*Inventariserend veldonderzoek opwaterfase*') in order to test the archaeological predictive model and further specify the type, vertical and lateral extent, age, integrity and preservation of ship wrecks, prehistoric landscapes and potential archaeological levels.

<table>
<tr><th>Archaeological Expectancy</th><th colspan="2">Method</th><th>Goal</th><th>Remarks</th></tr>
<tr><td rowspan="4">Ship and aircraft wrecks</td><td rowspan="5">Geophysical</td><td>Side Scan Sonar</td><td>detect and map wreck sites</td><td>wrecks exposed at, or protruding from the seabed</td></tr>
<tr><td>Multibeam</td><td>characterize wreck sites morphologically;
detect (partially) buried wrecks by the occurrence of scours</td><td>in addition to side scan sonar</td></tr>
<tr><td>Sub-bottom Profiler</td><td rowspan="2">detect buried objects including possible ship wrecks and remains of aircraft</td><td rowspan="2">nature of the buried object cannot be determined directly</td></tr>
<tr><td>Magnetometer</td></tr>
<tr><td>Prehistoric settlements</td><td>Sub-bottom Profiler</td><td>map the Pleistocene landscape;
specify expectancy</td><td>supported by, and validated with drill data</td></tr>
</table>

Archaeological Expectancy	Method		Goal	Remarks
(camp sites)	Geotechnical	Geological Sampling	determine lithostratigraphy, soil layer boundaries (erosive or gradual) and characteristics of soil formation and maturation; specify expectancy	designation of borehole and/or vibrocore locations for geo-archaeological research based on SBP data
		Cone Penetration Test	determine lithostratigraphy	correlate with drilling data

In general, similar investigations carried out in the past consist of a geophysical survey with *side scan sonar*, *magnetometer* and *subbottom profiler* and a geotechnical survey. The resulting data should be assessed after the general processing, interpretation and reporting has been performed by the survey contractor.

The archaeological assessment of the data shall to be conducted by a geophysical specialist (KNA prospector Waterbodems). The data quality from the surveys needs to match the demands for this archaeological assessment. To ensure compatibility between the site investigation and the required quality for this assessment it is recommended to define a Program of Requirements (In Dutch: 'Programma van Eisen') in accordance with the 'KNA' (the Dutch quality standards for archaeological research), to be authorized by the competent authority.

1 Introduction

Periplus Archeomare was assigned by Fugro to conduct an archaeological desk study of the area of interest for the proposed Aramis pipeline routes. The area of interest of 11.355 km^2 is located in the North Sea off the coast of the Netherlands.

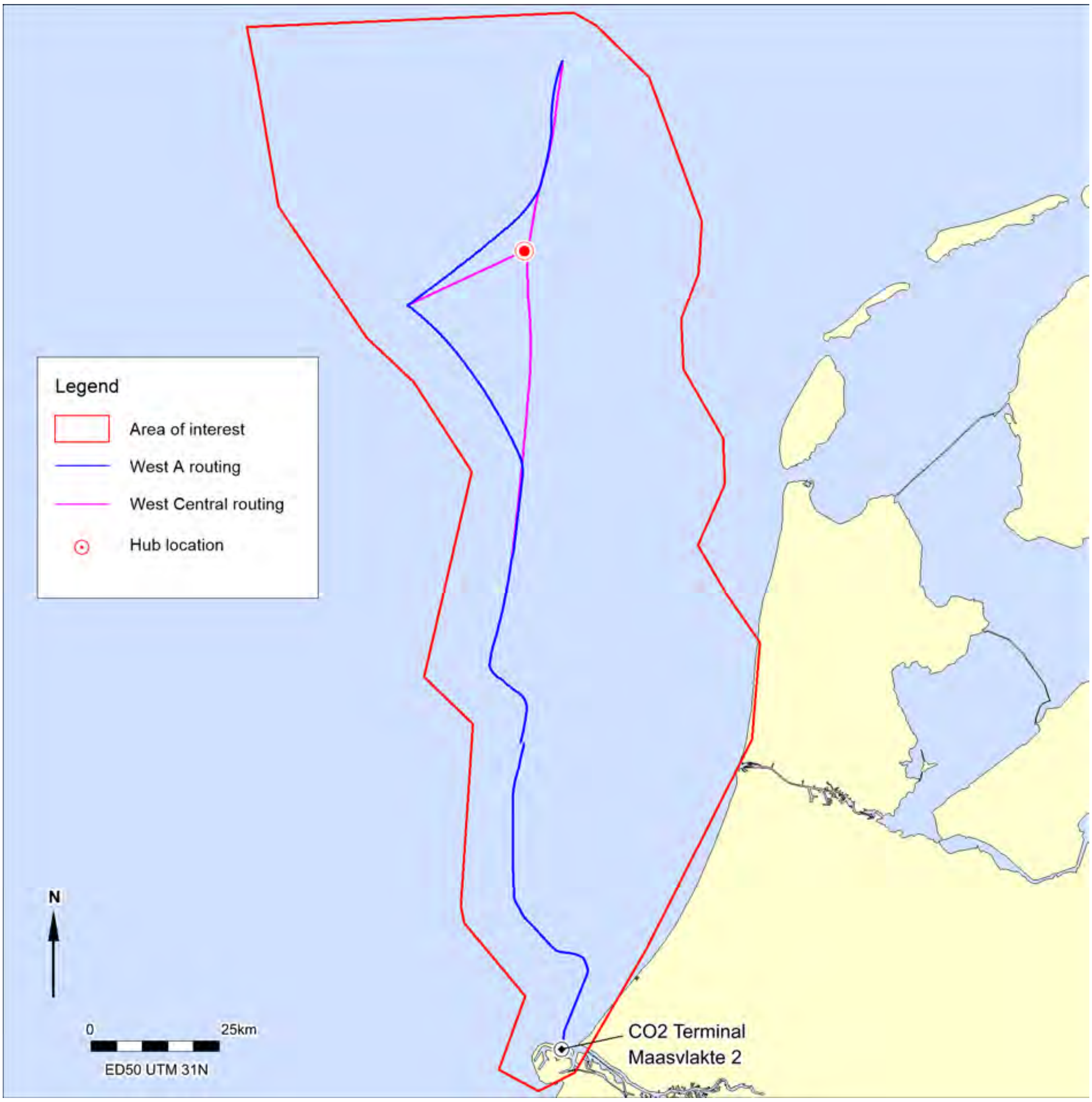

Figure 1. Location map of the area of interest

The desk study and reporting were carried out in accordance with the Dutch Quality Standard for archaeological research[1].

[1] Kwaliteitsnorm Nederlandse Archeologie (KNA waterbodems 4.1).

1.1 Background

TotalEnergies plans to build a new pipeline from Maasvlakte 2 to offshore blocks L4/K6 as part of the CCS Aramis project. The area to be investigated encompasses:

(1) the shore approach/Landfall pipeline routing for HDD and dredging part at Maasvlakte
(2) the offshore rigid pipeline routing from Maasvlakte to blocks L4/K6
(3) the offshore distribution hub.

As a preparation phase of the future surveys to be performed, TotalEnergies intends to conduct desktop studies of the area of interest. The final routing and the location of the distribution hub are not defined yet.

In the Law on Archaeological Heritage (Erfgoedwet 2016), emerged from the Malta Convention (1992), incorporated in the Monuments Act through the Archaeological Heritage Act, the protection of the archaeological heritage is regulated. Planned activities, such as the installation of pipelines in the North Sea, may affect the archaeological values if present. If effects on possible remains are expected, there is a statutory obligation to conduct archaeological research. This process is also outlined in the Water Decree (Dutch: Waterbesluit).

This archaeological desk study for the proposed Aramis pipeline is the first step in the archaeological process as part of the so-called *AMZ* cycle.

1.2 Objective

The purpose of an archaeological desk study in general is to specify the archaeological expectancy for a certain area. More in detail, the purpose of this desk study is to establish whether archaeological remains are, or are likely to be, present along the pipeline route, and whether these (possible) remains could be affected by the installation of the pipeline. Where possible, the desk study aims to give insight into the (possible) archaeological value of these remains in terms of their physical or scientific value, such as the overall quality of preservation and the rarity of the remains. Furthermore, this report aims to make recommendations regarding subsequent steps in dealing with known and expected archaeological remains along the pipeline route.

The archaeological management procedure (‘AMZ-cycle’) is a defined sequence of steps and decisions within archaeological heritage management in the Netherlands. The procedure is embedded in the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1) as the mandatory workflow for archaeologists. A detailed description of the different phases of archaeological research is included in appendix 1.

1.3 Research questions

For an archaeological desk study, the following research questions are applicable:

- Are there any known archaeological values present within the area of interest? If so, what is the nature, extent (depth) location and dating of these sites?
- Are there, in addition to any known values, archaeological remains to be expected? If so, what are the nature, extent (depth) location and date of the expected archaeological remains?
- Can the proposed activities affect known or expected archaeological values? If so, can an impact on archaeological assets be prevented or restricted by planning adaptation?
- If the archaeological values cannot be saved: What kind of further research is needed to determine the presence of archaeological values and their size, location, type and date to be determined enough to come to a selection decision?
- What are the possible effects of the installation of the pipeline on the areas with specific archaeological interest?
- What are the possibilities to mitigate the disturbance of areas with specific archaeological interests?
- Should further investigations be carried out from archaeological point of view and what are the recommendations on the scope and specifications of these investigations?

If, on the basis of this desk study, a connection can be made with other questions from the *NoaA* 2.0, then these must be answered. Given the nature of the research and the often limited possibilities for the identification of archaeological object, it is not possible to select all the questions in advance. As far as the possible find categories are concerned, there are also various ongoing research programs at universities, with which a relationship can be established.

1.4 Research and management framework

Our knowledge of the development of *Pleistocene* and Early *Holocene* landscapes and the plants, animals and humans who lived in the North Sea area is limited. This gap in geo-archaeological knowledge was recognized by the Dutch Cultural Heritage Agency (Rijksdienst voor het Cultureel Erfgoed). To provide tools to fill this gap the 'North Sea Prehistory Research and management Framework (NSPRMF)' was published, in which the foundation was laid for future research and management of the prehistoric heritage. The themes and topics of the NSPRMF are listed in table 3.

Theme	Topics
A. Stratigraphic and chronological frameworks	A.1: Lithostratigraphic classification and chronological anchoring A.2: Sea level change and glacio-isostacy A.3: Survival of deposits of archaeological significance A.4: Biostratigraphies and absolute dating
B. Palaeogeography and environment	B.1: Middle/Late Pleistocene reshaping of topography and river drainage B.2: Development of the Weichselian/Devensian landscape B.3: Palaeogeographic evolution after the Last Glacial Maximum (LGM) B.4: Quaternary palaeoecology
C. Global perspectives on intercontinental hominin dispersals	C.1: North Sea coastal dynamics and human uses of the coastal zone C.2: Pleistocene North Sea level oscillations and population of islands
D. Pleistocene hominin colonisations of northern Europe	D.1: Early human exploitation strategies in changing environments D.2: Natural barriers for hominin expansion
E. Reoccupation of northern Europe after the Last Glacial Maximum (LGM)	E.1: Post-LGM occupation flux E.2: Occupation strategies
F. Post-glacial land use dynamics in the context of a changing landscape	F.1: Changing landscape structure F.2: Behavioural diversity among hunter-gatherers F.3: Maritime archaeologies of the North Sea
G. Representation of prehistoric hunter-gatherer communities and lifeways	G.1: Spatial perspectives on North Sea palaeolandscapes G.2: The distributional nature of early hominin communities G.3: Enculturated hunter-gatherer landscapes

* Despite the fact that theme G primarily focusses on post-LGM hunter-gatherers, topic G.2 was broadly defined, and of equal relevance to theme D.

Table 3. NSPRMF - research themes and topics (Peeters 2009)

In 2019 the NSPRMF agenda was retuned based on the developments in the previous decade. This report contains the basis for policy in the years to come. The archaeological studies currently conducted in the context of wind farm development, pipeline and cable installation, sand extraction and exploration for oil and gas in the North Sea area, are conducted in accordance to the AMZ-cycle. These studies shall contribute to the goals set in the NSPRMF.

As described above little is known about the early *Holocene* inhabitants of the North Sea region, their settlements and the way in which they maintained themselves in the rapidly changing landscape. The information value of the expected settlements is therefore large. This is also stated in the National Research Agenda for Early Prehistory: *Locations and any surrounding phenomena that are located in paleo-landscape contexts that have not or have hardly been investigated have by definition a large information value.* For future investigations, reference shall therefor be made to the framework and the research questions in the *NOaA* in addition to the NSPRMF.

2 Methodology

The desk study was conducted in accordance with the Dutch Quality Standard for Archaeology (KNA Waterbodems 4.1, Protocol 4002). This concerns in particular the specifications LS01, LS02, LS03, LS04 and LS05. The study is reported in accordance with specification LS06.

In order to comply with the main objectives and answer the research questions, the archaeological desk study is carried out according to the scope of Work as described in the following steps:

- Description of the Area of Interest and determination of the consequences for future use (LS01);
- Description of the current usage of the area of Interest (LS02);
- Description of the historical situation and possible disturbances (LS03);
- Description of the geological setting within which the archaeological objects are to be found (LS04);
- Description of the known archaeological features and objects (LS04);
- Definition of a specified archaeological expectation (LS05).

Based on these components a specified archaeological expectation is defined. It is expressed whether, and if so, which archaeological values can be expected. The properties of these values will be indicated in as much detail as possible. The results of the study are summarized in chapter 3. Based on the results the research questions are answered in chapter 4. The study concludes with a summary and recommendation in chapter 5.

The research and reporting were conducted by S. van den Brenk (senior marine archaeologist) and R. van Lil (senior marine prospector). The results were approved and authorized by B. van Mierlo (Senior marine prospector).

2.1 Sources

The following sources were consulted for the study:

- Archis III, archaeological database of the Dutch Cultural Heritage Agency
- Databases of Periplus Archeomare
- Dutch Federation for Aviation Archaeology (NFLA)
- Geological maps
- Geological publications
- Scope of Work NL DTS Aramis (Memo TotalEnergies)
- National Contact Number (NCN) database Rijkswaterstaat
- Rijkswaterstaat Zee en Delta
- The Hydrographic Service of the Royal Netherlands Navy
- *TNO-NITG*; geological borehole data and maps
- Various results from previous investigations in the area of interest
- Various sources from the Internet

For a complete overview of the sources and literature see references on page 51. Words in *italics* and abbreviations are explained in the glossary on page 50.

3 Results

3.1 Definition of the area of interest and consequences of future use (LS01)

The area of interest is located off the west coast of the Netherlands and stretches from Maasvlakte 2 to mining block L4, 75 km northwest of the island of Texel.

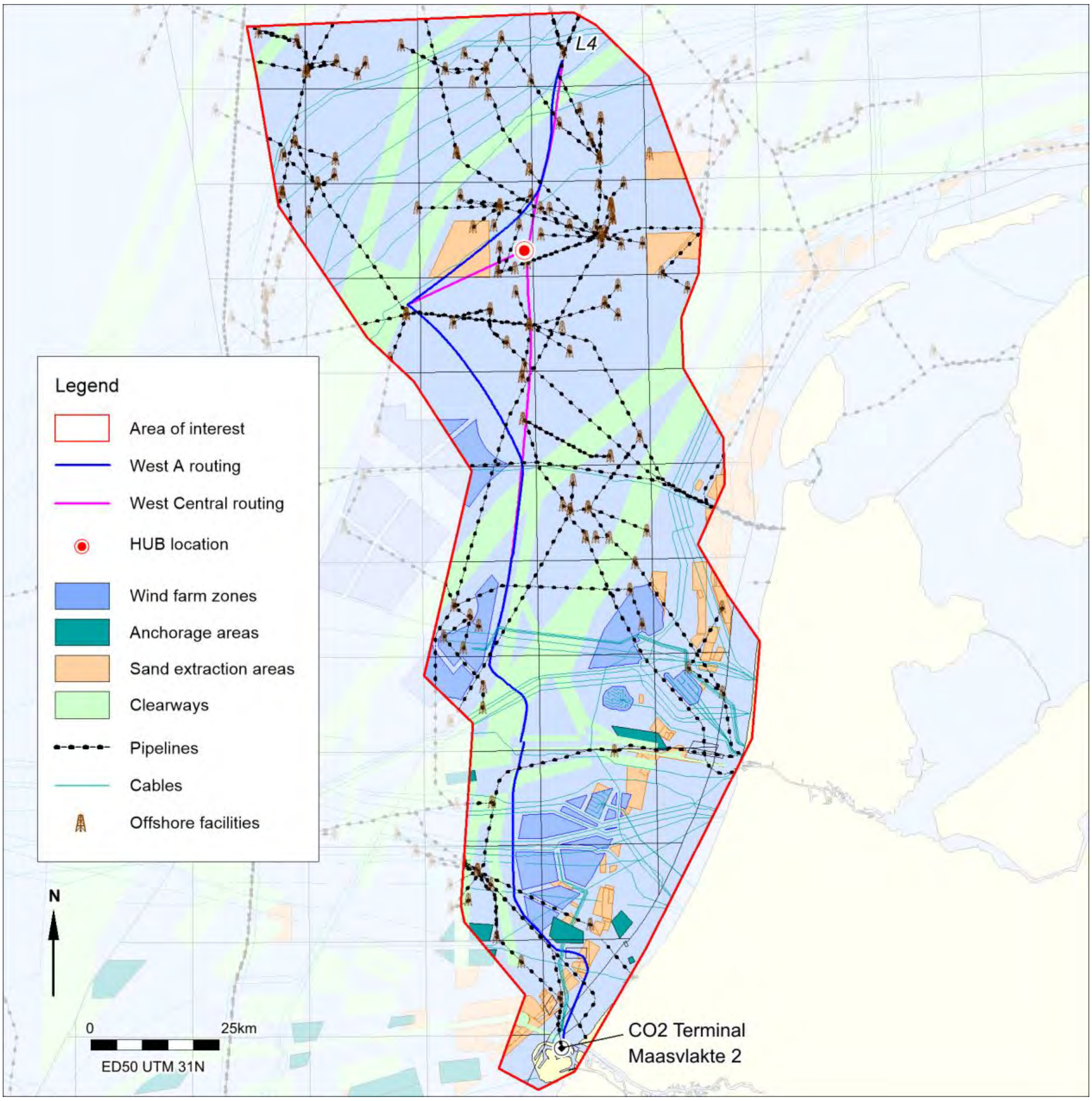

Figure 2. Overview of the area of interest in relation to other areas of use

The trenching of the pipelines has a direct impact on the seafloor, which might have an effect on the possible presence of cultural heritage. In the longer term, exposed pipelines can cause a change in seafloor morphology due to change of tidal currents. This may cause, in turn buried ship wrecks to emerge at the surface, exposing them to erosion.

Previous research

Parts of the area of interest have been investigated in the past for archaeological purposes:

- Several offshore drill locations
- Wind farm zones Hollandse Kust North, South and West
- Cable and pipeline corridors

The outlines of the investigated areas are shown in the figure below.

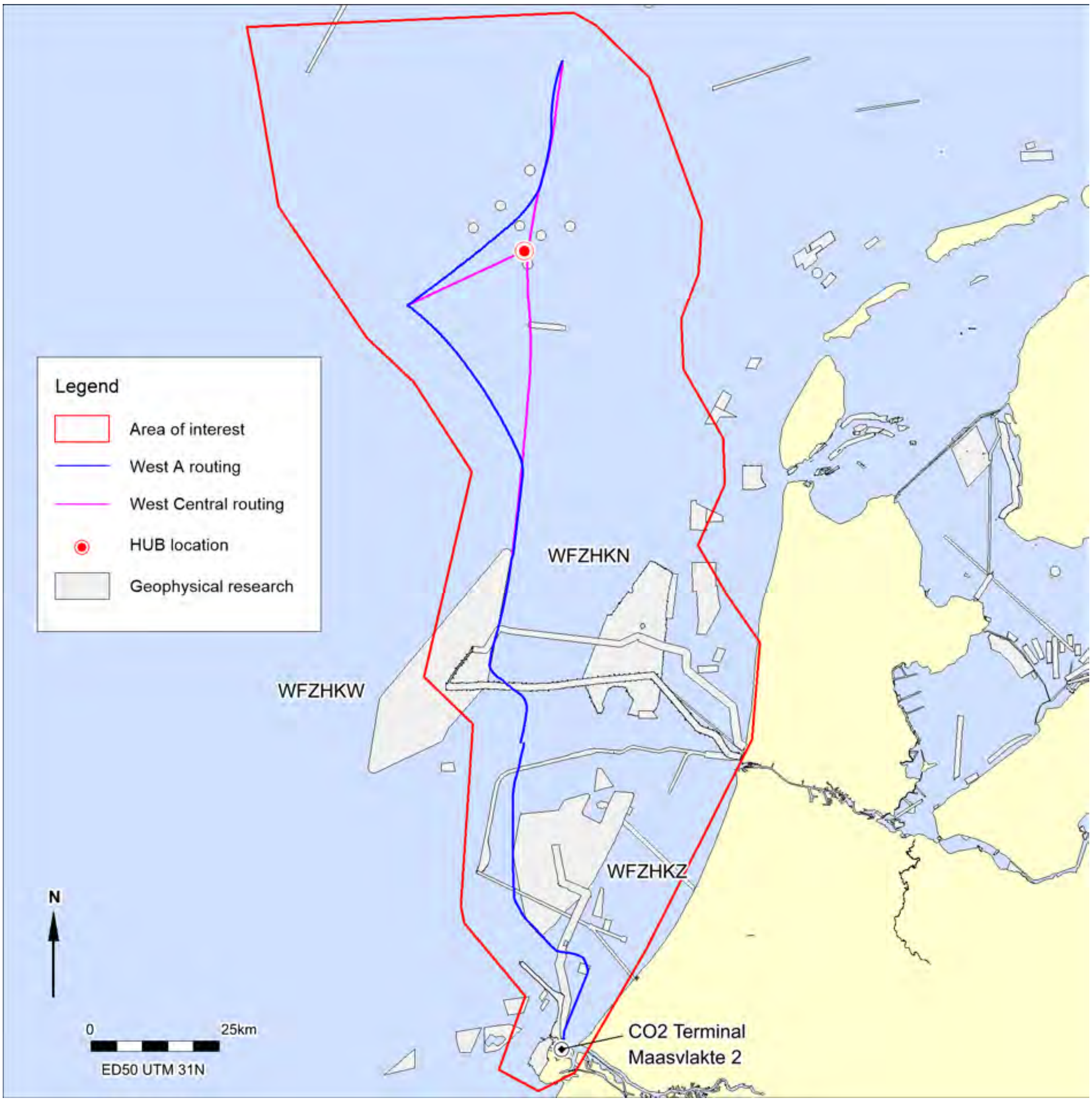

Figure 3 Previous conducted archaeological investigations in the area

The results of these investigations have been incorporated in paragraph 3.5, description of known archaeological values.

3.2 Description of the current situation (LS02)

The figure below shows a colour depth map based on composite data from the Hydrographic Service (25m grid, 2009) and data from various wind farm zones (5m, 2026-2020).

The water depth within the area of interest varies from 0 to 46.1 meter (LAT), with an average of 26.7 meter (LAT).

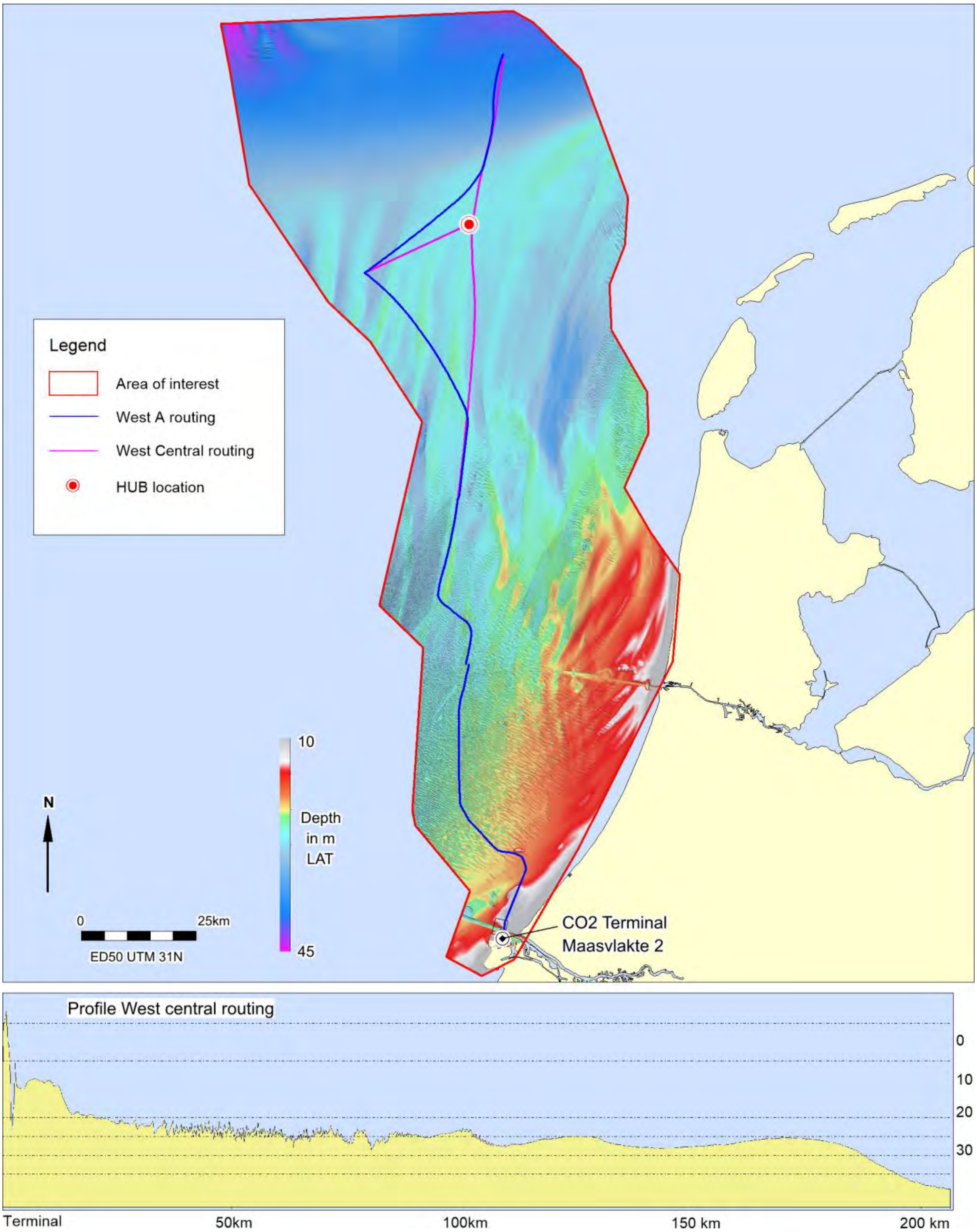

Figure 4. General bathymetry of the seabed and profile along the West central routing

The seabed is characterized by three types of morphological structures. The largest structures are north-south orientated ridges. The ridges vary in width from 1km to 4km and are generally up to 10m in height.
Superposed on the ridges sand waves have developed. The occurrence of sand waves is confined to the southwestern and central part of the area. The sand waves are up to 4m in height; the average distance between the crests is 300m. The crest heights tend to diminish towards the north. The sand wave crest orientation changes from west-east to northwest-southeast at the intersections with the large north-south orientated ridges.

Mega-current ripples which developed on top of the sand waves cannot be distinguished due to the grid-scale available (25m), but are nonetheless expected to be present. The ripple height is often less than a few dm; the distance between the current ripple crests is up to 10m.

The large ridges, sand dunes and current ripples have formed in the top layer of mobile sand. The ripples migrate along with tidal currents; the sand dunes typically migrate with a speed of 1 to 10 m/year. The migration rate of sand dunes in the Princes Amalia Wind Farm Zone was assessed to be in the order of 4 m/year[2].

[2] Laban 2004.

Landfall area

An overview of the recent bathymetry in the landfall area is constructed based on composite data from various surveys (Hydrographic service, Rijkswaterstaat and Tennet, with permission).

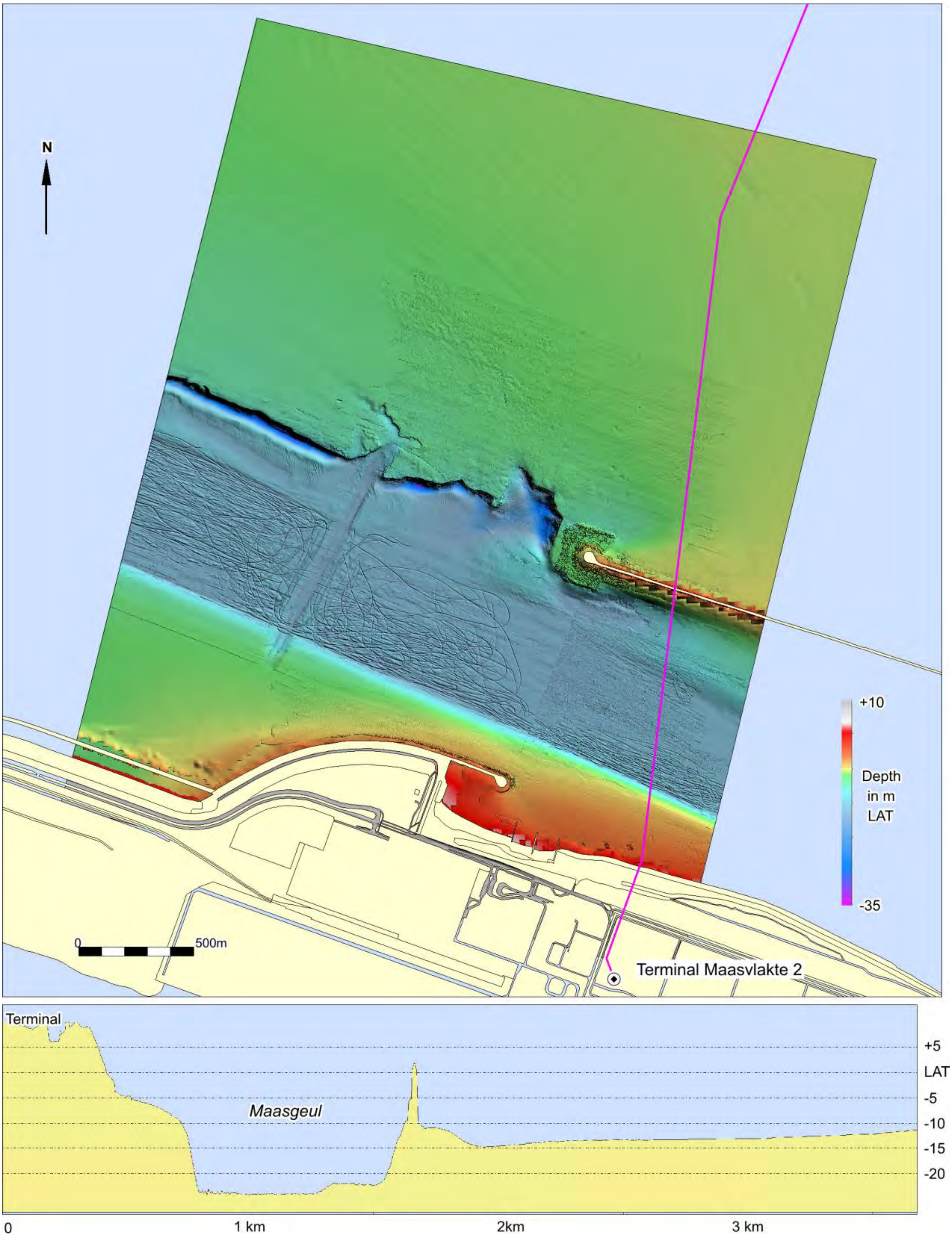

Figure 5. Bathymetry of the seabed in the landfall area

Seabed morphology

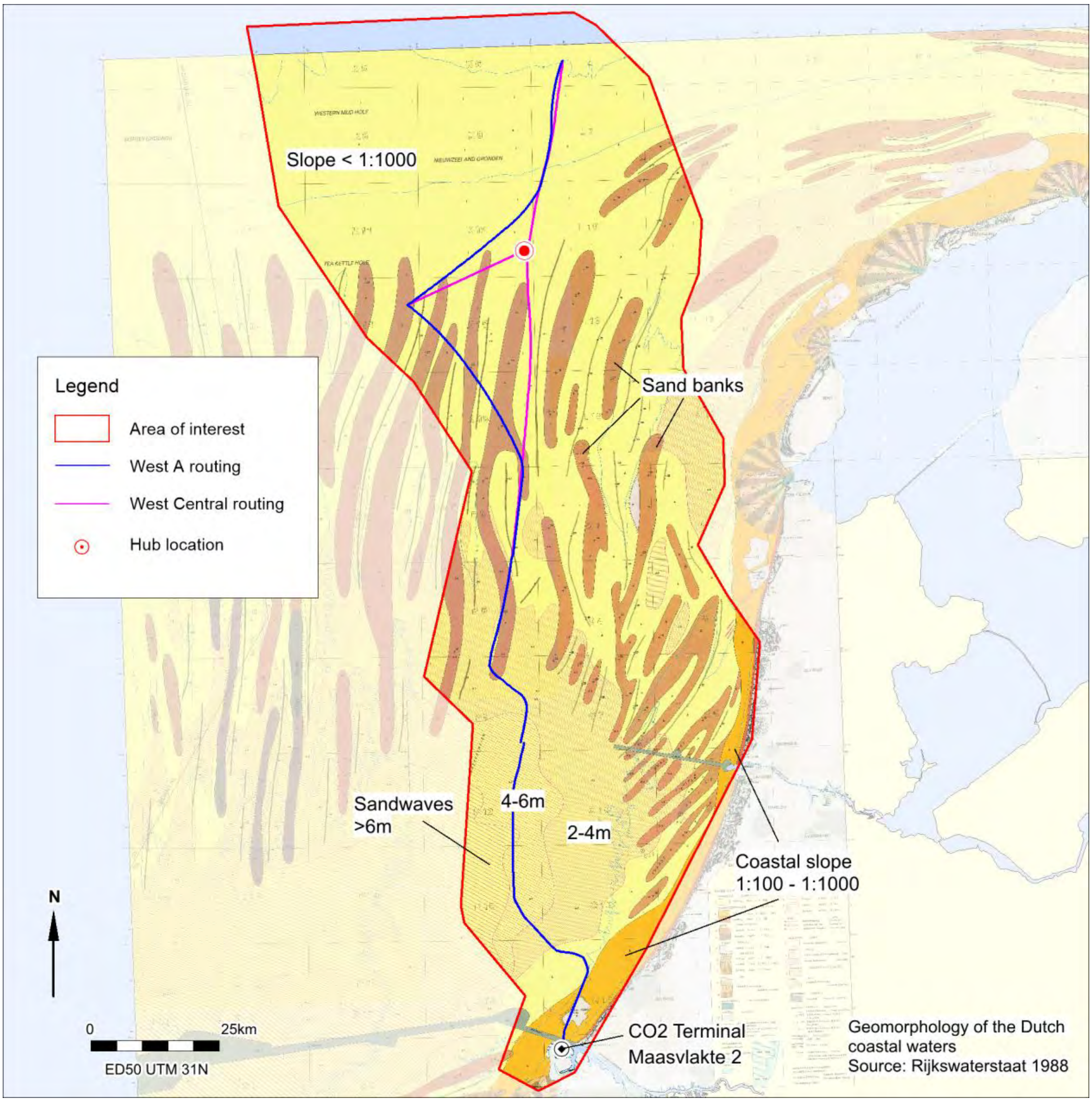

Figure 6. Geomorphology of the seabed

The southern part of the area of interest is dominated by sand waves with a northwest-southeast orientation and a height of 4 to 6 meters. The central area is dominated by large north-south oriented sand banks, superimposed by sand waves. The northern part is predominantly flat and featureless.

3.3 Historical situation and possible disturbances (LS03)

The North Sea basin formed about 12000 years ago as an extensive aeolian sand landscape with a tundra climate. At the end of the last Ice Age (ca 11500 years ago), the temperature rose as a result, the northern glaciers melted. The sea level rose and the North Sea basin was gradually filled. The filling of the North sea plains did occur over a period of 3500-5000 years. During this time the landscape changed, from freezing tundra to woodland where birch dominated the region, with some alder, hazel, juniper, and pine[3]. During this time, the North sea rose more rapidly than it does today, therefore, the residents of the area had to leave eventually for higher ground.[4]

Figure 7. Reconstruction of the historical coast lines in the North Sea basin (map by: McNulty, W.E. and J.N. Cookson in National Geographic Magazine)

The Dogger Bank in the North of the Dutch Continental Shelf is an example of an elevated area. Remnants of the tundra landscape and its inhabitants are regularly found in the nets of fishermen. However, all over the North Sea, remnants are found of hominin occupation of the region. For example, the only known Neanderthal from the Netherlands was found in the North sea. Moreover, multiple Palaeolithic and Mesolithic artefacts and even human remains have been found within the remains of the North Sea[12]. A number of artefacts have been found within the area of interest [5]. By 6000 years ago, the North sea plains were fully submerged, and the North sea looked very much as it does today.

[3] Van de Noort, 2011

[4] Gaffney e.a. 2005.

[5] Louwe Kooijmans 1970.

Due to the sea level rise the ancient landscapes drowned. These landscapes are depicted through geophysical and geotechnical engineering. Recently, for example, on the basis of seismic data from the oil industry a prehistoric landscape was reconstructed near the east coast of England[6]. Authors concluded that a large part of the Southern North Sea contains an in-situ prehistoric landscape.

Figure 8 shows the remains of mammal bones, among which many remains of mammoths which have been found in the nets of fishermen in the North Sea area. Among the finds is a well-preserved prehistoric human skull. Possibly the skull has been found near the Brown Bank area, but unfortunately the location of these finds is not known [7].

The finds are done by different fishermen, but given to fisherman Kommer Tanis who preserves and collects the finds. Tanis reports important finds, such as the human skull shown in figure 8 to scientists. In close cooperation with the scientists he makes the finds available for further analysis, such as DNA research.

Figure 8. Human skull found in the nets of fishermen in 'North sea/Doggerland' in November 2019

[6] Project 'North sea paleo-landscapes' of the University of Birmingham

[7] Pers. Comm. Fisherman and collector Kommer Tanis.

Figure 9. Prehistoric artefacts collected by fishermen and found at the beach (after Kooijmans 1970 en Armkreutz 2018).

Shipping

The earliest evidence of shipping in the North Sea dates from the Neolithic. For example, evidence of this can be found in prehistoric Rhineland burials. In this region the access of tin was limited and was therefore considered a luxury good. It had to be imported from other regions. One of such regions is South-West Britain[8]. It can be seen the other way around as well, Alpine jade axe heads have been sporadically found across the British Isles. Since this age, there is an increase of shipping in the North Sea with a few well-documented historical peaks. During Roman times, the North Sea and in particular the Channel served as connecting bridge for the empire. From the Early and High Middle Ages new centres of power arose along the North Sea coast. Furthermore, the raids of the Vikings should also be mentioned in this context. From the late Middle Ages, the international trade and the shipbuilding industry developed so that the North Sea was a stepping stone for global shipping routes. In all periods, ships were lost at sea. Ship wrecks are

[8] Van de Noort 2011.

the traces of the maritime past and this can be preserved under favourable storage conditions in sediment. Obviously, the possible existing wreck sites only occupy a very small area of the total area of interest.

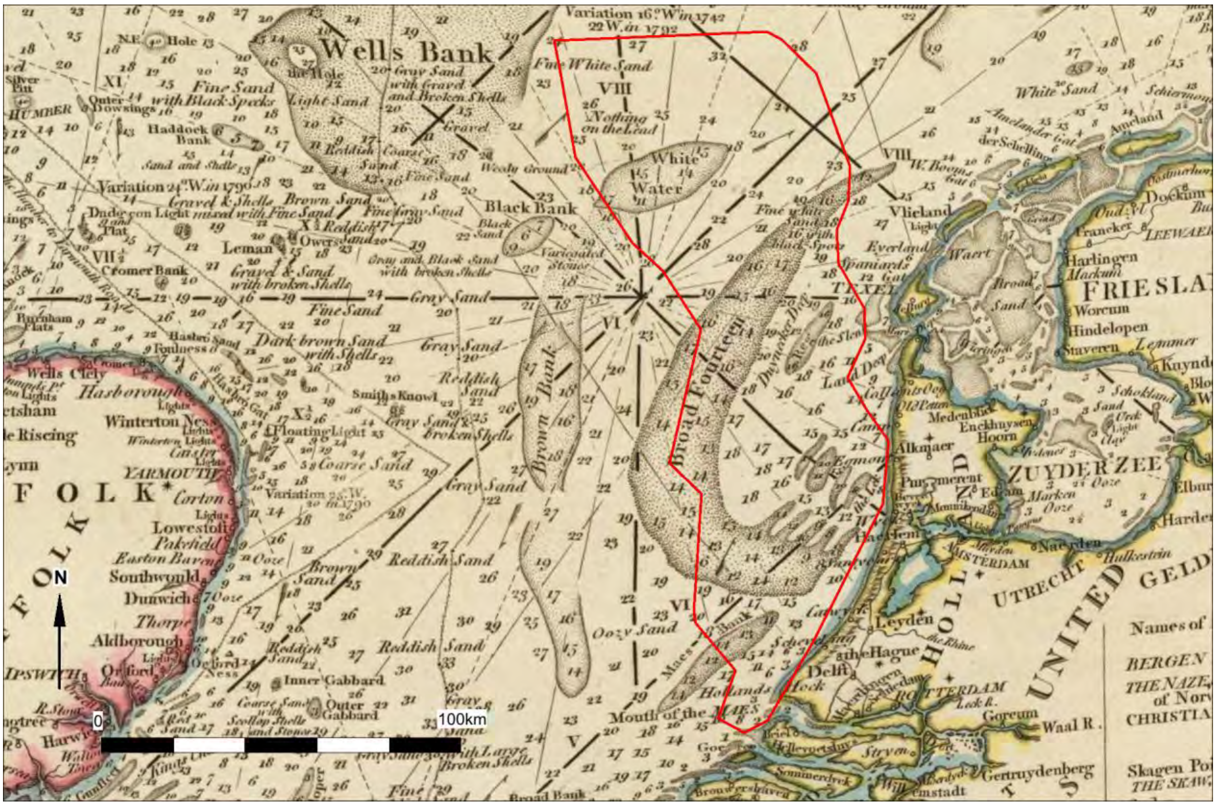

Figure 10. The area of interest on the historical map of 1777 (Faden)

Known disturbances of the seabed

In the past, parts of the seabed within the area of interest have been disturbed by trenches for cables and pipelines. The initial depth of burial of the cables is unknown, but should be a minimum of 1 meter according to the environmental permits. It is however expected that the cables are laid at a depth of 2 meters up to a maximum of 5 meters below the seabed. This also applies to the pipelines in the area.
Within the area of interest, more than 100 areas are known where sand is extracted, generally to a depth of 2 meters in relation to the seabed.

In general, large parts of the seabed have been disturbed by trawl nets of fishermen.

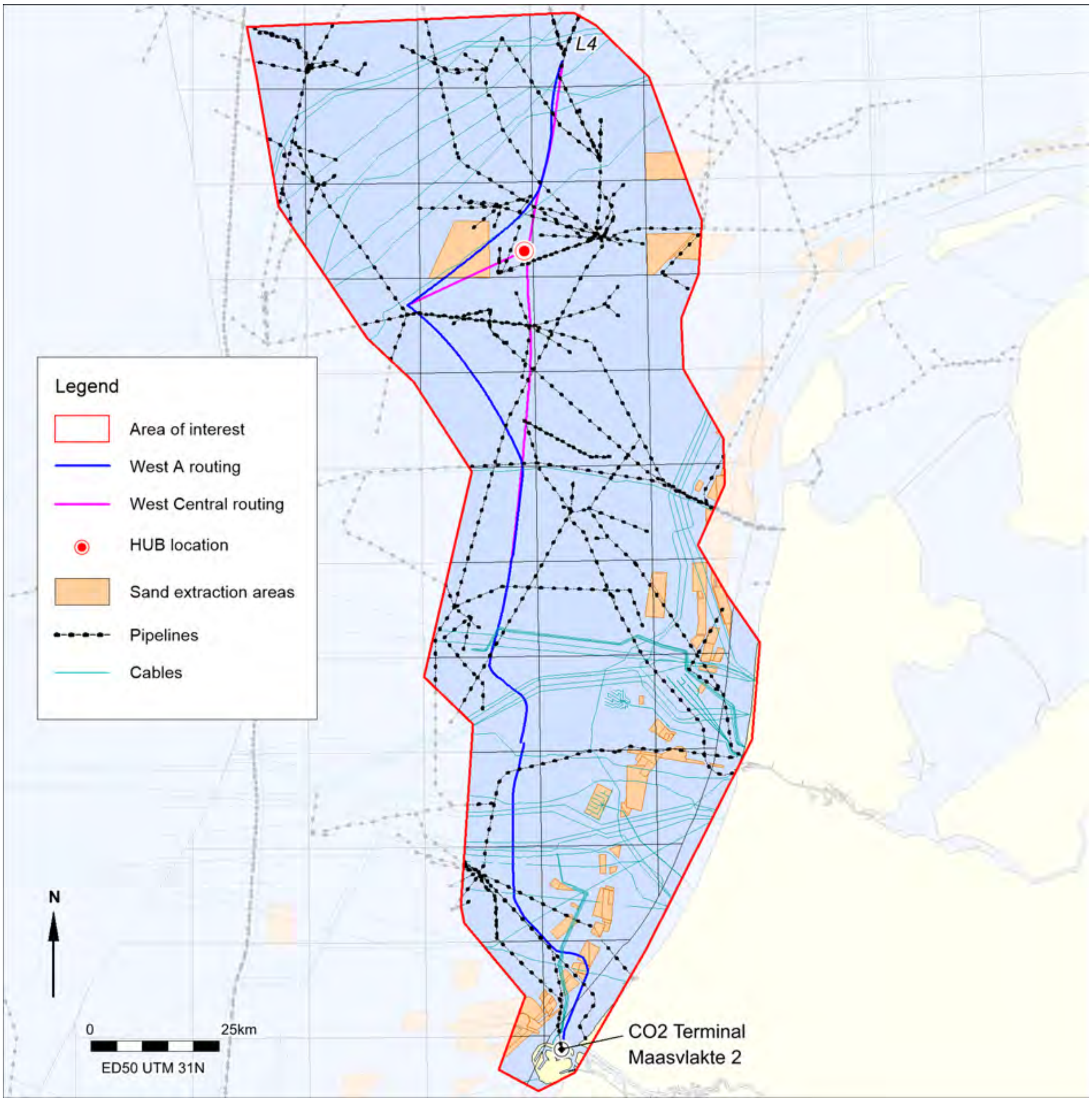

Figure 11. Pipelines, cables and sand extraction areas in the area

Locations and status of cables, pipeline and sand extraction areas are based on the database of Rijkswaterstaat (November 2021). This may differ from the as-built data from the operators.

3.4 Geological setting within which the archaeological objects are to be found (LS04)

The archaeological prospect for (pre)historic settlements is strongly related to the geogenesis of the plan area. The geogenesis is reflected by the lithostratigraphic units present, the character of layer boundaries (erosive vs non-erosive) and indications for the development of soils within the sediments in prehistoric times. Therefore geophysical and geological data are an important source to answer questions with respect to the nature, age, depth and location of occurrence, integrity and preservation of the archaeological remains which are to be expected within the area of interest.

Seabed sediments

The seabed sediments in the area of interest consist mainly of sand, with patches of gravelly sand in the southern and central area. In the northern part the sediments become finer (muddy sand).

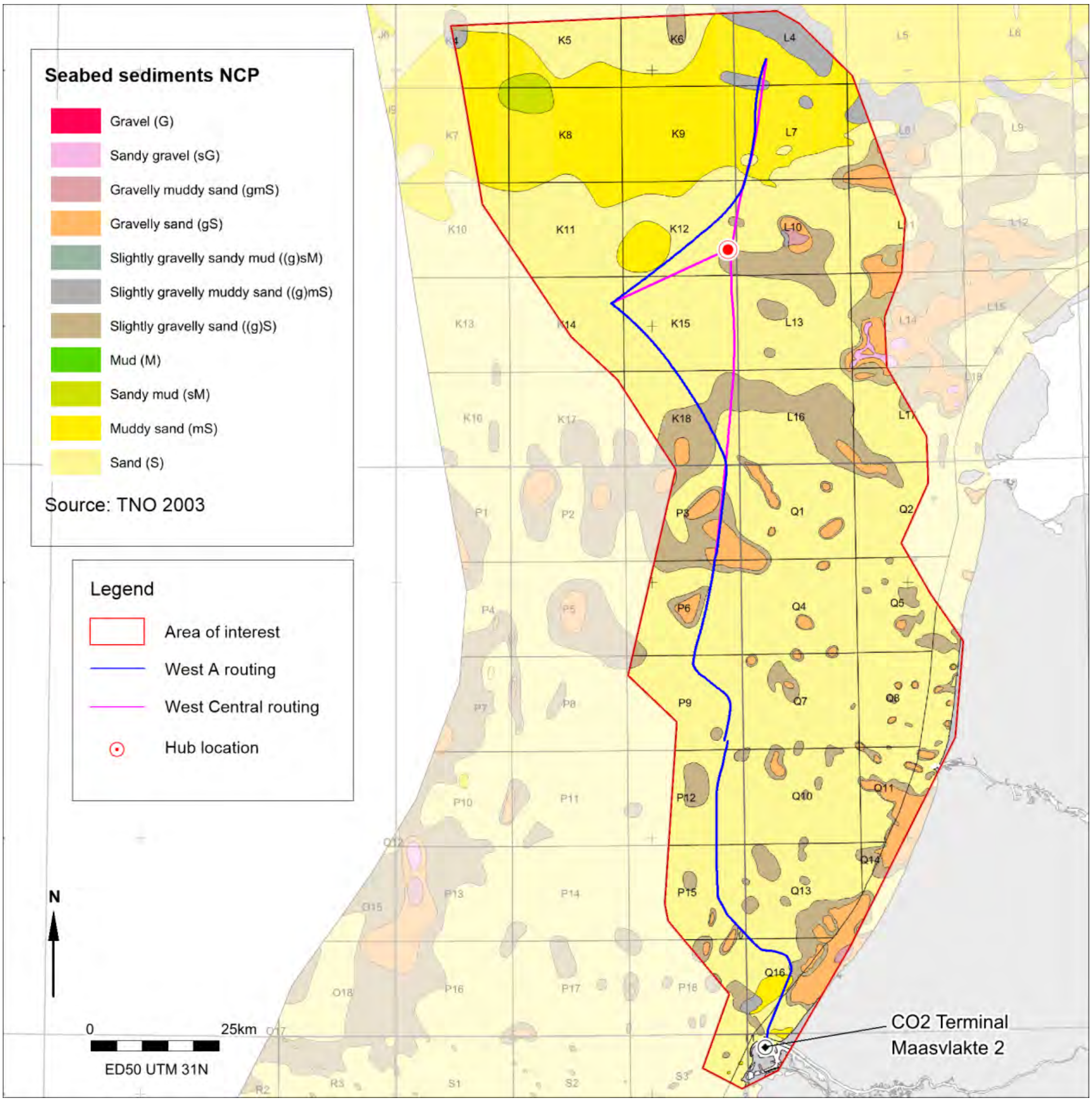

Figure 12. Seabed Sediments (Laban 2003)

Pleistocene Units

Figure 13 shows the different subcropping *Pleistocene* units in the area of interest[9].

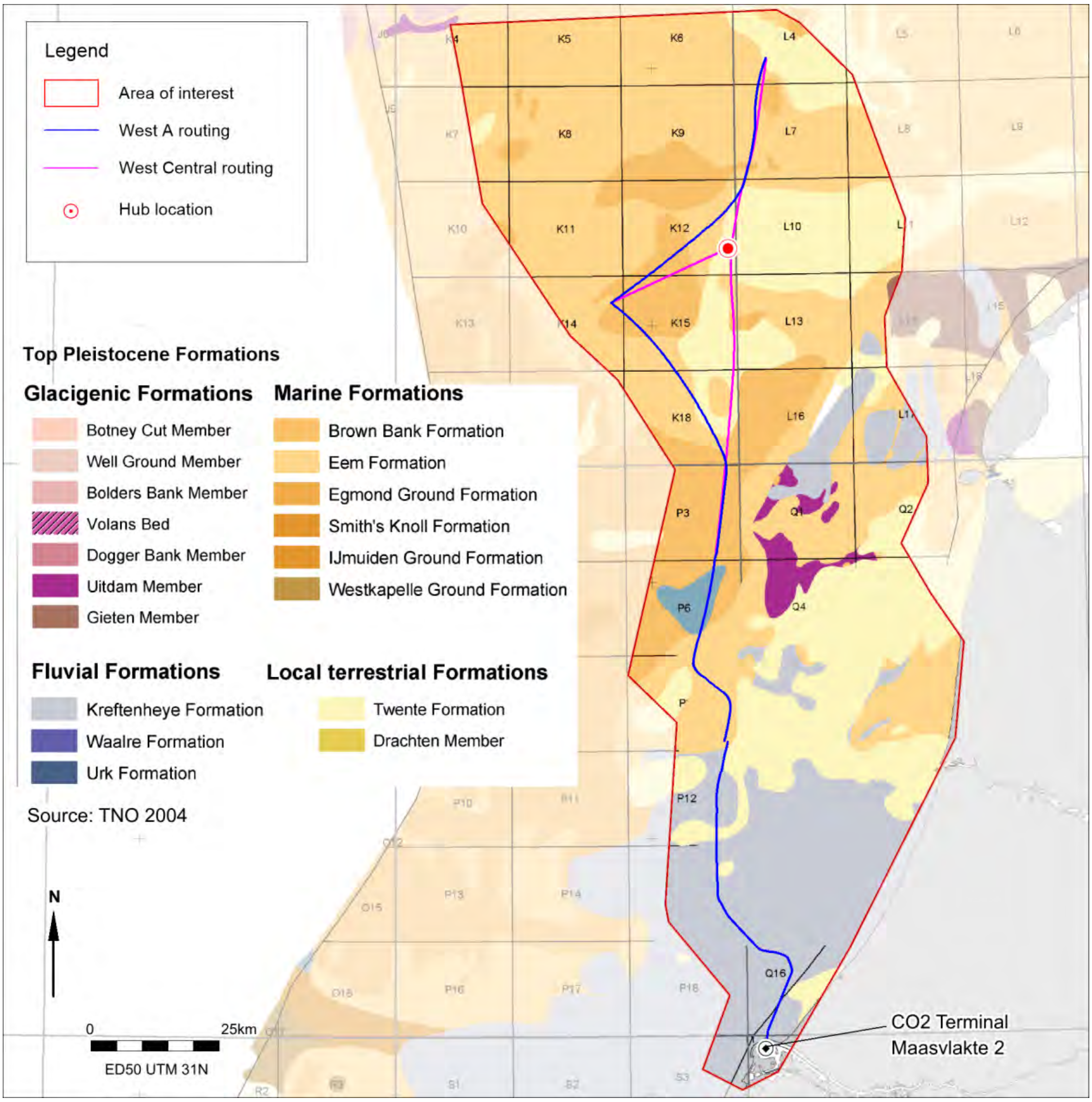

Figure 13. Subcropping Pleistocene formations

Within the boundaries of the area of interest several subcropping *Pleistocene* units have been mapped. The most relevant are described below.

<u>Yarmouth Roads Formation</u>

The Yarmouth Roads Formation consists of fine or medium-grained grey-green sands, typically non-calcareous, with variable clay lamination and local intercalations of reworked peat. According to the Lexicon of Named Rock Units of the British Geological Survey the depositional environment of the Yarmouth Roads Formation is interpreted to be 'mainly fluviatile, with possible shallow marine incursions'.[10]

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[9] Laban 2004.

[10] https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=YM.

In the DINO nomenclature the depositional setting is described as 'predominantly low energy open-marine deltaic, delta top and fluvial'.[11] The Yarmouth Roads Formation is older than 500 kyr. The unit has been glacially deformed into ice-pushed ridges in the section that is crossed by the current Aramis route trajectory.

Egmond Ground Formation

The Egmond Ground Formation consists of fine-grained, sparsely shelly marine sands with clay interbeds. The amount of shells and shell fragments is markedly less than the overlying younger sands of the Eem Formation.[12] The marine deposits date from the Holsteinian interglacial period. The exact age of the deposit is uncertain, including both Marine Isotope Stage 11 (424 kyr – 374 kyr ago) and Marine Isotope Stage 11 (424 kyr – 374 kyr ago) and Marine Isotope Stage 9 (300 kyr – 337 kyr years ago). The deposits of the Egmond Ground Formation predate the Saalian glacial period and can therefore be part of the ice-pushed ridges.

Eem Formation

The Eem Formation predominantly consists of shell bearing fine sands deposited in an open marine environment during the Remain interglacial (warm) period.[13]

Brown Bank Member (Eem Formation)

At the end of the Eemian period brackish and fresh water clays were deposited in lagoons and lakes which remained in the glacial basins during regression of the Eemian Sea. These lake and lagoonal deposits have separately been classified as the Brown Bank Member within the Eem Formation. The Brown Bank Member was previously referred to as Brown Bank Bed or Brown Bank Formation.

Woudenberg Formation

In the Early Weichselian cooling climate peat was locally deposited on top of the clayey Brown Bank Member. At its base the peat is often rich in wood remains; at the top moss is a major constituent. The unit consists of firm, amorphous, clayey, non-calcareous, brown to black peat or gyttja. The peat has been deposited in a nutrient-poor (moss peat) to nutrient-rich (reed, sedge and woody peat) marsh or swamp. Occurrences of the Woudenberg Formation have been described in the Amersfoort Basin, not in the North Sea area. Formerly, this unit was part of the Eem Formation. As the Saalian glacial basins are present in the North Sea area which is crossed by the proposed Aramis pipeline routes, local occurrences of this unit could be crossed.

Kreftenheye Formation (Weichselian)

The Kreftenheye Formation consists of sands of the Rhine | Meuse fluvial system. The depositional environment includes braided and meandering stream, and braidplain and floodplain. The deposits consist of yellowish grey to greyish brown medium to very coarse sand. The sands are moderately to very gravelly. Locally, fine to coarse gravel lags occur. Occasional thin clay laminae and clay pebbles can be present intercalations in the predominantly sandy sequence. Characteristic of the Kreftenhye river deposits is a parallel layering on mm- to cm-scale which is related to small variations in grain size and composition. Offshore the coast of South Holland, small shallow channel incisions are observed in subbottom profiler data. These incisions occur in the top of the Kreftenheye Formation which is truncated by the Bligh Bank

[11] In accordance with Rijsdijk 2005.

[12] British Geological Survey: Lexicon of Named Rock Units.

[13] Eemien: interglacial period between 128.000 and 115.000 years ago.

Member. The channels are filled with fine sand. An impression of the stratigraphy that is to be expected in the southern part of the current Aramis route trajectory in the vicinity of sand extraction areas Q16H and Q16H is illustrated in figure 14 below.

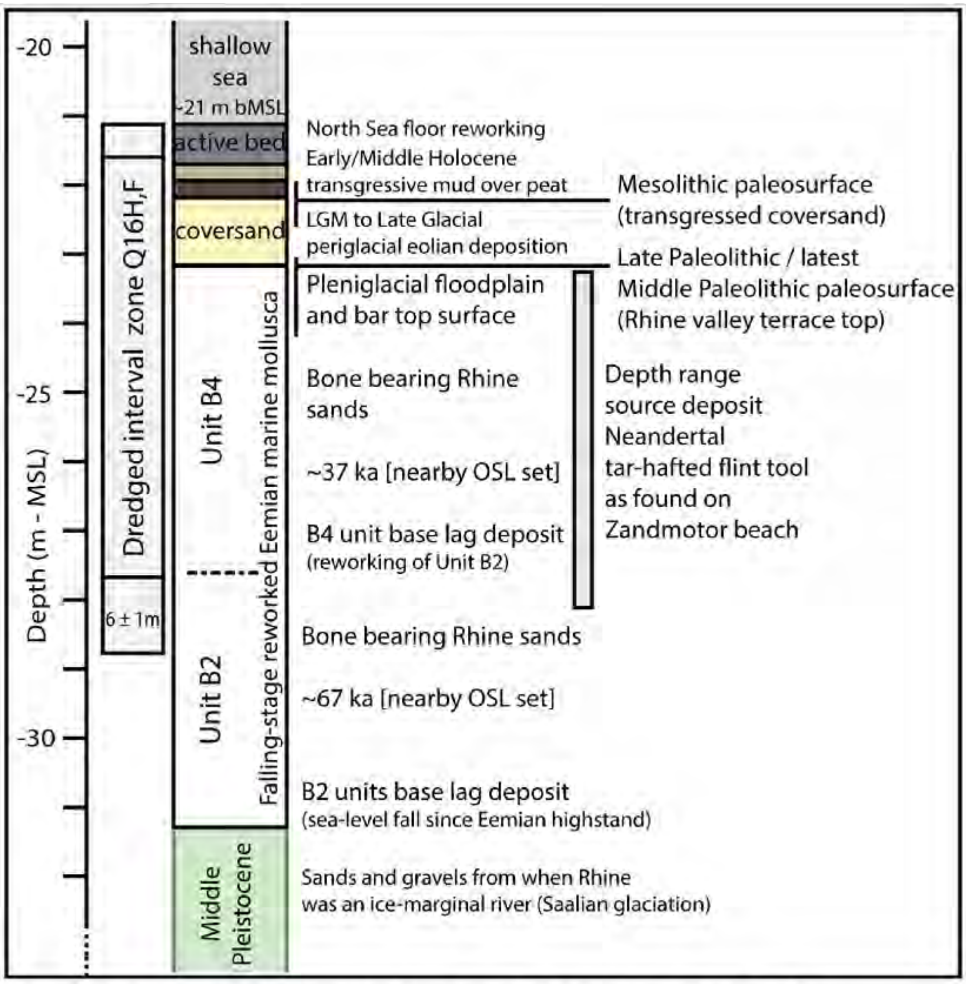

Fig. S2. Stratigraphy of the dredging area Q16. The upper 6-8 meters of the sedimentary column consist of: 1) a dynamic sheet of shelly sand of the active sea bed, 2) beds of Early-Middle Holocene transgressive tidal muds on basal peat, 3) Late Glacial eolian coversands containing Mesolithic materials (27, 28), and 4) medium to coarse grained fluvial sands of the Rhine-Meuse valley, Units B2 and B4, dating to 70-30 ka.

Figure 14. Stratigrafie van het zandwingebied Q16 (Niekus 2019).

During the installation of the Hollandse Kust (zuid) export cables mammoth bones were found on the trencher when the trencher emerged above water (see for site location figure 1). The very well preserved mammoth bones probably originate from an infilled channel.

The course of the river Rhine changed during the Weichselian. The extent and distribution of the Rhine - Meuse channel belts is shown in figure 15, below.

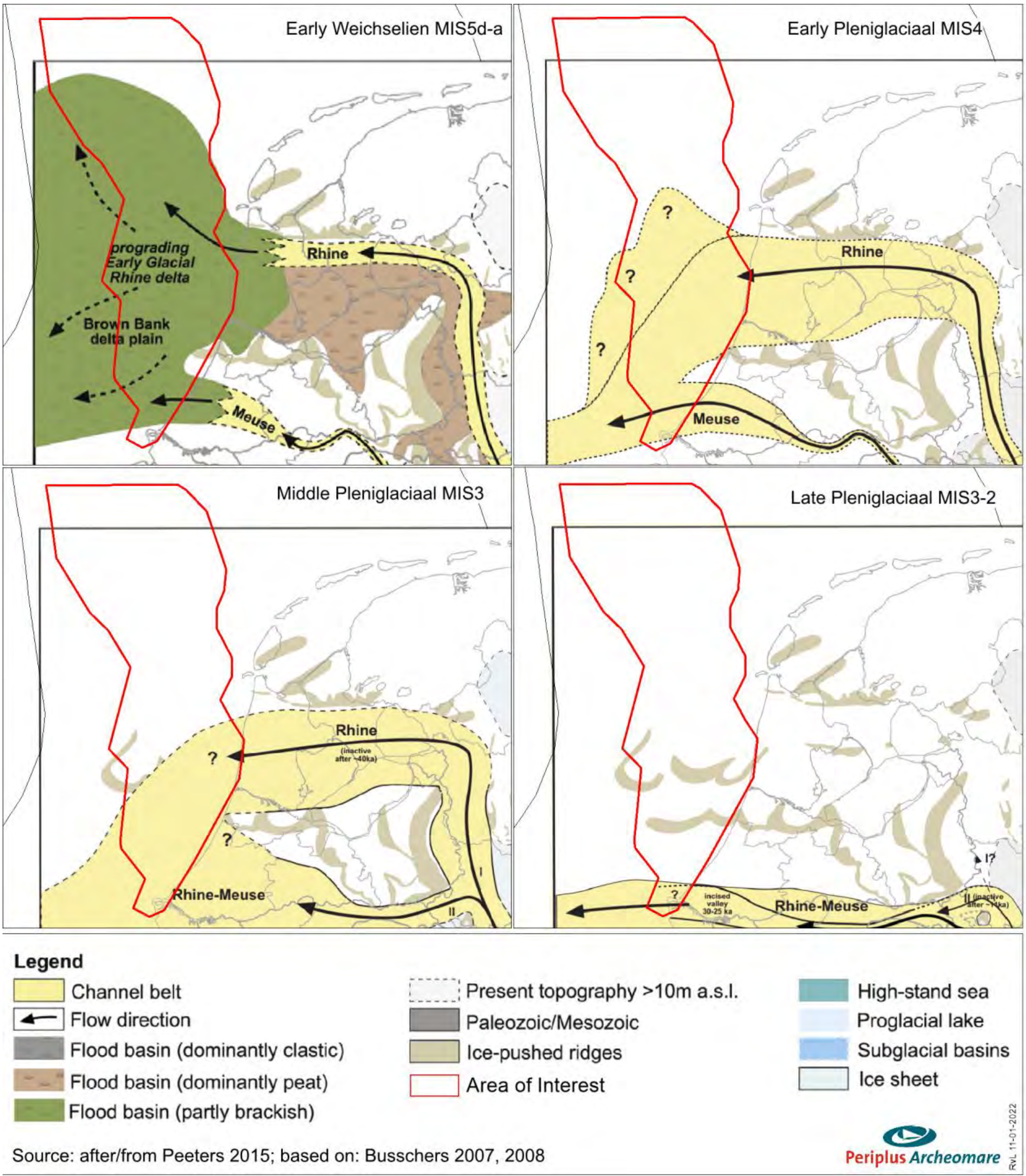

Figure 15. Paleogeographic maps of the Weichselian.

North and south of Maasgeul firm beds of clay and loam occur at the top of the Kreftenheye Formation. The firm clay dates from the Late Weichselian (Allerød interstadial) and Early *Holocene* and is separately classified as the Wijchen Bed. The Wijchen Bed has been deposited in meandering floodplain of the Rhine which is subject to frequent overbank flow.[14] The deposition of the Wijchen Bed is related to the evolution of the Rhine – Meuse river pattern from braided to meandering. The change to a meandering river pattern is triggered by a warming of the climate, which resulted in the development of a vegetation cover. The landscape morphology is more or less fixed by the vegetation, thus promoting incision of the river. This

[14] Törnqvist 1994; Makaske 1995; Busschers 2008.

also explains why the overbank clay of the Wijchen Bed is characterized as ‘humic and non-calcareous, especially at the organic-rich top, which may be marked by a palaeosol’.[15]

The Late Glacial fluvial evolution of the Niers–Rhine and Maas in relation to climate and vegetation changes is nicely illustrated by Kasse (see, below).[16]

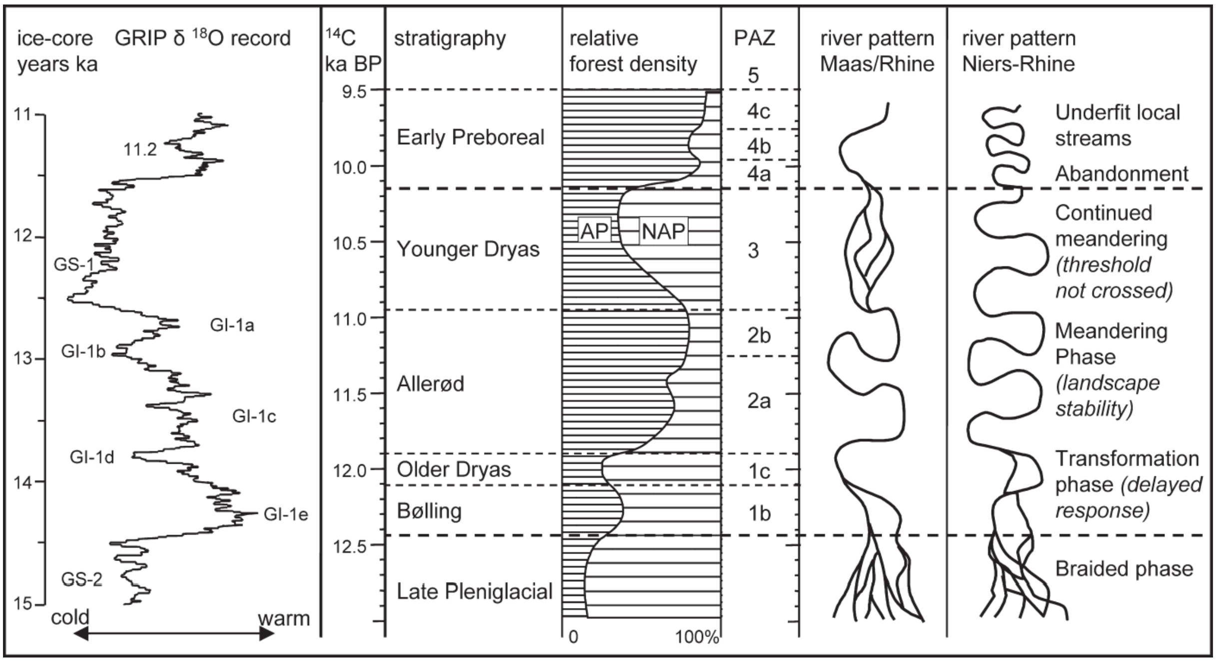

Figure 16. Late Glacial fluvial evolution of the Niers–Rhine and Maas in relation to climate and vegetation changes (from: Kasse 2005).

In the Yangtze area two separate beds are distinguished in the Wijchen Bed:[17] a lower bed that is described as ‘grey loam, sandy clay and clayey sand, and is internally stratified’, and an upper bed that is described as ‘moderately silty to strongly silty and humic (often humically stratified), and at the base sandy and mostly sandy-stratified.’ The lower bed was found between 23m and 22m – asl; the upper bed between 22m and 19m – asl. In the upper bed charcoal is found which is related to the archaeological sites that were found on the nearby river dunes.

Boxtel Formation (Weichselian and Early *Holocene*)

The Boxtel Formation consists of terrestrial deposits. The upper part of the unit subcrops below a cover of *Holocene* deposits in parts of the area of interest (figure 13). The subcrops of the Boxtel Formation shown in figure 13 date from the latest ice age, the Weichselian, and Early *Holocene*. This upper part of the unit most probably consists of aeolian deposits of the Wierden Member (cover sands) and loamy stream deposits of the Singraven Member. Apart from loam (=silt) the Singraven Member can contain sand, clay and peat. The Boxtel Formation overlies brackish to fresh water lagoonal and deposits or laminated fresh water lacustrine clays of the Brown Bank Member and peat of the Woudenberg Formation. The thickness of the Boxtel Formation is unknown.

[15] TNO-GDN (2022). Wijchen Bed. In: Stratigraphic Nomenclature of the Netherlands, TNO – Geological Survey of the Netherlands. Accessed on 13-01-2022 from http://www.dinoloket.nl/en/stratigraphic-nomenclature/wijchen-bed-0.

[16] Kasse 2005.

[17] Moree and Sier 2015; The Wijchen Bed is refered to as Wijchen Member.

During the Early *Holocene* aeolian sands were deposited within the floodplain bordering the dry bed of the river Rhine (these river deposits themselves are part of the Kreftenheye Formation; see above). The so-called river dunes are found in the subsurface of the route trajectory north and south of the Maasgeul. The river dune deposits are described as grey to brown, fine to medium, moderately sorted sand, mostly non-calcareous but calcareous near base, with sporadic silt layers or granule laminae. The river dune deposits are separately classified as the Delwijnen Member within the Boxtel Formation.

Drachten Formation

Terrestrial deposits can also occur at a deeper stratigraphic level. The Drachten Formation is located in between the Egmond Ground Formation and the Eem Formation. Formerly the Drachten Formation was onshore classified as the Eindhoven Formation and later as a member of the Boxtel Formation. Offshore the Drachten Formation was referred to as the Tea Kettle Hole Formation. The local terrestrial deposits date from the Saalian ice age and consist of fine grained periglacial aeolian, fluvial and lacustrine sands. The Drachten Formation predates the Saalian glaciation and is often deformed due to the overriding ice-sheet. Deposition took place during the Hoogeveen and Bantega interstadials (227 – 180 ka. ago), when the landscape was covered by temperate zone forests. In the 1980s, Neanderthal camps related to the Hoogeveen or Bantega interstadials were excavated in the Maastricht-Belvédère quarry in Limburg. Therefore, remains of Neanderthal camps may exist *in situ* if intact palaeosol are present.

Holocene Units

The *Pleistocene* units are - except from some local outcrops - covered in by a sequence of *Holocene* deposits. The overall thickness of the *Holocene* sediments ranges from 0m to 37m. The differences in thickness are for a major part related to the present-day seabed morphology, which is characterized by sand dunes, ridges and valleys. The occurrence of *Holocene* units which are exposed at the seabed is shown in figure 17. Because this map displays the exposed lithostratigraphic units, under these units older *Holocene* deposits can occur.

Nieuwkoop Formation (*Holocene*)

Fluvial deposits of the Kreftenheye Formation and terrestrial deposits of the Boxtel Formation are in places covered by peat. This Early *Holocene* peat layer is classified as the Basal Peat Bed within the Nieuwkoop Formation. Occurrences of the Basal Peat Bed could indicate that the underlying *Pleistocene* landscape has been preserved intact, provided that no erosion as taken place prior to the deposition of the peat. If the Basal Peat Bed is found in borehole or vibrocore samples, signs that the top of the underlying unit is intact can be found in the occurrence of palaeosol horizons. Known are the podzol soils which developed at the higher parts of the cover sand landscape during the Early *Holocene*. These cover sands are classified as the Wierden Member within Boxtel Formation (see text above).

Echteld Formation (*Holocene*)

Both north and south of the Maasgeul a bed of silty humic clay with silty laminae occurs. The presence of washed-in wood remains is characteristic.[18] The clay is deposited in a freshwater environment, with slight tidal influence. Presumably, sedimentation took place under water (subaquatic, subtidal). The bed of humic clay is classified by Hijma as Terbregge Member | Echteld Formation. The classification as a separate member has not been formalized in the DINO nomenclature, yet. The Terbregge Member covers the Early *Holocene* Basal Peat Bed and is itself covered by the Wormer Member | Naaldwijk Formation.

Naaldwijk Formation (*Holocene*)

Pleistocene units and the Early *Holocene* Basal Peat Bed are in places covered by *Holocene* tidal deposits (clay and fine sand). These layered and laminated tidal deposits are part of the Wormer Member within the Naaldwijk Formation. The earliest clastic deposits are those of the Velsen Bed. The Velsen Bed consists of firm to stiff humic clay, sometimes containing considerable amounts of Hydrobia shells. The lower boundary can be present as a gradual transition from peat deposits of the Basal Peat Bed to clastic lagoonal deposits of the Velsen Bed.

Southern Bight Formation (*Holocene*)

The Southern Bight Formation consists of reworked sediments. The Southern Bight Formation is exposed at the seabed surface in major part of the Aramis route trajectory (see figure 17). Along the route, three members of this formation have been mapped. The Bligh Bank Member is a mobile sand layer in which sand ridges, dunes and mega-ripples have developed. This unit predominantly consists of marine sands with variable admixtures of gravel. The formation often has a more gravelly structure towards the base. It should be noted that shell fragments over 4 mm are considered to be 'gravel'.

In the northern part of route, the Bligh Bank Member changes into the Terschellingerbank Member, which consists of reworked (peri-)glacial sand with a small amount (< 10%) of mud.[19]

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[18] Moree and Sier 2015.

[19] Mud = clay (< 2µm) + silt (>2µm and <63µm)

Urania Formation (*Holocene*)

The Urania Formation is found in the northernmost of the route, where the Western Mudhole Member is mapped. Alike the Terschellingerbank Member, the Western Mudhole Member consists of reworked (peri-)glacial material, but the grain size of the sediments is smaller. The unit is described as very fine sand with a considerable admixture (> 10%) of mud.

Figure 17. Geological overview map (De Mulder 2003).

Only the total thickness of the *Holocene* sequence including the Basal Peat Bed, the Naaldwijk Formation, the Southern Bight Formation and Urania Formation is known. The total thickness of the *Holocene* layer ranges from less than 1 to over 10 meters in the area of interest (see figure below).

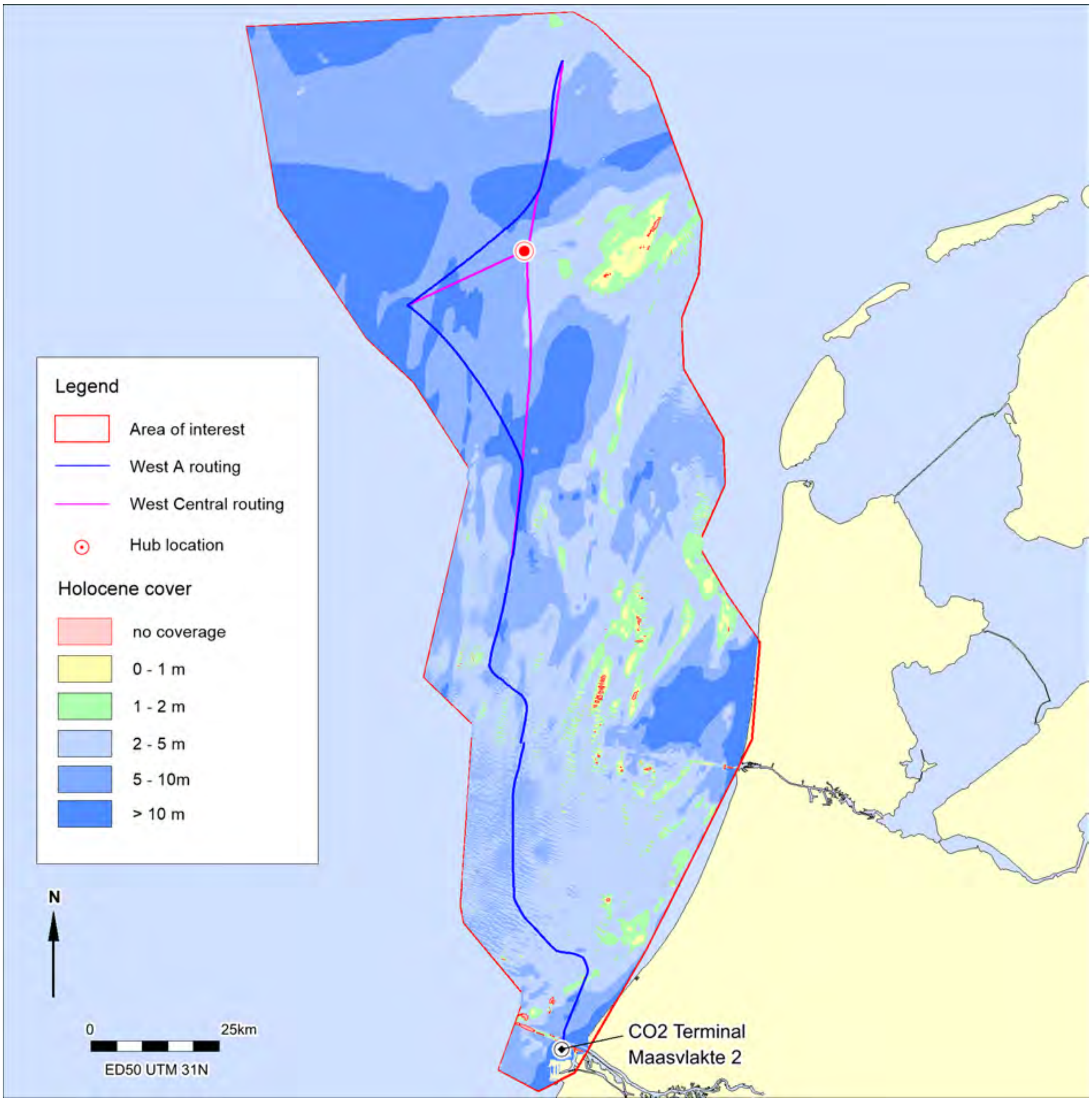

Figure 18. Thickness of Holocene cover

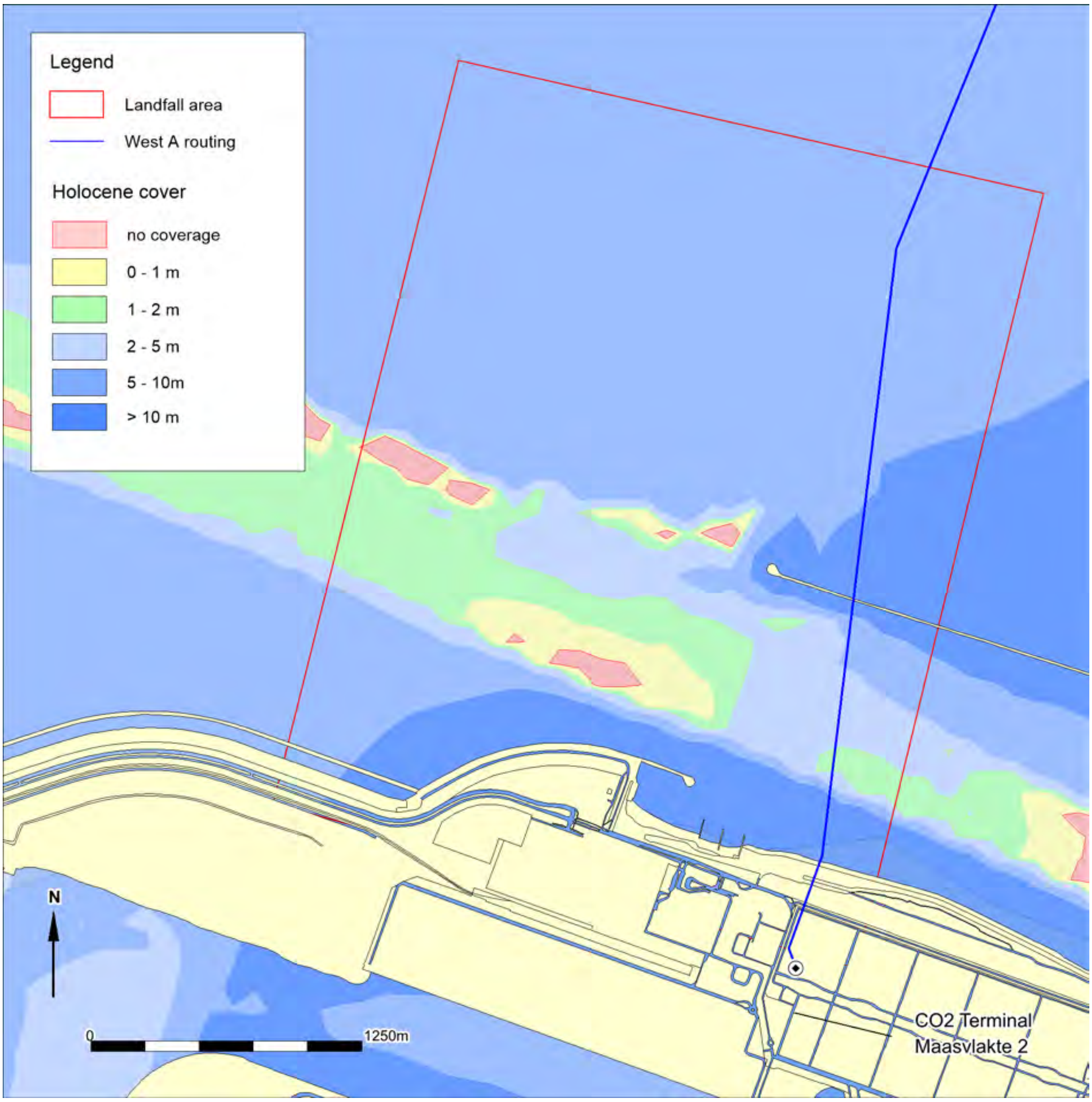

Figure 19. Holocene cover within the landfall area

3.5 Known archaeological values and other objects (LS04)

The former National Service for Archaeological Heritage (ROB, now Dutch Cultural Heritage Agency or RCE) in collaboration with Rijkswaterstaat and TNO NITG has developed a comprehensive archaeological map of the continental shelf based on geological and archaeological observations (see figure below)[20].

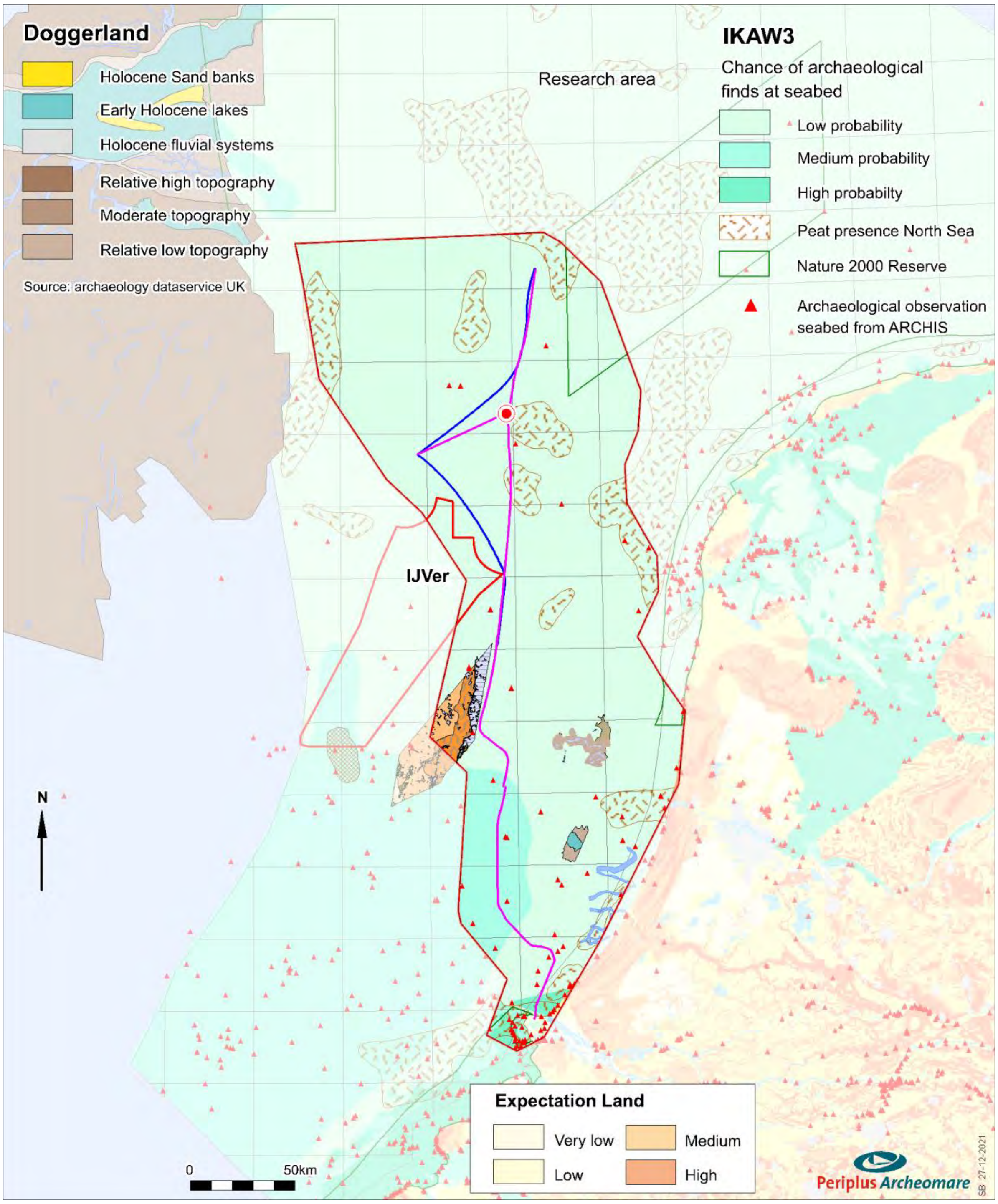

Figure 20. Overview indicative map of archaeological values (IKAW)

[20] IKAW 3e generatie, RCE 2008.

This global map presents the probability of well-preserved shipwrecks to be encountered (and often a ship's discovery of high archaeological value) in the Dutch part of the Continental Shelf, expanded with available palaeogeographic reconstructions.

However, this map is of very limited use. This is partly due to the large scale (1: 500,000). Further the map has become outdated, because it shows the state of knowledge 25 years ago. The degree of conservation of wreck remains is closely related to geology and morphology which has not been taking into account in the IKAW3 map. The idea here is that in channel deposits or regions with soft sediment, a wreck quickly sinks into the seabed and therefore remains in good condition. In other areas with harder top sediments the chance of a find is not necessarily lower, but the chance to find a well-preserved ship with the cargo and equipment still intact is considerably less.

Figure 20 also indicates areas where peat and clay have been preserved. This cover with clay / peat only refers to the possible location of *Pleistocene* deposits on / near the seabed. Where *Holocene* clay or peat is eroded *Pleistocene* layers with artefacts and fauna fossils may be present. The presence of early *Holocene* sediments could indicate the presence of a well preserved prehistoric landscape. West of the area of interest lies the nature reserve Brown Bank, a shoal known for its paleontological and prehistorical finds. At this archaeological hotspot rigid *Pleistocene* clays and silts of the Brown Bank Member are exposed at the seabed. These sediments contain the prehistoric remains which are found in the nets of fishermen.

Research in the last decade has shown that the probability of encountering prehistoric residues in the North Sea is much greater than originally thought. The archaeological map for the Dutch continental shelf is therefore being revised. In 2016, an indicative model of the archaeological potential of the North Sea was published by Deltares[21]. A detail of this map is shown in figure 21. The potential for prehistoric remains is closely related to the lithostratigraphic units which have been discussed and outlined in previous paragraphs. For instance the potential for Middle Palaeolithic remains indicated in red coincides with the occurrence of the Kreftenhye Formation and Brown Bank Member, the potential for residual Mesolithic and Late Palaeolithic remains indicated in beige coincides with the occurrence of the Boxtel Formation and the limited potential for prehistoric remains in areas indicated in grey relates to the occurrence of the marine deposits of the Egmond Ground Formation and the Eem Formation[22].

It should however be stressed that figure 21 offers a two dimensional view. The occurrences of the Eem Formation (grey), the Kreftenheye Formation and the Brown Bank Member (red) are not limited to the mapped areas but extend underneath the Boxtel Formation (beige). This means that Middle Palaeolithic remains are also to be expected in those areas.

It is important to bear in mind that the occurrences and boundaries of the lithostratigraphic units mapped are based on a limited amount of geological data. The occurrences and boundaries should therefore not be considered definite, but an indication of what is to be expected in the area and a framework for further research. Also morphological phenomena like the ice-pushed ridges have not been taken into account in this map.

[21] Vonhögen et al, 2016.

[22] Occurrence Naaldwijk Fm according to Deltares grids (2004).

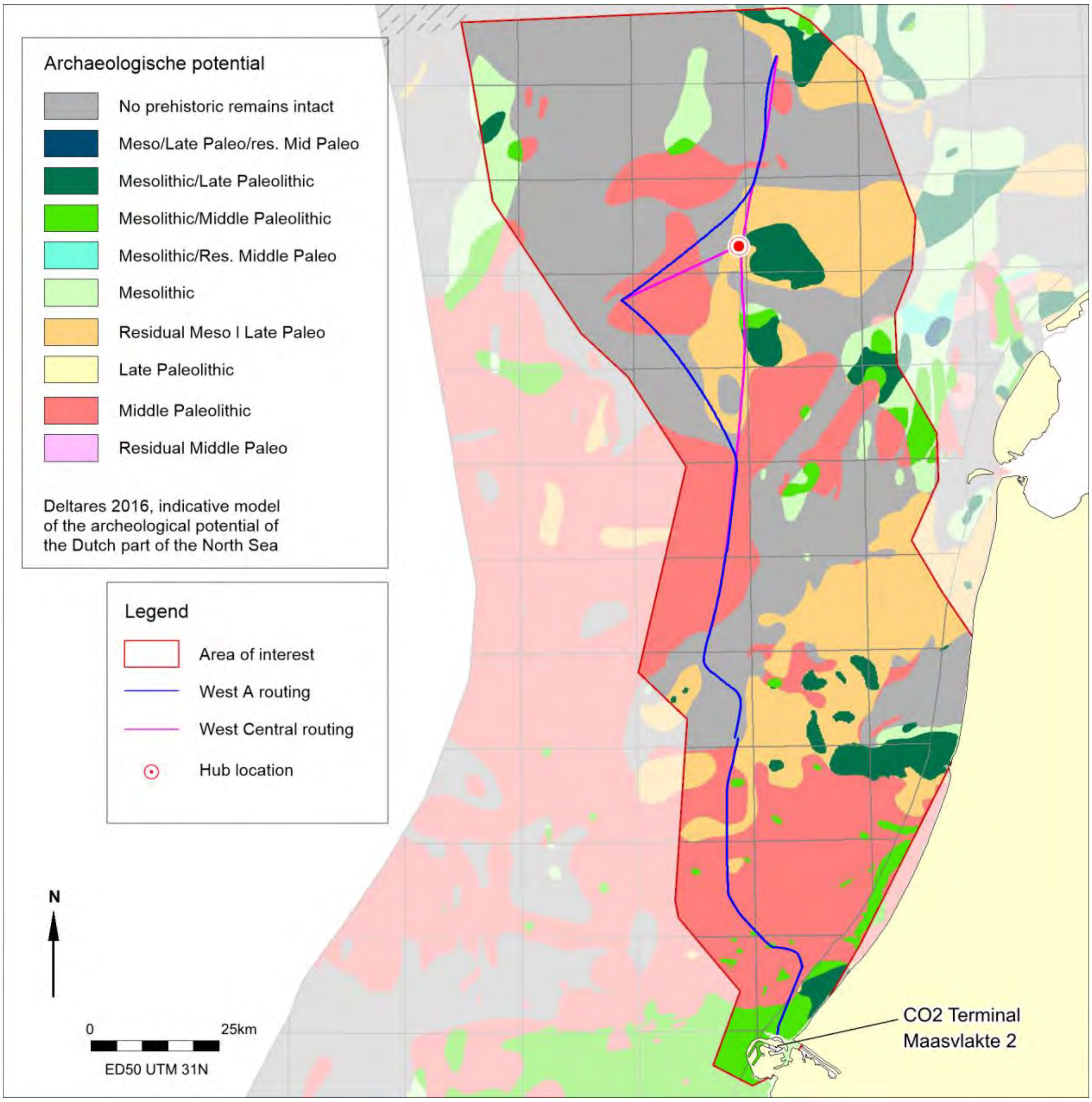

Figure 21. Archeological potential for prehistoric remains

Ice-pushed ridges

The ice-pushed ridges have been formed by Saadian glaciers which stretched into the North Sea area. pre-dates the Eemian, Weichselian and Early *Holocene* deposits. The ice-pushed river sands of the Yarmouth Roads Formation can contain reworked flint artefacts from Lower and Middle Palaeolithic times. At the top of the ice-pushed ridge in situ remains of camp sites and inhumations of Neanderthal and Late Palaeolithic and Mesolithic hunters and gatherers can be expected.

Open sea (Eemian)

The Eem Formation consists predominantly of marine sand deposited in the Eem Sea during the Eemian interglacial (warm) period.[23] Within the sandy marine deposits no *in situ* archaeological remains are expected.

[23] Eemien: interglacial which lasted from 130.000 till 115.000 years ago.

Lagoons, lakes and fens (Eemian to Early Weichselian)
The Brown Bank Member at the top of the Eem Formation consists of lacustrine fresh water and coastal marine brackish water deposits of silty clay. At the end of the Eemian the sea regressed and the Brown Bank clays were deposited. This layer can contain Middle Palaeolithic artefacts from, or remains of Neanderthals who in this period populated the Netherlands and the North Sea area. Little archaeological research has been done into this often deep-seated stratigraphical unit. Camp sites are expected to be intact and well preserved, especially when the remains are contained in a clayey context and covered by peat of the Woudenberg Formation and/or cover sands of the Wierden Member | Boxtel Formation. The Woudenberg Formation can contain dumps from close-by camps, lost hunting gear and intended depositions. The available geological information does not suffice to assess whether the Late Eemian to Early Weichselian facies of sandy lagoonal beaches and/or clayey shores of lakes and fens is present.

The top of the Brown Bank Member is expected at depths varying from 0m to 30m below the seabed.

River valley (Weichselian)
The Kreftenheye Formation consists of fluvial deposits of the Rhine and Rhine - Meuse system. The extent and distribution of the channel belts during the Pleniglacial (74 ka – 15 ka ago) is illustrated in Figure 15. Well-preserved finds prove that Neanderthal occupied the Rhine valley. Melt water discharged through the braided channels of the Rhine. Peak discharge occurred during the summer months, when temperatures rose above freezing point in the hinterland. Large mammals including woolly mammoths, woolly rhinoceros, musk ox and steppe wisent migrated over the steppe-tundra landscape. This landscape was vegetated with grasses, herbs and occasional dwarf birches. The water-intake of mammoths was immense, so the fresh-water-filled channels must have had a large attraction to these animals, thus offering Neanderthal the opportunity to hunt them. The change of encountering *in situ* remains in the residual infilled channels of the Kreftenheye Formation is considered to be relatively large. It is believed that the Neanderthal became extinct some 40 kyr to 35 kyr ago, prior to the Late Glacial Maximum, some 27 kyr to 19 kyr ago.

The Wijchen Bed at the top of the Kreftenheye Formation consists of firm, matured humic clays in which locally palaeosol developed. In the clayey context of this bed well-preserved Late Palaeolithic and Mesolithic remains could be encountered. These remains include lost hunting gear and waste of camp sites which are found on nearby river dunes. Also the presence of camp site relics on the overbanks deposits cannot fully be excluded.

Cover sand landscape (Late Weichselian and Early *Holocene*)
The camp sites of Late Palaeolithic and Mesolithic hunters and gatherers are found in a cover sand landscape with ridges and dunes and valleys formed by small streams. Stream valleys offered fresh water, a large variety of plant species and ample opportunities for hunting. Camps were installed along the borders of those valleys. The remains of sites can be encountered in the context of sandy, loamy, clayey or peaty beak deposits of the Singraven Member. The lithological context of settlements found at the dunes and ridges comprises well sorted non-calcareous fine cover sand of the Wierden Member. Both Singraven and Wierden Member are part of the Boxtel Formation.

Late Palaeolithic and Mesolithic remains are expected at two distinct levels within the cover sand sequence. The first is a palaeosol found in between two cover sand layers Late Palaeolithic remains of camp sites of reindeer hunters are to be expected. The palaeosol is a charcoal rich layer called the Usselo Bed, which has been formed during the Bølling and Allerød interstadials. The second level is the top of the cover sand sequence. The sandy dunes and ridges often display a well-developed podzol, if not eroded. Due to the low carbonate content presence of oxygen in the pores of the sand the preservation conditions for organic remains (wood, bone, et cetera) is a priori not so good in cover sands. The preservation of organic remains is therefore highly dependent on the timing of the water table rising above the archaeological level.

If the Boxtel Formation is covered by the Basal Peat Bed or the Velsen Bed the integrity and conservation of archaeological remains is expected to be high. Considering our limited knowledge of prehistoric sites in the North Sea area such well-preserved finds would *a priori* be worth preserving. Archaeological markers consist of flint and bone artefacts, burnt nuts and seeds and charcoal. Zones of interest are locations where the top of the cover sands and river dunes (if present) are not eroded. The presence of the Basal Peat Bed and Velsen Bed indicate that underlying Boxtel Formation and possible archaeological remains herein could be intact.

Peat and humic clays
The Basal Peat Bed and Velsen Bed themselves can also contain archaeological remains. These remains include dumped waste from nearby camp sites, lost hunting gear or intentional (e.g. ritual) depositions. Due to the low levels of oxygen and wet conditions both organic and inorganic remains might be very well preserved.

Site characteristics
The expected camp sites of hunters and gatherers are generally small (a few sqm), although larger settlements (up to approximately 2000 sqm) can occur in case the site repeatedly or for prolonged period of time was occupied. Sites are characterized by the presence of concentrations of charcoal, flint artefacts, bone remains, burnt seeds and nuts, natural stones and artefacts of bone or horn. Inhumations can occur. The density of finds (debris of flint processing) can vary from low to high.

Physical Quality
It is not known to what extent erosion has affected the integrity of the *Pleistocene* landscape and embedded remains of prehistoric settlements. The presence of the Basal Peat Bed, the Terbregge Member (Maasgeul area) and/or Velsen Bed provides an indication for an intact *Pleistocene* landscape, although it should be noted that erosion could have taken place prior to the deposition of peat and clay, leading to degradation or even annihilation of prehistoric remains. If the *in situ* prehistoric remains did not suffer from erosion, the very rapid Early *Holocene* ‘drowning’ of the *Pleistocene* landscape and local deposition of a peat and/or clay cover offered perfect conditions for the conservation of both organic and inorganic remains. In this situation well-preserved sites of high physical quality can occur.

Occurrence and spacial distribution
The occurrence and spacial distribution of Late Saalian ice pushed-ridges, Early Weichselian lagoons, lakes and fens, Pleniglacial river deposits and the Late Weichselian wind-blown dunes and stream valleys in the area of interest is not known in detail. Surely the available geological maps of the Flemish Bight Map (1984), the Indefatigable Map (1986), the Top *Pleistocene* Formation map and Deltares’ grid data (2004) and palaeogeographic maps (2015) provide an indication, but the actual situation can only be established through subbottom profiling in combination with borehole sample analysis. The depth below the seabed of the *Pleistocene* landscape ranges from 0m (*Pleistocene* exposed) to nearly 30m.

Known objects and shipwrecks

For a listing of known objects and shipwrecks within the area of interest, the united NCN database is consulted[24].

The National Contact Number (NCN)

The NCN database combines the data from three governmental databases:

- The Dutch Continental Shelf and Westerschelde wrecks register from The Hydrographic Service of the Royal Netherlands Navy.
- The SonarReg92 object database of Rijkswaterstaat
- The ARCHIS database (the official archaeological database of the Ministry of Cultural Heritage)

The permission for the use of the NCN database was granted by the owner (Rijkswaterstaat Sea and Delta)

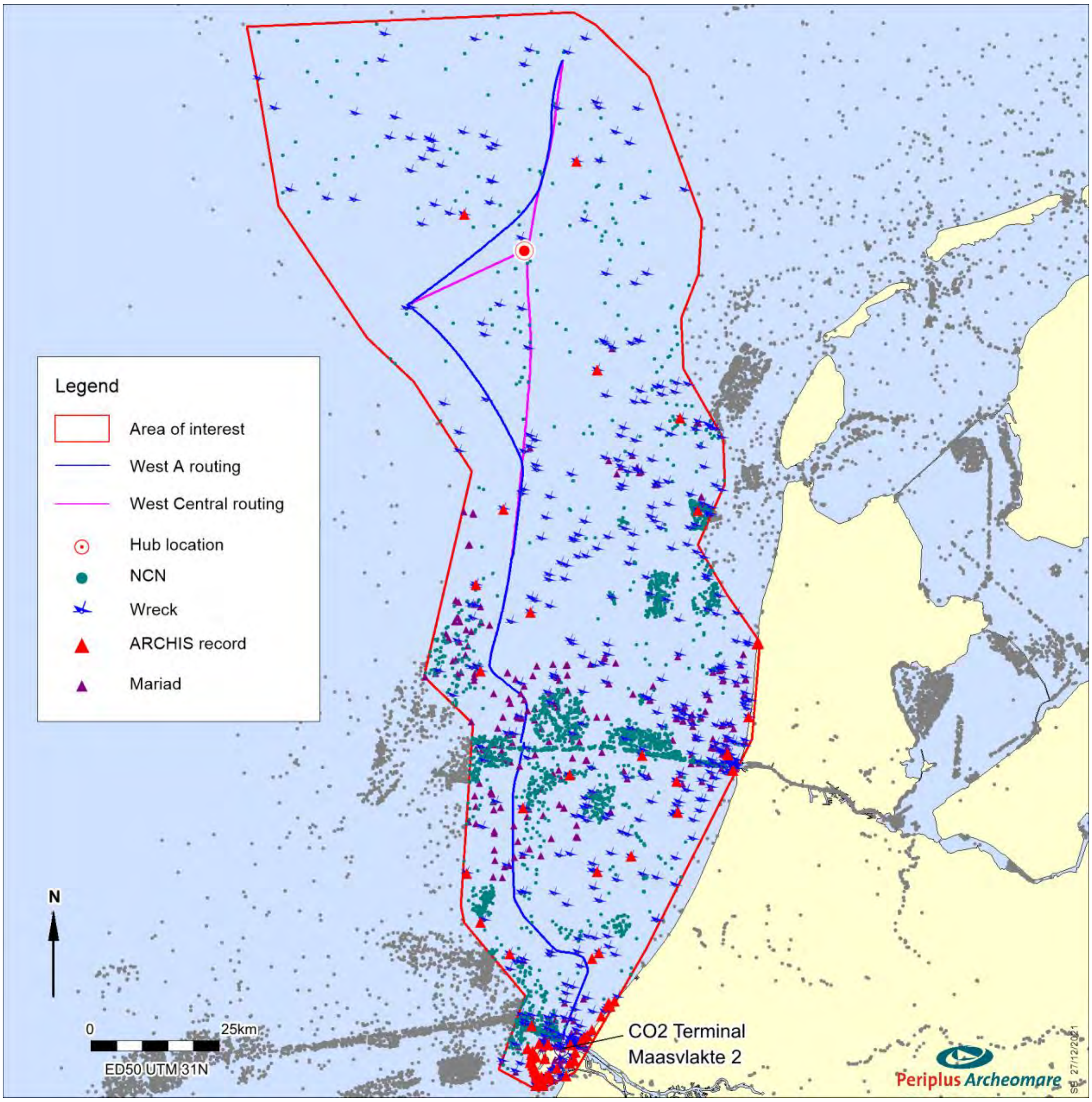

Figure 22. Overview of known objects and contacts in the area of interest

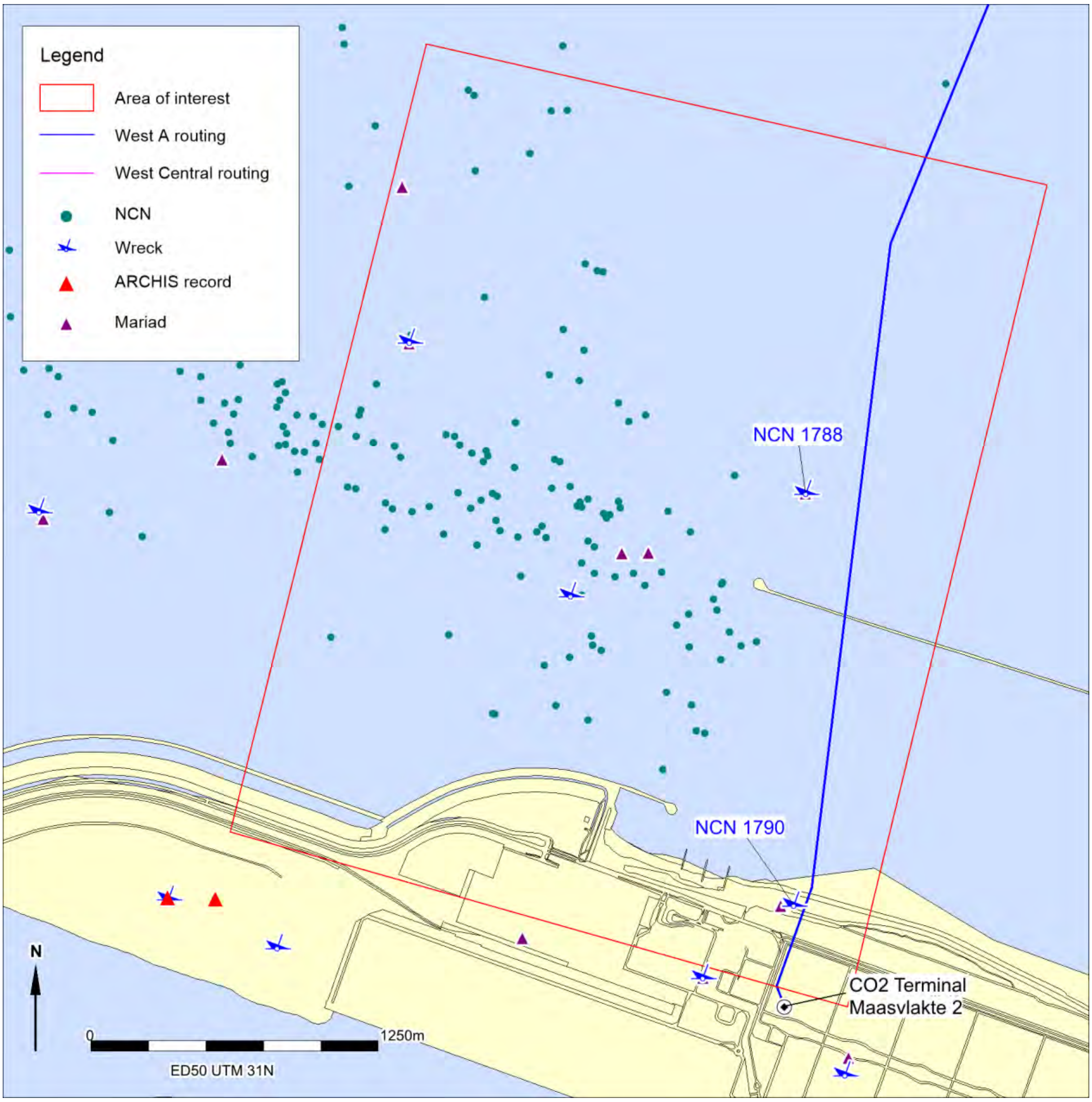

Figure 23. Overview of known objects and contacts in the landfall area

Archaeological records.

Within the area of interest, 316 records of archaeological finds are known with the ARCHIS 3 database. These vary from prehistoric artefacts (mainly concentrated around Maasvlakte 2) to remains of shipwrecks, (see next paragraph).

Shipwrecks

There are 458 known shipwrecks within the area of interest of which 38 are officially recorded in the ARCHIS database. 307 wrecks are identified and date from the 16th to the 21st century. The remaining 151 wrecks have not been identified and dated yet. Additional research is needed to determine the cultural-historical value.

Within the landfall area, two records of ship wrecks are known in the vicinity of the proposed route. NCN 1788 was the wreck of the *SS Ceres*, sunk in 1934, and was cleared away to a depth 0f 75 dm. Remains may still be present. NCN 1790 was the wreck of the *Hertha Engelina Frit, sunk in 1941.* It is now covered by sand in reclaimed area.

In general, when a sinking ship ends up on the seabed, the tidal currents will create scouring around the wreck, and bury it down to a level of a harder surface within the sedimentary sequence. The thicker the layer of loose material, the more the ship will be packaged therein and will be retained. Especially in areas where the sediments have high clay content the wreck remains will be sealed and well preserved. In more sandy areas this effect is much smaller. Uncovered wooden parts may be affected by a naval shipworm (Teredo Navalis).

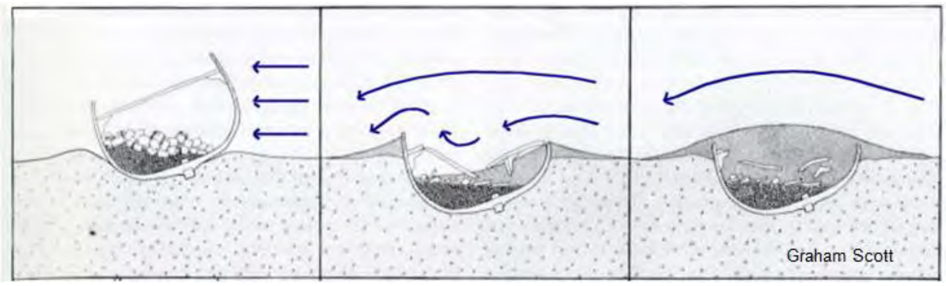

Figure 24. Example of wreck site formation (Graham Scott)

Other know objects

Besides wrecks, the SonarReg database contains records of 3494 other known objects within the area of interest. A summary is listed below.

Classification	**Amount**
Anchors	121
Boulders	77
Cables/Chains	304
Man-made objects	193
Natural phenomena	10
Seabed disturbances	226
Unidentified objects	2563
Total	**3494**

Table 4. Observations of known objects

Among the man-made objects and unidentified objects archaeological artefacts may be present.

Airplane wrecks

During World War II, many airplanes crashed into the North Sea. Several sources are ambiguous about the number of aircraft still missing. It is at least hundreds[25]. Remains are found on a regular basis by fishermen or during sand extraction or and beach protection projects. Within the area of interest, five locations with remains of aircrafts are known.

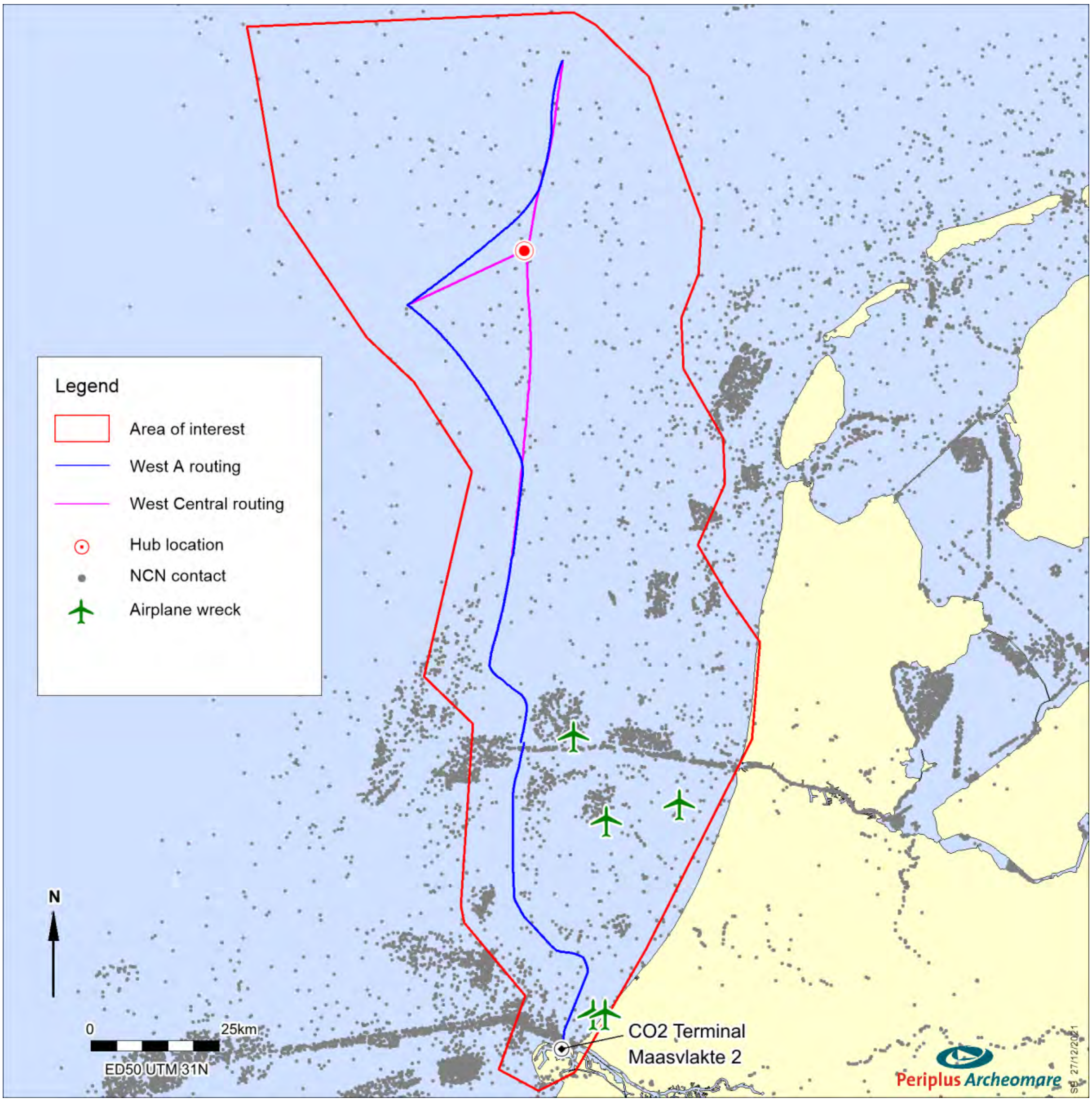

Figure 25. Known airplane wrecks within the area of interest

A complete listing of all known wrecks and objects within the area of interest can be made digitally available in consult with the administrator, Rijkswaterstaat Zee en Delta.

[25] Dutch Federation of Aviation Archaeology

3.6 Specified archaeological expectancy (LS05)

Shipwrecks

The area has a high expectation for shipwrecks from all periods. A total of 458 shipwrecks are known in the area, and more undiscovered wrecks can be expected. For some of the wrecks details like names, types and date of sinking are not known. Further research is needed to determine the cultural-historical value of these wrecks.

Plane wrecks

The area has a high expectation for plane wrecks from the Second World War. Several sources are ambiguous about the number of aircraft still missing. It is at least hundreds [26]. Within the area of interest, five locations with remains of aircrafts are known.

Current theme : wrecks from the First and Second World Wars

In addition to archaeological and cultural-historical value, ship and aircraft wrecks can also have a, memorial or emotional value. The commotion that arose as a result of the clearing of WWII wrecks in the Java Sea can be mentioned as an example. With regard to wrecks from the World Wars in Dutch waters, more and more voices are coming from society to deal with this respectfully.

Prehistory

During the last ice ages the area of interest was exposed due to very low sea levels. In those times the landscape was occupied by hunters and gatherers. Therefore camps sites are to be expected in the top of *Pleistocene* formations. The archaeological expectancy is discussed below by means of the geogenesis of the area and lithostratigraphic units present. As discussed in the section on ship wrecks, also for the *Pleistocene* landscape applies that our specific knowledge is limited, because a major part of the area has not been investigated by detailed geophysical surveys or the analysis of high quality borehole samples. As part of the Aramis pipeline development shall therefore be strived to gather additional information to broaden and deepen our geo-archaeological knowledge of the area, as outlined in the NSPRMF report.

[26] Dutch Federation of Aviation Archaeology.

Formation	Member / Bed	Lithology	Environment	Age	Arch. Potential*	Period
Southern Bight	Bligh bank	sand	open marine	Holocene	I, IV	Historical periods
Naaldwijk	Wormer	clay and sand	tidal		I	
	Velsen	humic clay	lagoon	Early Holocene	II	Meso
Echteld	Terbregge	humic clay with plant remains	freshwater tidal		II	
Nieuwkoop	Basal Peat	Peat	coast marsh		II	
Boxtel	Singraven	sand, loam, clay and peat	small-scale fluvial	Weichselian and Early Holocene	II and III	LPaleo + Meso
	Delwijnen	sand	river dune		III	
	Wierden	fine sand	cover sand		III	
Kreftenheye	Wijchen	clay and loam	overbank	Weichselian and Early Holocene	II and III	
		sand	bedding sand		II and III	MPaleo
Woudenberg		Peat	lakes	Eemian and Early Weichselian	II	
Eem	Brown Bank	humic clay and silt	lagoons and lakes	Eemian and Early Weichselian	II and III	
		sand and clay	open marine	Eemian	IV	
Boxtel | Drachten		gravel, sand, loam, peat	terrestrial	Late Saalian to Early Eemian	II and III	
Egmond Ground (ice-pushed)		sand with clay beds	open marine	Pre-Saalian deposition; Saalian (ice-push event)	II, III and IV	MPaleo - Meso
Yarmouth Roads (ice-pushed)		sand and clay	open-marine deltaic, delta top and fluvial	Pre-Saalian deposition; Elsterian/Saalian (ice-push event)	II, III and IV	Paleo - Meso

Table 5. Relation between lithostratigraphy and archaeological potential

*

Archaeological Expectancy	
I	Ship wrecks and shipping related objects; air planes from World War I and II
II	Lost or dumped objects including flint and bone hunting gear, fish weir, fish traps and dugout boats
III	Camp sites and inhumations
IV	Artefacts in reworked context

Archaeological levels are contained in the stacked sequence of *Pleistocene* and *Holocene* units. The relationship between the lithostratigraphic units and archaeological levels contained herein is summarized in table 5.

4 Synthesis

Based on the results of de data analysis the research questions are answered.

Are there any known archaeological values present within the area of interest? If so, what is the nature, extent (depth) location and dating of these sites?
Yes, within the area of interest, 316 records of archaeological finds are known with the ARCHIS 3 database. These vary from prehistoric artefacts (mainly concentrated around Maasvlakte 2) to remains of shipwrecks.

Are there, in addition to any known values, archaeological remains to be expected? If so, what are the nature, extent (depth) location and date of the expected archaeological remains?
Yes. There are 458 known shipwrecks within the area of interest of which only 38 are officially recorded in the ARCHIS database. 307 wrecks are identified and date from the 16th to the 21st century. The remaining 151 wrecks have not been identified and dated yet. Additional research is needed to determine the cultural-historical value.

The area may contain shipwrecks, remains of shipwrecks or remains of airplanes from the Second World War which have not been discovered to date. Apart from undiscovered ship and plane wrecks it is expected that locally prehistoric landscapes have been preserved intact. Related to these intact landscapes *in situ* prehistoric remains left behind by Palaeolithic and Mesolithic hunters and gatherers can be encountered.

Those *in situ* prehistoric remains include camp sites, burials, lost hunting gear, et cetera. Remains of camp sites are characterized by the presence of flint and bone artefacts, burnt nuts and seeds, charcoal and hunting gear.

Can the proposed activities affect known or expected archaeological values? If so, can an impact on archaeological assets be prevented or restricted by planning adaptation?
This question can only be answered once the area has been geophysically investigated and when the cultural historic value of the objects in the area has been determined.

If the archaeological values cannot be saved: What kind of further research is needed to determine the presence of archaeological values and their size, location, type and date to be determined enough to come to a selection decision?

Further research is to be performed within the framework of the standardized sequence of phases of maritime archaeological research as defined in the Dutch archaeological management procedure (Dutch: 'AMZ Cycle'). The research strategy is further determined by the type of archaeological remains which, based on the archaeological expectancy outlined in section 3.6 of this report, are to be expected. In summary the expectancy is two-fold comprising plane and ship wrecks on one hand and prehistoric remains on the other. The first phase after the archaeological desk study is an inventory field research. This field research comprises a geophysical survey. The methods employed include multibeam echo sounder, side scan sonar and magnetometer to trace and map wrecks and shipping related objects. A subbottom profiler is used to assess the potential for prehistoric remains by mapping the top of the buried *Pleistocene* landscape, identify seismostratigraphic units and correlate those units with the expected lithostratigraphic units (and potential archaeological remains herein), and determine the locations at which archaeological levels have been affected by erosion.

What are the possible effects of the installation of the pipeline on the areas with specific archaeological interest?

Archaeological values can be affected by human activities which result in a disturbance of the seabed. Direct disturbances are caused by trenching operations. Scouring adjacent to the pipeline is considered to be an indirect disturbance which might lead to the exposure of wrecks and erosion of the prehistoric landscape.

What are the possibilities to mitigate the disturbance of areas with specific archaeological interests?

In general, a buffer or safety zone of 100 meters around an archaeological object or an object with an archaeological expectation is to be defined in which seabed disturbing activities are not allowed[27]. If additional research shows that the object has no archaeological value, the location and the buffer zone can be omitted. The identification and mapping of camp sites from the Palaeolithic and Mesolithic is, due to their limited size and depth of burial, in practice troublesome. Mitigating measures to preserve those sites can therefore only be effected by excluding areas in which prehistoric landscapes have been preserved intact and which are considered to have a high probability for containing those sites.

Should further investigations be carried out from archaeological point of view and what are the recommendations on the scope and specifications of these investigations?

Additional research in the form of a geophysical survey is standard in the process of archaeological investigations. (in Dutch: *Inventariserend veldonderzoek opwaterfase*). The scope and specifications for this geophysical survey are to be recorded in a mandatory Program of Requirements (PvE). Typical requirements include restrictions about the maximum range and minimum frequency of the side scan sonar, survey speed and line spacing.

[27] Beleidsregels ontgrondingen in Rijkswateren, see http://wetten.overheid.nl/BWBR0028498/

5 Summary and recommendations

The installation of the pipelines may affect archaeological remains in the area, if present. According to the Law on Archaeological Heritage (Dutch: Erfgoedwet 2016) there is a statutory obligation to conduct archaeological research in order to protect the remains. This archaeological desk study is the first step in the archaeological process aiming to establish whether archaeological remains are, or are likely to be, present, and whether these remains could be effected by the development of the planned pipelines. The results are summarized below.

The area of interest has a high expectation for the presence of (remains of) ship wrecks and WWII plane wrecks. Intact prehistoric landscapes and related *in situ* remains of Palaeolithic and Early Mesolithic camp sites and inhumations are expected to have been preserved in places.

The proposed pipeline routes have not been investigated by detailed geophysical surveys yet. These areas may contain more undiscovered shipwrecks or remains of shipwrecks than currently known.

At this stage little is known about the integrity of the *Pleistocene* and Early *Holocene* landscapes. By means of subbottom profiling the occurrence geological units (both horizontal as vertical) and archaeological levels herein can be mapped. The character of layer boundaries (erosive or non-erosive) can be interpreted. It is unlikely however that archaeological remains of Palaeolithic and Mesolithic camp sites can be identified with sufficient certainty (based on the geophysical and geotechnical surveys) to impose restrictions on pipeline development. At this stage focus should therefore not be put on tracing prehistoric camp sites but on a pragmatic employment of geophysical techniques in order to obtain a better insight in (the integrity of) the *Pleistocene* landscape. The insights gained shall be used to a) refine the archaeological expectancy model and b) allocate areas with a high expectancy for *in situ* prehistoric remains.

In accordance with the AMZ cycle it is advised to conduct a field investigation (in Dutch '*Inventariserend veldonderzoek opwaterfase*') in order to test the archaeological predictive model and further specify the type, vertical and lateral extent, age, integrity and preservation of ship wrecks, prehistoric landscapes and potential archaeological levels.

Archaeological Expectancy	Method		Goal	Remarks
Ship and aircraft wrecks	Geophysical	Side Scan Sonar	detect and map wreck sites	wrecks exposed at, or protruding from the seabed
		Multibeam	characterize wreck sites morphologically; detect (partially) buried wrecks by the occurrence of scours	in addition to side scan sonar
		Sub-bottom Profiler	detect buried objects including possible ship wrecks and remains of aircraft	nature of the buried object cannot be determined directly
		Magnetometer		
Prehistoric settlements (camp sites)		Sub-bottom Profiler	map the Pleistocene landscape; specify expectancy	supported by, and validated with drill data
	Geotechnical	Geological Drilling	determine lithostratigraphy, soil layer boundaries (erosive or gradual) and characteristics of soil formation and maturation; specify expectancy	designation of borehole and/or vibrocore locations for geo-archaeological research based on SBP data
		Cone Penetration Test	determine lithostratigraphy	correlate with drilling data

Table 6. Testing of archaeological expectation with geophysical and geotechnical methods

In general, similar investigations carried out in the past consist of a geophysical survey with *side scan sonar*, *magnetometer* and *subbottom profiler* and a geotechnical survey. The resulting data should be assessed after the general processing, interpretation and reporting has been performed by the survey contractor.

The archaeological assessment of the data shall to be conducted by a geophysical specialist (KNA prospector Waterbodems). The data quality from the surveys needs to match the demands for this archaeological assessment. To ensure compatibility between the site investigation and the required quality for this assessment it is recommended to define a Program of Requirements (In Dutch: ‘Programma van Eisen’) in accordance with the ‘KNA’ (the Dutch quality standards for archaeological research), to be authorized by the competent authority.

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Glossary and abbreviations

Terminology	Description
AMZ	Archeologische Monumenten Zorg
CPT	Cone penetration test
Ferrous	Material which is magnetic or can be magnetized, and well known types are iron and nickel
Holocene	Youngest geological epoch (from the last Ice Age, around 10,000 BC. To the present)
In situ	At the original location in the original condition
KNA	Kwaliteitsnorm Nederlandse Archeologie
Magnetometer	Methodology to measure deviations from the earth's magnetic field (caused by the presence of ferro-magnetic = ferrous objects)
Multibeam	Acoustic instrument that uses different bundles or beams to measure the depth in order to create a detailed topographic model
NoaA	Nationale Onderzoeksagenda Archeologie
NSPRMF	North Sea Prehistory Research and management Framework
Pleistocene	Geological era that began about 2 million years ago. The era of the ice ages but also moderately warm periods. The *Pleistocene* ends with the beginning of the *Holocene*
PvE	Program of Requirements (Programma van Eisen)
RCE	Rijksdienst voor het Cultureel Erfgoed
ROV	Remotely Operated Vehicle
Side scan sonar	Acoustic instrument that registers the strength of reflections of the seabed. The resulting images are similar to a black / white photograph. The technique is used to detect objects and to classify the morphology and type of soil
Current ripples	Asymmetrical wave pattern at the seabed caused by currents. The steep sides of the ripples are always on the downstream side.
Subbottom profiler	Acoustic system used to create seismic profiles of the sub surface.
Trenching	Construction of a trench for the purpose of burying a cable or pipeline
Vibrocore	A special drilling technique where a core tube is driven by means of vibration energy in the seabed. In addition, the core tube is provided with a piston so that the bottom material in the core tube remains in place.

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- Databases Periplus Archeomare
- KNA Waterbodems 4.1
- Nationaal Contactnummer Nederland (NCN)
- SonarReg92, objectendatabase Rijkswaterstaat Zee en Delta

Appendix 1. Phases of maritime archaeological research

The Dutch Quality Standard for Archaeology (KNA waterbodems, version 4.1) describes all procedures and requirements for the archaeological research process. Below a brief description of the steps involved:

Desk study

The purpose of a desk study is to collect and report all available historical data, geological information and information about disturbances in the past. The result is an archaeological expectation map or model.
The desk study may be expanded with an analysis of sonar and multibeam data, if available.

IF the outcome of the desk study shows that there is a risk of occurrence of archaeology, then the next phase must be carried out:

Exploratory geophysical field research (opwaterfase)

In order to test the archaeological expectation, a geophysical survey is carried out. The type of survey depends on the type of expected objects, local geology and expected depth of the objects below the seafloor. In practice, the research usually consists of a side scan sonar survey, if necessary, supplemented with multibeam echo sounder recordings, subbottom profiling and magnetometer measurements. The requirements of the survey are based on the desk study and should be included in a program of requirements which must be approved by the competent authorities.

IF potential archaeological objects are found, then the next phase must be carried out:

Exploratory field research under water (onderwaterfase verkennend)

The suspected sites are investigated by specialized divers in order to identify the objects. The requirements of the underwater research are included in a program of requirements which must be approved by the competent authorities.

IF as site is identified as an archaeological object or structure then the next phase must be carried out:

Validating field research (onderwaterfase waarderend)

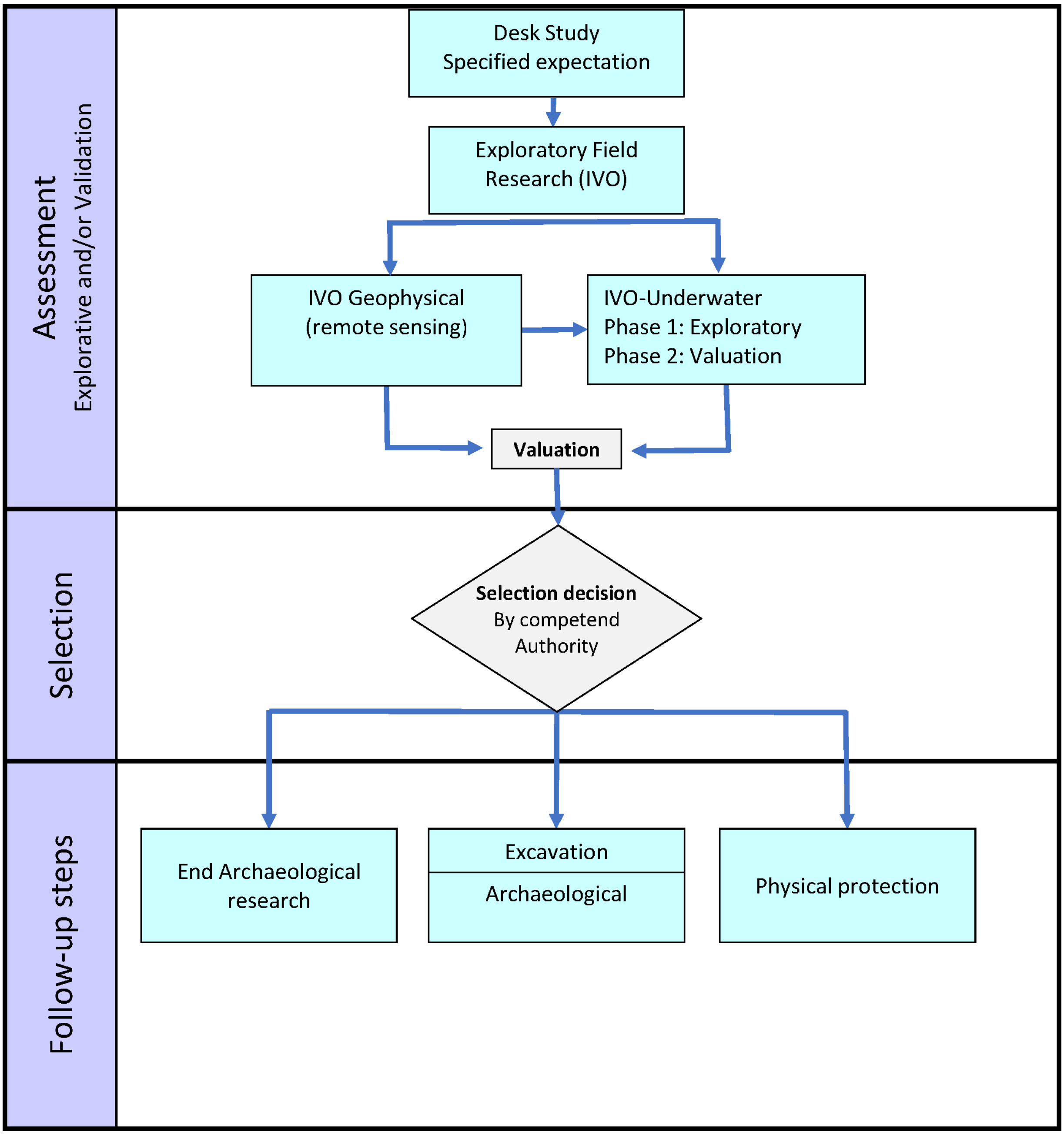
The archaeological remains at the site are thoroughly investigated and mapped by a specialized archaeological diving team and samples are collected for additional research. Then a decision will be made whether the archaeological remains are worth preserving. If the latter is the case, then there are two possibilities: either the remains can be preserved in situ (adjustment of plans) or the next phase will be conducted:

Archaeological excavation

The archaeological remains are excavated under supervision of a senior maritime archaeologist. All remains need to be documented, registered and conserved. The requirements of the underwater research are included in a program of requirements which must be approved by the competent authorities.

The phases described above contain a number of decision points that are dependent on the detected archaeological objects and structures. The figure on the next page shows these moments schematically.

Schematic overview KNA Waterbodems version 4.1



Appendix 2. Archaeological and geological periods and time scale

Chronostratigrafie

Serie	Etage - Chronozone			Tijd
Holoceen	**Laat Subatlanticum**			**1150 n. Chr**
Holoceen	Vroeg Subatlanticum			0
Holoceen				450 v. Chr
Holoceen	Subboreaal			3700
Holoceen	Atlanticum			7300
Holoceen	Boreaal			8700
Holoceen	Preboreaal			9700
Pleistoceen	Weichselien	Laat Glaciaal	Jonge Dryas	11.000
Pleistoceen	Weichselien	Laat Glaciaal	Allerød	12.000
Pleistoceen	Weichselien	Laat Glaciaal	Oude Dryas	12.100
Pleistoceen	Weichselien	Laat Glaciaal	Bølling	13.000
Pleistoceen	Weichselien	Pleniglaciaal L		17.000
Pleistoceen	Weichselien	Pleniglaciaal L	Late Glacial Max	20.000
Pleistoceen	Weichselien	Pleniglaciaal L		31.500
Pleistoceen	Weichselien	Pleniglaciaal L	Denekamp	34.000
Pleistoceen	Weichselien	Pleniglaciaal M		40.000
Pleistoceen	Weichselien	Pleniglaciaal M	Hengelo	41.500
Pleistoceen	Weichselien	Pleniglaciaal M		45.000
Pleistoceen	Weichselien	Pleniglaciaal V	Moershoofd	50.000
Pleistoceen	Weichselien	Pleniglaciaal V		71.000
Pleistoceen	Weichselien	Vroeg Glaciaal	Odderade	74.000
Pleistoceen	Weichselien	Vroeg Glaciaal		
Pleistoceen	Weichselien	Vroeg Glaciaal	Brørup	
Pleistoceen	Weichselien	Vroeg Glaciaal		
Pleistoceen	Weichselien	Vroeg Glaciaal	Amersfoort	
Pleistoceen	Weichselien	Vroeg Glaciaal		114.000
Pleistoceen	Eemien			126.000
Pleistoceen	Saalien			236.000
Pleistoceen	Oostermeer			241.000
Pleistoceen	onbenoemd			322.000
Pleistoceen	Belvédère			336.000
Pleistoceen	onbenoemd			384.000
Pleistoceen	Holsteinien			416.000
Pleistoceen	Elsterien			463.000

Archeologische periode

Tijdperk				Datering
Nieuwe tijd			C	1850
Nieuwe tijd			B	1650
Nieuwe tijd			A	1500
Middeleeuwen		Laat	B	1250
Middeleeuwen		Laat	A	1050
Middeleeuwen		Vroeg	D	900
Middeleeuwen		Vroeg	C	725
Middeleeuwen		Vroeg	B	525
Middeleeuwen		Vroeg	A	450
Romeinse tijd			Laat	270
Romeinse tijd			Midden	70 n. Chr.
Romeinse tijd			Vroeg	15 v. Chr.
Prehistorie	Metaaltijden	IJzertijd	Laat	250
Prehistorie	Metaaltijden	IJzertijd	Midden	500
Prehistorie	Metaaltijden	IJzertijd	Vroeg	800
Prehistorie	Metaaltijden	Bronstijd	Laat	1100
Prehistorie	Metaaltijden	Bronstijd	Midden	1800
Prehistorie	Metaaltijden	Bronstijd	Vroeg	2000
Prehistorie	Steentijd	Neolithicum	Laat	2850
Prehistorie	Steentijd	Neolithicum	Midden	4200
Prehistorie	Steentijd	Neolithicum	Vroeg	4900/5300
Prehistorie	Steentijd	Mesolithicum	Laat	6450
Prehistorie	Steentijd	Mesolithicum	Midden	8640
Prehistorie	Steentijd	Mesolithicum	Vroeg	9700
Prehistorie	Steentijd	Paleolithicum	Laat (B)	12.500
Prehistorie	Steentijd	Paleolithicum	Jong (B)	16.000
Prehistorie	Steentijd	Paleolithicum	Jong (A)	35.000
Prehistorie	Steentijd	Paleolithicum	Midden	250.000
Prehistorie	Steentijd	Paleolithicum	Oud	

Appendix C

UXO desktop Study

Historical Desktop Study

Unexploded Ordnance (UXO)

Maasvlakte Aramis CCS Project

RO-220005 Report version 1.0 (final)
9th February 2022

Riel Explosive Advice & Services Europe B.V. • Vijfhuizenbaan 1b 5133 NH Riel Nederland
Postbus 21 5133 ZG Riel Nederland • T +31 (0) 13 518 6076 • www.reaseuro.com • info@reaseuro.com

Historical Desktop Study

Unexploded Ordnance (UXO)

Maasvlakte Aramis CCS Project

Client	:	Fugro GB Marine Limited
Label	:	74497 / RO-220005 version 1.0 (final)
Place, Date	:	Riel, 9th February 2022

REASeuro			
	Name/Function	Signature	Date
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Fugro			
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Front page image: Fragment of oblique aerial photograph showing Bristol Beaufighter's of the North Coates Strike Wing attacking a small enemy convoy off Terschelling, Holland. The nearest trawler is being attacked with cannon gunfire, and also with rocket projectiles fired by the aircraft from which the photograph was taken. Source: Imperial War Museum.

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SUMMARY

Historical research

The Central North Sea was the scene of several war related events during World War I and II. Among these are the sinking of a large amount of vessels and aircraft, bombing by planes, naval battles and the presence of minefields, military exercise zones and munition dumping grounds. Due to these events UXO may be located within the area of interest. The UXO items considered most likely to be present within the investigation area are shown in the overview below. Note that the overview shows the likelihood of presence of generic UXO types within the site based on the evidence available in the REASeuro GIS-Database at the time of writing this report.

UXO type	Likelihood of presence	Subtype / calibre	Remarks
Naval mines (WWII)	Feasible Probable	German E-Mine moored contact mines British Vickers / British Elia and H Mark II moored contact mines	The area of interest was situated between the British coast and Germany. During the First World War this area was a theatre of mine warfare. Multiple German and British minefields were laid within the area of investigation. This evidence supports a strong likelihood that naval mines are present within the boundaries of the known minefields. Outside these boundaries likelihood of presence is determined to be feasible.
Naval mines (WWII)	Probable Certain	British Mk I-IV ground mines and British Mk VII- VIII and Mk XIV German EMB, EMC, EMD, UMA, RMA, KMA contact mines German LMB Ground mines German Exploding Floats (and also non explosive sweep obstructors) Dutch Model 1921 '2e soort'	During the Second World War the area of interest was situated between the British oast and the German occupied coasts of Europe. During the Second World War this area was once again a theatre of mine warfare. Multiple German and British minefields (filled with mines and sweeping obstructers) were laid within the area of investigation. Primary sources lead to the conclusion that within the boundaries of the known minefields, the likeliness of presence of naval mines is certain. Outside these boundaries likelihood of presence is determined to be probable.
Aerial bombs	Certain Probable	4 lbs, 25 lbs, 30 lbs, 100 lbs, 250 lbs, 260 lbs, 300 lbs, 500 lbs, 1.000 lbs, 4.000 lbs	During the Second World War, aerial warfare played a huge factor. Research shows that a large amount of allied airstrikes took place in the area of investigation. Depending on the target bombs, rockets, torpedoes and depth charges could be deployed. Besides airstrikes, allied aircraft often jettisoned bombs over the North Sea. At least one direct indication of jettisoning in the area of investigation has been derived from the historical sources. Indirect indications are plentiful. Due to the large amount of sources stating attacks near the convoy routes it is deemed certain that UXO as a result of aerial warfare might still be present near these convoy routes. In the rest of the area of investigation the likelihood of presence of UXO is deemed probable due to the large amount of jettisons in the North Sea.
Rockets	Certain Probable	3 inch rocket with 25 lbs or 60 lbs (SAP) warhead	
Under water ammunition	Certain Probable	18 inch torpedo Mk XV Depth charge	

UXO type	Likelihood of presence	Subtype / calibre	Remarks
Artillery Shells Small calibre ammunition (Naval weaponry)	Probable Remote	Small Calibre Ammunition .303 .50 13,2 mm 15 mm Artillery Shells 2 cm/20 mm 2 pr. pompom 3.7 cm 6 pr. 8.8 cm	As mentioned, German shipping was attacked regularly by Allied aircraft. As a countermeasure German ships were equipped with anti-air (machine)guns. Due to the deployment of these guns, UXO might be present near the commonly used German convoy routes. Outside of these convoy routes the likelihood of presence of UXO is deemed remote. This statement is further enhanced by the fact that British surface craft tried to infiltrate the German convoy routes and, in some instances, fought small scale naval battles with German ships.
Artillery Shells	Probable Negligible	Coastal guns: 5 cm 7,5 cm 9,4 cm 10,5 cm 12 cm 14,91 cm 15 cm 15,2 cm 24 cm 28 cm	After the German occupation coastal guns were installed along the Dutch coast as part of the *Atlanikwall*. The coastal guns covered the whole coast in order to repel a possible Allied attack. Due to exercises and combat UXO of artillery shells could be present within the area of investigation. However, UXO could only have reached as far as the range of the coastal guns. Within range of the coastal guns the likelihood of presence is deemed to be probable, outside of this range the likelihood of presence is deemed negligible.
Unknown (exercise) munition	Certain Negligible	Each military exercise zones had it's own purpose, it is outside the scope if this research to determine the munition used in each zone.	Within the area of investigation there were several military exercise zones. Some were already in use by German troops during the Second World War, others taken into use by the Dutch military after the war. It is deemed certain that UXO of (exercise) munition is still present within the boundaries of the military exercise zones, outside these zones the presence of UXO of (exercise) munition is deemed negligible.
Unknown dumped munition	Certain Probable Negligible	-	A total of three known munition dumping grounds overlap with the area of investigation. Sources state that fishermen found munition outside of the dumping grounds, therefore a buffer of three nautical miles was projected around dumping grounds. 'Fishing, intrusive, and seismographic activities' were deemed dangerous within this buffer. The presence of munition dumping grounds lead to the determination of a UXO Risk Area at the location of the dumping ground. The likelihood presence of UXO at this location is deemed certain. Within the buffer of three nautical miles this likelihood presence is deemed probable, in the rest of the area of investigation the likelihood presence is set to negligible.

Table 1: UXO items likely to be encountered in the area of interest.

REASeuro

1 GENERAL INFORMATION

This chapter describes the context and goal for the Historical Desktop Study–Unexploded Ordnance (HDTS-UXO). Furthermore the area of investigation, the area of interest, the purpose and methodology are described. The chapter concludes with a general structure of the report.

2.1 INTRODUCTION

Fugro has invited REASeuro to conduct an HDTS-UXO for the CCS Aramis project. The plans are to build a new pipeline from Maasvlakte (man-made westward extension of the Europoort port and industrial facility within the Port of Rotterdam) to offshore blocks L4/K6. To obtain insight in the possible chance of encountering UXO during this project, Fugro Survey B.V. has requested REASeuro to provide a HDST-UXO.

2.2 AREA OF INTEREST AND AREA OF INVESTIGATION

The area of interest is located off the Maasvlakte, Netherlands to offshore blocks L4/K6, located within the northwestern part of the North Sea. The area of investigation is the given radius, based on the inaccuracies inherent to conducting offshore desk research. The positions of naval minefields, air strikes, crashes and convoy routes in historical sources are given approximately only, since navigation equipment was not nearly as accurate as it is in modern systems. The most common method of marking locations during the World Wars was based on decimal degrees, which were accurate down to 1 naval mile (1,852 meters). Another way of positioning is found in German sources, which are based on the German Naval Grid (*Kriegsmarine Quadranten*), with a grid size of 6x6 nautical miles. Historical sources based on this grid thus position war related events in an area of 123 square kilometres.

Besides these inherent inaccuracies from historical sources, one must take into account the displacement of UXO on the seabed. Bottom trawling, tides and currents, and recent developmental activities may have caused this displacement. The area of interest and research area are shown in Figure 1.

Figure 1: Area of interest and area of investigation (Source of base map: ESRI).

2.3 PURPOSE AND MAIN OBJECTIVES

The HDTS-UXO will be performed with sources which are currently in the REASeuro-database and open sources in a short amount of time. Therefore, it provides an indication if UXO might be present in the Area of interest. By conducting the sources which are mentioned above, historical research will be conducted on the war-related events that took place within the Area of Interest. More specifically, the HDTS-UXO will provide historical research on:

- Aerial attacks on ships
- Airplane crashes
- Shipwrecks
- Laying of minefields (WWI, WWII)
- Dumping of UXO
- Military zones

The starting point of REASeuro is, that the presence of UXO cannot be excluded. In the HDTS-UXO REASeuro will examine whether this premise is true and if there are areas with an increased risk of UXO. Based on the historical sources, the possible calibres and type of UXO are determined which could be present within the Area of Interest.

The HDTS-UXO will provide historical research on:

1. The military events, battle activities, aerial attacks on ships, airplane crashes, shipwrecks, laying of minefields (WWI, WWII), dumping and submarine activities.
2. The possible calibres and type of expected UXO.

3 APPRAISAL OF HISTORICAL SOURCES

This chapter describes the consulted sources. Detailed information extracted from each source is included within the annexes. Information extracted from the sources, results in an overview of relevant war events. These events are the starting point for the review and analysis of sources in chapter 4 of this historical research.

3.1 METHODOLOGY OF HISTORICAL RESEARCH

This research report is conducted in accordance with the Dutch CS-OOO regulations for UXO research and REASeuro's internal standards for offshore desk top studies. War related events that took place in the area of investigation are derived from historical sources, and subsequently analysed. Based on this analysis a UXO risk area may be demarcated.

Due to several years of experience with offshore research, REASeuro has built up a substantial database regarding war related events in the North Sea. A multitude of sources are consulted for this report. All consulted sources are listed and explained in paragraph 2.2.

The research has been conducted by an historian. Page 1 of this report mentions the involved experts. ArcGIS Pro version 2.9.0[1] has been used as a tool to conduct this research. Historical maps and other information have been gathered and projected in this geographical information system for analysis[2]. GIS is also used to position and clarify the relevant war related events mentioned in the list of war related events in chapter 3.

3.2 SOURCES

For more than twenty years, REASeuro has collected historical sources regarding war-related events within the North Sea. Many of these sources have been made available for historical research through an internal database in our own Geographical Information System (GIS). This database contains a wide variety of sources. The following sources will be consulted for the HDTS-UXO:

Sources
Literature • Maps and charts regarding minefields
Nationaal Archief, The Hague, The Netherlands • Coastal guns
Noorzeeloket, The Netherlands • Military zones
Dienst der Hydrografie, Koninklijke Marine, The Netherlands • Wrecks • Military zones
Nederlands Instituut voor Militaire Historie, The Hague, The Netherlands • Minefields
Marinemuseum, Den Helder, The Netherlands • Coastal guns
Bundesarchiv-Militärarchiv, Freiburg, Germany • ZA 5 Deutscher Minenräumdienst (German Minesweeping Administration) – mine-clearance operations
The National Archives, Richmond, United Kingdom • Bomber Command: aerial attacks and minelaying within the North Sea

[1] Mentioned as 'GIS' throughout this report.

[2] Historical charts are "georeferenced" in GIS and used for this report. Georeferencing is the name given to the process of transforming a scanned map or aerial photograph so it appears "in place" in GIS. By associating features on the scanned image with real world x and y coordinates, the software can progressively warp the image so it fits to other spatial datasets. For this research, historical charts have been georeferenced by distinguishing points of recognition on both the historical and present maps and placing 'those points together' so that both maps align. Since several of these charts are hand-drawn or lack exact coastlines, inaccuracies may occur and exact inaccuracies in meters could not be given.

• Coastal Command: aerial attacks and minelaying within the North Sea • Squadrons: Loss charts
National Archives and Records Administration, College Park (MD), United States • Documents from the US Army Air Forces (USAAF)
Beneficial Cooperation - The Royal Netherlands Navy and the Belgian Navy • UXO-clearance operations • Military zones
OSPAR-convention • UXO-clearance operations
Wrecksite • Locations of wrecks (airplanes/ships etc.) within the North Sea
UK Hydrographic Office • Charts regarding minefields • Charts regarding naval routes
Library of Congress • Charts regarding minefields

Literature
An overview of used literature can be found in Annex 2. Literature is consulted in order to get a general depiction of the war related events (especially the laying of minefields) within the area of investigation. The resulting events are shown in chronological order in tables. The references (book and page) for each event are included in the tables.

Nationaal Archief, The Hague, The Netherlands
The Dutch National Archives have been consulted for more information on the coastal guns on the Dutch Coast.

Noordzeeloket, The Netherlands
The Noordzeeloket is a comprehensive website, covering relevant Dutch maritime policy related North Sea information. On the website relevant information about the locations of Voormalige munitiestortplaatsen (Former munitions dump locations), Oefengebieden Mijnenruimen (Mine clearance training areas), (Laag)vlieggebieden ((Low) flying areas) and Schietterrein / onveilige zone (Shooting site / unsafe area) is available.

Dienst der Hydrografie, Koninklijke Marine, The Netherlands
Naval charts of the area of analysis have been acquired through the Hydrographic Service. Besides naval charts regarding military usage the HP39 (wreck registry) publication has been consulted to gain information on possible wrecks in the area of investigation.

Nederlands Instituut voor Militaire Historie, The Hague, The Netherlands
The ‘Nederlands Instituut voor Militaire Historie’ has been consulted on information about Dutch naval minefields.

Marinemuseum, Den Helder, The Netherlands
The map collection of the Marinemuseum (Navy Museum) in Den Helder has been consulted. NEMEDRI-maps were found in this collection. These maps offer information on minesweeping after the Second World War. The NEMEDRI maps show some information about mine clearance shortly after the war.

Bundesarchiv-Abteilung Militärarchiv (BAMA) in Freiburg
The German military archives were severely damaged during World War II. The remains of the archives are kept and maintained in the Bundesarchiv in Freiburg. The archives of the German navy (*Kriegsmarine*) survived the war relatively well compared to the other service branches. These have been consulted for this

desktop study, as well as the German Air Force (*Luftwaffe*) archives, of which only 2% of the documents survived the war. Annex 4 contains the relevant information from the BAMA.

The National Archives (TNA) in Londen

The National Archives have been consulted for information on naval minefields, air strikes, naval combat, bomb jettisoning and other relevant war related events. The Admiralty, War Cabinet and Air Ministry archives have been consulted for this information. Annex 4 contains relevant results from TNA.

National Archives and Records Administration (NARA) in College Park (MD)

Research has been conducted in the US National Archives and Records Administration. The NARA has been consulted for documents from the US Army Air Forces (USAAF) and for the collection of captured German records. Annex 4 contains the relevant information from the NARA.

Beneficial Cooperation - The Royal Netherlands Navy and the Belgian Navy

The Dutch navy is working with the Belgian navy to keep the sea, coastal waters and harbour mouths free of mines. Therefore, the UXO-related interventions in the database of the Beneficial Cooperation is consulted.

Post-war UXO clearance: OSPAR

The area of interest is situated in the North Sea. Therefore, the UXO-related interventions in the database of the OSPAR Commission[3] were consulted. The results are shown in Annex 4.

Wrecksite

The wreck site is the world's largest online wreck database. The website has information about 205.740 wrecks around the world. When information about the reason for the sinking of a ship is known, it is mentioned on the website.

UK Hydrographic Office

The UK hydrographical office maintains a collection of historical naval charts, including charts that contain minefields and convoy routes. Naval charts showing the area of investigation have been consulted, but no map has been found with information regarding the area of interest.

Library of Congress

On the website of the Library of Congress, which is known as the national library of the United States, a chart has been consulted regarding minefields in the First World War. This chart is shown in Annex 5.

[3] The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR-convention) provides a framework for reporting encounters with conventional and chemical munitions in the OSPAR maritime area.

4 ANALYSIS OF WAR RELATED EVENTS

The consulted historical sources (see annexes) indicate several war related events within the area of interest. The war related events derived from the historical sources that are relevant for the area of interest are listed categorically in the tables underneath. The events are grouped into four categories: war at sea, the air war, naval mines, and other UXO-related events. Following these tables per category, the UXO type and likeliness of presence within the area of interest is determined. Before each category is analysed below, the method of defining UXO risk areas is explained.

Defining the UXO risk area

The UXO items considered most likely to be present within the area of interest are shown in each specified category. Note that the table at the end of each paragraph shows the probable presence of generic UXO types within the site based on the evidence gathered about potential UXO sources. It's important to recognise that the presence of a UXO type does not necessarily mean that it will be encountered. The likelihood of encounter (i.e. a positive interaction with the UXO during a specific project activity), will generally be less than the probability of items of that particular UXO type being present across the whole area of interest; given that the actual footprint of the anchor locations will be less than the total investigation area volume. In the following table the terminology used for the likely presence of UXO is shown.

"Presence" Term	Meaning
Negligible	No evidence pointing to the presence of this type of UXO within an area but it cannot be discounted completely.
Remote	Some evidence of this type of UXO in the wider region but it would be unusual for it to be present within the area of study.
Feasible	Evidence suggests that this type of UXO could be present within the area.
Probable	Strong evidence that this type of UXO is likely to be present within the area.
Certain	Indisputable evidence that this type of UXO is present within the area.

Table 2: Definitions of terminology used for the likely presence of UXO.

Condition of expected UXO

The majority of the expected UXO are likely to be in an armed condition. This means that the safety devices preventing the UXO from premature detonation, e.g. during handling, have been removed. Therefore, the explosive train, is in line.

The explosive train is a sequence of events that culminates in the detonation of explosives and can be different for each type of UXO:

- In the case of aerial bombs which were dropped by aircraft in distress situations, the bombs could have been dropped with safety features still in place, however they still present an explosive risk, e.g. as a result of corrosion of vital safety features.
- Some of the expected UXO, e.g. naval munitions, contain a large quantity of explosives and may be encountered in very poor condition as the thin metal casings may have severely eroded. In many cases, the explosive capability could remain more or less undiminished. Some explosive charges neither absorb nor dissolve in water, and some charges do. However, stability of the explosive charge may have deteriorated with age.
- Naval contact mines from the period of interest typically contained a dry cell battery with an electrical detonating circuit which was connected to external conventional switch horns. These batteries will have now deteriorated and no longer have the ability to supply sufficient power to function. However, the condition of the explosives can be unstable.
- Contact mines with Hertz Horns were also common from World War I and onwards. Each horn contains a container of acid. Heavy contact with the horn can brake the acid container within, which

subsequently energizes a battery and detonates the main charge. Therefore, this type of mine (like all other UXO) must be handled with extreme caution.

Although corrosion can make a UXO more sensitive, it can also make it less likely to detonate, as i.e. electrical wiring may have corroded resulting in a break in the explosive train. As a wide range of UXO can be expected, all UXO must be handled with extreme caution until the exact state is determined after positive identification by an EOD-expert.

4.1 NAVAL MINES

Naval mines were laid in the North Sea during the First and Second World War. The purpose was twofold. Mines were used in a defensive way to protect own waters and ports and to hold off enemy ships. At the same time, mines could be used to harass enemy shipping and obstruct military movements. Mines could be laid by surface ships, submarines and aircraft. During the First World War moored contact mines were used almost uniquely. Moored mines float beneath the water surface and are kept in position with an anchor and anchor cable. This technique was also used during the Second World War. Next to contact mines, the belligerent parties developed influence mines. These mines were laid on the sea bottom and would detonate if sensors in the mine detect a difference in pressure, sound, or magnetism caused by a passing ship.

The area of investigation has overlap with a suspected British minefield from the First World War and several German minefields from the Second World War. These minefields, the post-war clearance and UXO encounters are discussed in the next paragraphs. A conclusion is added in paragraph 4.1.4.

4.1.1 First World War

A map from the Library of Congress (see Annex 3) shows two minefields on relatively large distance from the area of investigation. It was a large German minefield (red, marked with a '3') lying along the Dutch coast. The map title (see subscript of Figure 2) explains that only the approximate position of the minefield is showed. The presence of the minefield is confirmed in the book *The Hidden Threat* (see Annex 2). According to this book 664 mines were laid in the field. No information about the exact type of mines was found, but the belligerent parties during the First World War used almost uniquely moored contact mines.

The second Minefield was British (bordered in red, northeast of the area of investigation). The border indicates an area in which multiple smaller minefields were laid. The mined area, the German Bight, was a major theatre of naval warfare during World War I. British forces laid 42.899 naval mines in the Bight. Only few German minefields can be found in the German Bight.

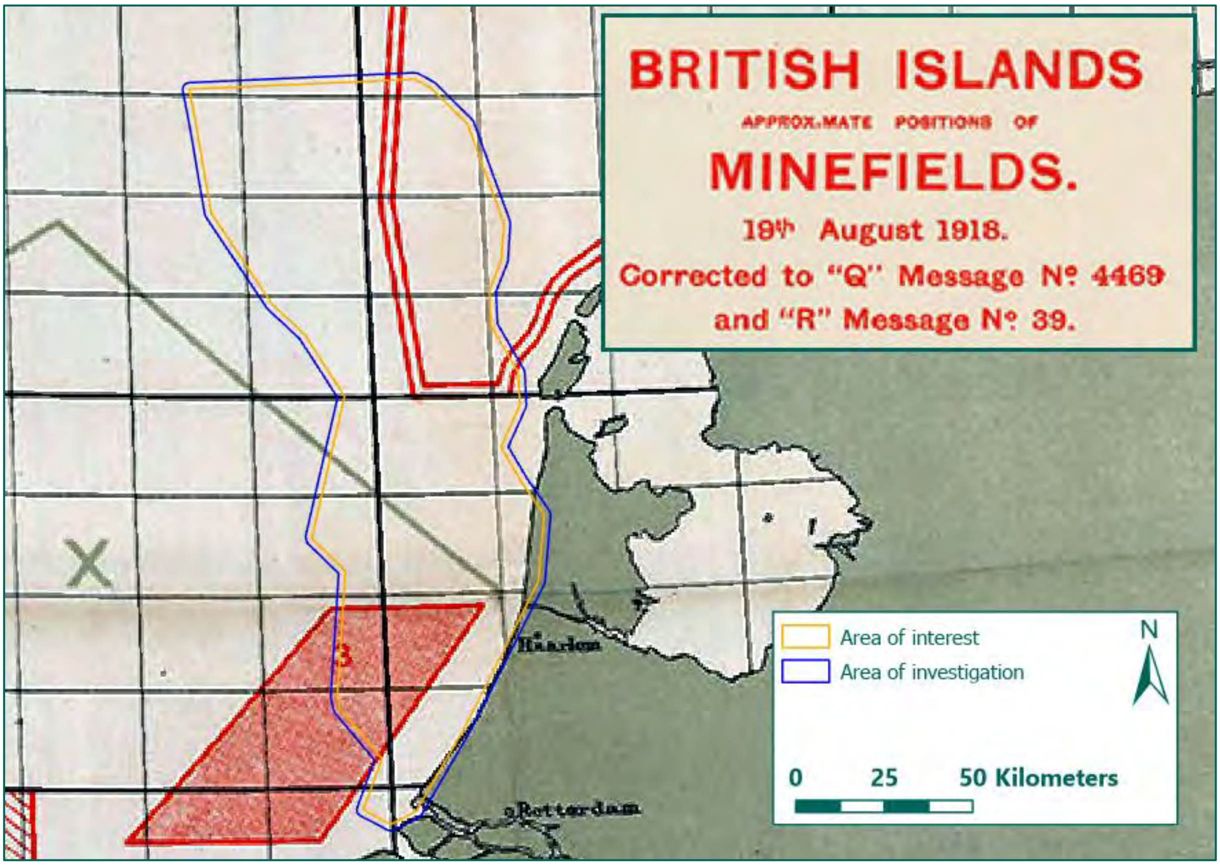


Figure 2: Cutout of the map *British Islands. Approximate position of minefields*, *19th August 1918,* showing minefields around the British Islands (Source: Library of Congress).

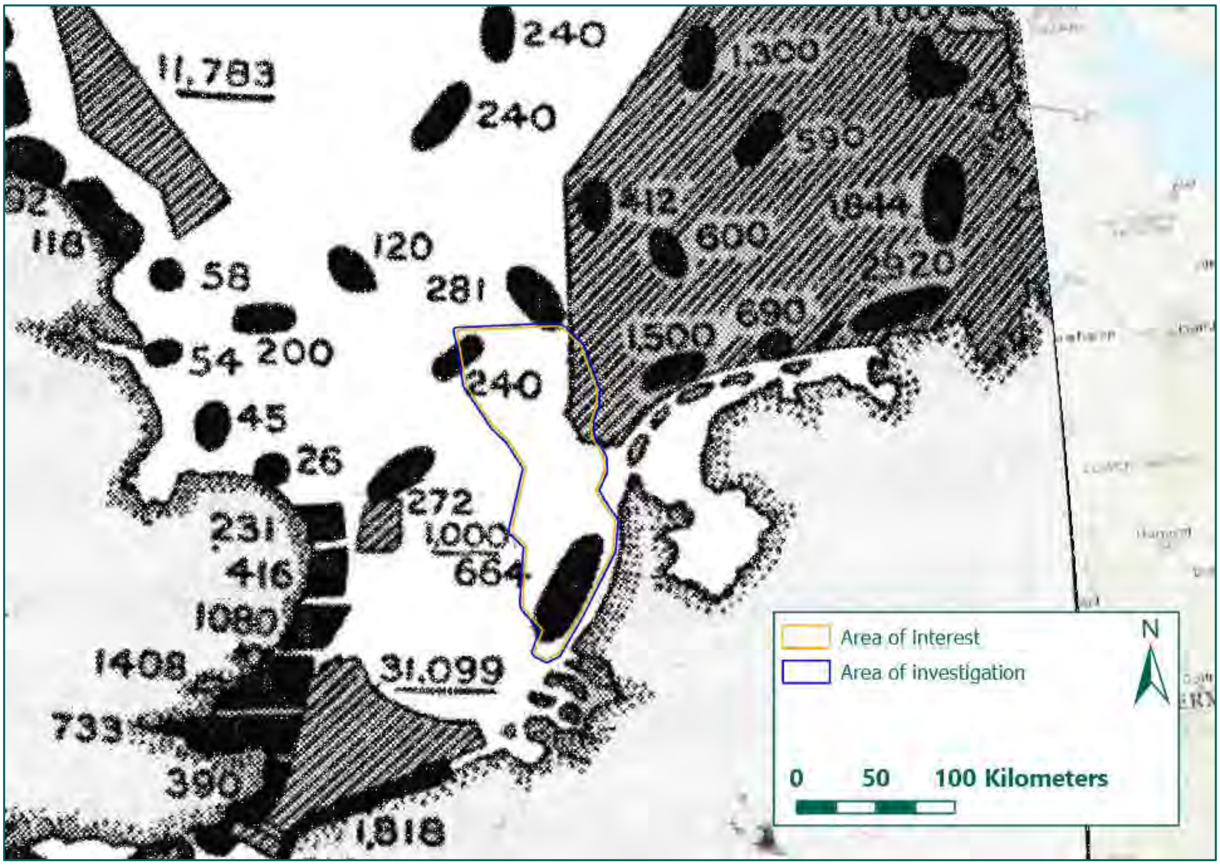


Figure 3: British, German and American mines laid during the First World War (Source: Literature CRO 62).

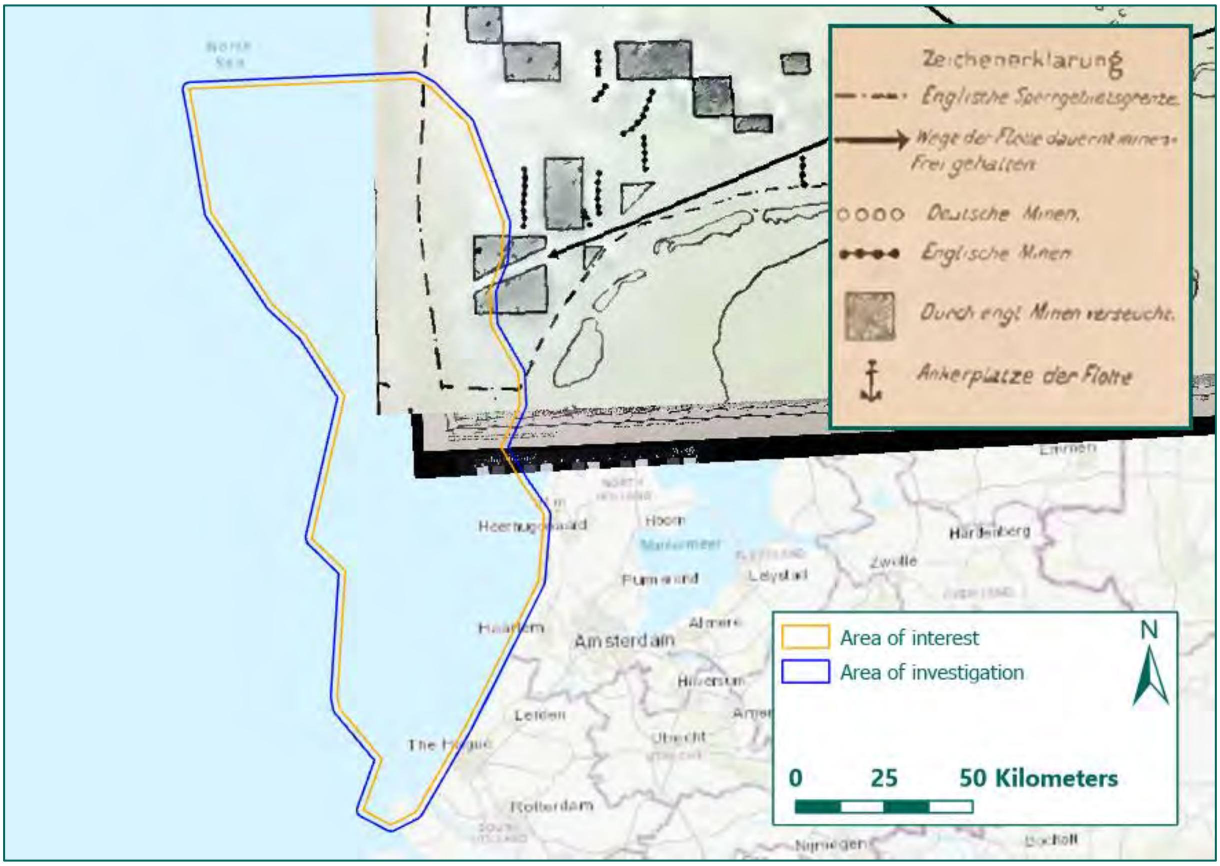


Figure 4: Details about minefields near the Dutch coast (Source: Literature SCH 288)

According to German sources derived from the Bundesarchiv, the area of investigation has overlap with an area which is suspected to have been mined. Reports from the *Kommando der Hochseestreitkräfte* (Command of the Naval Forces) contain a map showing the minefield. *Treibende Minen* (Contact mines) were laid on the Dutch Coast. Additional information about these minefields is not given.

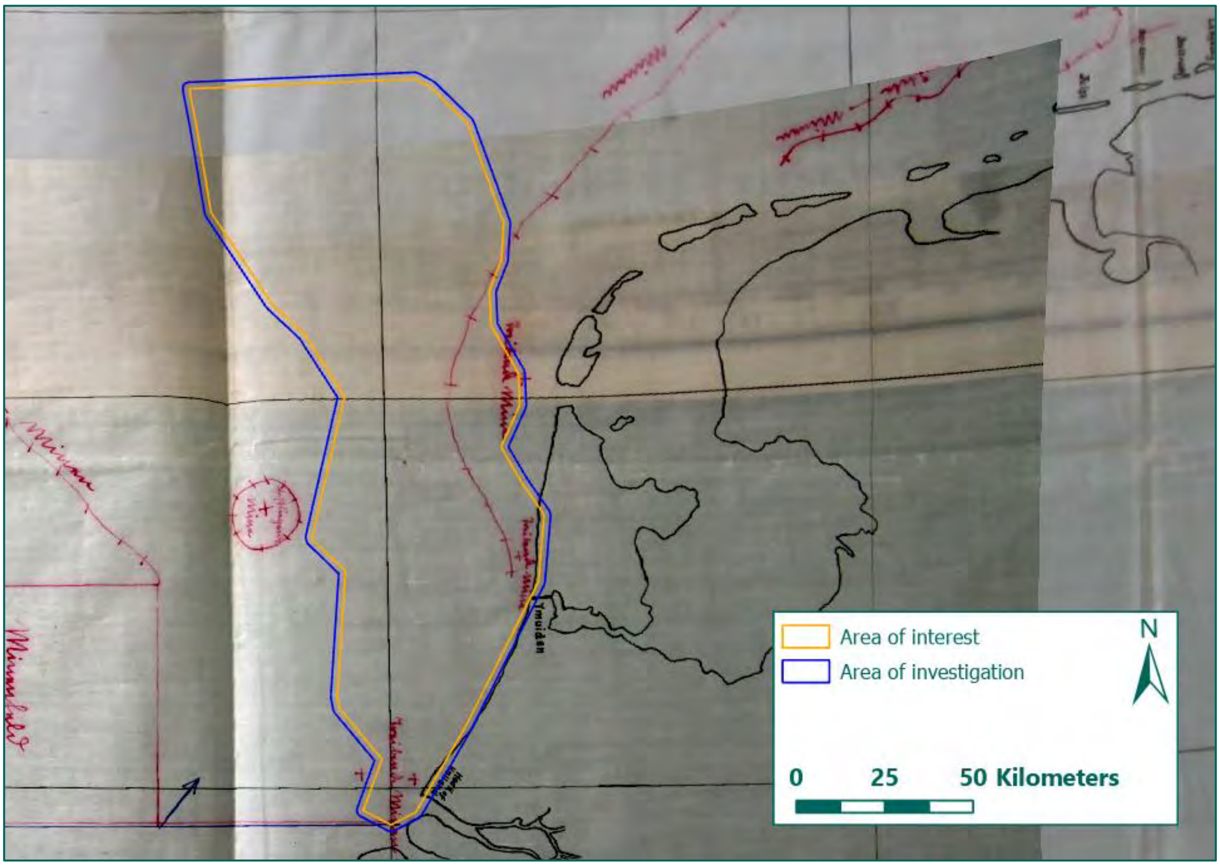


Figure 5: German map showing the suspected Allied minefield, according to the situation of March 1915 (Source: BaMa, RM 5/4721K).

During the First World War, a lot of mines broke loose from their anchor and drifted away. A total of 6.000 mines washed ashore on the Dutch beaches. Amongst those mines 4.981 were from British origin, 431 were German, 81 were French, and 500 mines were from other or unknown origins. It is estimated that no less than 240.000 mines have been spread out in the North Sea.

The information about minefields have been entered into our GIS-system. Relevant minefields within the area of investigation are shown below.

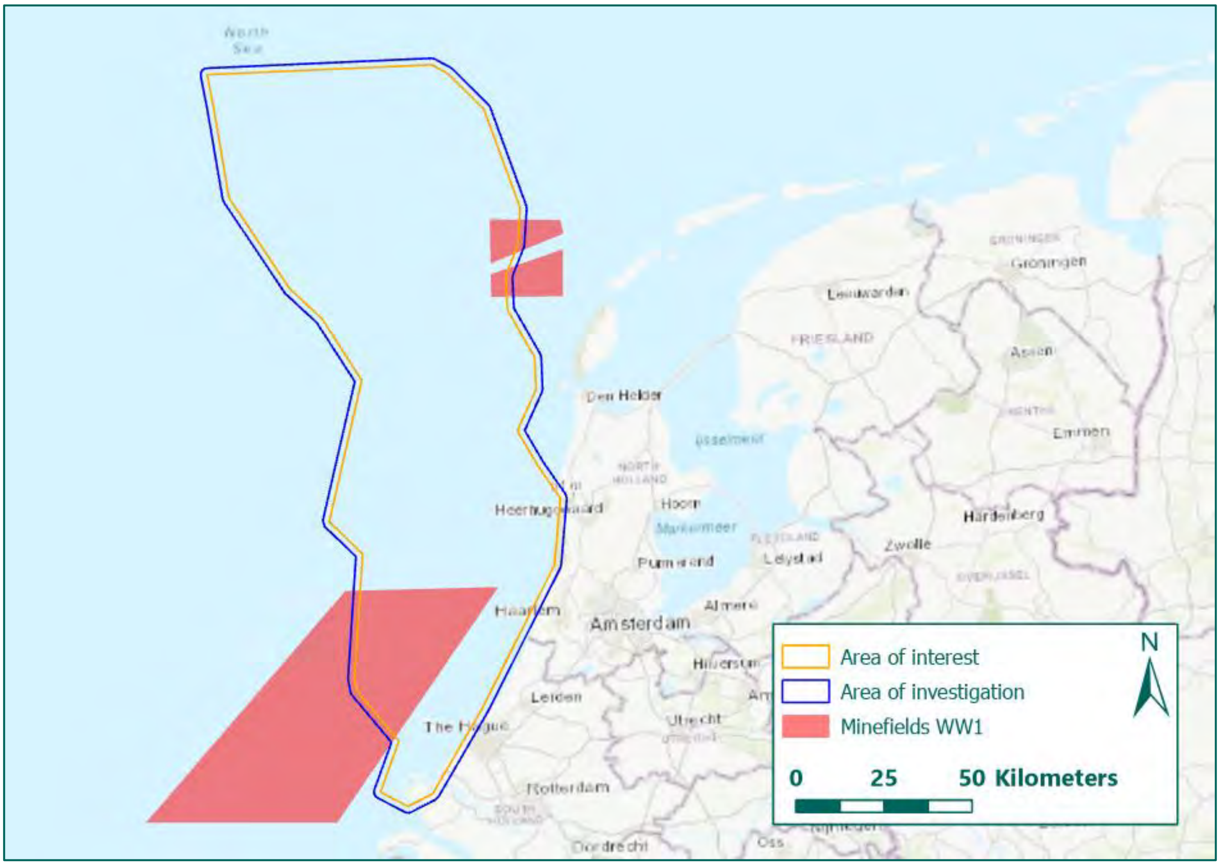


Figure 6: British and German minefields during WW1 (Source basemap: ESRI).

Records from The Dutch National Archives (see Annex 3) contain evidence that mines were present in the area of investigation during the First World War. On a map obtained in the "Nationaal Archief" (Dutch National Archives) it is shown that during 1914-1916 multiple Dutch ships ran onto mines. Most of these accidents happened outside of known minefields. One of these incidents occurred within the area of investigation. As can be seen in the figure below, the black dots indicate the locations where Dutch ships ran onto contact mines. Several black dots are visible within the area of investigation. However, no details have been provided about the ship that sunk at this location. Because there are no known minefields near the locations of the incidents, it is possible that the ships ran upon a contact mine that broke loose from the minefields seen in Figure 2, Figure 3, Figure 5.

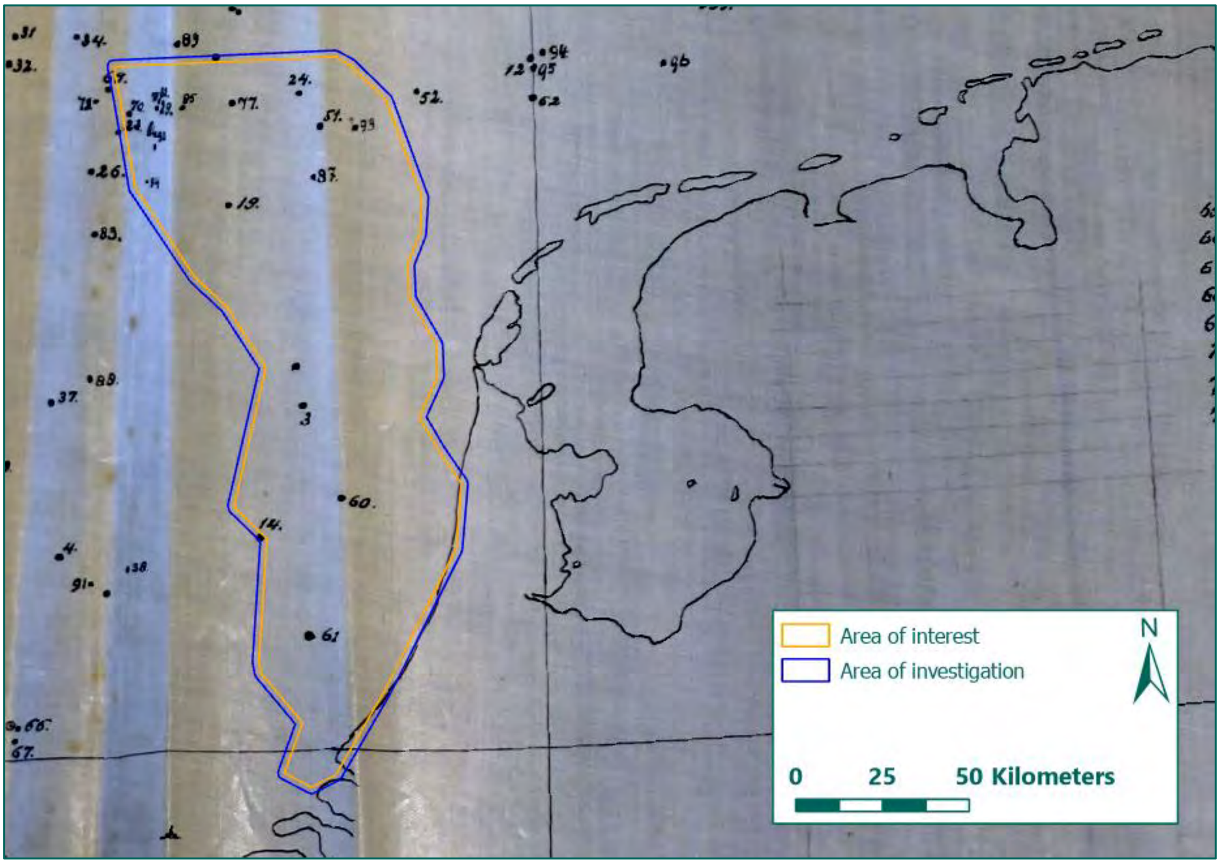


Figure 7: Map showing locations where Dutch ships ran onto mines during 1914-1916 (Source: NA, 2.05.32.09, file 44).

Wrecksite.eu also shows a lot of wrecks within the North Sea. A total of 39 ships were sunk due to mines laid in WW1 and WW2. Besides that a lot of ships were sunk due to unknown causes. The book 'HP39 Wrakkenregister, Nederlands Continentaal Plat en Westerschelde' (abbreviated to HP39), drawn up by the Dutch navy, show an abundance of wrecks (ships and aircraft) within the area of interest. In HP39 no details are given about the reason/cause of the sinking of the ships or aircraft. However. An overview of all wrecks according to this book is shown below.

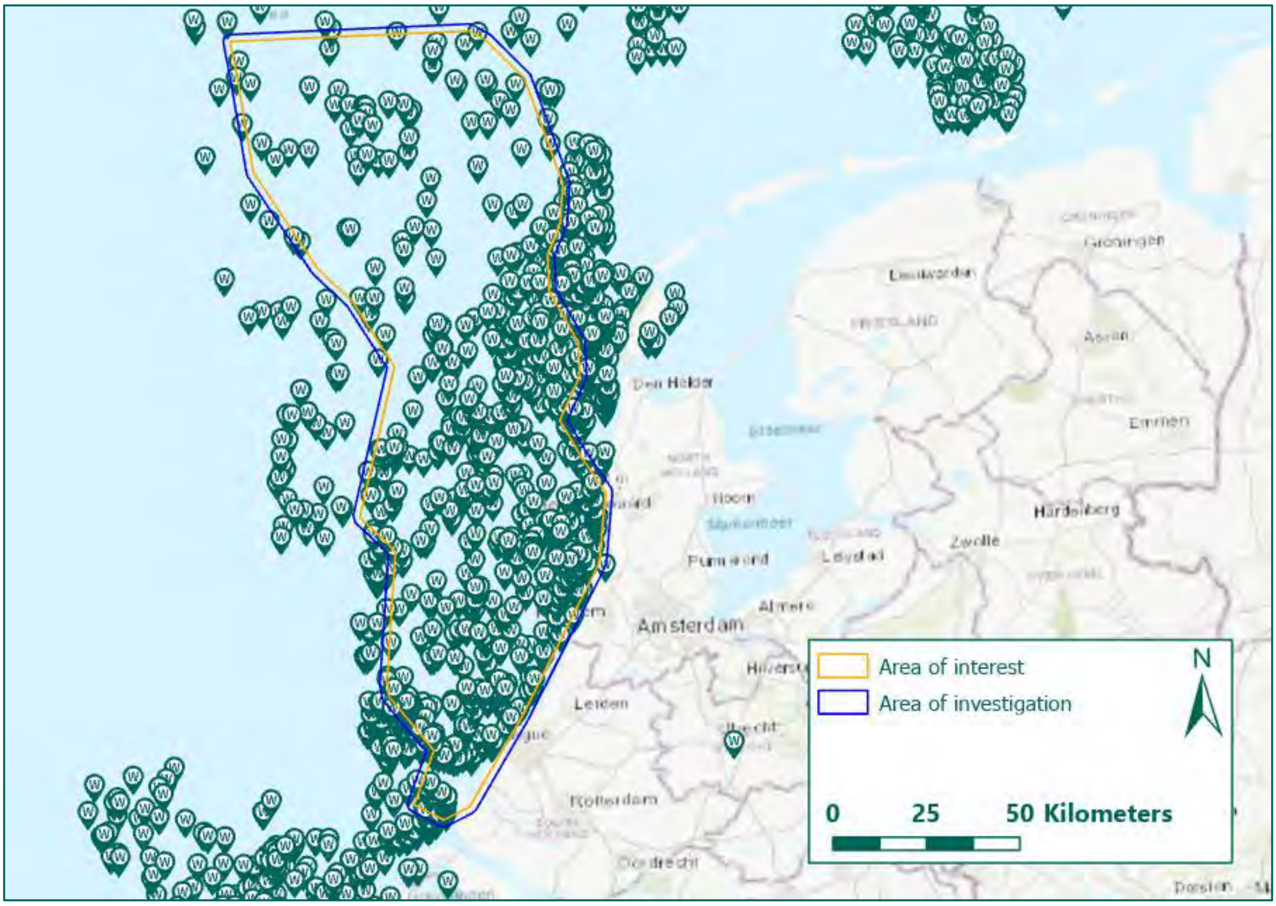


Figure 8: Overview of wrecks within the area of interest according to HP39 (Source: HP39).

According to sources that were consulted by REASeuro British and German minefields overlapped the area of investigation during the First World War. Several ships were sunk due to mines laid within the Area of investigation.

Based upon the sources available, it is concluded that First World War German and British contact mines could be present in the area of investigation. Since no information is found about the precise types of the mines, it is presumed that the most common types of German and British mines could be present in the area of investigation, the German E-Mine and British Vickers / British Elia and H Mark II moored contact mines. Conclusions about the UXO Risk Area as a result of naval mines is given in paragraph 4.1.4.

4.1.2 Second World War

During the Second World War several German minefields were laid in the area of investigation. The German minefields were laid defensively, with the intention to hinder allied ships from approaching the Dutch Coast. British offensive minelaying was aimed against German convoy routes sailing by the Dutch Coast. Some of these British offensive minefields overlap the area of Investigation.

Different sources show maps and coordinates of German and British minefields within the area of investigation. The German minefields within the area of investigation are well documented. During the war the British authorities were quite aware of the locations of German minefields, as can be seen in Figure 9 several minefields overlapped with the area of investigation. The large minefield 404X consists of many smaller minefields. Detailed information about these, and other, minefields that overlap with the area of investigation can be found in the Bundesarchiv (see Figure 10). The German minefields were also littered with sweeping obstructers, suchs as Exploding floats, *Sprengboje* (with explosive load) and Static cutters/Static Conical Sweep Obstructor, *Reisboje* (without explosive load). It is also known that some Dutch minefields were laid in the beginning of WW2. Most Dutch and German mines were laid by surface crafts. Although the British used surface craft as well, they also deployed aircraft.

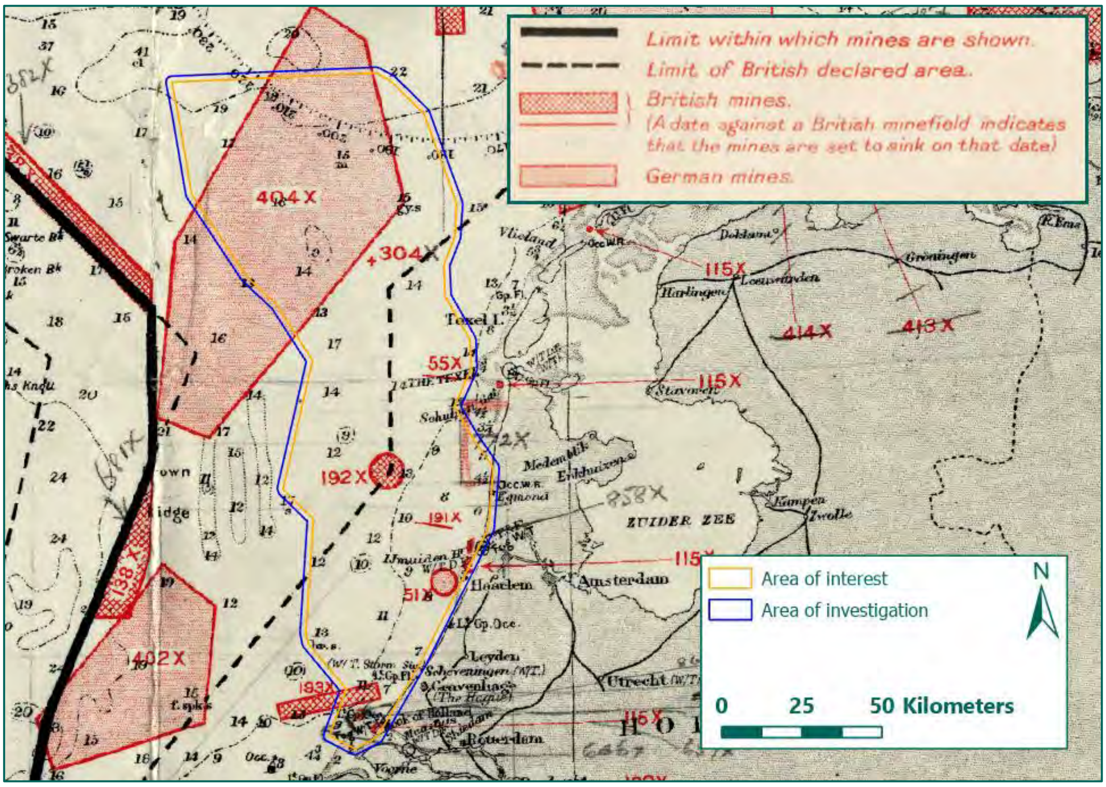


Figure 9: British map showing German and British minefields (Source: TNA, ADM 239/304).

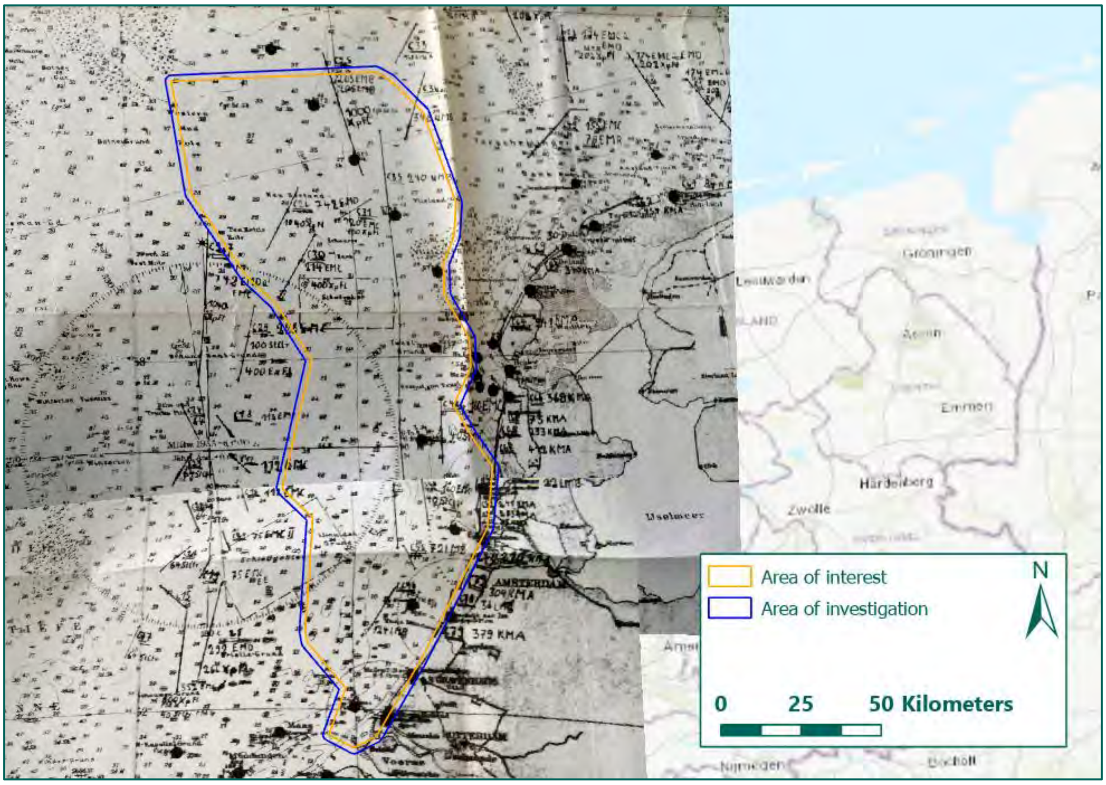


Figure 10: Naval chart showing numbered German minefields. Multiple minefields are present in the area of interest. (Source: BAMA, ZA 5/27).

Another means of minelaying were the "Gardening" operations. These operations were carried out by the Royal Air Force. Planes dropped mines into designated zones. Three zones laid in front of the Dutch coast. Two of these zones, "Whelks" and "Trefoil", have overlap with the area of investigation. The mines laid by planes were ground mines. Over 1200 mines were laid in these 'gardens'.

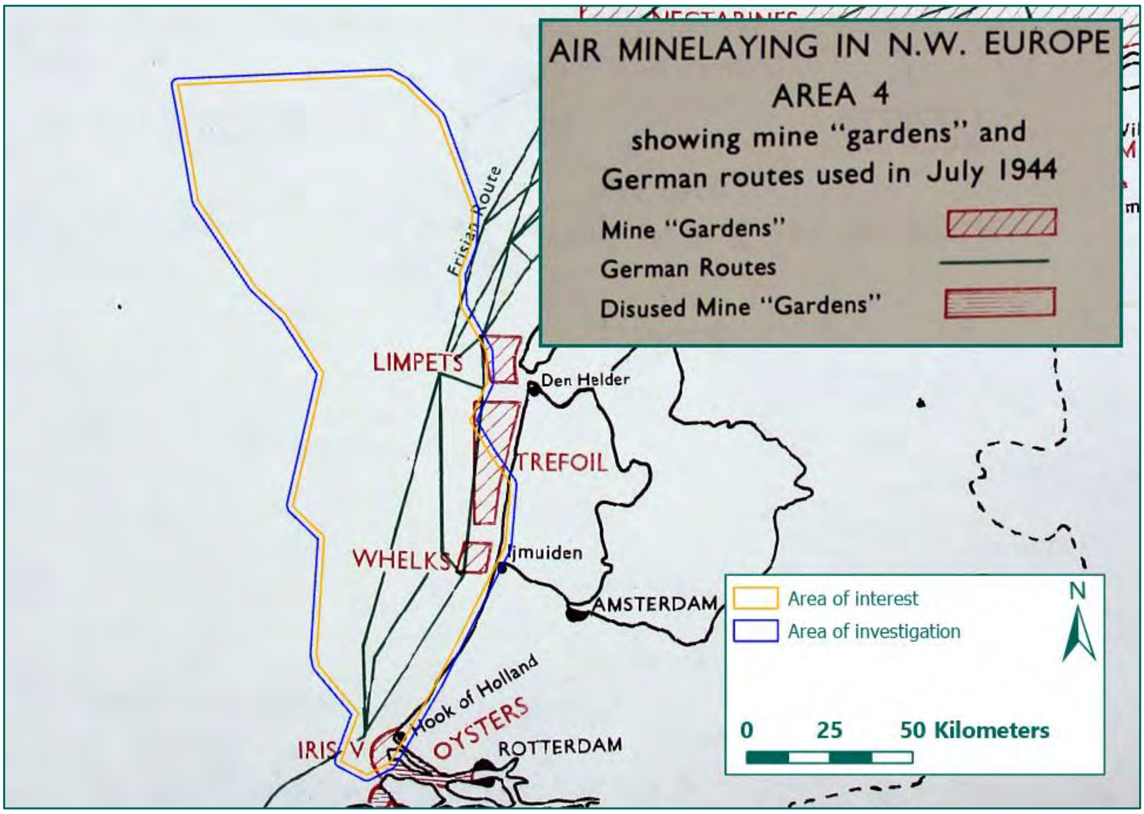


Figure 11: British 'Gardens' within the area of investigation (Source: TNA, ADM 234/561).

All minefields that were mentioned within the consulted sources have been incorporated in our GIS-system. In the figure below all these minefields are shown.

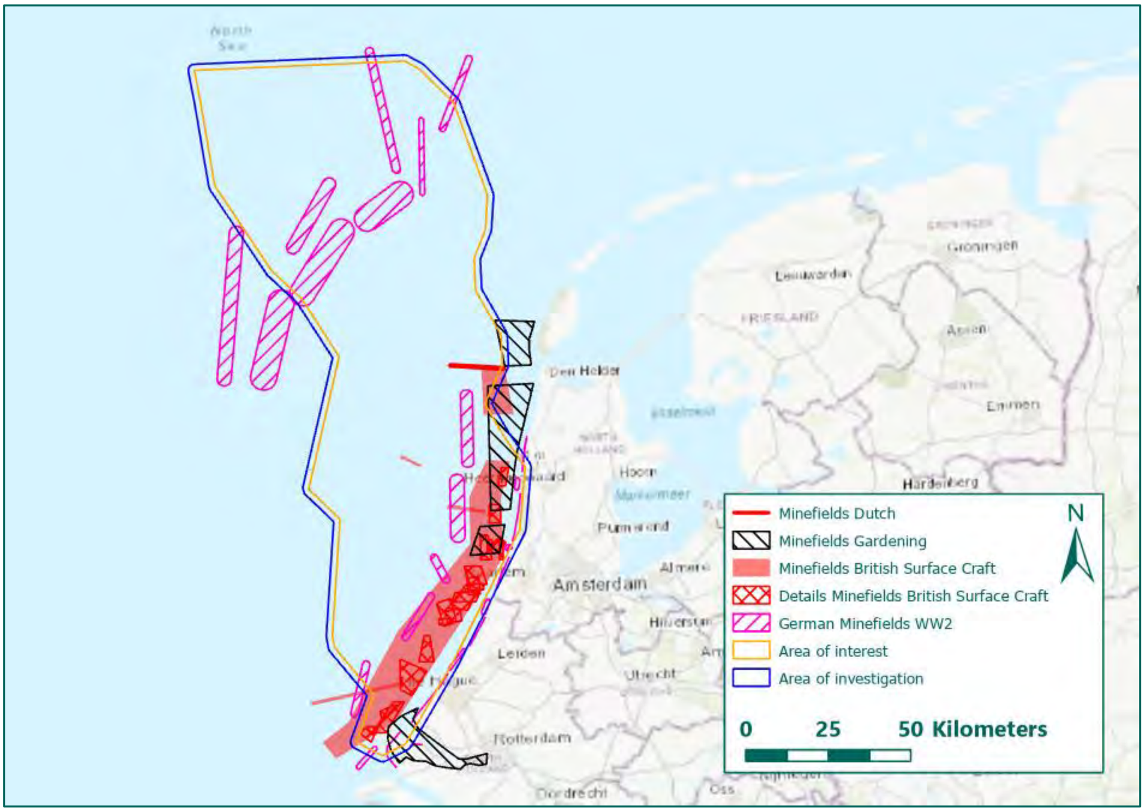


Figure 12: Minefields in WW2 (Source basemap: ESRI).

It is not known what kind of mines were laid in the Dutch and British minefields. Therefore, it is assumed that the most common types of mines were used within these minefields. In the Dutch minefields it is assumed that contact mines from the type 'Model 1921 2e soort' can be encountered. The British minefields consist of minefields laid by surface craft and aircraft. Mines dropped by aircraft were ground mines, mines laid by surface craft are either ground mines or contact mines. The most used types of British ground mines are Mk I-IV. The most common types of British contact mines are Mk VII- VIII and Mk XIV contact mines. The German mines used within the Area of investigation are EMB, EMC, EMD UBA and KMA contact mines, and LMB ground mines. Some German minefields were also fitted with German sweep obstructers: Exploding floats, *Sprengboje* (with explosive load) and Static cutters/Static Conical Sweep Obstructor, *Reisboje* (without explosive load).

4.1.3 Post-war mine clearance

After the First World War, a large effort was made to clear shipping lanes of naval mines. It took several months and a fleet of minesweepers to clear the minefields. Sweeping was carried out by sweeping a cable with anchors below the water surface. The cable was dragged by two ships (see Figure 13).

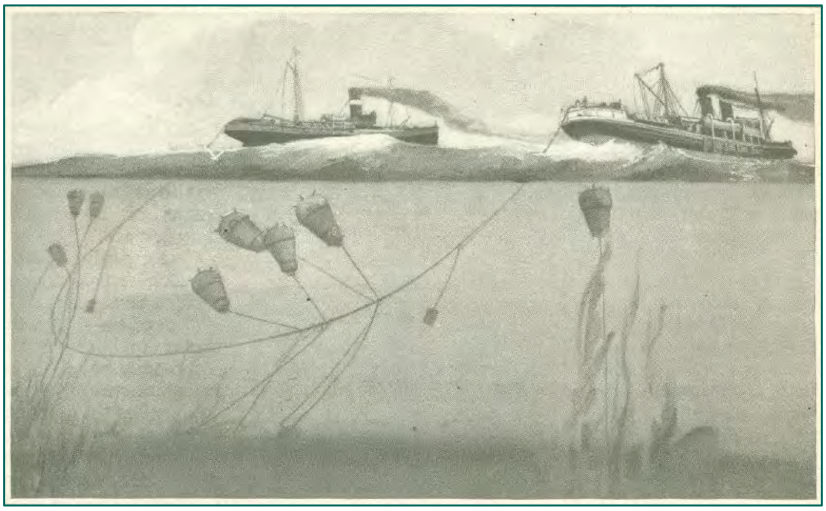


Figure 13: Post WWI-mine sweeping. (Source: http://www.digitalhistoryproject.com/2012/06/submarine-mines-in-world-war-i-byleland.html)

Mines also continued to pose a danger to shipping after the Second World War. In order to combat this threat, a large-scale minesweeping campaign was set up. The area of investigation was situated in the Dutch sweeping zone. Charts of the *Marinemuseum* (see Annex 3) show some details of minesweeping in the area of investigation. Details about minesweeping have not been found in the consulted sources. Minesweeping was conducted with a variety of methods. Moored mines were usually swept with Oropesa sweeping gear[4] (see Figure 14).

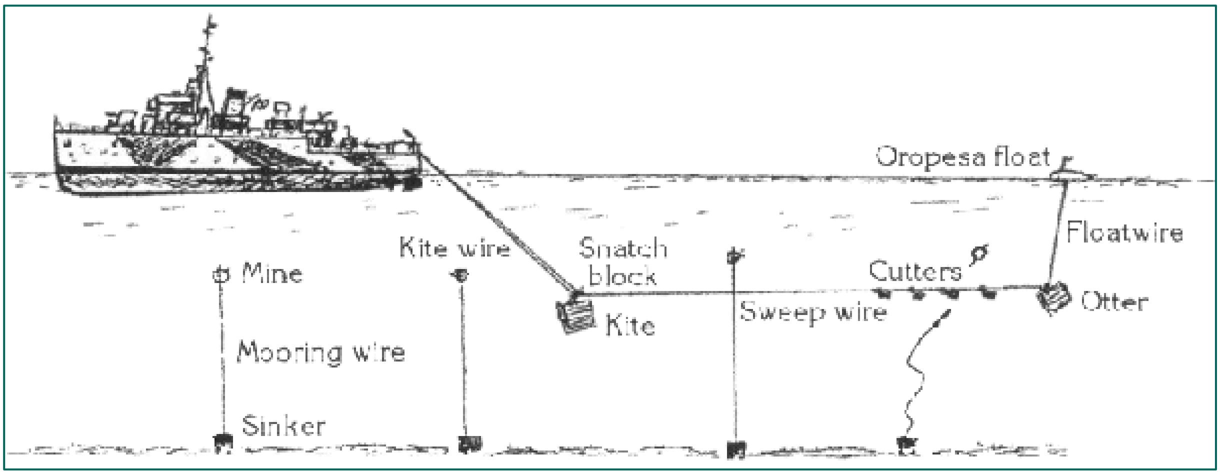


Figure 14: Oropesa sweeping (source: 'The 'Art' of Minesweeping', 27 May 2013, http://www.minesweepers.org.uk/sweeping.htm, consulted 2 August 2019).

The moorings of the mines were cut with cutters dragged on a wire behind a ship. Cutting the mooring wires/cables caused the mines to float to the surface, where the mines could easily be shot with cannon or rifle fire (see Figure 15). Shooting the mines caused them to sink or to detonate. Ground mines were swept with acoustic hammer boxes, triggering the acoustic mines, or by magnetic sweeping gear to trigger magnetic mines.

[4] So named after the World War I trawler in which the technique was first developed. Till then all sweeping was done using two ships joined by a single wire.

Figure 15: Mine disposal team preparing to fire on swept mines. (Source: TNA, ADM 199/154).

Minesweeping was not synonymous to mine clearance. Objective of the operations was to clear the shipping lanes for navigation. The sea bottom is still littered with unexploded mines, including swept and sunken moored mines, self-disarming mines and ground mines with empty batteries[5]. Nowadays, fishermen and dredging ships still encounter these naval mines on a regular basis.

As a result of clearance operations, tidal and other weather conditions, moored mines could break loose from their anchor and migrate. Furthermore, due to extensive pair and beam trawling there is often no clear relation between the positions of encountered mines and the locations of historical minefields. This observation is confirmed in the paragraphs 4.1.1 and 4.1.2. These paragraphs show mine incidents/encounters outside known minefields. Clearance reports of the Dutch Coast Guard and the OSPAR Commission also show that mines can be found outside the boundaries of known minefields. In Figure 16 the locations of cleared mines are shown relative to the area of investigation.

[5] According to international laws, mines are obligated to include mechanisms to automatically disarm or 'self-sterilize' them after a set time. Moored mines were to sink to the seabed after a given time through, for example, a soluble plug, while ground mines disarmed automatically through a timing mechanism or simply at the end of their battery life. These mechanisms move the mine out of harm's way, but do not disable mechanical fusing mechanisms like *herz horns* and anti-handling devices.

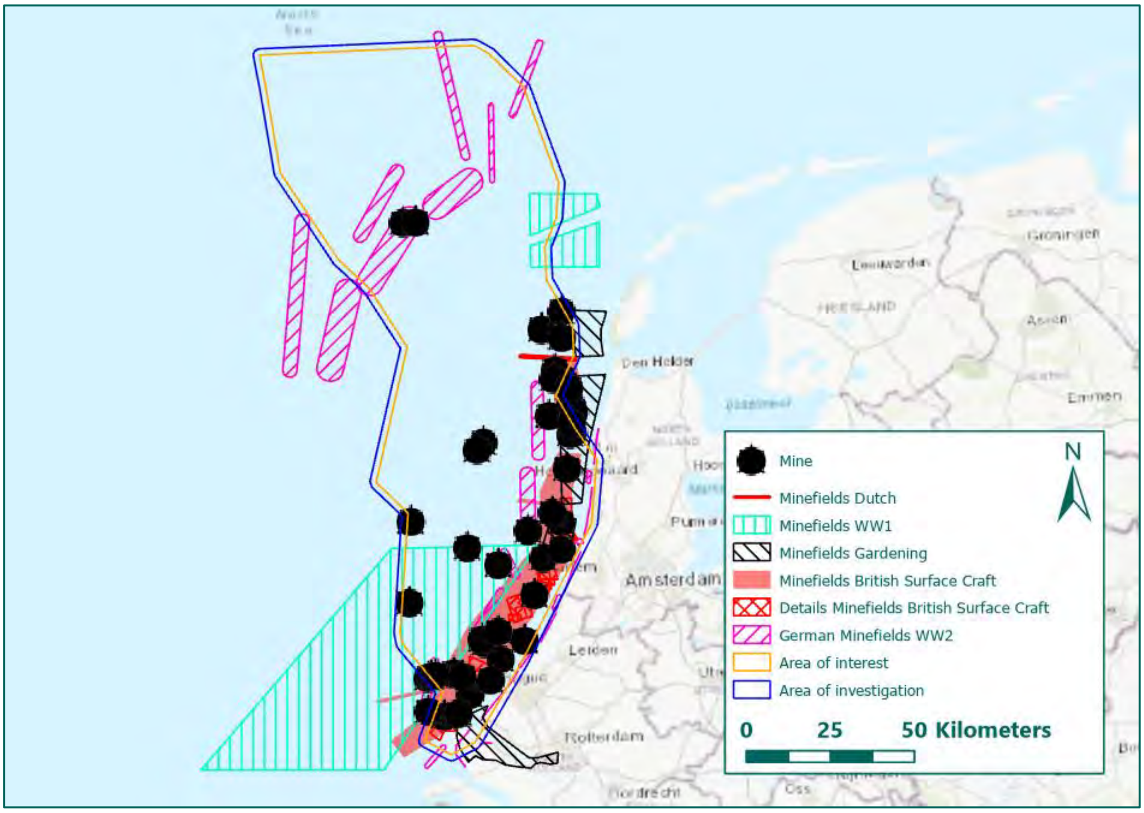


Figure 16: Locations of known minefields and locations where the Dutch Coastguard cleared mines (Source basemap: ESRI).

4.1.4 Conclusion

The area of investigation intersects several minefields. During World War I, British and German minefields overlapped the area of investigation. Within the area of investigation, several mine related incidents occurred during the First World War. Most of these incidents happened outside of known minefields.

During the Second World War the German navy laid 33 minefields that intersect with the area of investigation. No information about the clearance of these fields is known to REASeuro. Several British and two Dutch minefields also overlapped with the area of investigation. Information about the clearance of these fields is also unknown to REASeuro.

Post-war (both World War I and II) minesweeping succeeded in securing the shipping lanes, but did not manage to dispose of all mines. Many mines still litter the seabed, with fuzes still intact. Sweeping, trawling, tides and currents have caused these mines to migrate over the years, resulting in a situation in which there is no longer a clear link between the location of the original minefields and the current positions of the naval mines. As a result of this, it is possible that UXO is still encountered within the area of investigation.

A distinction needs to be made between the likelihood of encountering UXO related to World War I and to World War II. During World War II multiple minefields overlapped the area of investigation. A total of thousands of mines were laid by German surface craft and British surface craft and aircraft. Sweeping operations could have these mines and sweep obstructors (*Sprengboje*) to have sunken to the seabed within the area of investigation. The likelihood of encountering UXO related to World War II minefields is deemed certain within the borders of the minefields and, due to migration, probable outside of these borders.

During World War I the area of investigation only overlapped with a single suspected German minefield and some small British minefields. The consulted sources do not state the amount or types of mines laid in this field. However, factual evidence points out that multiple mine related incidents occurred within the area of investigation. Because of the relative sparse amount of information known about World War I minefields within the area of investigation the likelihood of encountering UXO related to World War I minefields is lower than the World War II minefields. Therefore encountering UXO of WW1 naval mines is deemed probable to within the borders of the WW1 minefields, and feasible outside of these minefields.

UXO type	Reference Nr.	Type/calibre	Condition
Naval Mines	1	German E-Mine moored contact mines	Armed
	2	British Vickers / British Elia and H Mark II moored contact mines	Armed
	Outside the borders of the known minefields all abovementioned types of naval mines can be encountered. The likelihood of presence outside the known minefields is set to feasible.		

Table 1: Expected UXO due to WW1 Minefields.

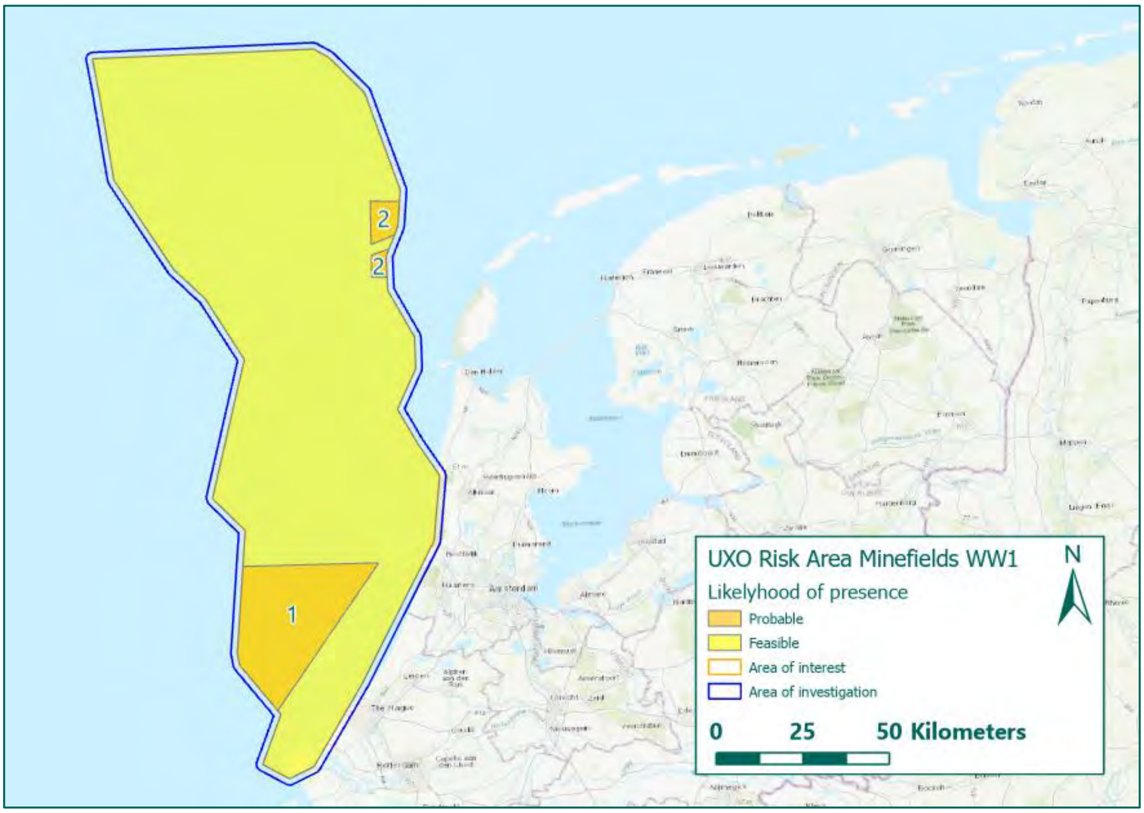


Figure 17: Likelihood of presence of UXO as result of the WW1 minefields. (Source basemap: ESRI).

UXO type	Reference Nr.	Type/calibre	Condition
Naval Mines	1	British ground mines Mk I-IV	Armed
	2	German EMB Contact mines and Exploding Floats	
	3	German EMC Contact mines (also non explosive sweep obstructors)	
	4	German EMC Contact mines and Exploding Floats	
	5	German EMD Contact mines and Exploding Floats	
	6	German KMA Contact mines	
	7	German LMB Ground mines	
	8	German LMB Ground mines and German EMC Contact mines	
	9	German UMB Contact mines	
	10	German RMA Contact mines	
	11	British Mk I-IV ground mines and British Mk VII-VIII and Mk XIV contact mines	
	12	Dutch Model 1921 '2e soort'	
	Outside the borders of the known minefields all abovementioned types of naval mines can be encountered. The likelihood of presence outside the known minefields is set to probable.		

Table 2: Expected UXO due to WW2 Minefields.

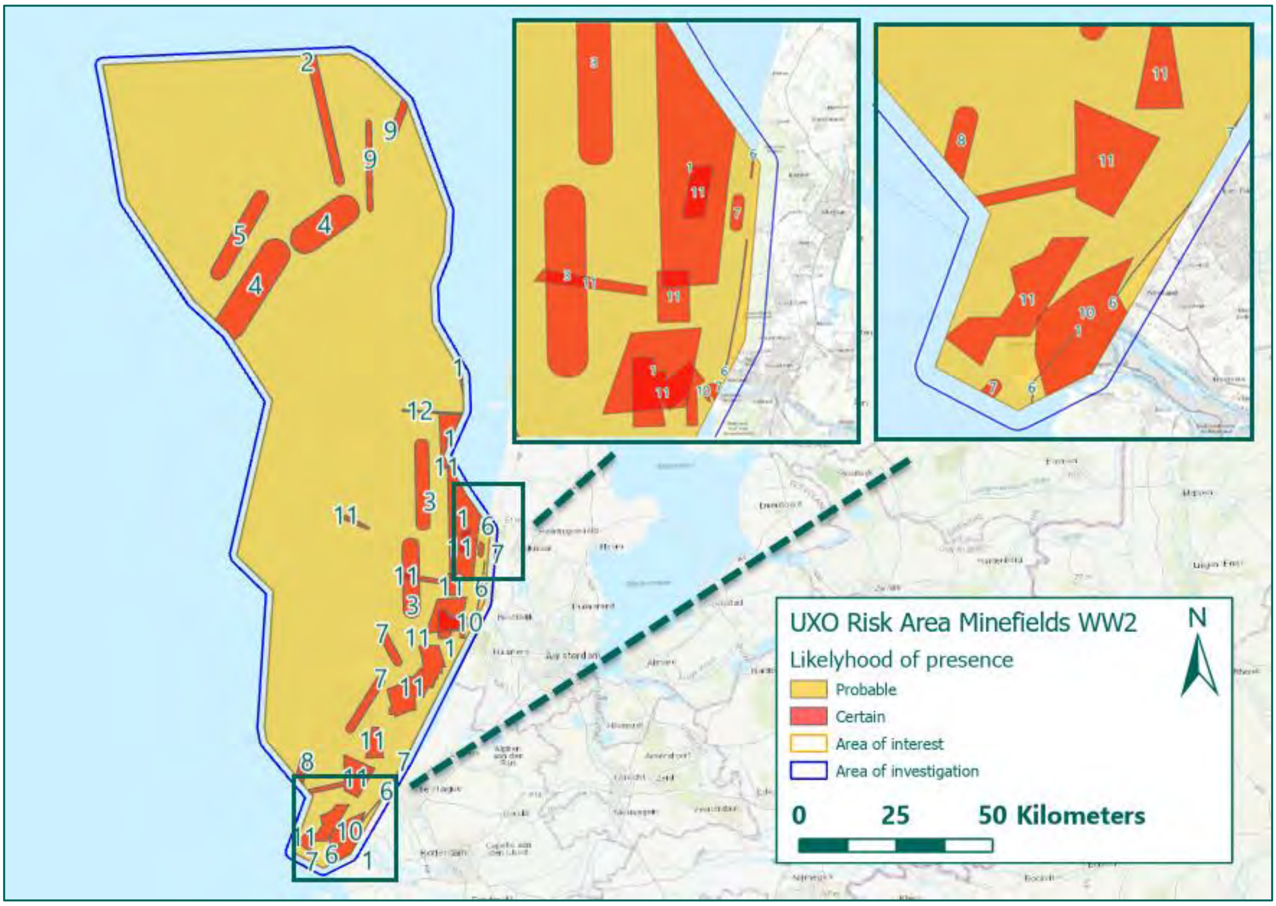


Figure 18: Likelihood of presence of UXO as result of the WW2 minefields. (Source basemap: ESRI).

4.2 AIR WAR

In and in the vicinity of the area of investigation many events relating to the air war did occur. This concerns air strikes on shipping, jettisons of bombs, and anti-aircraft gunfire.

4.2.1 Air strikes on surface vessels

A German convoy route crossed the area of analysis. During the Second World War the British Air Force almost continuously attacked the German convoys and other ships like minesweepers or the *Vorpostenboote*. From November 1944 onwards, attacks were also carried out on submarines and midget submarines (Anti-Seehund missions) which threatened the Allied convoys towards the harbour of Antwerp.

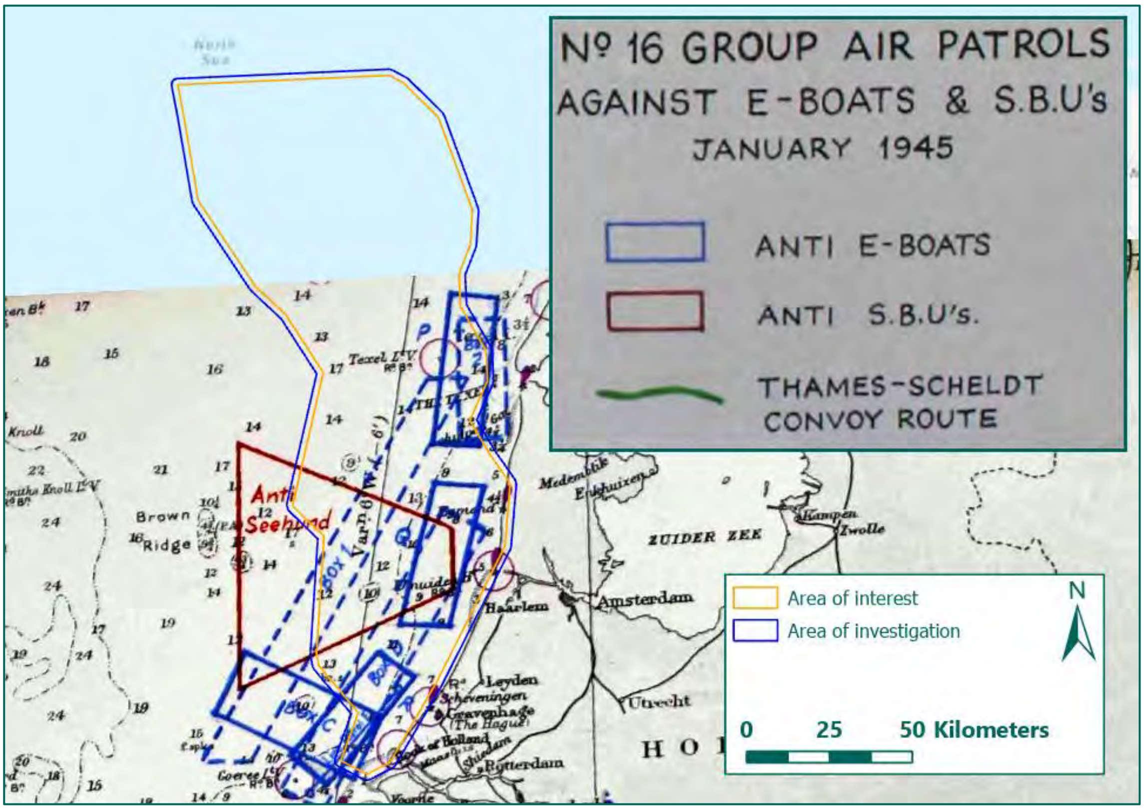


Figure 19: Coastal Command, No.16 Group, Air Patrols against E-Boats & S.B.U.'s January 1945 (Source: CAB 101/324).

The locations of the air strikes are seldom very accurate. Navigating above the sea was not an easy task. The consulted literature (see Annex 2) points out that a lot of ships were attacked along the Dutch coast. It started with the German invasion on 10 May 1940.

The air attacks by the British Bomber Command and Coastal Command are added in a geodatabase, if possible. Coastal Command used a code instead of decimal degrees. According to the information entered in the REASeuro database, a total of 508 attacks were made within the area of investigation by Coastal Command and Bomber Command. It is outside the scope of this research to examine the target and the results of each of these missions. Due to the large amount of attack locations near the known German routes, it is to be expected that a large amount of the attacks by the RAF was targeted at German shipping. In the figure below the relevant locations of attacks by Coastal Command and Bomber Command is shown. The locations of German convoy routes are also shown.

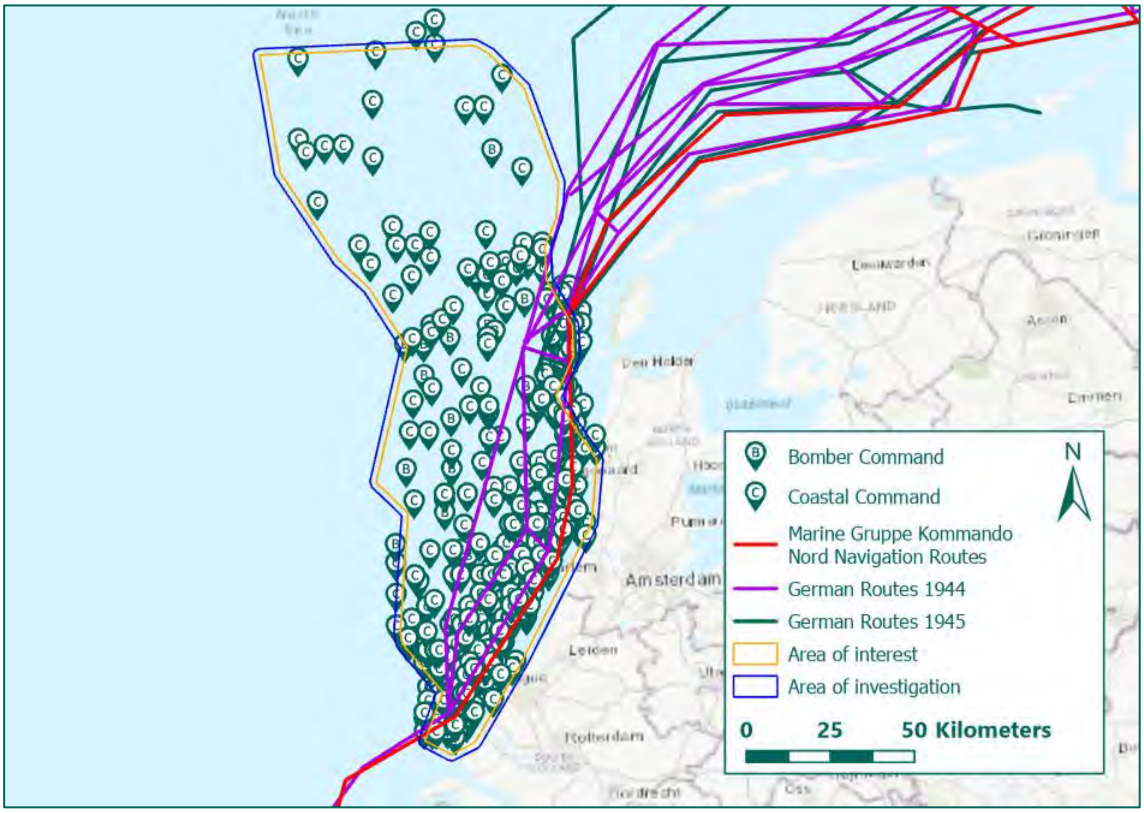


Figure 20: Attacks made by Coastal Command and Bomber Command, and relevant German convoy routes (Source basemap: ESRI).

Since more than 500 attacks took place in the area of investigation, it is expected that UXO remain. Air strikes on ships were carried out with aerial bombs, depth charges, torpedoes, and 3 inch rockets with a 60 lbs warhead semi armour piercing (SAP). The definition of the UXO risk area and the calibres is explained in paragraph 4.2.5.

4.2.2 Jettisoned bombs

During the Second World War groups varying from few to many British and American bombers flew almost on a daily basis (day and night) towards targets in Germany or German-occupied territory. The flight paths towards targets and back to base (in the United Kingdom) ran across the North Sea.

The Allied bombers were often attacked by German fighters in order to prevent the bombers from bombing their targets. Hundreds of planes were hit and/or shot down. When a bomber was involved in an air battle the procedure was to jettison the bombs. This would reduce the weight of the bomber enabling it to increase the speed and manoeuvrability, and thus the crew’s chance to survive. Normally, bombs had to be jettisoned in a safe, thus unarmed, condition. This procedure is documented in a record from The National Archives (see annex 3).

Jettisons in the sea also happened when aircraft could not find a suitable target or in other cases when a crew could not drop their bombs. The reason to jettison the bombs was to avoid a landing with the bomb load, which was a risky event. Jettisons were seldom accurately documented. Furthermore, bombs were also jettisoned live, thus without their safety. An example of this is shown in the figure below.

RFASeuro

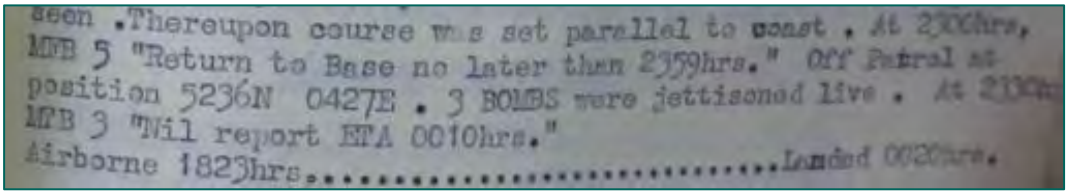

seen .Thereupon course was set parallel to coast . At 2300hrs, MTB 5 "Return to Base no later than 2359hrs." Off Patrol at position 5236N 0427E . 3 BOMBS were jettisoned live . At 2330hrs MTB 3 "Nil report ETA 0010hrs."
Airborne 1823hrs..................................Landed 0020hrs.

Figure 21: Example of a live jettison within the area of investigation, night 12/13 October 1944. (Source: TNA, AIR 25/367).

It is not clear how many times such jettisons occurred. The figure below gives an example of a flight path that crosses the area of analysis.

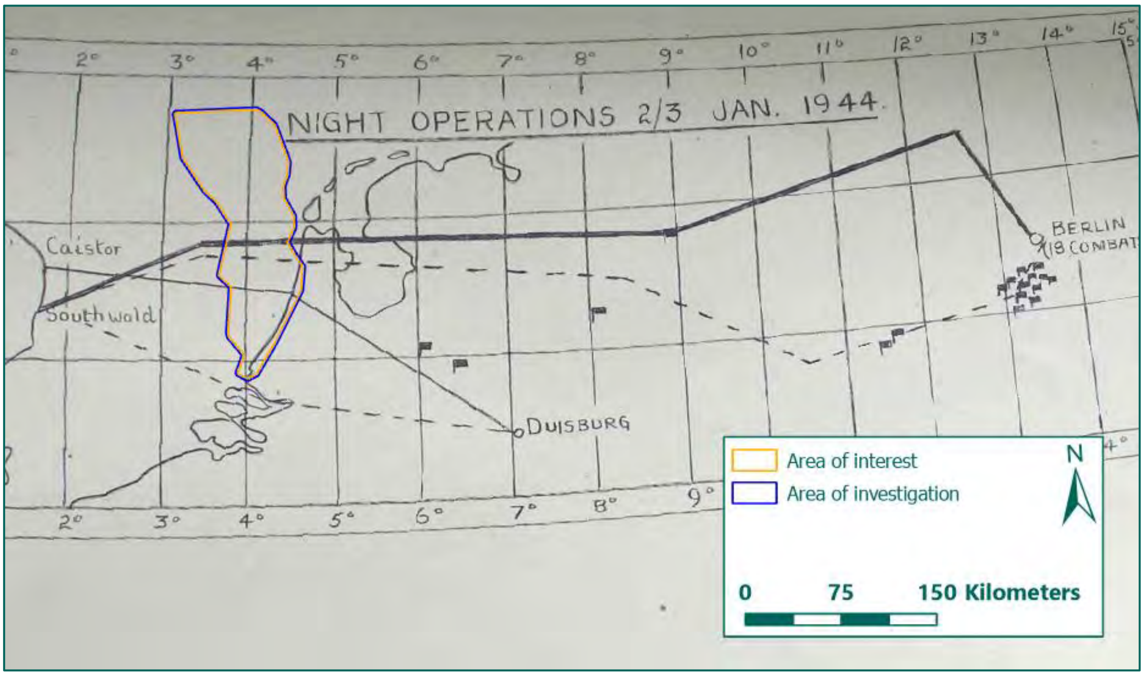


Figure 22: Example of a flight path over the area of investigation of bombers from Bomber Command, 2/3 January 1944 (Source, TNA, AIR 24/264).

Based upon the consulted sources, it is concluded that aerial bombs remain in the area of investigation as a result of jettisons. Because it is not possible to define the calibres specifically, the most common allied bombs are taken into account. The UXO risk area is specified in paragraph 4.2.5. Detailed information on the UXO is given in annex 10.

4.2.3 Anti-aircraft gunfire

The guns which were placed onto the German Vorpostenboote and escort ships were also used against enemy airplanes. The calibres of the guns vary from 2 cm to 8.8 cm. Machine guns (7.92 cm, 13,2 mm, 15 mm) completed the anti-aircraft weaponry on ships. Every time when ships and convoys were attacked, they opened fire.

Taking into account the large amount of air strikes on ships, UXO of anti-aircraft weapons are present in the area of investigation. Unexploded shells could come down and hit the sea level and sink to sea bottom. The UXO risk area is defined in paragraph 4.2.5

4.2.4 Post-war UXO encounters

As showed in annex 5, aerial bombs are encountered throughout the entire area of analysis. A total of 52 bombs have been encountered and disposed of since 2005. These bombs could originate from air strikes and/or jettisons. The Dutch Coastguard also encountered a lot of UXO that have not been specified. It is therefore unknown whether more bombs have been cleared. It is also unknown how many bombs have been encountered before 2005. Next to aerial bombs, torpedoes, depth charges and artillery shells have also been encountered. The latter were possibly caused by the use of anti-aircraft gunfire. A total of 130 artillery shells have been cleared by the Dutch Coastguard. In the figures below the locations of encountered UXO are specified. A combined total of 31 torpedoes and depth charges were encountered.

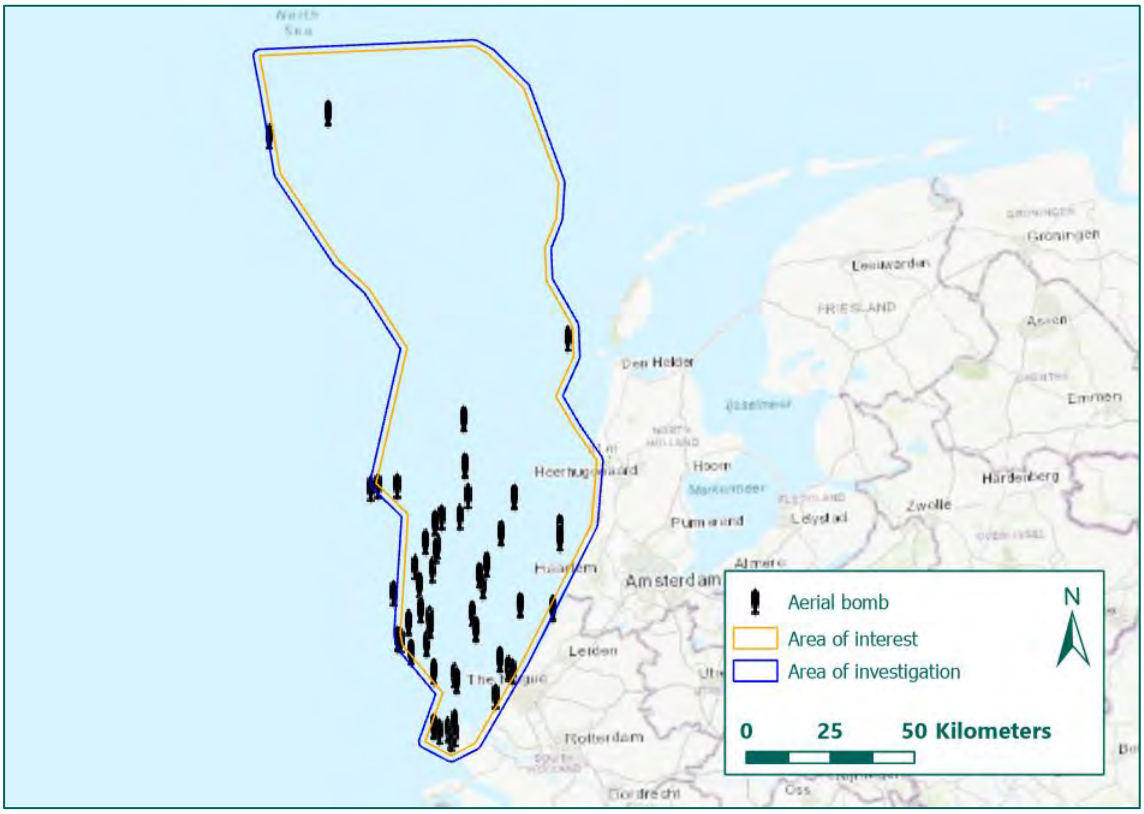


Figure 23: Cleared aerial bombs within the area of investigation (Source basemap: ESRI).

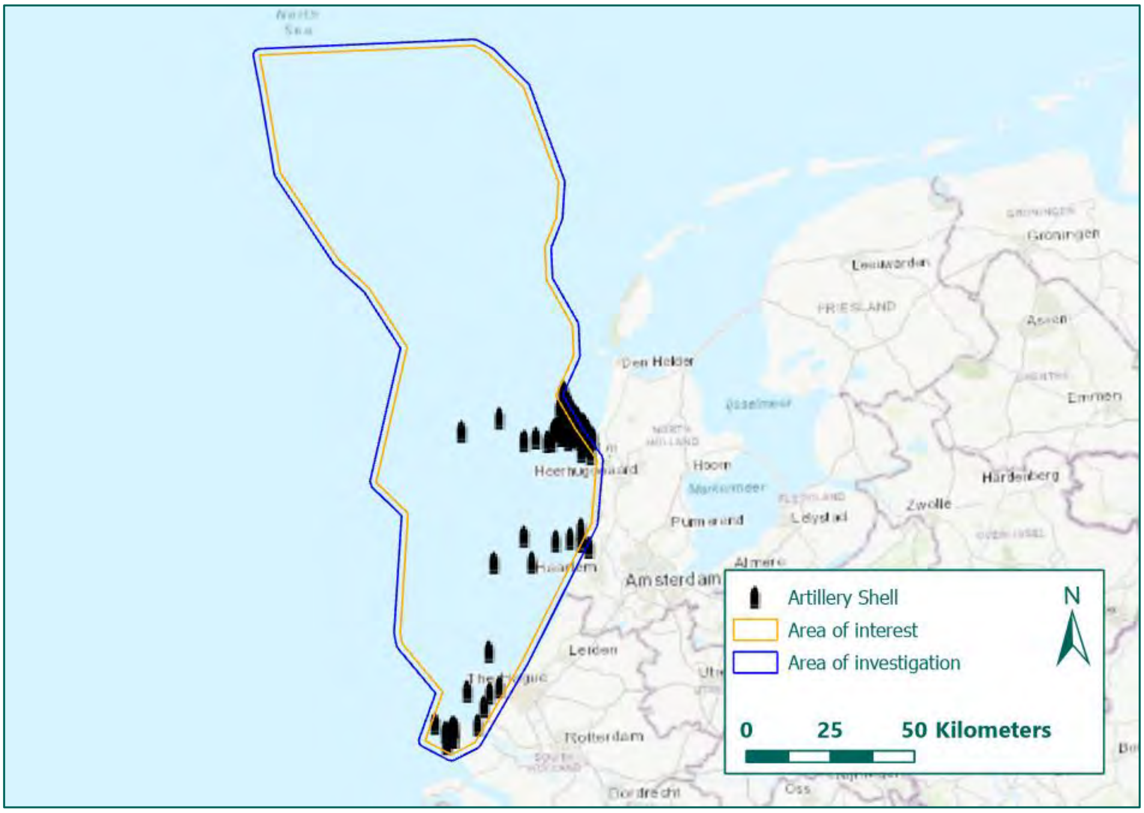


Figure 24: Cleared artillery shells within the area of investigation (Source basemap: ESRI).

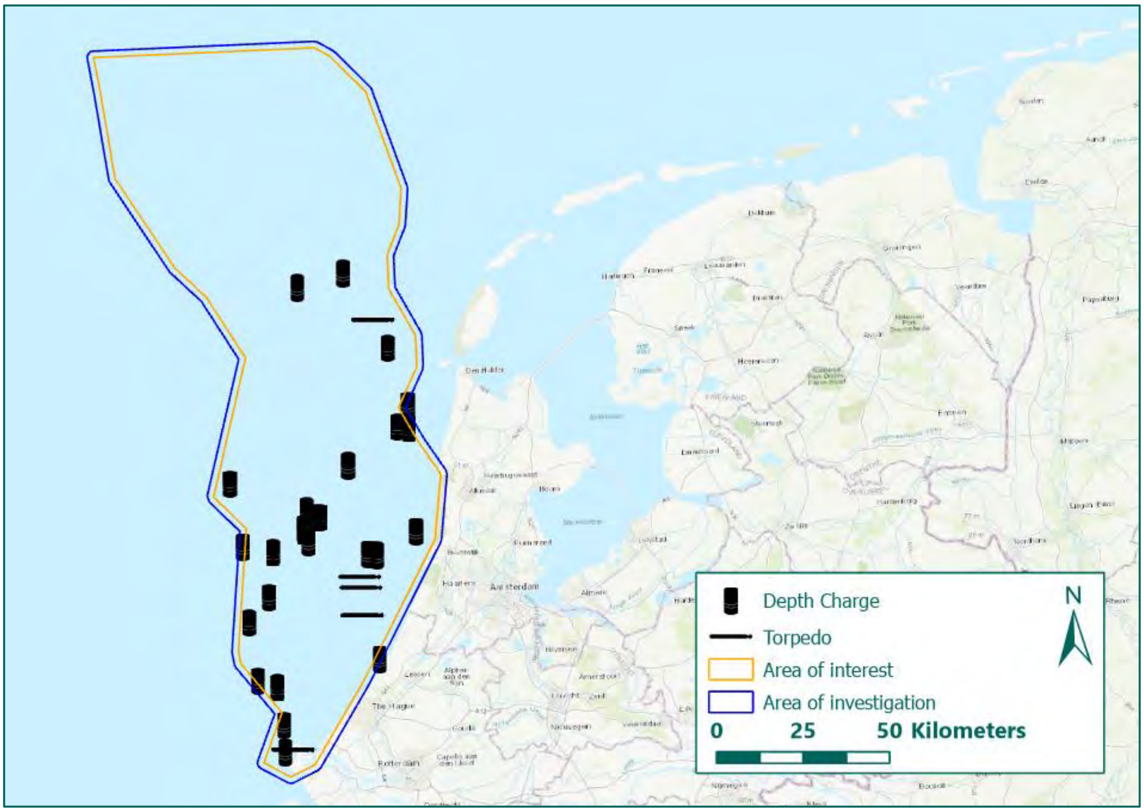


Figure 25: Cleared torpedoes and depth charges within the area of investigation (Source basemap: ESRI).

4.2.5 Conclusion

As a result of the various air strikes and jettisons UXO might still remain in the area of investigation. This is proved by the fact that since 2005 UXO have been encountered and disposed of in the area of investigation. Therefore, a UXO risk area is defined. The most probable locations of attacks are near the German convoy routes. This is confirmed by attack locations specified in the source material. Therefore the likelihood of presence of UXO regarding the air war is deemed certain along the convoy routes. The UXO risk area is projected between the most western route and the Dutch coast. A buffer of 1 nautical mile (1.852 meter) is taken into account for navigational inaccuracy of ships and aircraft. In the rest of the area of investigation the likelihood of presence of UXO is deemed probable due to the large amount of jettisons in the North Sea. In the figure and table below the UXO Risk Area regarding air war is shown. Details about calibres are also specified in the separately supplied shapefiles.

UXO type	Type/calibre	Condition
Aerial bombs	4 lbs, 25 lbs, 30 lbs, 100 lbs, 250 lbs, 260 lbs, 300 lbs, 500 lbs, 1.000 lbs, 4.000 lbs	Armed/not armed (safe)
Under water ammunition	18 inch torpedo Mk XV	Armed
	Depth charge	Armed
Rockets	3 inch rocket with 25 lbs or 60 lbs (SAP) warhead	Armed

Table 3: Expected UXO.

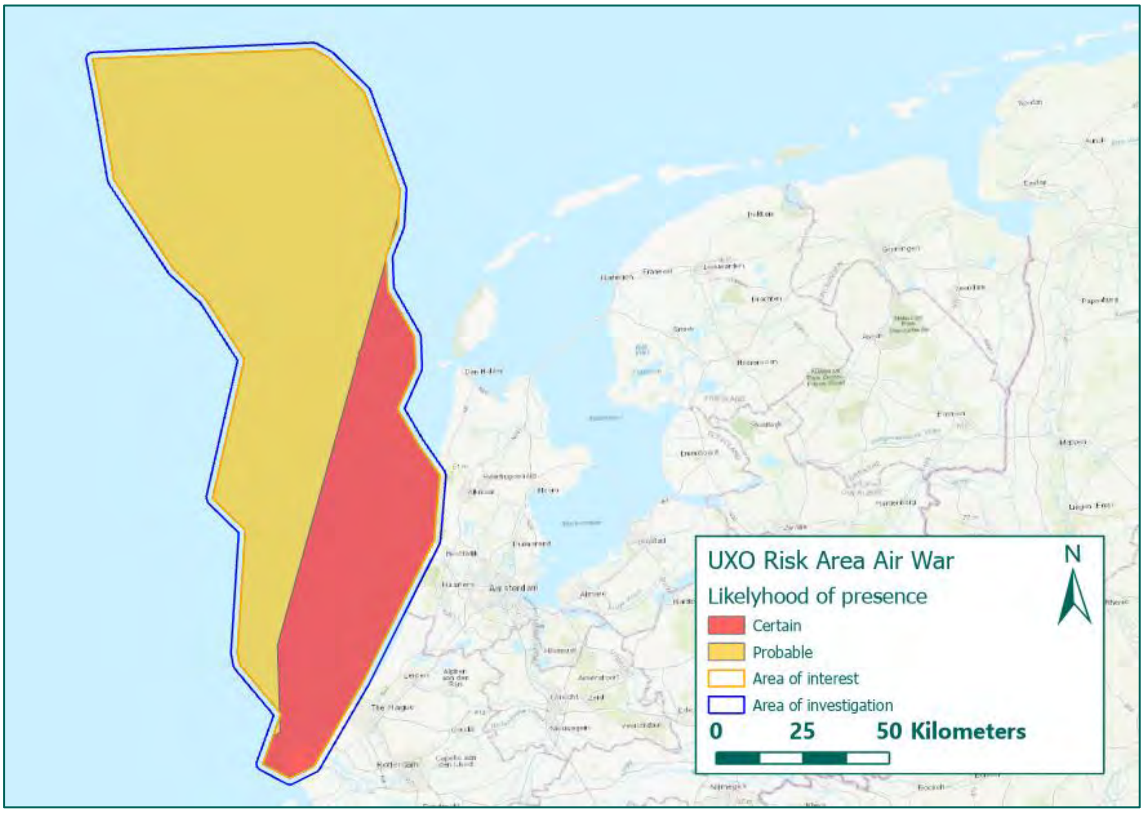


Figure 26: Likelihood of presence of UXO as result of the air war. (Source basemap: ESRI).

As on land, it is not possible to define a UXO risk area in response to the usage of anti-aircraft gunfire. The gunfire was aimed towards a moving target in the air. Unexploded shells could come down almost anywhere. It should be noted that probably most AA-projectiles came down between the shore and to the west of the convoy route. Part of this area was also covered by coastal guns. UXO of artillery shells that might be present in the coastal region will be further analysed in paragraph 4.3 and 4.4.

4.3 COASTAL GUNS

Coastal guns were traditionally used in strongpoints that had to defend harbours from enemy ships. At the start of WW2 some coastal guns were already installed on the Dutch Coast. After the German occupation of the Netherlands, a large amount of coastal guns were installed on the Dutch coast as part of the *Atlantikwall.* Source material shows that the German guns were used to stave off Allied ships nearing the Dutch Coast. Information from The National Archives (TNA) show that within the area of investigation shells fired by coastal guns exploded during an attack of the RAF. Below a strike photo is shown where the impact of a shell is highlighted.

Figure 27: Strike photo showing the impact of a shell, fired by a German coastal battery. 4 May 1942. (Source: TNA, AIR 28/595).

Various sources such as literature, records from the Dutch National Archives, the Bundesarchiv, maps and aerial photographs were used to determine the locations of coastal guns. These positions have been entered in the REASeuro GIS-database. The largest calibre that could strike the Area of investigation are 28 cm guns. They could hit targets at a range of 41100 meter. This range is extraordinary. Besides the 28 cm guns, guns from the calibres 17 cm and smaller were deployed along the coast. The maximum range of these 'smaller' calibre guns was 22000 meters. The known coastal guns near the area of investigation are shown in the figure below

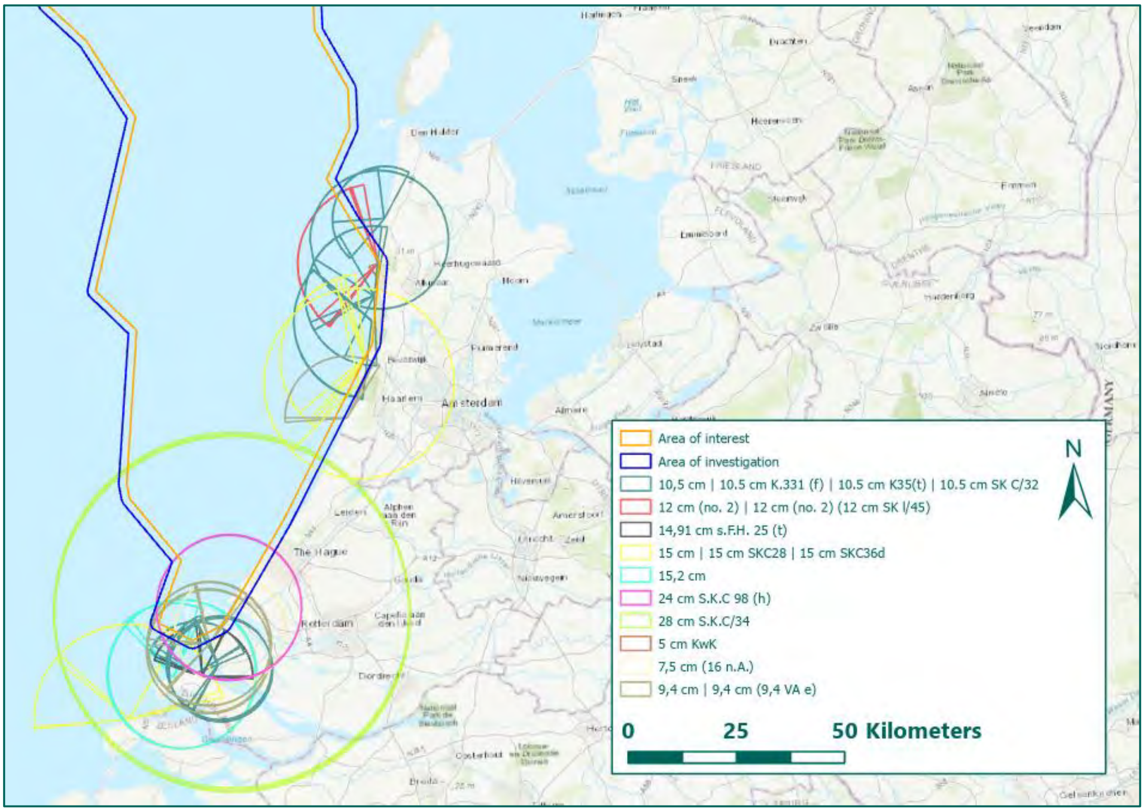


Figure 28: Locations and range of coastal guns near the area of investigation (Source basemap: ESRI).

Entering data in the REASeuro GIS-database is done on a project-by-project basis. Because REASeuro has not yet carried out Offshore Projects near the Dutch coast in the area between IJmuiden and Beverwijk, REASeuro does not yet have data on the coastal guns in this area. Consulting the Dutch 'Nationaal Archief' shows that strongpoints and military infrastructure were constructed on the Dutch coast. In order to find out the locations, calibres and range of the coastal guns on Texel and between IJmuiden and Beverwijk, REASeuro would need to visit the 'Nationaal Archief', analyse additional aerial photographs and consult literature and the internet. This is outside the scope of this research. As an example, a cutout of an 'Blokkaart' of the 'Nationaal Archief' is shown below. The map shows the contours of military infrastructure near Katwijk. Detailed information about the specific types of military infrastructure are not shown on these map, as is already mentioned, additional information is to be consulted separately.

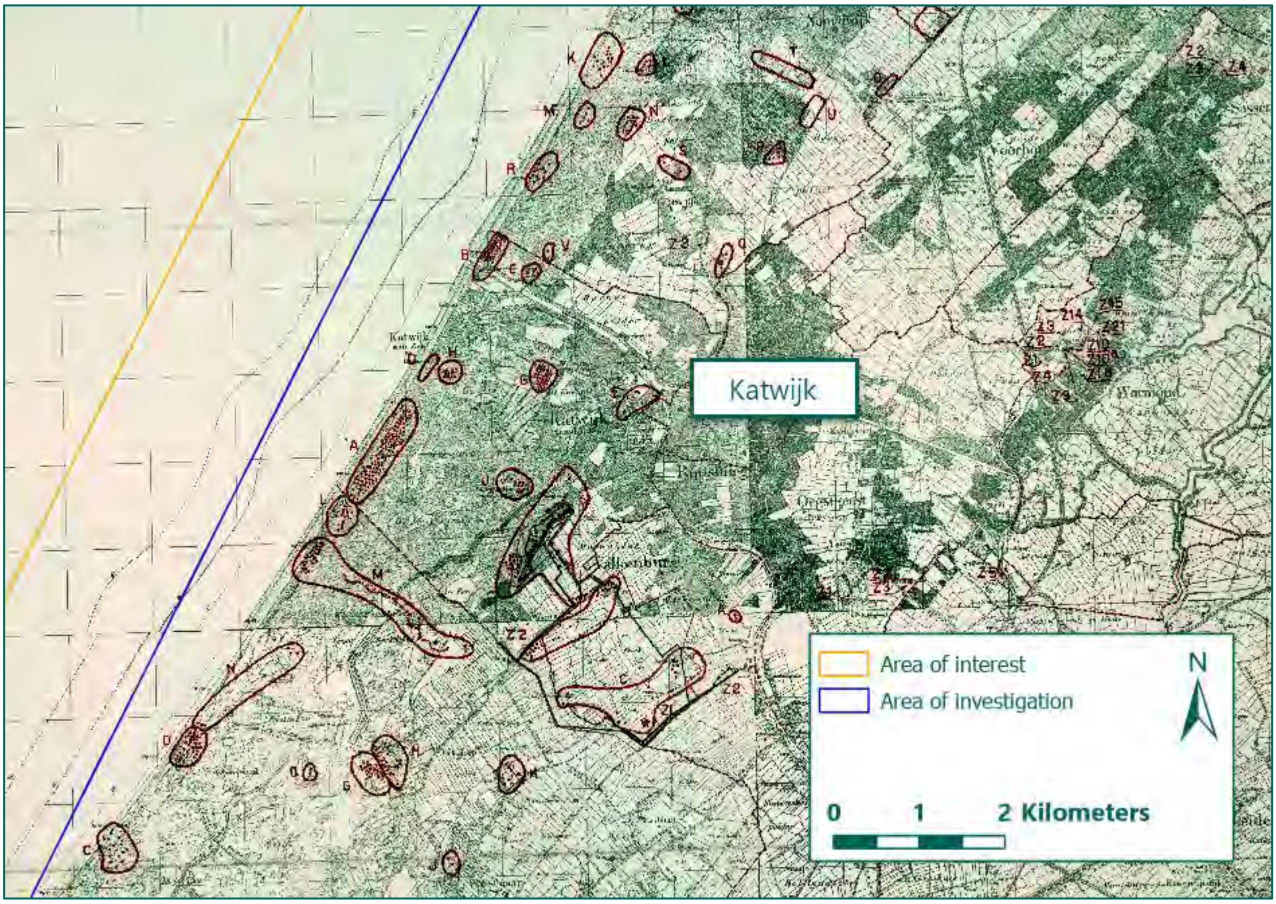


Figure 29: Cutout from a 'Blokkaart' showing the contours of military Infrastructure (Source: Nationaal Archief, 'Blokkaart' 275 3G).

4.3.1 Conclusion

Different guns could reach the area of investigation. Although the sources give only a few hints about the action of the coastal guns, it is estimated that all guns and crews had to practice from time to time. Due to the deployment of- and training with coastal guns it is probable that UXO of artillery shells are present in the area of investigation. These shells could possibly be encountered within, but no farther than, the maximum range of the coastal guns.

To cover the gap in knowledge about the coastal guns on Texel and between IJmuiden and Beverwijk the maximum range of coastal guns, not being 28 cm guns, is projected from the Dutch coast. This range is 22000 meters. Within the range of the known coastal guns and the range projected from the Dutch coast of Texel and between IJmuiden and Beverwijk an UXO Risk Area is projected. This UXO Risk area is shown in the figure below. Details about calibres are specified in the separately supplied shapefiles.

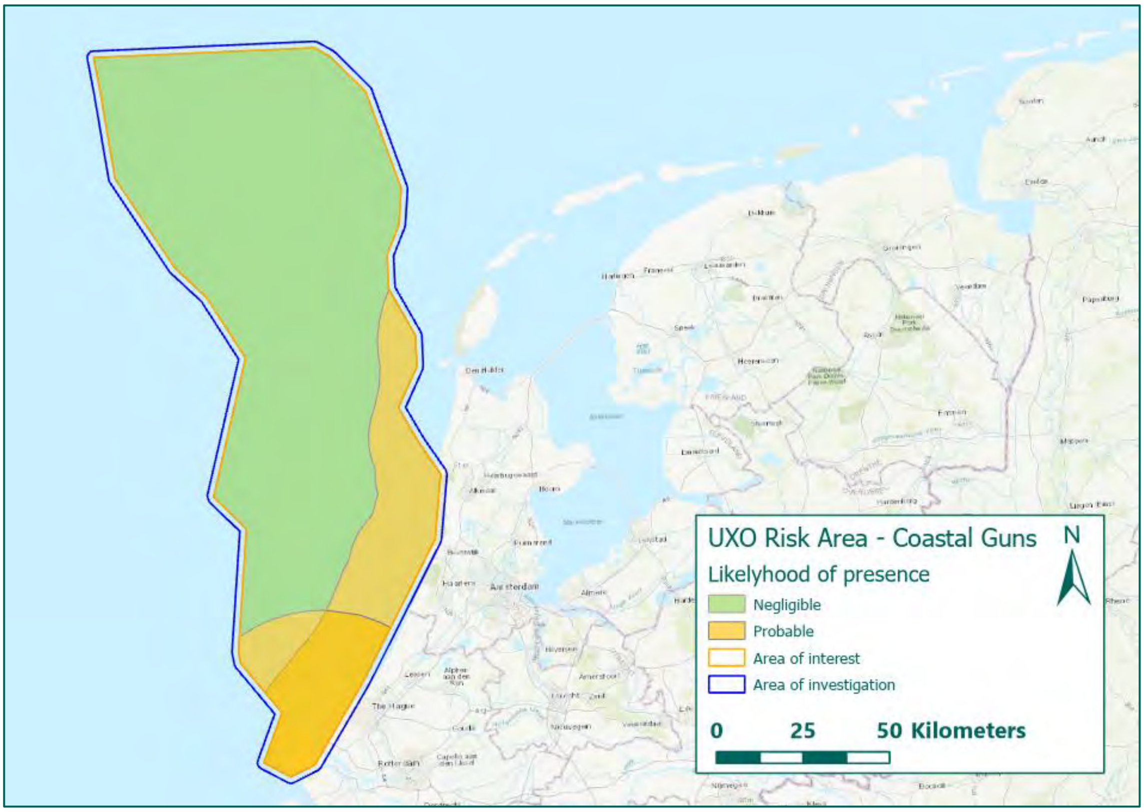


Figure 30: Likelihood of presence of UXO as result of the presence of coastal guns. (Source basemap: ESRI).

4.4 WAR AT SEA

Considering the surface craft battles, a large section of the area of investigation is situated on former German convoy routes. The convoys were accompanied with armed escort ships. Also, the convoy route itself was guarded by armed vessels and trawlers, the so-called "*Vorpostenboote*" that patrolled between checkpoints. The convoy routes are shown in Figure 31. Besides, IJmuiden and its harbour overlap the area of investigation. During the Second World War IJmuiden became an important base for the German fast attack boats (*Schnellboote*, S-Boats), for which a bunker was constructed. Later on, midget submarines also operated from IJmuiden.

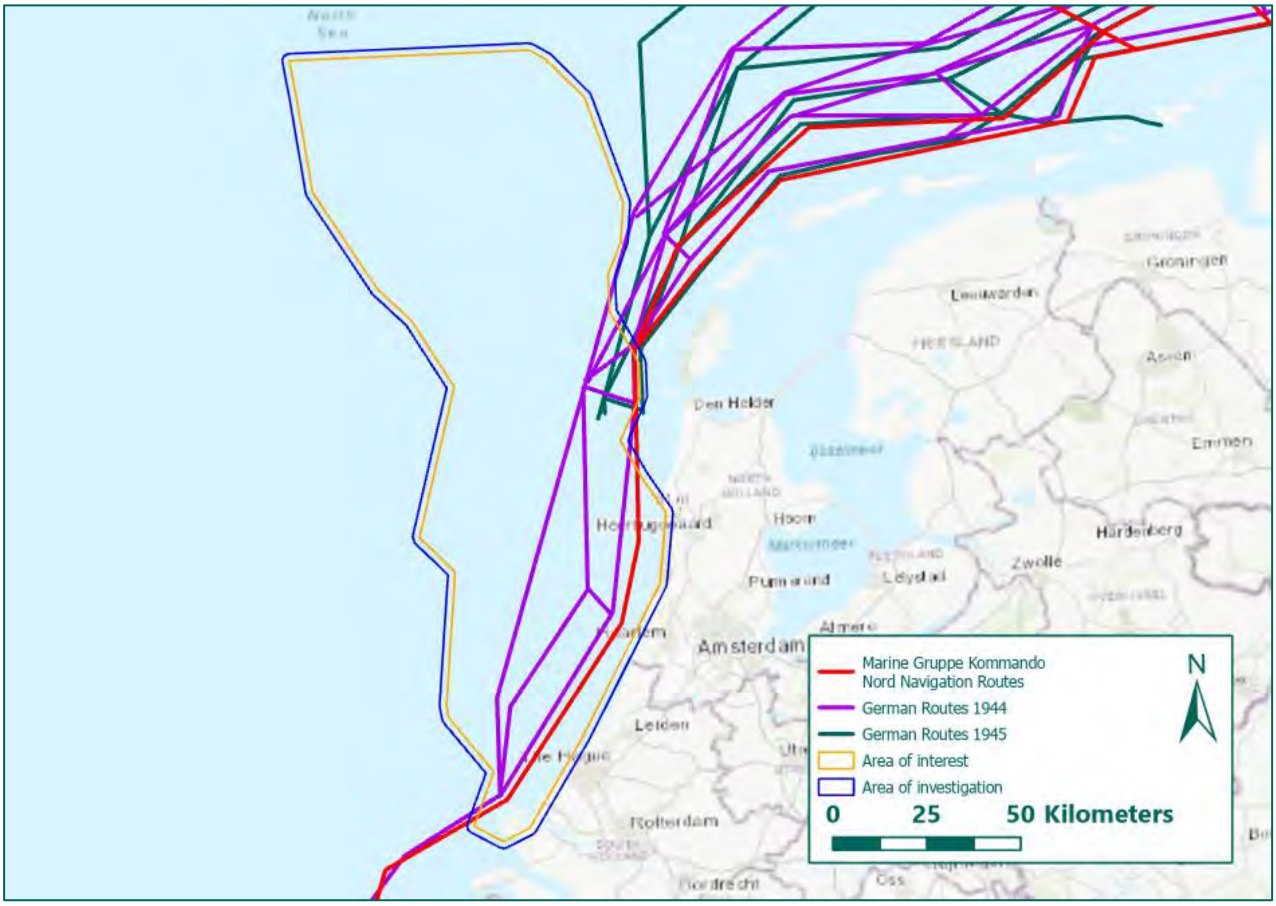


Figure 31: Convoy route "Weg Rot" and the quadrants used by the German navy. (Source basemap: ESRI).

The armed escorts and Vorpostenboote did not prevent the British Coastal Forces from attacking these ships and convoys. Detailed records about armed encounters between British and German ships can be found in German (BAMA), British (TNA) and American (NARA, Captured German Records) archives. Studying these records is outside the scope of this report. However, previously conducted studies by REASeuro (Amongst others 73556/RO-190149 Final Report DTS HKW Beta Export Cable Routes version 1.0) point out that near IJmuiden alone 36 confrontations between British and German vessels took place. The localisation is mainly based on the quadrants used by the German navy. The accuracy of these quadrants is not better than six to six nautical miles. For many of the surface craft battles only one source is available. Nevertheless, the German records show that most battles took place in a zone from the coast to the west of the convoy route.

4.4.1 Conclusion

Because of the large amount of naval battles that took place, an UXO risk area is defined. It is deemed probable that AA-shells and munition that could be used against enemy shipping might still be present in the area of investigation. UXO might be present near the convoy routes used by German ships. Therefore a UXO Risk Area is projected between the Dutch coast and the convoy routes. A buffer of 1 nautical mile (1.852 meter) is taken into account to mitigate the navigational inaccuracy. The likelihood of presence of UXO outside of the area between the Dutch coast and the convoy routes is deemed remote. In the table and figure below the UXO Risk Area is shown.

UXO type	Type	Condition
Small calibre ammunition	.303	Fired
	.50	
	13,2 mm	

	15 mm	
Artillery shells	2 cm/20 mm	
	2 pr. pompom	
	3.7 cm	
	6 pr.	
	8.8 cm	

Table 4: Expected UXO.

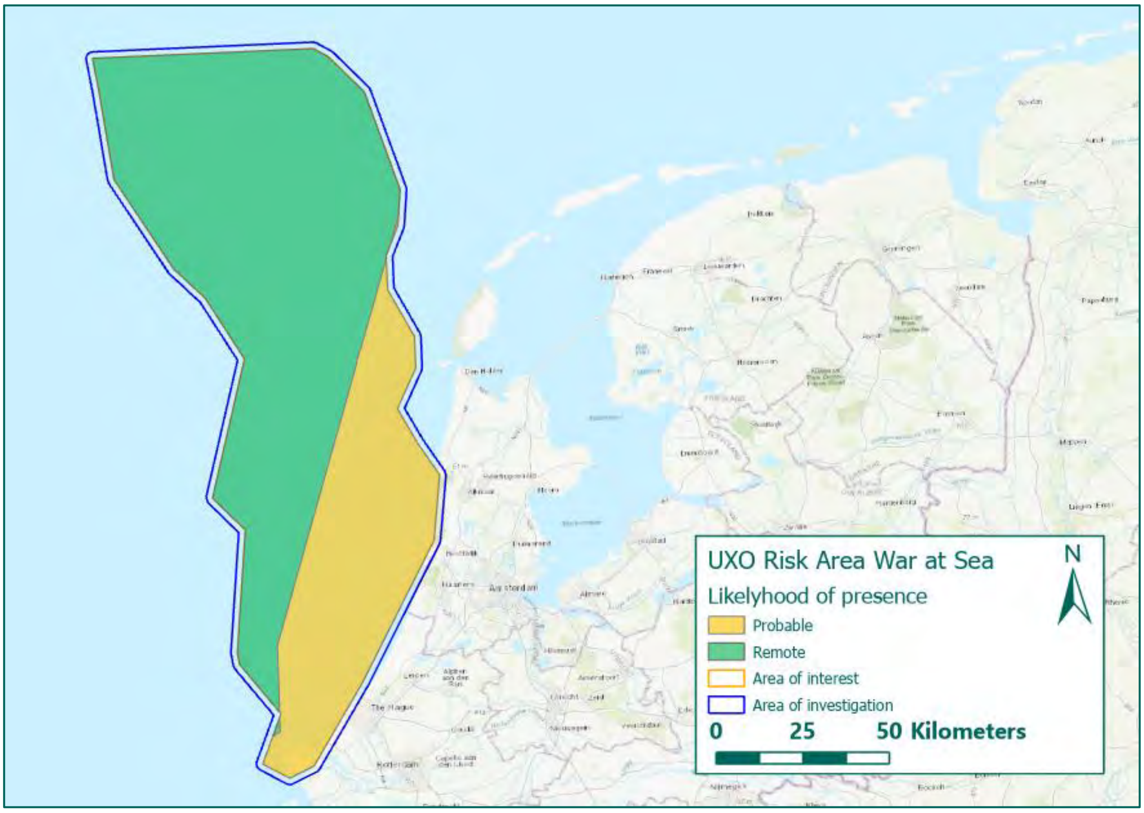


Figure 32: UXO risk area caused by surface craft battles. (Source basemap: ESRI).

4.5 MILITARY EXERCISE

On maps that show German minefields (used in paragraph 4.1.2) a German 'Schieβgebiet' ('Shooting area') can be seen that overlaps with the area of investigation. The 'Schieβgebiet' was drawn onto a map concerning German minefields in the North Sea. In the consulted sources there is no further mention about the 'Schieβgebiet'. It is therefore unclear what kind of exercising took place within this area. It could either be exercises carried out by the Kriegsmarine or the Luftwaffe. It is expected that within this area small arms calibres and artillery shells have been used. It is known that wartime exercises are often carried out with live ammunition, this in contrast to post-war exercises.

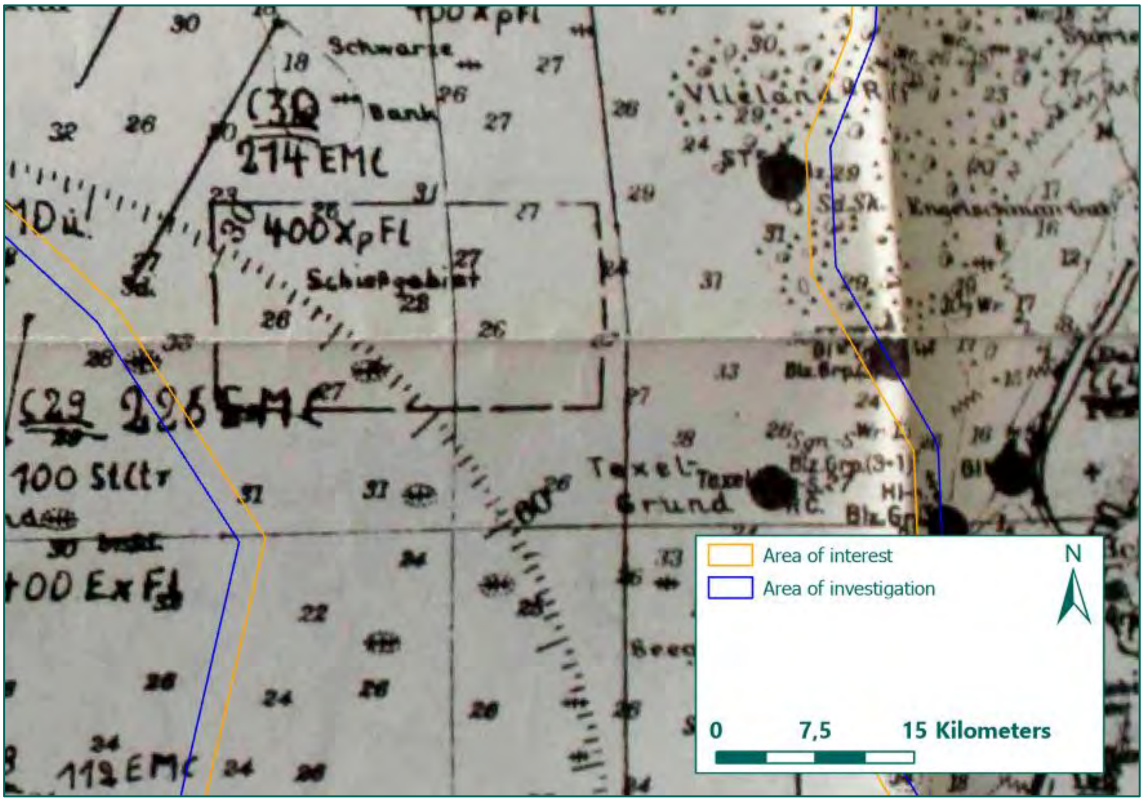


Figure 33: German map showing minefields and a 'Schieβgebiet' ('Shooting area') within the area of analysis (Source: BAMA, ZA 5/27).

Based upon information from the 'Nationaal Archief' in the Hague it is known that the above mentioned 'Schieβgebiet' was used by the Dutch Navy after World War II. The contours of the military exercise area appear to have an exact overlap with the contours of the German 'Schieβgebiet' discussed above. Sources from the Noordzeeloket (see Annex 3) show that this military exercise zone was used as a "laag vlieggebied" (low fly zone) where one of the activities carried out was 'gun fire'[6]. The map on which the military exercise area is drawn dates from 1965. It is not known for how long the Dutch Navy used the area for exercises and whether only 'gun fire' was carried out.

[6] It is expected that in this low fly zone exercises with both machine gun- and cannon fire were carried out with aircraft.

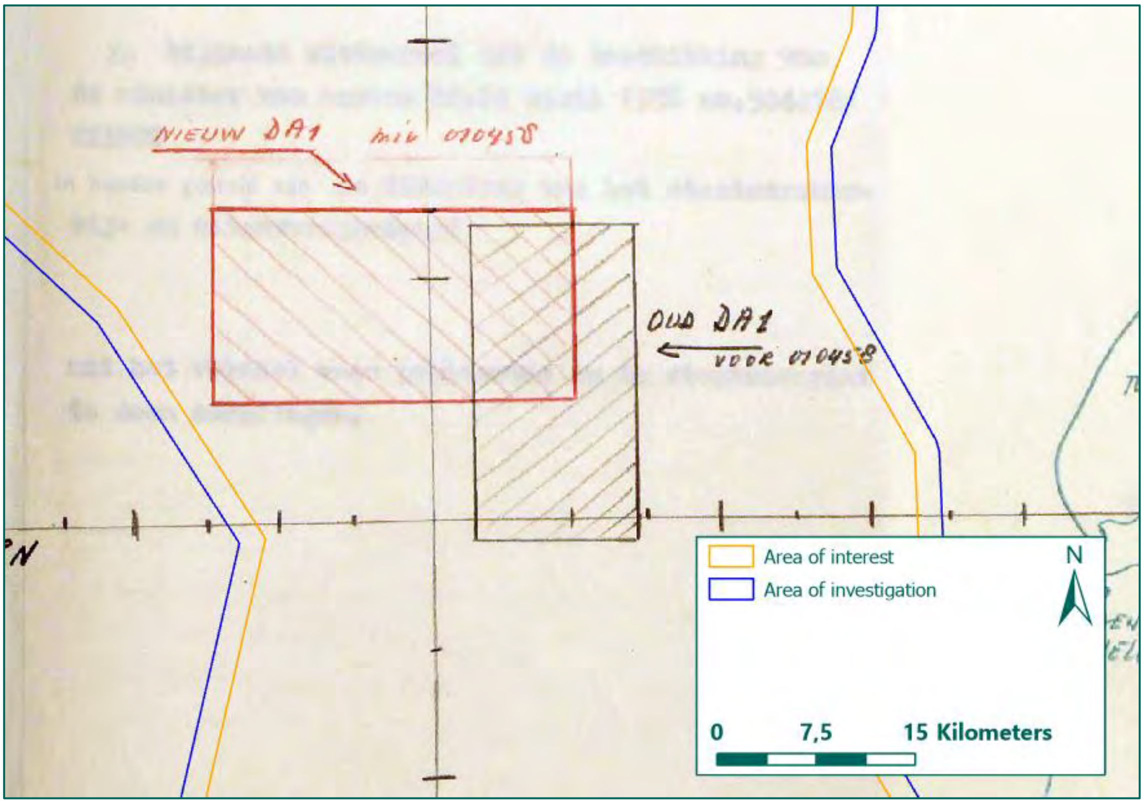


Figure 34: maps showing the location of a Dutch military exercise area within the area of investigation (Source: Nationaal Archief Toegang 2.12.56, folder 939).

Both during and after the war a military exercise area overlapped with the area of analysis. Normally, explosives are no part of exercise ammunition. However, as a result of German wartime practicing within the 'Schieβgebiet', UXO could be encountered within the 'Schieβgebiet' as wartime exercises were often carried out with live ammunition. It is to be expected that Dutch post-war exercises were carried out with small arms calibres and artillery shells. During peacetime military exercises would often be carried out with practice ammunition. Practice ammunition can incorporate devices to simulate the impact, like smoke markers or relatively small amounts of high explosives.

Besides the abovementioned 'Schieβgebiet', several other military exercise zones were located within the Area of investigation. It is known that some of these zones were in use during World War II. However, it is not clear whether this is the case for all exercise zones. It is outside the scope of this HDTS-UXO to conduct research in the usage of each of these zones. Because of the possible usage of live munition within the different exercise areas, it cannot be ruled out that UXO might still be present within the area of investigation.

The different military exercise zones as mentioned in the consulted sources are shown in the figure below.

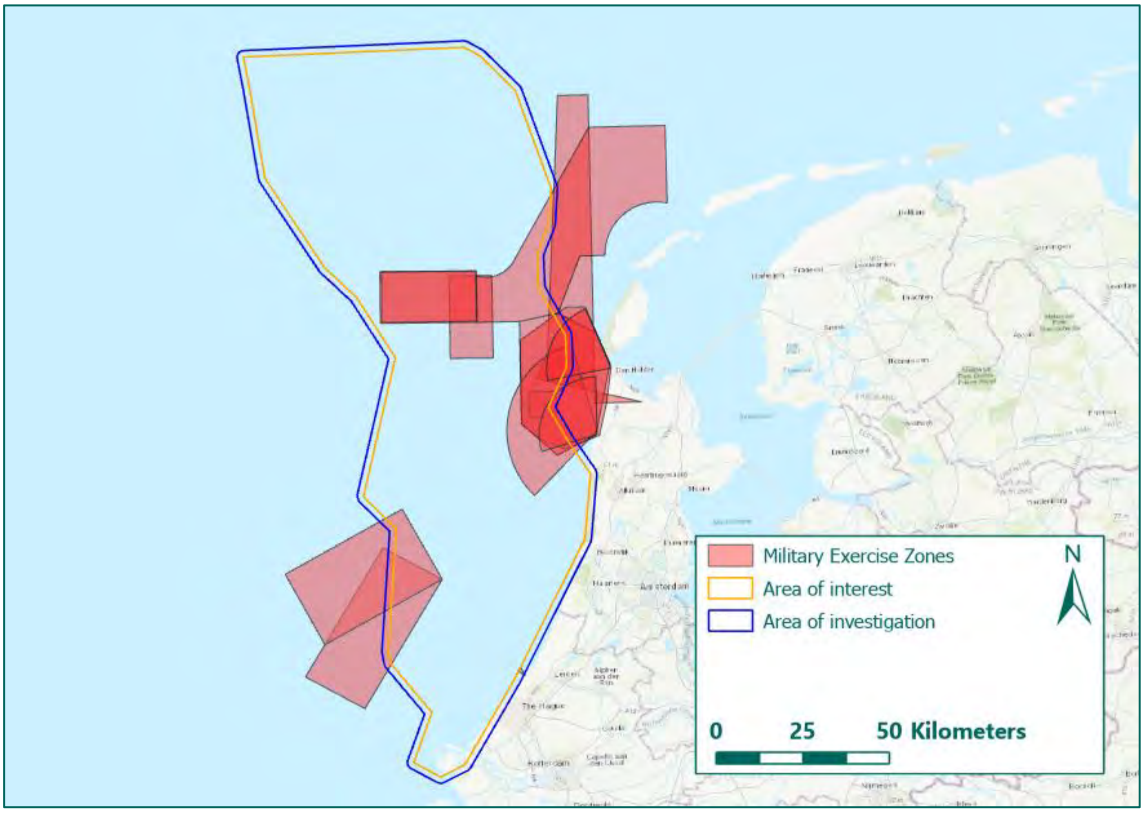


Figure 35: Military exercise zones within the area of investigation (Source basemap: ESRI)

4.5.1 Conclusion

The presence of several military exercise zones within the area of investigation, of which some were used during World War II, leads to the conclusion that UXO (either exercise ammunition or live ammunition) could still be present within the area of investigation. Additional research may be necessary to determine the type of munition used in each of the zones, and to determine whether or not live ammunition was used within the zones. This additional research is outside the scope of this research.

The sort, type, amount and condition of the munition used within the different military exercise zones can, at this time, not be determined. The consulted sources do not provide information about this. However, it cannot be ruled out that UXO might still be present within the area of investigation. Therefore, a UXO Risk Area is projected at the location of these military exercise zones. The likeliness of presence of UXO in these zones is deemed probable. The likeliness of presence of UXO in the other parts of the Area of investigation is deemed negligible.

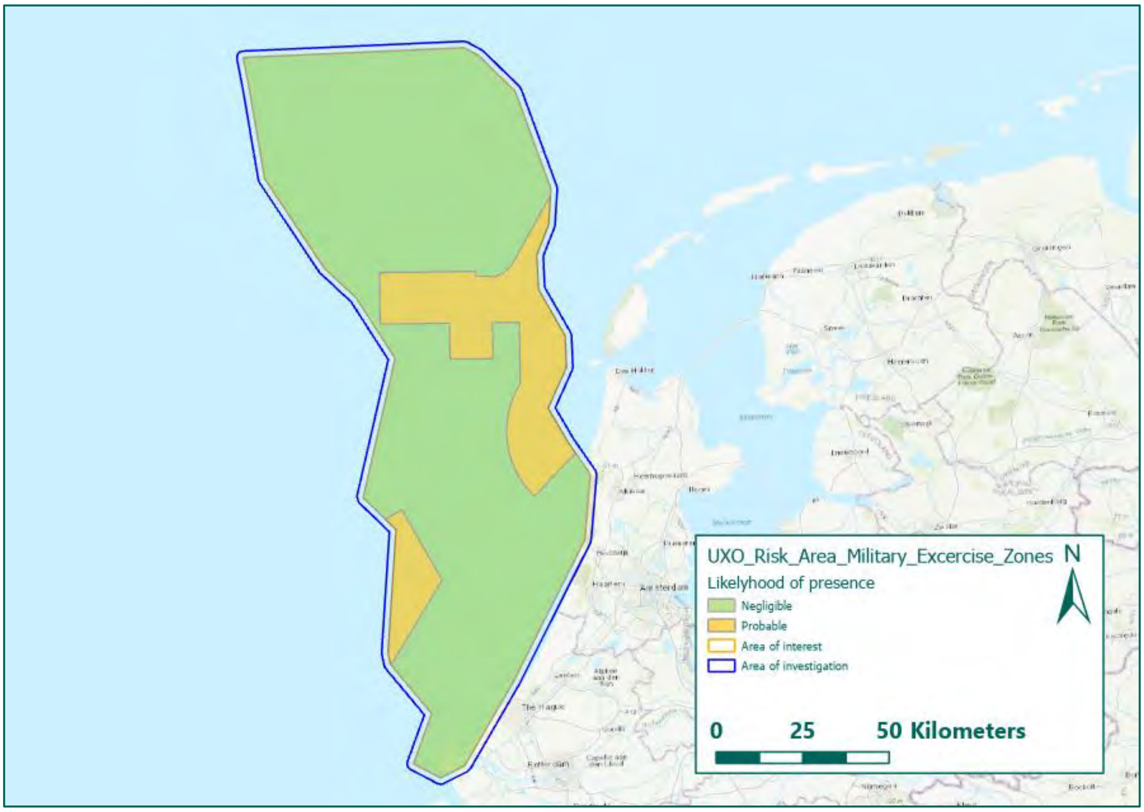


Figure 36: Likelihood of presence of UXO as result of the presence of coastal guns. (Source basemap: ESRI).

4.6 WRECKS

According to consulted sources (website of the Wrecksite and HP39 Wrakkenregister), various airplanes crashed into the area of investigation and boats sunk in the North Sea. For many crashes and shipwrecks the exact location is not known. Some wreck locations are therefore indicatively marked.

The wreck register (HP39 Wrakkenregister) shows 609 shipwrecks in the area of investigation (see annex 5). Detailed information about most wrecks are unknown. However, in some cases the name of the sunken vessel is known. It is possible to research whether or not these vessels sunk due to war related events. However, it is deemed outside the scope of this research to find additional information about 97 wrecks. Therefore, this additional research will not be conducted. In the figure below a total of all wrecks near the Area of investigation is shown.

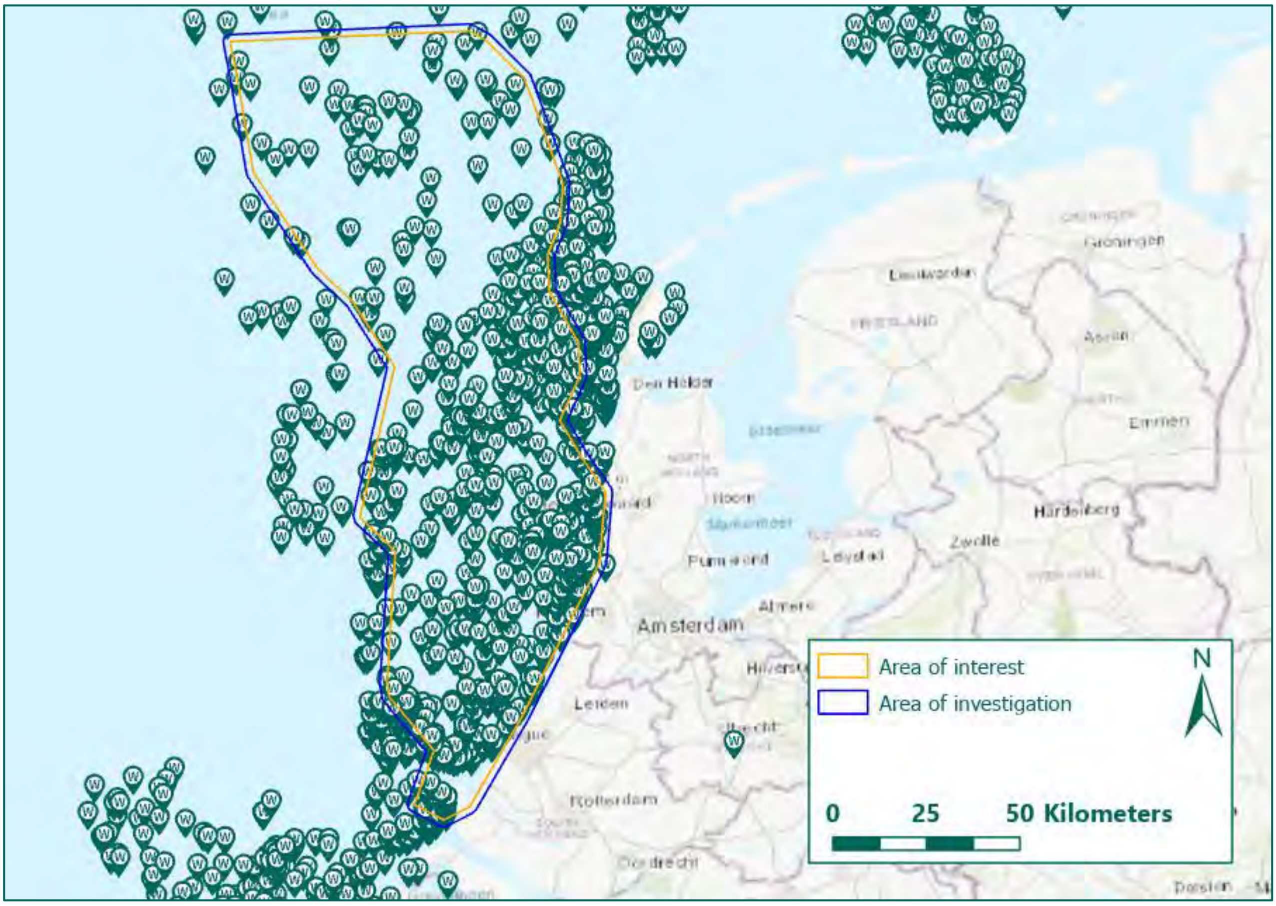


Figure 37: Overview of wrecks within the area of interest according to HP39 (Source: HP39).

The website of 'Wrecksite' also provides a lot of information about wrecks. Near the area of investigation, a total of more than 1800 wrecks lay within and near the area of interest. Plotting all these wrecks in the GIS-system would be too comprehensive and falls outside the scope of this report. In the table below a list of war related causes of sinking of ships/aircraft within the area of interest is shown. It should be mentioned that in most cases, no cause of sinking was mentioned.

Cause of sinking	Total number sunk
Airplane crashes, WW2	75
Air raids, WW2	19
Charges/explosives, WW1 and WW2	8
Depth charges , WW2	2
Explosions, WW2 and after WW2	4
Gunfire – shelled, WW1 and WW2	152
Mine, WW1 and WW2	39
Naval battles, WW1 and WW2	10
Torpedo, WW1 and WW2	21
War loss (Not specified), WW1	1

Table 3: Listing of ships/aircraft sunk by war related events.

4.6.1 Conclusion

As can be seen, most of the wrecks mentioned in this table can be ascribed to war related events described in paragraphs 4.1-4.3. The demarcation of UXO Risk Areas resulting from these war related events is also described in these paragraphs. Additional UXO Risk Areas will not be demarcated because of the possible presence of wrecks of ships or aircraft. However, if a wreck is encountered during activities in the Maasvlakte the authorities are to be alerted. Wrecks can possibly still house the bodies of fallen troops or might be considered cultural heritage.

4.7 MUNITION DUMPING

As shown on the map of the Noordzeeloket (Figure 38) and the naval chart of the Royal Netherlands Navy Hydrographic service (Figure 39), ammunition dumping sites are situated within the area of investigation. According to archival documents, tons of German left behind ammunition were dumped into this zone shortly after World War II. In the 1960's, it appeared that fishermen encountered also ammunition outside the most northern dumping site, therefore a larger zone was marked as "*dangerous for fishing, intrusive, and seismographic activities*". The centre of the dump ground is marked with a buoy in position 52-33,5N, 04-03,6E. The dangerous area is defined by a radius of three nautical miles around this buoy. For the two southern dumping sites no such 'danger zones' were determined. In the figures below, the location of the dumping sites are indicated.

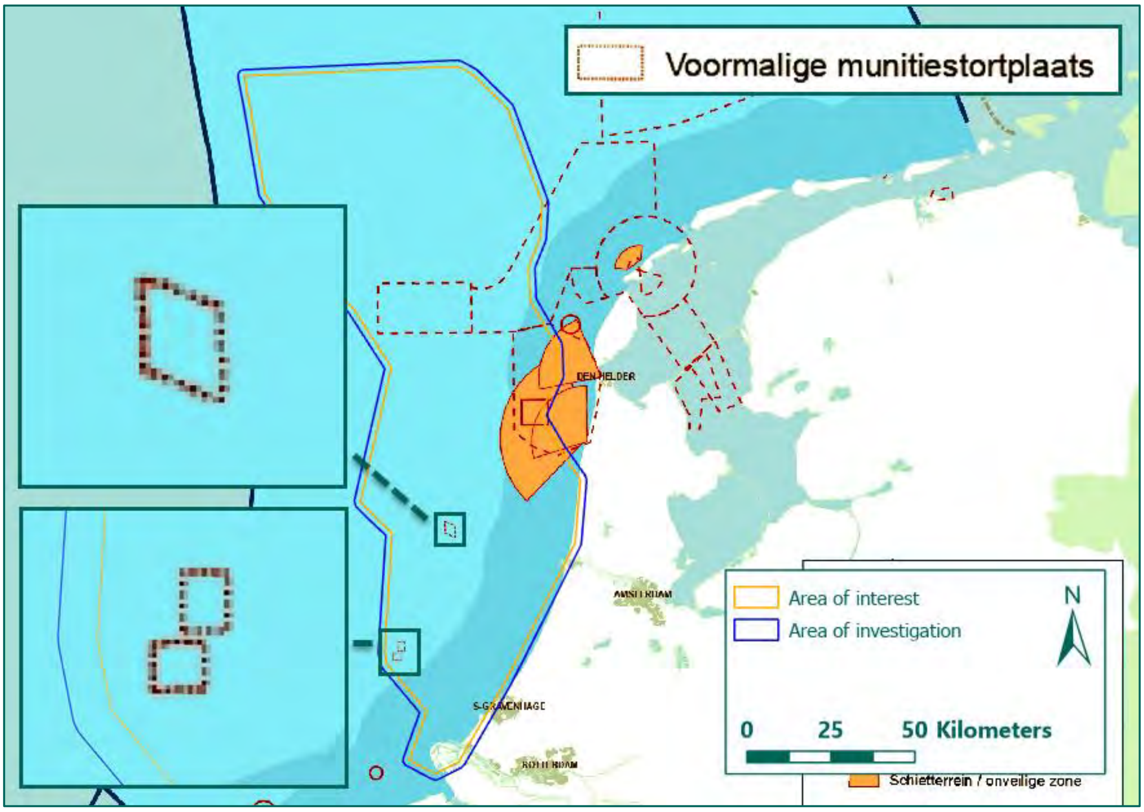


Figure 38: Map showing the military usage of parts of the North Sea, including munition dumping sites (Source: NZL).

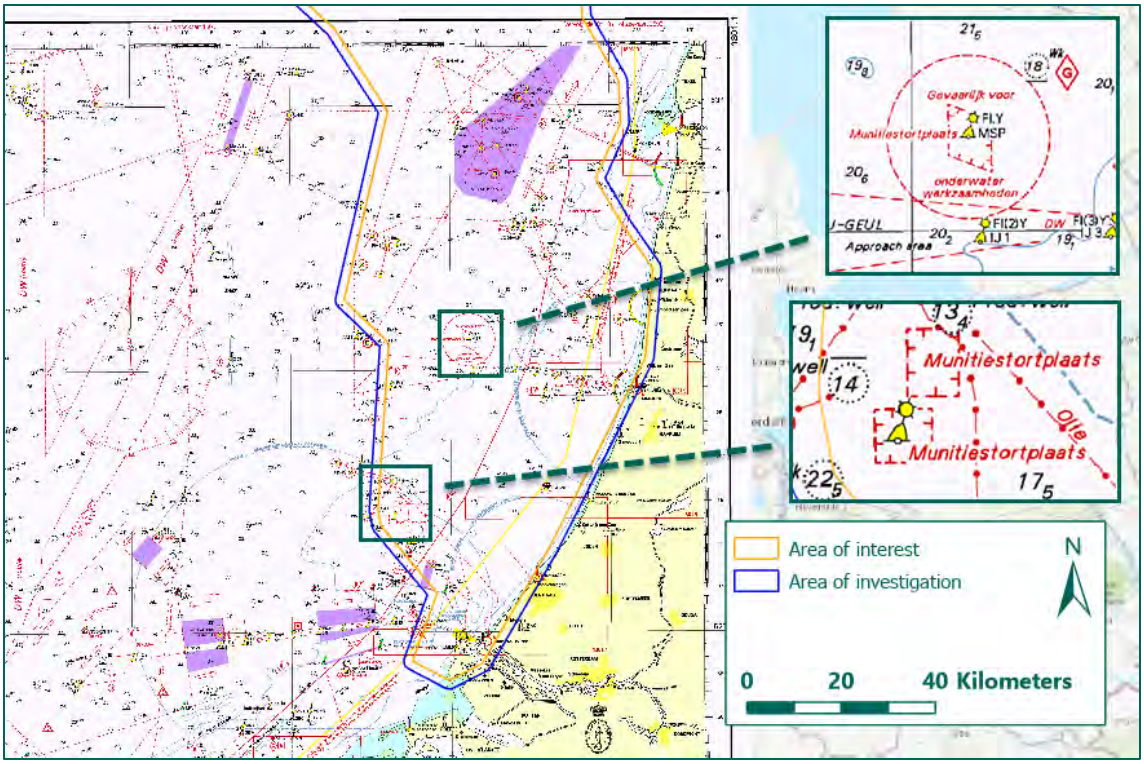


Figure 39: Naval chart (Source: Royal Netherlands Navy Hydrographic service).

4.7.1 Conclusion

Because of the large amounts of munition dumped within these sites, it is certain that UXO is still present within the dumping sites. It is also probable that munition was dumped outside of the determined dumping sites, as was the case near the most northern dumping site. Therefore, a buffer of three nautical miles is projected around these two munition dumping sites as well. Within these buffer zones the likelihood of presence is deemed probable. No information is available on the exact amount and type of the ditched ammunition. Therefore, the sort, type, amount and condition cannot be determined.

The consulted sources do not provide information about munition dumping in other parts of the Area of investigation. Therefore, the likeliness of presence of dumped munition in the other parts of the Area of investigation is deemed negligible.

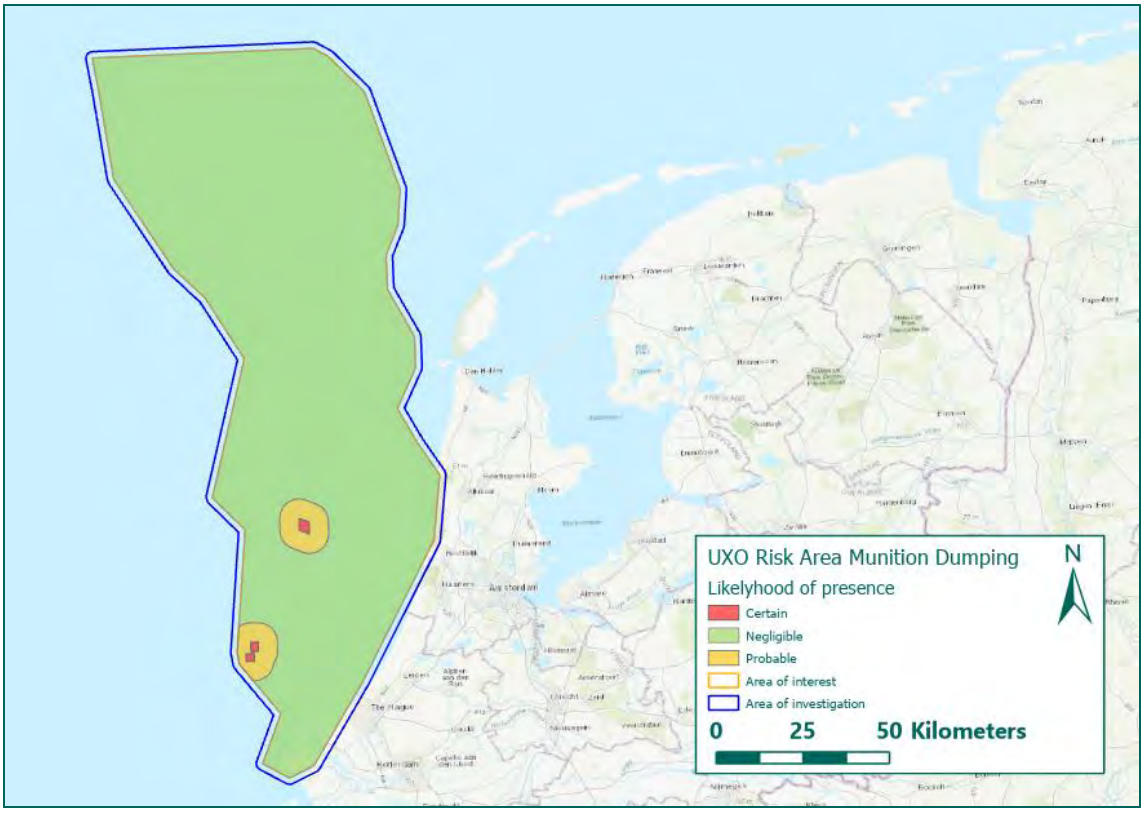


Figure 40: UXO risk area due to munition dumping. (Source basemap: ESRI).

4.8 V1 AND V2 BOMBS

During the last years of World War II, the German High Command started using new weapons with the hopes of stopping the Allied build-up and advance. These new weapons were the Vergeltungswaffe 1 (V1) and Vergeltungswaffe 2 (V2). The V1 was an early cruise missile with a pulsejet for power. The V2 was the world's first long-range guided ballistic missile. These weapons were targeted against, amongst others, Allied cities and harbours.


Figure 41: photographs of a V1 and V2 (Source: REASeuro-database).

V1 and V2 launch sites were constructed all over German-occupied territories. London was one of the main targets of the V1 and V2. Many of the V1s and V2s launched did not reach their target but landed prematurely or overshot their target due to navigational or technical errors. V1s and V2s were also vulnerable to Allied countermeasures such as anti-aircraft guns.

The consulted sources show that V1s and V2s could also land in the sea near the United Kingdom (see Figure 42). It is possible that, either through navigational or technical errors or through Allied countermeasures, UXO of V1s and V2s are left within the Area of investigation. However, in the consulted sources there are no indications that this has occurred.. A UXO Risk Area can therefore not be determined.

Figure 42: V1 and V2 bombs hitting targets in the United Kingdom (Source: V2, See Annex 2)

4.8.1 Conclusion

Although it is known that V1s and V2s could at times strike down at the sea, there are no indications in the consulted sources that this has occured within the area of investigation. It is therefore not possible to determine a UXO Risk Area within the Area of investigation.

5 GAPS IN KNOWLEDGE

During the analysis and review of historical sources some gaps in knowledge occurred that could not be filled in with the consulted sources:

- Knowledge of previous UXO clearance operations is often absent. Therefore, it is not fully known if during the period 1914-2016 UXO were encountered in and/or removed out of the area of investigation.
- It is unclear whether the source material concerning German convoy routes is complete. The consulted sources mention several attacks on convoys sailing outside the convoy routes that are known by REASeuro.
- Pinpointing the locations of all 1800 wrecks within and near the Area of Investigation was considered too comprehensive a task with regards of the scope of this research. Therefore, not all (approximate) locations of wrecks as mentioned in the consulted sources are pinpointed.
- The REASeuro-database did not contain detailed information about all individual coastal guns on the Dutch coast bordering the Area of investigation.
- Detailed records about armed encounters between British and German ships are not yet entered into REASeuro's GIS-Database. Therefore, it was not possible to give an overview of all (approximate) locations of these encounters.
- The type and amount of ammunition used by German and allied submarines, planes and ships is not always known.
- The types, calibres and amounts of munition used in the different military exercise zones are not always known
- It is unclear which types, calibres and amounts of munition were dumped in the munition dumping ground within the area of investigation.
- The REASeuro database does not contain every sortie made by Coastal Command planes during the Second World War.

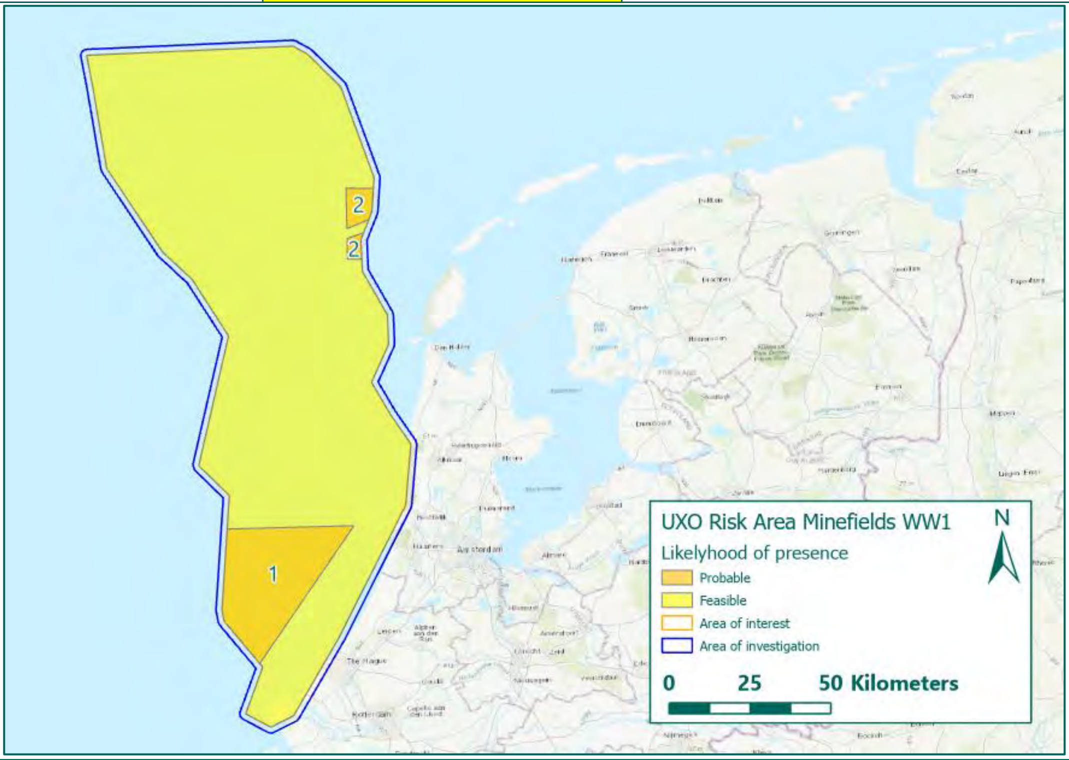
Besides these gaps of knowledge, there are also some uncertainties concerning source material relevant for this report:

- It is not possible to pinpoint exact locations of war-related events at sea. This problem is partly solved by defining a large area of investigation. Events that took place within this area could have led to a UXO risk area.
- Compared to land, the North Sea offers few reference points. Therefore, specific information about locations is often lacking. Furthermore, it must be noted that information can be inaccurate.
- Because of the systematic destruction of the *Luftwaffe* archives, there is only sporadic information available on German Air Force activity.
- Crash locations of planes during World War II are not exactly known. This is also the case for many shipwrecks, which are also unknown on Wrecksite.eu.
- There is no exact information about the locations, amounts, conditions and types of dropped bombs during aerial attacks or jettisoning above the North Sea.

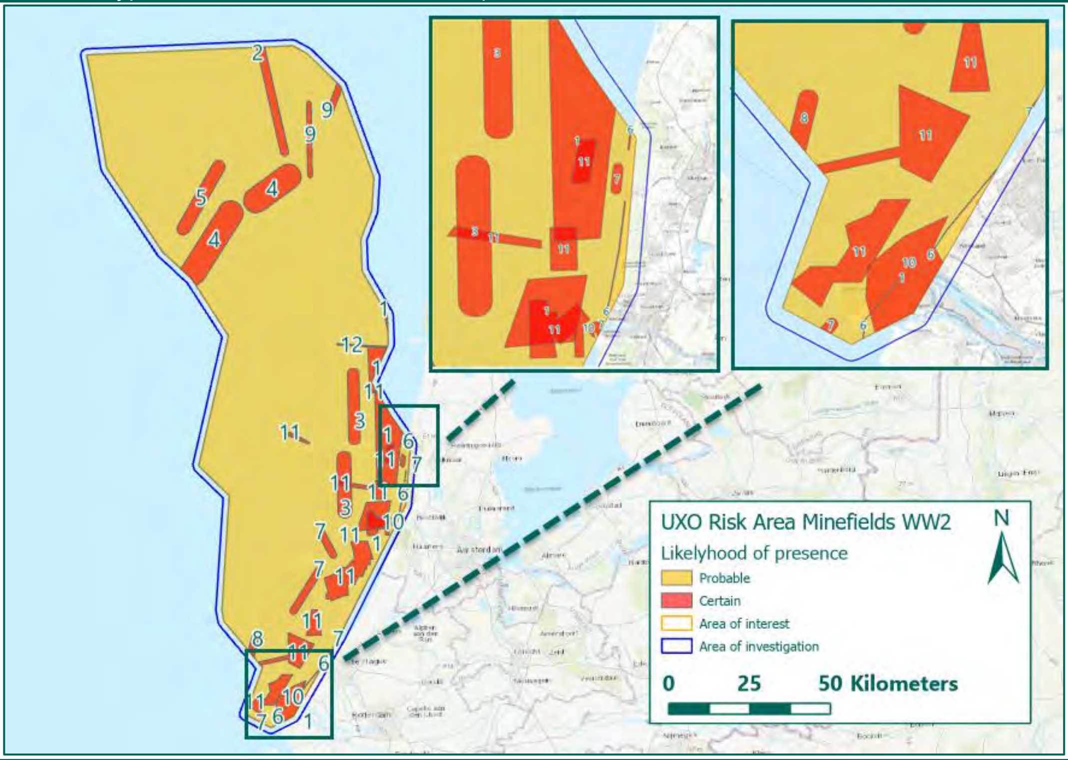
6 OVERVIEW OF UXO RISK AREAS

Based on the assessment and analysis of the source material, several UXO Risk Areas have been identified within the area of investigation. The main types of UXO found in each UXO risk area are outlined in chapter 4. The horizontal demarcation of UXO Risk Areas is discussed per type of warfare in the conclusions of paragraph 4.1, 4.2, 4.3, 4.4, 4.5, 4.7 and are presented in tables below.

UXO Risk Area as a result of the naval mines (paragraph 4.1)

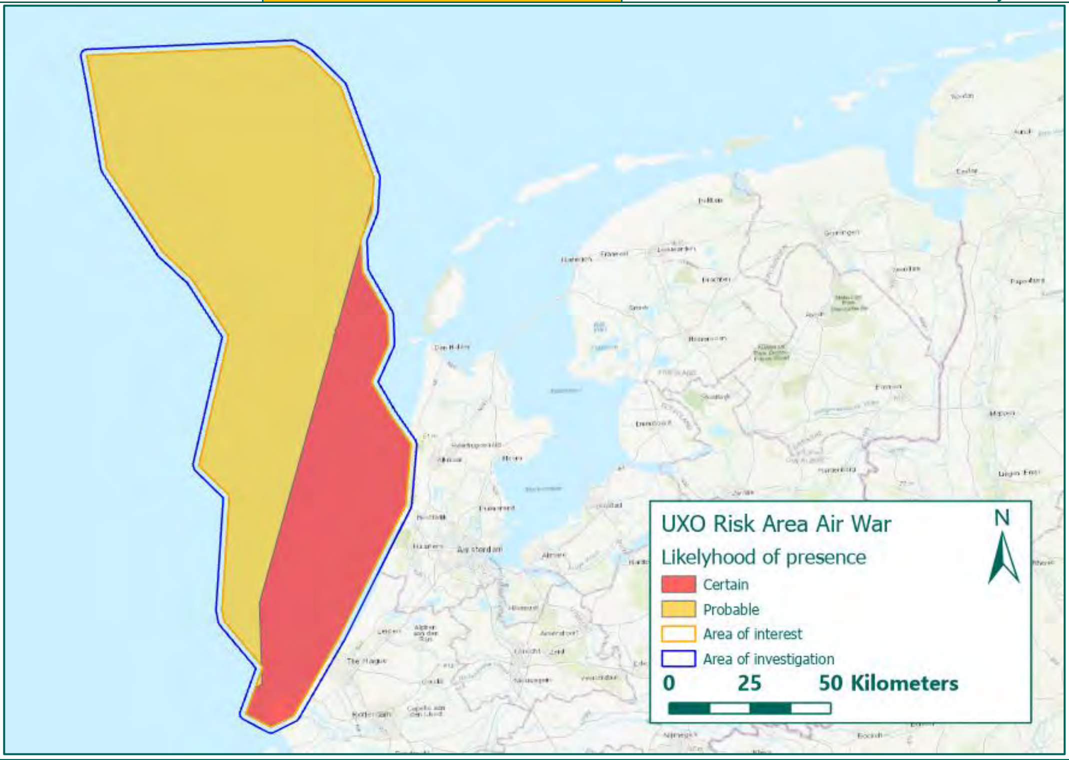
UXO (sub)type and calibre	Likelihood of presence	Demarcation
Naval Mines WW1: German E-Mine moored contact mines, British Vickers / British Elia and H Mark II moored contact mines	Probable	Within the boundaries of known minefields.
	Feasible	Outside the boundaries of known minefields.
		
Naval mines WWII: British Mk I-IV ground mines and British Mk VII- VIII and Mk XIV German EMB, EMC, EMD, UMA, RMA, KMA contact mines German LMB Ground mines German Exploding Floats (and also non explosive sweep obstructors) Dutch Model 1921 '2e soort'	Certain	Within the boundaries of known minefields.
	Probable	Outside the boundaries of known minefields.

UXO (sub)type and calibre	Likelihood of presence	Demarcation



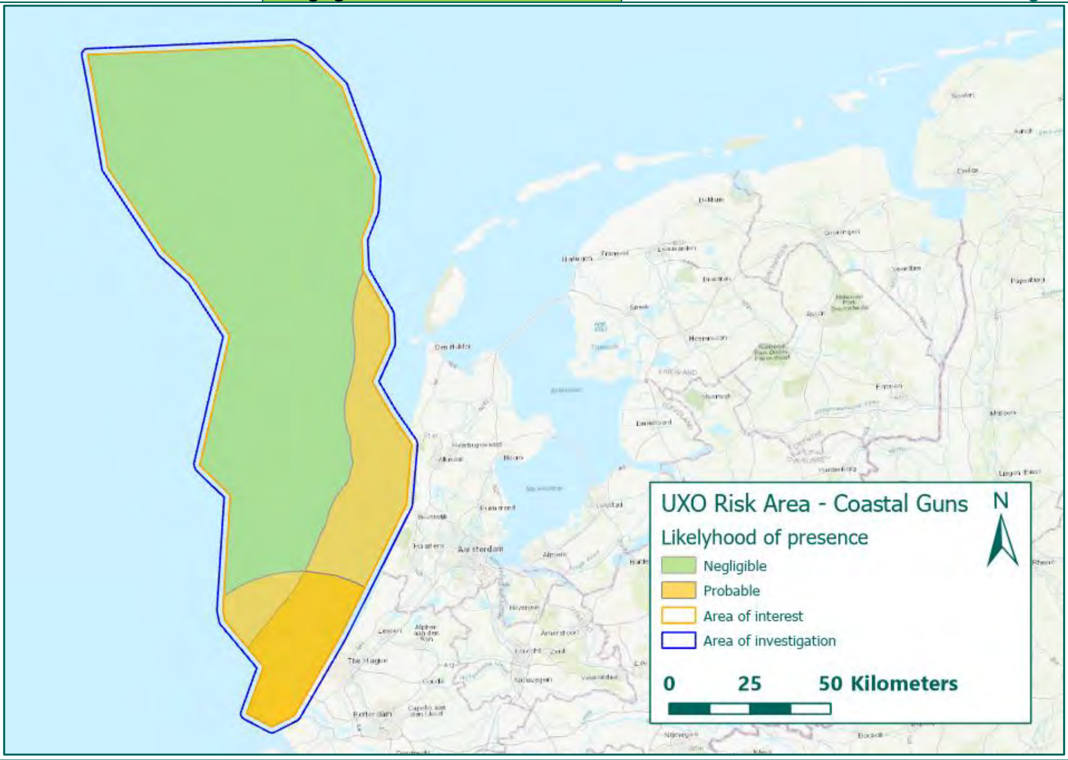
UXO Risk Area as a result of the air war (paragraph 4.2)

UXO (sub)type and calibre	Likelihood of presence	Demarcation
Aerial bombs: 4 lbs, 25 lbs, 30 lbs, 100 lbs, 250 lbs, 260 lbs, 300 lbs, 500 lbs, 1.000 lbs, 4.000 lbs	Certain	The UXO risk area is projected between the most western convoy route and the Dutch coast. A buffer of 1 nautical mile (1.852 meter) is taken into account for navigational inaccuracy of ships and aircraft.
	Probable	Areas outside of the known convoy routes.
Under water ammunition: 18 inch torpedo Mk XV Depth charge	Certain	The UXO risk area is projected between the most western convoy route and the Dutch coast. A buffer of 1 nautical mile (1.852 meter) is taken into account for navigational inaccuracy of ships and aircraft.
	Probable	Areas outside of the known convoy routes.
Rockets: 3 inch rocket with 25 lbs or 60 lbs (SAP) warhead	Certain	The UXO risk area is projected between the most western convoy route and the Dutch coast. A buffer of 1 nautical mile (1.852 meter) is taken into account for navigational inaccuracy of ships and aircraft.
	Probable	Areas outside of the known convoy routes.



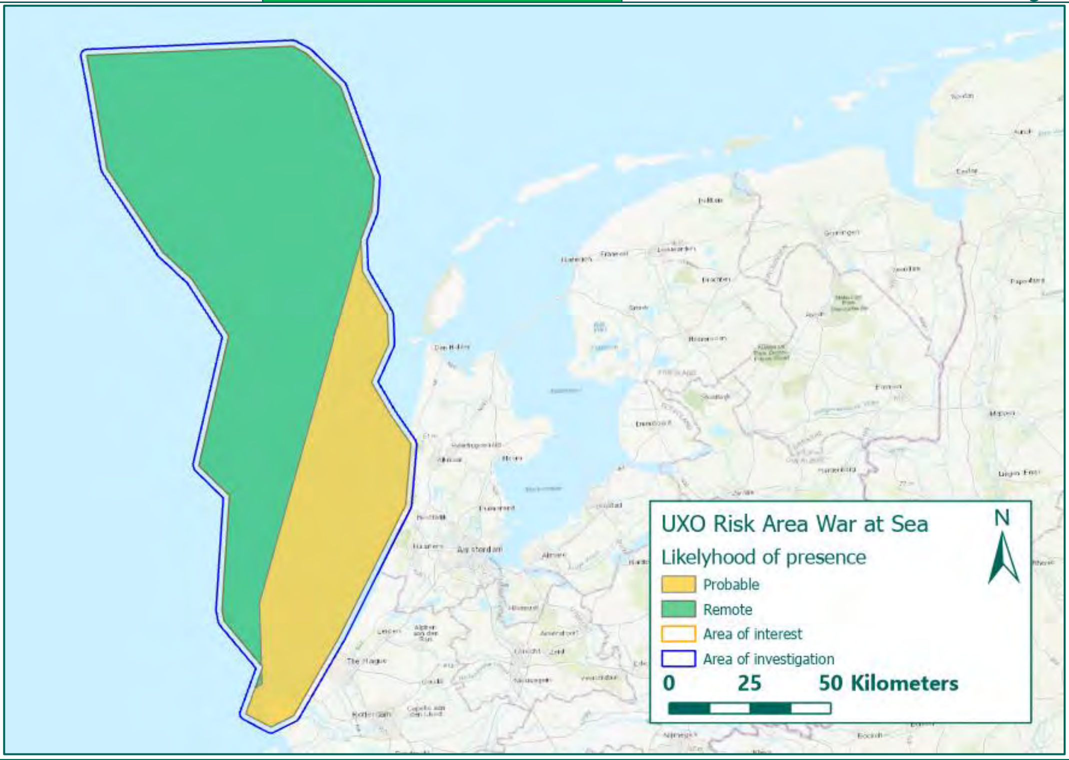
UXO Risk Area as a result of the coastal guns (paragraph 4.3)

UXO (sub)type and calibre	Likelihood of presence	Demarcation
Artillery shells: 5 cm, 7,5 cm, 9,4 cm, 10,5 cm, 12 cm, 14,91 cm, 15 cm, 15,2 cm, 24 cm, 28 cm	Probable	Within reach of the coastal guns. Where the REASeuro Database lacked information about coastal guns, the maximum range of coastal guns, not being 28 cm guns, is projected from the Dutch Coast.
	Negligible	Areas outside of reach of the coastal guns.



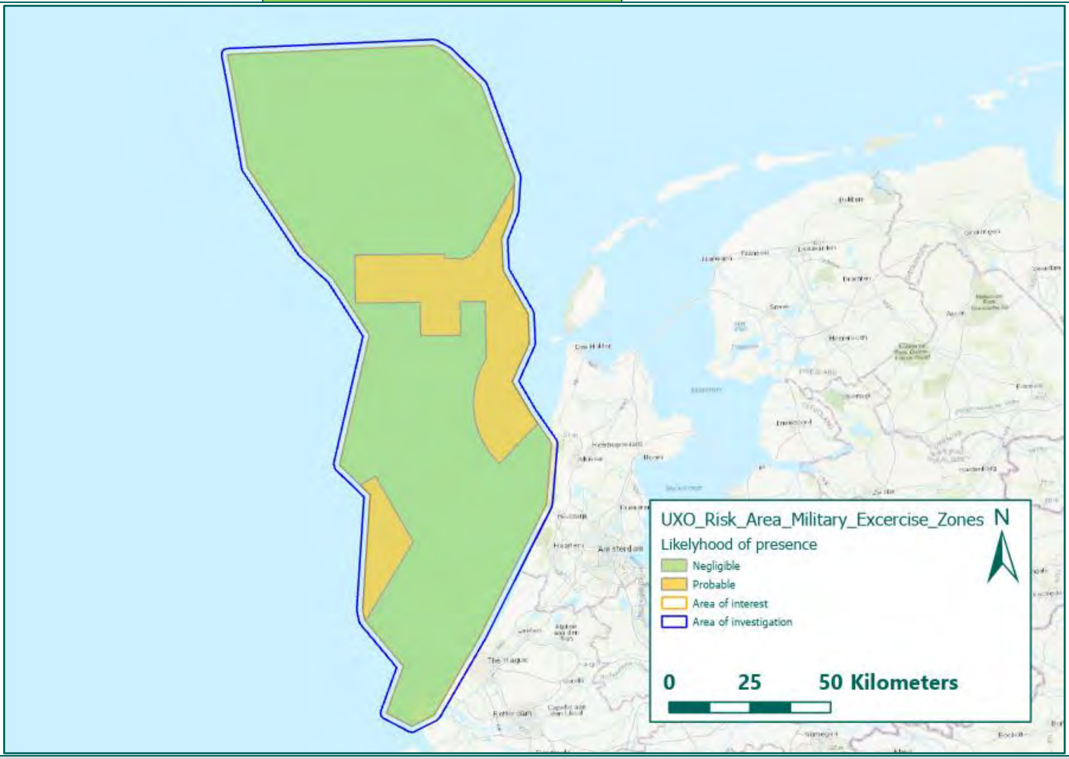
UXO Risk Area as a result of the war at sea (paragraph 4.4)

UXO (sub)type and calibre	Likelihood of presence	Demarcation
Small Calibre Ammunition: .303, .50, 13,2 mm, 15 mm Artillery Shells 2 cm/20 mm, 2 pr. Pompom, 3.7 cm, 6 pr., 8.8 cm	Probable	The UXO risk area is projected between the most western convoy route and the Dutch coast. A buffer of 1 nautical mile (1.852 meter) is taken into account for navigational inaccuracy of ships and aircraft.
	Remote	Areas outside of reach of the coastal guns.



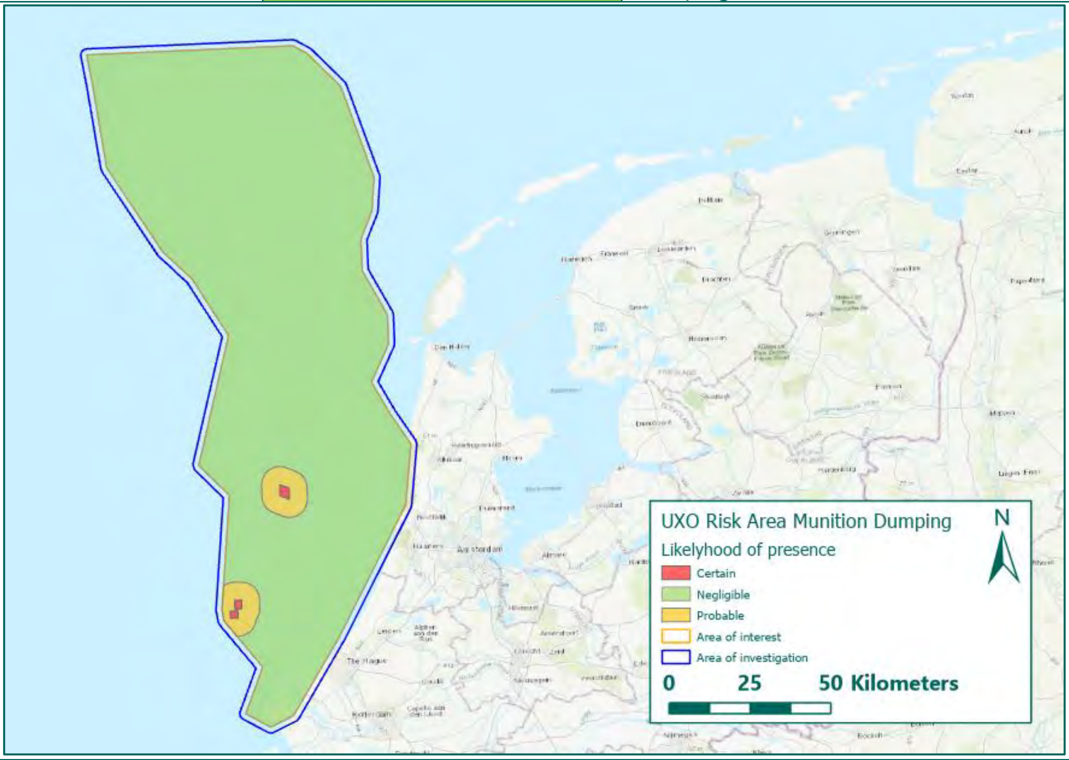
UXO Risk Area as a result of military exercises (paragraph 4.5)

UXO (sub)type and calibre	Likelihood of presence	Demarcation
Unknown (exercise) munition: Each military exercise zone had it's own purpose, it is outside the scope if this research to determine the munition used in each zone.	Probable	Within the boundaries of known military exercise zones.
	Negligible	Outside of the boundaries of known military exercise zones.



UXO Risk Area as a result of munition dumping (paragraph 4.7)

UXO (sub)type and calibre	Likelihood of presence	Demarcation
Unknown dumped munition	Certain	Within the boundaries of known munition dumping sites
	Probable	Three nautical miles around the munition dumping sites due to large amounts of munition being found outside the munition dumping sites
	Negligible	Outside of the boundaries of known munition dumping sites



7 CONCLUSION AND ADVICE

The Historical Desktop Study leads to the conclusion that the presence of UXO within the whole Area of interest ranges from certain to negligible, depending on the type of UXO involved. In particular, the presence of UXO resulting from minefields, aerial warfare and the dumping of munition is deemed certain. Therefore, there is a severe risk of encountering UXO within the Area of interest.

Only a few specific locations wherein certain types of UXO could be present can be demarcated in this HDTS-UXO. Performing a full Historical Research will produce some further results. REASeuro advises to implement an UXO Risk Assessment (RA) alongside full Historical Research. The purpose of the RA is defining the risk that UXO poses to the planned activities in the area of analysis. This risk is a function of the 'Likelihood of Occurrence' and the 'Hazard Severity'. The 'Likelihood of Occurrence' is the product of the 'Likelihood of Presence' as defined in this HDTS-UXO and the likelihood of initiation of an item of UXO, which will be assessed in a RA. Therefore, the likelihood of presence alone is not enough to define the risk of UXO to the planned activities.

Several factors like the burial of UXO, migration of UXO, the planned intrusive activities, hazards of UXO likely to be encountered and effects of detonation are analysed and assessed for use in a Semi Quantitative Risk Assessment (SQRA). The following matrix is used to quantify the risk. Each generic UXO hazard is assessed for severity and likelihood of occurrence. This model is generally considered best practice for assessing risk in the marine environment, although it has been modified where required to ensure it is UXO centric. The risk matrix is presented in Table 3.

Once the risks have been identified fitting mitigation strategies to bring the risk down to an acceptable level will be proposed. The mitigation strategies are focused on bringing the risk down to a level that is defined as 'As Low As Reasonably Practicable' (ALARP).

		Hazard Severity				
Likelihood of Occurrence		1 = Negligible	2 = Slight	3 = Moderate	4 = High	5 = Very High
	1 = Very Unlikely	1 LOW	2 LOW	3 LOW	4 LOW	5 LOW/MODERATE
	2 = Unlikely	2 LOW	4 LOW	6 LOW/MODERATE	8 MODERATE	10 MODERATE/HIGH
	3 = Possible	3 LOW	6 LOW/MODERATE	9 MODERATE	12 MODERATE/HIGH	15 HIGH
	4 = Likely	4 LOW	8 MODERATE	12 MODERATE/HIGH	16 HIGH	20 HIGH
	5 = Very Likely	5 LOW/MODERATE	10 MODERATE/HIGH	15 HIGH	20 HIGH	25 HIGH

(red)	Unacceptable
(orange)	ALARP with reduction measures
(yellow)	ALARP
(green)	Acceptable

Table 3: UXO Risk Assessment Matrix.

8 ANNEXES

ANNEX 1 GLOSSARY TERMS

Term	Definition
Historical Desk Study - UXO	Preliminary desk study in which war related events in the 1940-1945 period (including post-war detection and clearance) are being analysed. The aim is to determine whether there can be a UXO risk area in the area of interest. The historical desk study UXO consists of: - Reports. - Affirmative or negative recommendation. - In case of an affirmative recommendation: - Horizontal delimitation UXO-Risk area(s). - UXO risk map.
Historical Quick Scan - UXO	A narrower preliminary desk study than a Historical Desk Study – UXO. The aim of a HQS is to examine whether UXO cannot be excluded within the area of interest and if there are areas with an increased risk of UXO.
Unexploded ordnance (UXO)	- Unexploded ordnance (UXO) is explosive ordnance that has been primed fused, armed, or otherwise prepared for use and used in an armed conflict. It may have been fired, dropped, launched or projected, and should have exploded, but failed to do so. - For the purposes of this publication, the term UXO is used generically to also refer to explosive ordnance that has not been used during an armed conflict, which has been left behind or dumped by a party to an armed conflict, and is no longer under control of that party. Such UXO may or may not have been primed, fused, armed or otherwise prepared for use.
Area of interest	Area of focus for the historical desk study. The area of investigation is wider than the area of investigation in order to get a full view of any war related events which could be relevant.
Area of investigation	The area specified by the client in which regular work unrelated to UXO will be performed or in which a change of function will be implemented.
Detection area	The possibly contaminated area within the area of investigation where UXO detection is recommended prior to commencing regular work activities.
War related event	Events that could possibly have led to the presence of UXO. Examples of war related events are: - Aerial Bombardment - Artillery fire - Ammunition dumping or jettisoning - Ammunition related accidents - Aircraft crashes
UXO Risk map	Cartographic view of the UXO risk area(s).
UXO Investigation (Five phases policy)	REASeuro developed a five phases policy: the integral total approach to UXO related issues comprised of five separate phases. This allows the client to make a well-considered decision for each phase and to plan follow-up actions with the aim of keeping the client in control of the project. Five phases policy: 1. Historical research 2. Project risk assessment 3. Project management plan 4. Execution 5. Clearance certificate and final report
Risk assessment	The process of identifying potential threat and estimating the risks of harm and loss associated with that threat. A risk assessment also contains the evaluation of the acceptability of the assessed risk including the consequences of a materialised risk and identifies potential risk reduction and control measures.
Risk mitigation	Eliminating risk or reducing it from an identified unacceptable risk to an acceptable level.

Term	Definition
As low as reasonably practicable (ALARP)	A risk tolerability principle that has particular connotations in UK health and safety law. It requires a developer to reduce the risks from UXO until or unless the cost of implementing those measures is considered to be grossly disproportionate to the risk averted.
"CS-OOO"	The CS-OOO is the Dutch branch specific certification plan for the system certificate "detection of conventional explosives". This includes guidelines, process requirements and expertise standards. Since January 1st 2020, the CS-OOO has been the successor to the "*Werkveldspecifieke certificatieschema voor het Systeemcertificaat Opsporen Conventionele Explosieven*" (WSCS-OCE) and is legally anchored in the Working Conditions Act (Arbowet). In order to safeguard societal interests – health and safety in relation to work – the government has opted for a mandatory certification plan to guarantee the quality and safety of detecting conventional explosives.

ANNEX 2 LITERATURE

The scope of this research was to insight in the possible chance of encountering UXO within the area of investigation by consulting the REASeuro-Database. In addition several books have been consulted in order to get a clear depiction of war related events within the area of interest. In consulting literature the focus has been placed on the First World War to fill the gaps in the REASeuro-Database. For this research the following literary sources have been consulted:

Abbreviation	Author	Title	Relevant
AAS	Air and Space	*These Amateur Archaeologists Dig Up the Buzz Bombs That Fell on England in WW2* *Two brothers scour the English countryside for remnants of Hitler's vengeance weapons.*	Yes
CRO	Crossley, J.,	*The Hidden Threat. The story of mines and minesweeping by the Royal Navy in World War I* (South Yorkshire 2011).	Yes
SCH	Scheer, R.	*Germany's High Sea Fleet In The World War* (London 1920)	Yes
VER	Vergeltungswaffen	*http://www.vergeltungswaffen.nl/*	Yes
V2	V2 Rocket	*http://www.v2rocket.com*	Yes

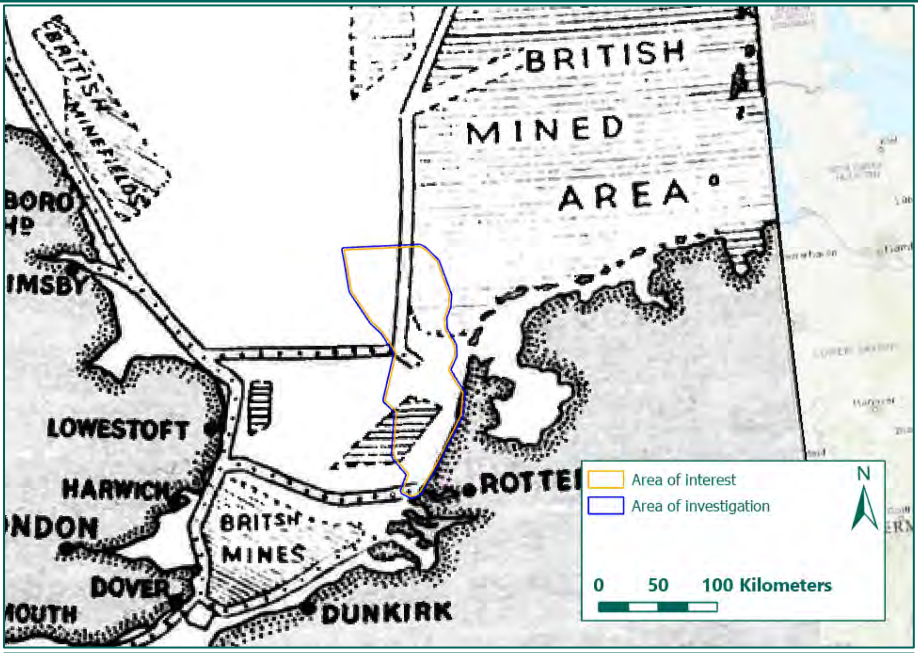
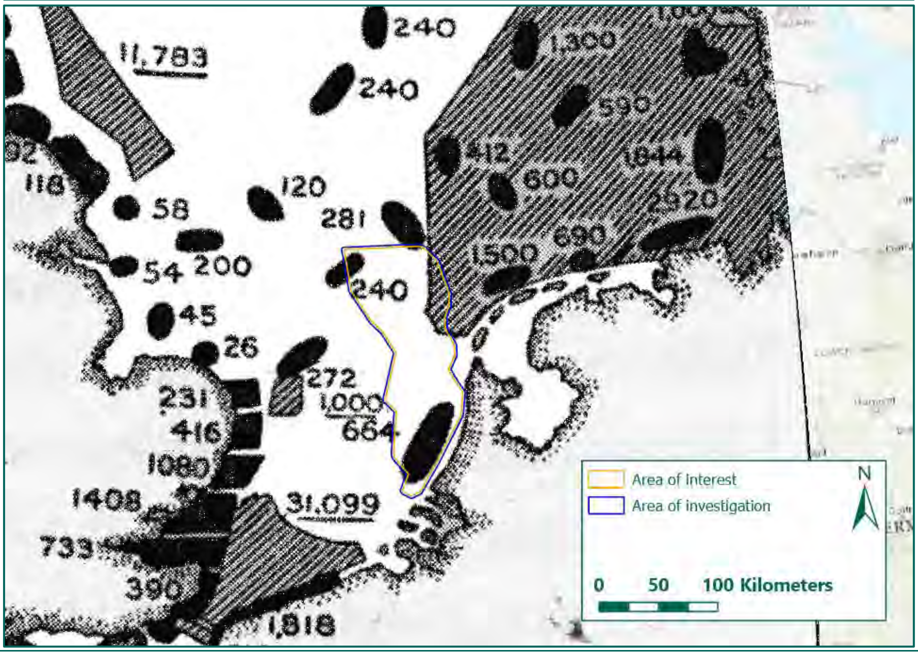
Table 4: Reference to literature.

The annex in this table contain the events that are considered relevant for the area of interest.

First World War mobilization and interbellum, 1914-1939

The First World War forced the armed forces of many nations to mobilize. Coastal guns were installed to protect strategic positions on the coast. Furthermore, shipping took considerable damage from mine and U-vessel warfare. Dozens of merchant vessels were sunk by the thousands of mines laid by the German and British navies. Large scale efforts to clear the minefields after the First World War did not succeed in clearing all these mines. The following literature is relevant for this period:

Date / year	Event	Source	Page
1914-1918	British, German and American mines laid during the war. The German minefields are in black, whereas the Allied fields are shaded. The underlined figures are numbers of Allied mines, and other figures are numbers of German mines. With their vastly greater resources, the Allies laid far more mines in the latter part of the war placing them strategically where they would effectively trap the maximum numbers of U-vessels. German mines were placed mainly close to headlands where ships would make landfalls and around the approach to major ports. From 1916 onwards, most of the German mines were laid by submarines, whereas the Allies were able to use surface ships, especially fast destroyer-minelayers, to operate close to enemy coasts. The chart gives an idea of how dangerous mine laying and minesweeping operations were as both enemy and friendly mines might be laid in the same areas. *Hatched areas in the figure below indicate allied minefields, solid areas indicate German minefields. No minefields are shown within the area of interest.*	CRO	55, 62

Date / year	Event	Source	Page
			
1918	Mines, of course, remain deadly irrespective of peace treaties or armistices. No fewer than 240,000 mines were scattered about the seas, some in their original position, some having dragged their moorings and settled in a new location, and some drifting freely. These constituted a major danger to shipping after the end of the war. To clear them up an international committee was formed, which included most belligerent and neutral countries, and was eventually joined by the defeated powers. This was called the International Mine Clearance Committee (IMCC) and was organized principally by the Royal Navy. All members carried out mine clearance activities and reported regularly to the IMCC, who issued regular charts and updates showing safe areas and known danger zones. The main part of the clearance work was divided between the maritime nations, Germany being responsible for sweeping Heligoland Bight, France the waters off the French and Belgian coasts, America the Northern Barrage and the UK, most of the rest, working through a new organization called the Mine Clearance Service. The service	CRO	149-160

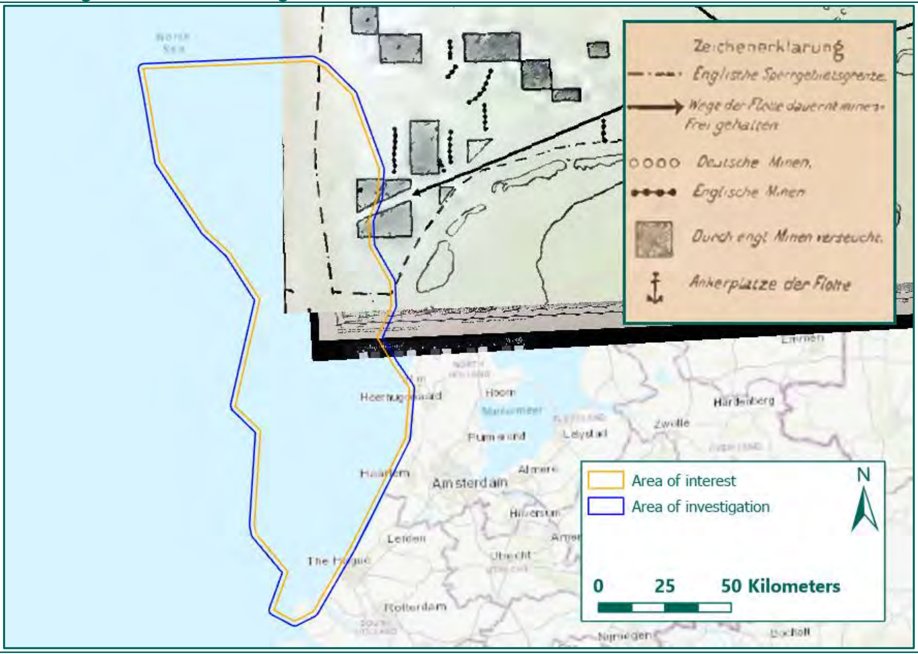
Date / year	Event	Source	Page
	was manned mainly by Royal Navy personnel and fishermen and consisted of 14,500 men and 700 officers at its peak. A particular danger when clearing dense fields was what was known as ‘counter mining’. This occurred when exploding one mine would set off others in the vicinity – possibly dangerously close to the sweeper involved. Normally, deep minefields were left until last, as they did not constitute a serious danger to shipping, but sometimes some of the mines were laid incorrectly and finished up close to the surface. It was determined to skim of any of these shallow mines first, and the sweep began in the normal way. The intensive mining of the eastern North Sea also affected the German Navy to such an extent that it could not even undertake exercises safely, the British offensive mining campaign contributed to the collapse of fleet discipline and hence to the popular revolt against the Kaiser’s government, which resulted in the Armistice.		
		SCH	288

Table 5: Overview of events World War 1 – Interbellum.

German invasion and subsequent occupation, 1939-1945 and Post-war period

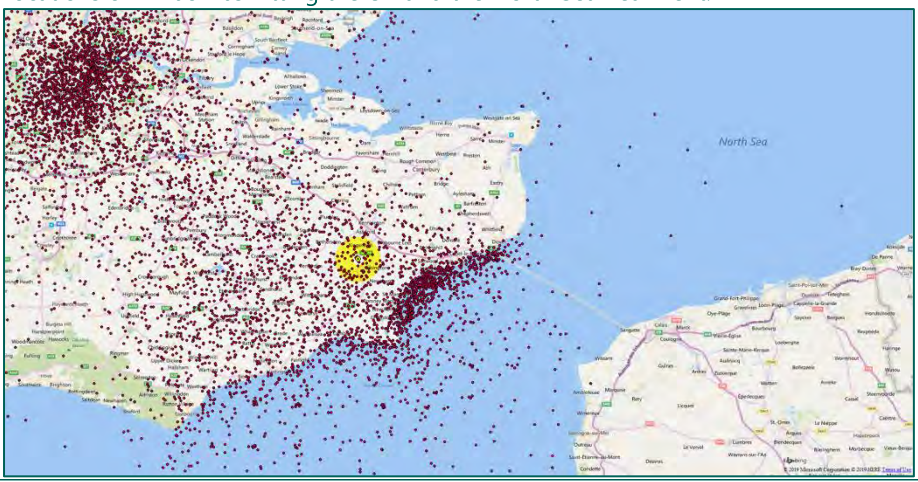
When the inevitability of the Second World War became clear in August 1939, the allied and non-aligned armies of the countries surrounding Germany once again mobilized to prepare for an imminent attack. While serious naval threats were not foreseen, preparations also took place on the coast and the sea. Coastal guns were once again installed, and vital waterways were mined.

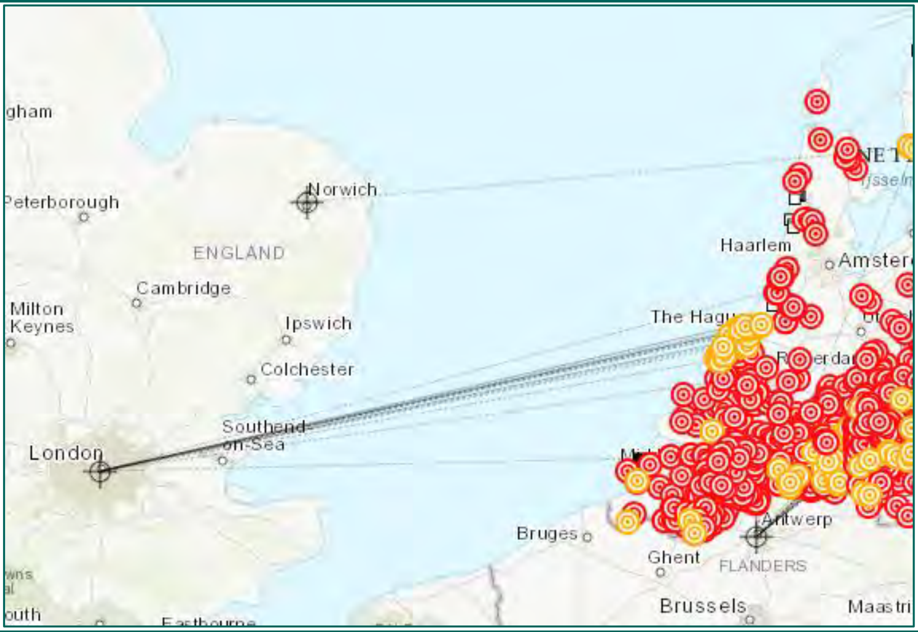
The North Sea became the frontline between Great-Britain and occupied mainland Europe. Fast attack craft from the Royal Navy coastal forces attacked German shipping close to the coast and laid mines to further hamper German navigation of the North Sea. Patrolling allied aircraft attacked convoys, submarines and surface vessels with all possible means, while heavy bombers dropped even more mines in the waters around de occupied European Coast. To make matters worse, thousands of aircraft flew over the North Sea on route to targets in Germany, jettisoning their bombs in the sea when they encountered German fighters or anti-air guns.

Immediately after the war, the reconstruction Europe began. Defensive works, bunkers and remaining UXO were cleaned up.

Literature about this period was not consulted for this report. The REASeuro-Database already contains a large quantity of sources about war related events within the North Sea. Moreover, consulting literature about this period is outside of the scope of this research.

Some information about the locations of V1s and V2s was consulted:

Date / year	Event	Source	Page
1944-1945	V1 and V2 bombs hitting the UK 	V2	-
	Locations of V1 bombs hitting the UK and the North Sea near Kent. 	AAS	-
	V1s and V2s were also launched from the Netherlands to the UK. It is possible that bombs that did not reach the UK landed in the North Sea and possibly within the Area of interest.	VER	-

Date / year	Event	Source	Page
			

ANNEX 3 (INTERNATIONAL) ARCHIVES

Several international archives have been consulted in order to gain information on the war related events in the area of investigation. The REASeuro database contains a large quantity of documents from the British, American and German archives. The following international archives yielded relevant documents for this desk top study:

- Noordzeeloket, The Netherlands.
- Dienst der Hydrografie, Koninklijke Marine, The Netherlands
- Nationaal Archief, The Hague, The Netherlands
- Nederlands Instituut voor Militaire Historie, The Hague, The Netherlands
- Marinemuseum (Navy Museum), Den Helder, The Netherlands
- UK Hydrographic Office (UKHO), Taunton, Somerset, United Kingdom.
- Library of Congress (LOC), Washington D.C., United States.
- The National Archives (TNA) in London, United Kingdom.
- National Archives and Records Administration (NARA) in College Park (MD), United States.
- Bundesarchiv-Militärarchiv (BaMa) in Freiburg, Germany.

Noordzeeloket (NZL)

The Noordzeeloket is a comprehensive website, covering relevant Dutch maritime policy related North Sea information. On the Website relevant information about the locations of Voormalige munitiestortplaatsen (Former munitions dump locations), Oefengebieden Mijnenruimen (Mine clearance training areas), (Laag)vlieggebieden ((Low) flying areas) and Schietterrein / onveilige zone (Shooting site / unsafe area) is available

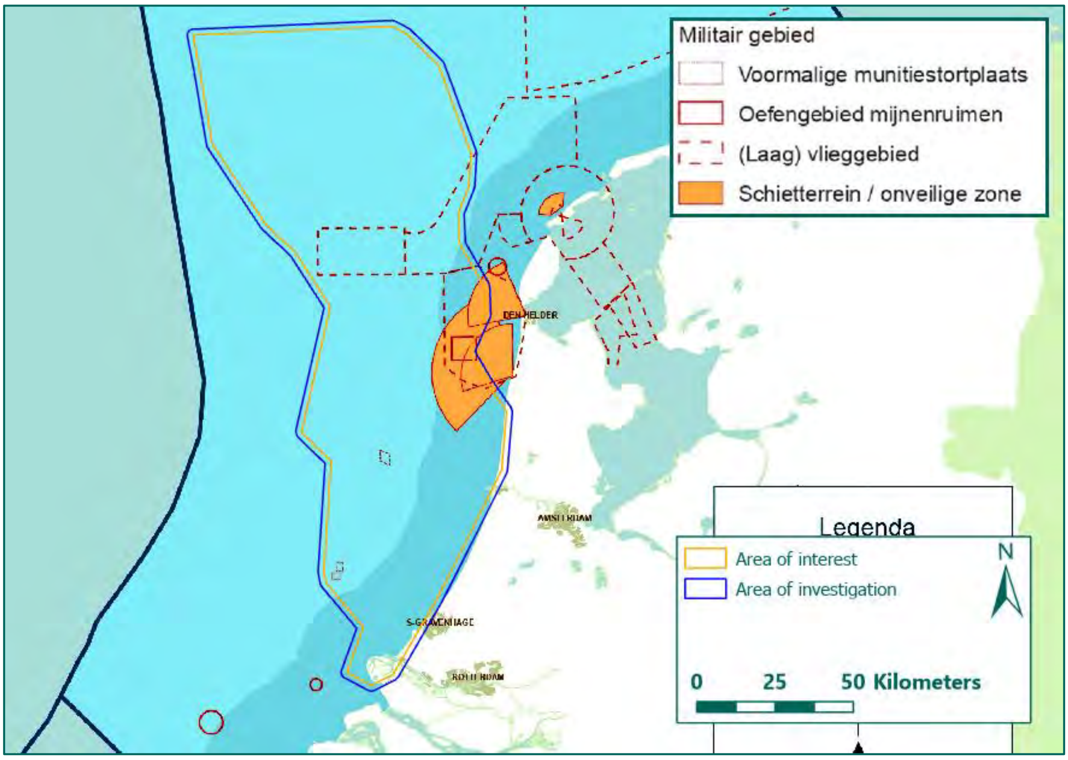


Figure 43: Map showing the military usage of parts of the North Sea (Source: NZL).

Dienst der Hydrografie, Koninklijke Marine (Royal Netherlands Navy Hydrographic service)

Naval charts of the area of analysis have been acquired through the Hydrographic Service. Besides naval charts the HP39 (wreck registry) publication has been consulted to gain information on possible wrecks in the area of investigation.

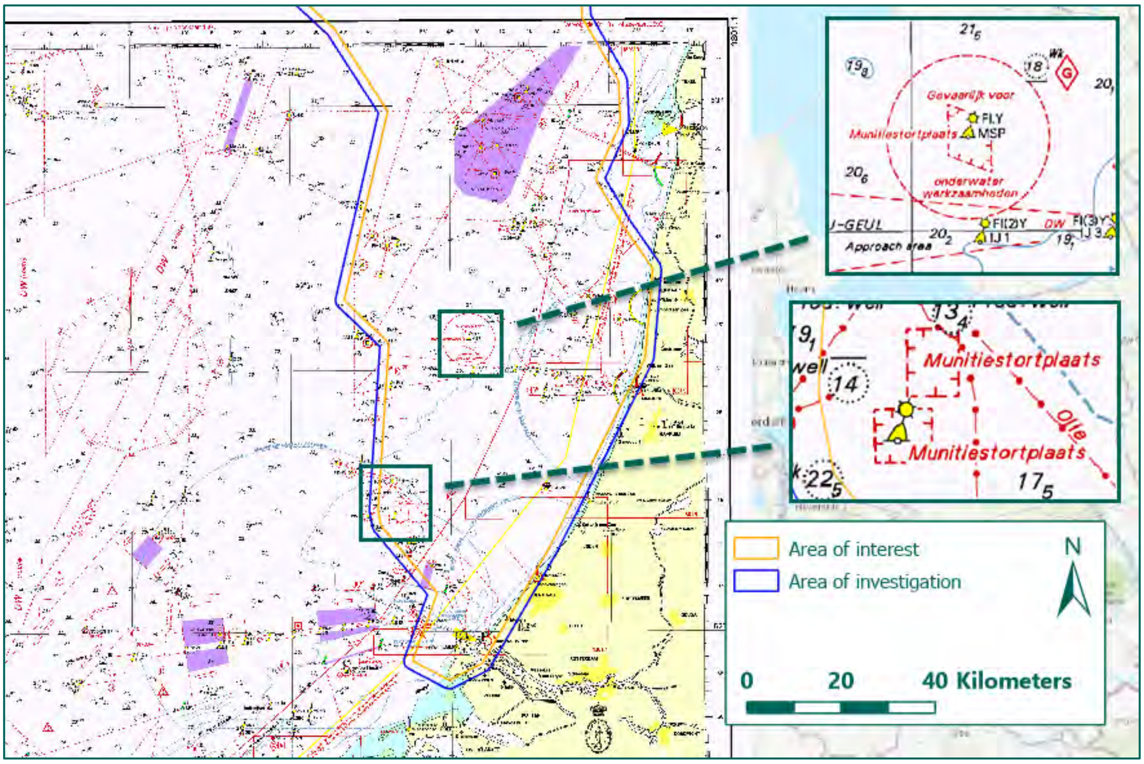


Figure 44: Naval chart (Source: Royal Netherlands Navy Hydrographic service).

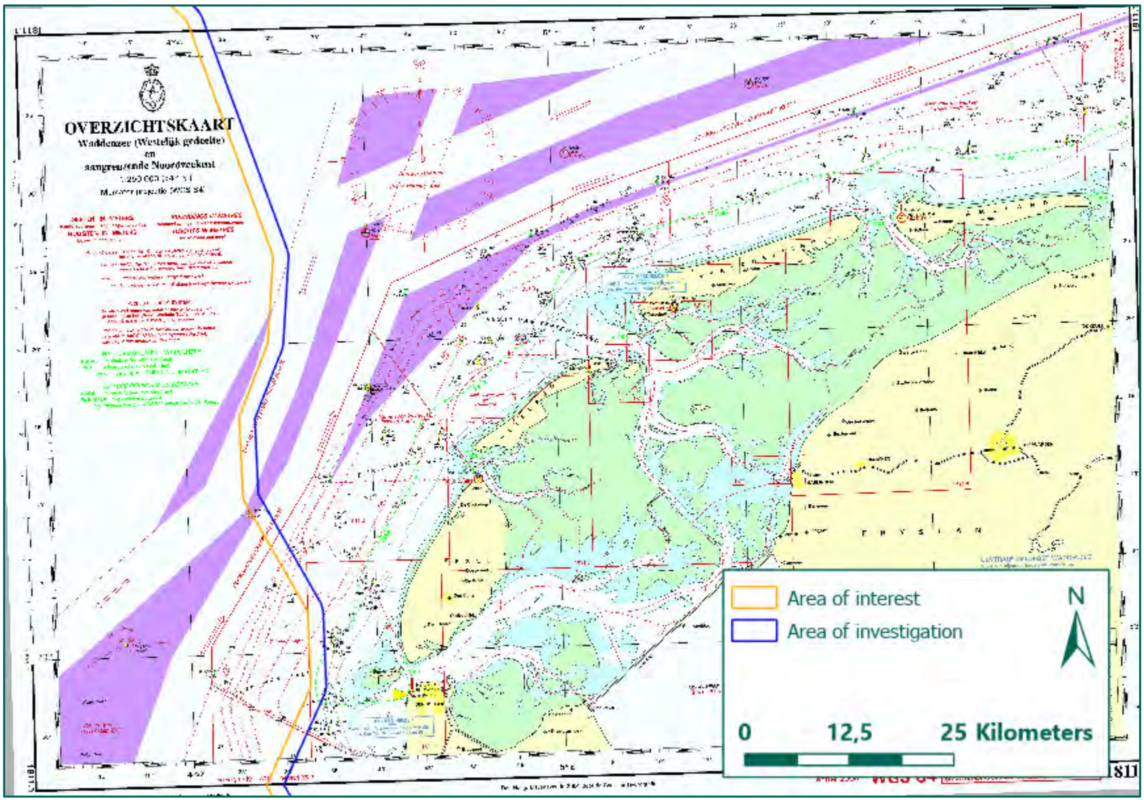


Figure 45: Naval chart (Source: Royal Netherlands Navy Hydrographic service).

Nationaal Archief

The Dutch 'Nationaal Archief' (National Archives) has been consulted for more information on the dumping of explosives, naval minefields and minesweeping, shipwrecks and other relevant information for the area of investigation.

Toegang 2.12.18: Archief van de Koninklijke Marine: Chef van de Marinestaf te ''s-Gravenhage, 1886-1942	
Inventaris 162	Stukken betreffende verboden en gevaarlijke vaargebieden 1914-1939
Map showing area's that are 'gevaarlijk voor de visserij' (Dangerous for fishing activities):	

Onder verwijzing naar circulaire N°. 41 der Visscherij-Inspectie, vestigt de Hoofdinspecteur der Visscherijen de aandacht van belanghebbenden er op, dat vanaf 22 November 1917, het door Duitschland als gevaarlijk aangegeven gebied in de Noordzee, inzooverre is gewijzigd, dat als Oostgrens daarvan dient te worden aangenomen een lijn loopende van het einde der Nederlandsch-Belgische grens over het punt:

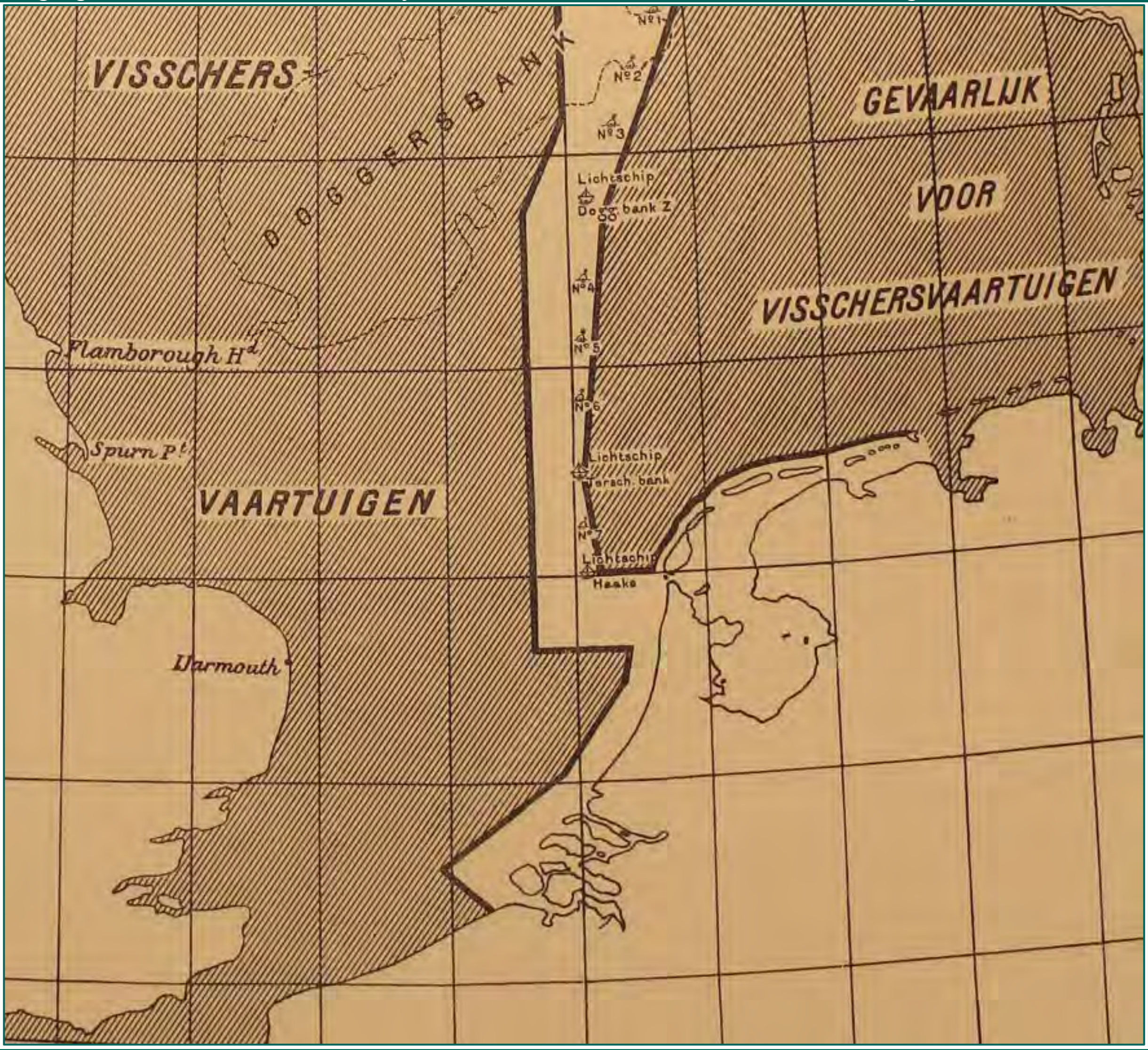
	51°	35′	N.B.	2°	57′	O.L.
naar	52°	2′	N.B.	3°	52′	O.L.
"	52°	28′	N.B.	4°	22′	O.L.
"	52°	40′	N.B.	4°	25′	O.L.
"	52°	40′	N.B.	3°	40′	O.L.
"	54°	45′	N.B.	3°	40′	O.L.
"	55°	10′	N.B.	4°	0′	O.L.
"	56°	0′	N.B.	4°	0′	O.L.
"	56°	0′	N.B.	4°	50′	O.L.

verder daarvandaan langs den lengtegraad 4° 50′ O. tot op een punt, dat 10 zeemijlen van den vuurtoren van Udsire af ligt.

Het thans voor de visscherij gevaarlijke gebied in de Noordzee, alsmede de ligging van lichtschepen en lichtbrulboeien, zijn op bijbehoorend kaartje aangegeven.

'S-GRAVENHAGE, 26 November 1917.

De Hoofdinspecteur voornoemd,
J. M. BOTTEMANNE.

Toegang 2.12.18: Archief van de Koninklijke Marine: Chef van de Marinestaf te ''s-Gravenhage, 1886-1942


Toegang 2.12.56: Marine na 1945	
Inventaris 939	Vaststelling oefengebieden voor schietoefeningen. 1950-1975
Maps and information about Military training area's in the North Sea. Relevant maps and information regarding the area of investigation are shown below: Training Ground Aircraft:	

Toegang 2.12.56: Marine na 1945

Bepaalt:

dat de navolgende gebieden, voorzover zij vallen onder het gebied des Rijks, gesloten worden verklaard voor de luchtvaart, en voorzover zij niet vallen onder het gebied des Rijks, worden bekend gesteld als terrein, waar regelmatig militaire schietoefeningen worden gehouden.

1. het luchtgebied gelegen binnen de volgende hoekpunten tot op een hoogte van 1000 m

52° - 05' N,	52° - 25' N,	52° - 10' N,	52° - 30' N
03° - 40' E	04° - 00' E	03° - 25' E	03° - 25' E

Training Ground Cruisers

Ingevolge Uw telefonisch verzoek hierbij de dzz. voorgestelde onveilige gebieden i.v.m.schietoefeningen,nabij den Helder.

1. Kruiseroefenterrein
   tussen meridianen 4° - 16' - 20 " en 4° - 26' - 40 "
   en parallellen 52° - 52' - 0 " en 53° - 4' - 40 "

2. Vanaf Oostbatterij,sector tussen peilingen 276° en 308° tot afstand 6 mijl.

3. Erfprins vanaf Kaap Hoofd sector tussen peilingen 260° en 340° tot afstand 8 mijl.

4. L.A. Schietoefeningen omgeving Haaks met gebruik "Stereomatrolage Erfprins.
   Gebied begrensd door Kaap Hoofd naar

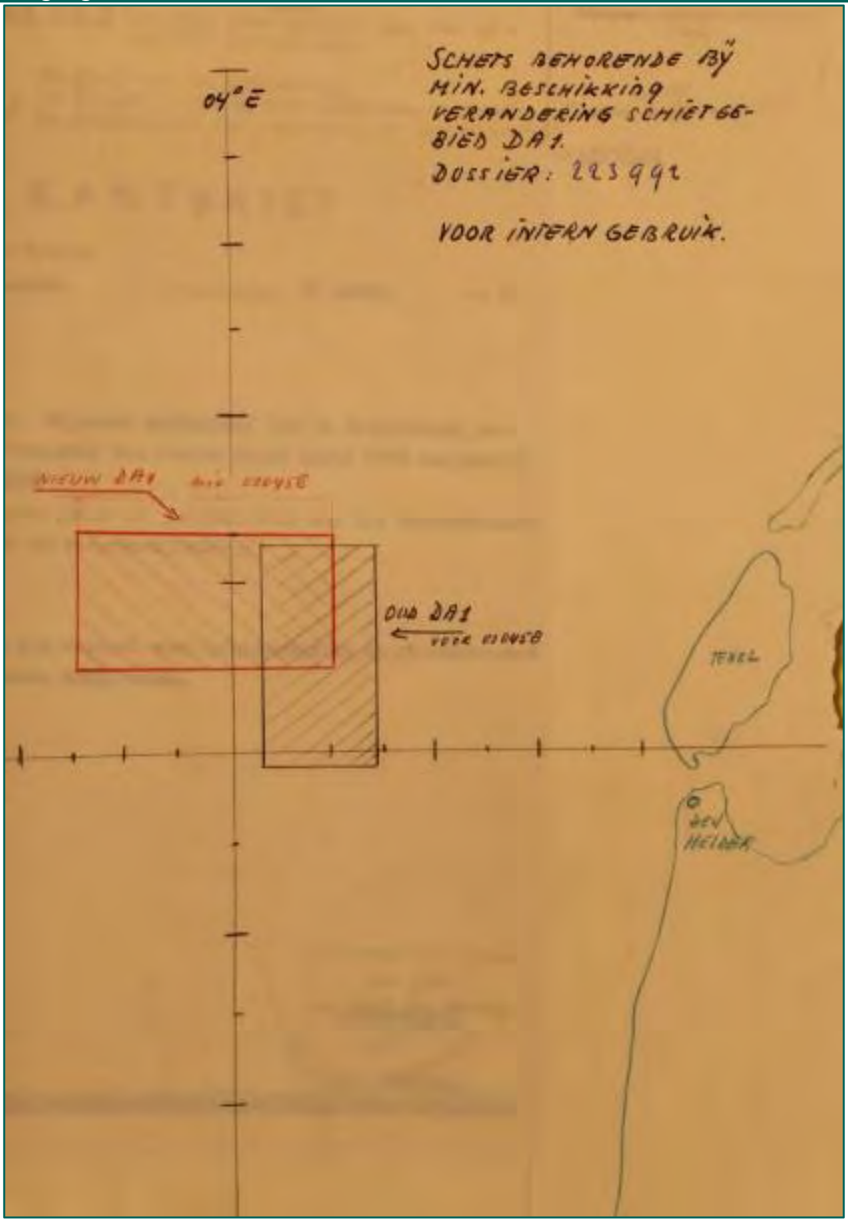
   $\frac{52° - 52' N}{4° - 40' E}$ naar $\frac{52 - 52 N}{4° - 52' E}$ naar $\frac{52 - 56 N}{4° - 28' E}$

   naar $\frac{53° - 0' N}{4° - 28' E}$ naar $\frac{53° - 4' N}{4 - 32' E}$ naar $\frac{53° - 4' N}{4° - 40' E}$

   naar Kaap Hoofd.

Old en new site of DA1:

Toegang 2.12.56: Marine na 1945



Training Grounds in the North Sea:

Besluiten:

I.1. In de hieronder nader omschreven gebieden zijn de Commandant der Zeemacht in Nederland, de Chef van de Generale Staf en de Chef van de Luchtmachtstaf, ieder voor zover hem aangaat, bevoegd om in overleg met de Directeur Generaal van de Rijksluchtvaartdienst de uitoefening van de burgerlijke luchtvaart in verband met militaire oefeningen te beperken dan wel geheel te verbieden.

<u>DA 1 (Den Helder I)</u>

Het gebied, begrensd door een lijn, welke de volgende posities verbindt:
53.05.00 N — 03.45.00 O; 53.13.00 N — 03.45.00 O;
53.13.00 N — 04.10.00 O; 53.05.00 N — 04.10.00 O,
tot een hoogte van 9150 meter.

Toegang 2.12.56: Marine na 1945	

DA 2 (Den Helder II)

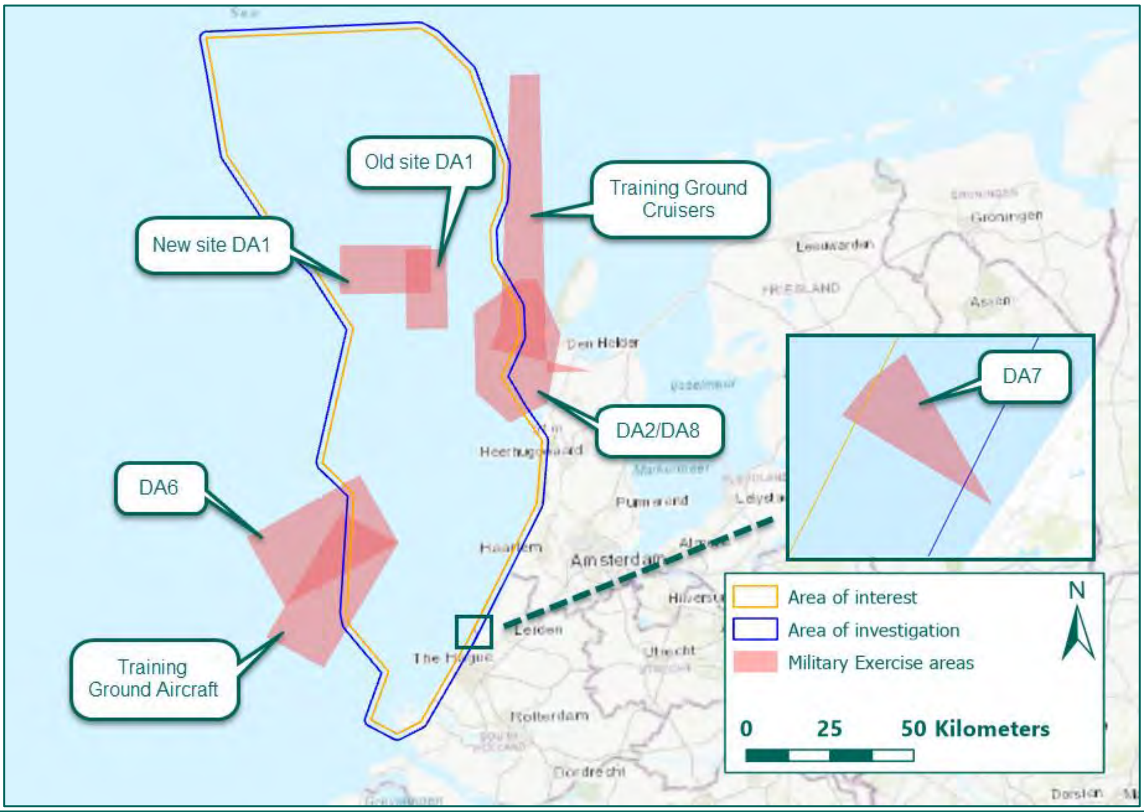
Het gebied, begrensd door een lijn, welke de volgende posities verbindt:
52.58.00 N — 04.44.00 O; 52.47.00 N — 04.40.00 O;
52.44.00 N — 04.30.00 O; 52.49.00 N — 04.21.00 O;
53.02.00 N — 04.21.00 O; 53.07.00 N — 04.33.00 O en
53.07.00 N — 04.38.00 O,
tot een hoogte van 10.000 meter.

DA 6 (Noordzee)

Het gebied, begrensd door een lijn, welke de volgende posities verbindt:
52.26.00 N — 03.20.00 O; 52.36.00 N —03.50.00 O;
52.25.00 N — 04.00.00 O; 52.15.00 N —03.30.00 O,
tot een grootste hoogte van 900 meter.

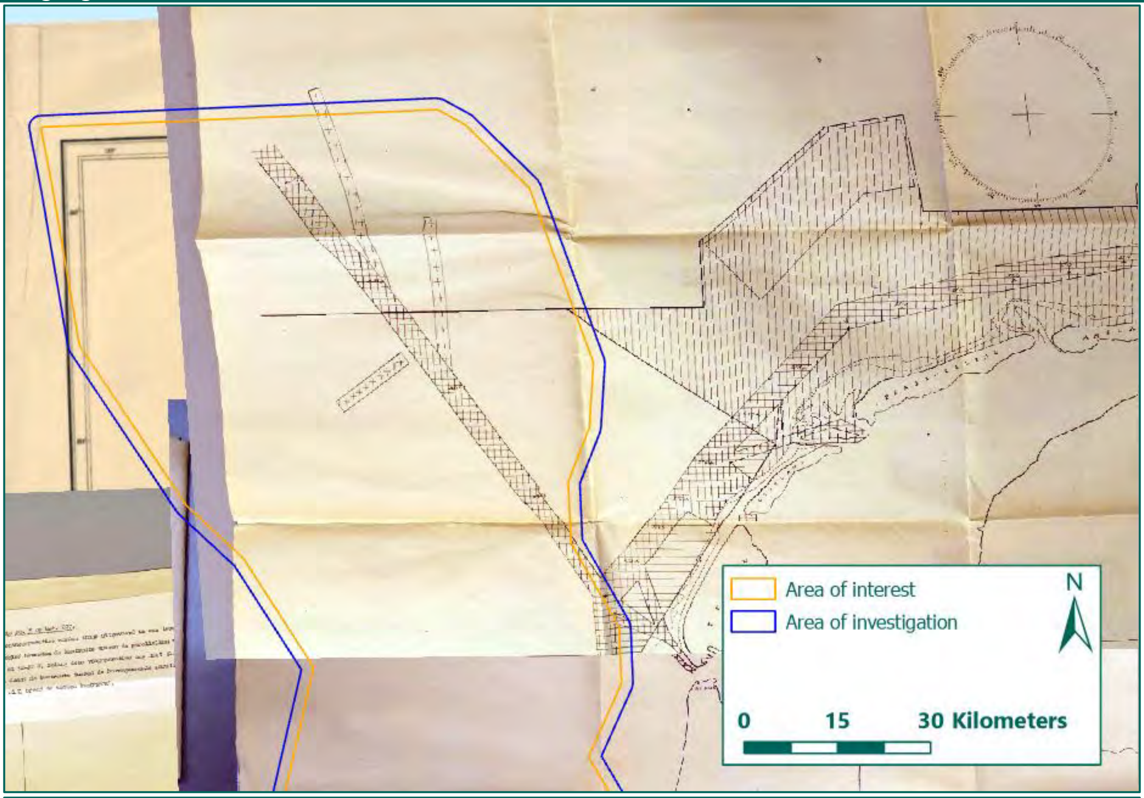
DA 7 (Wassenaarse slag)

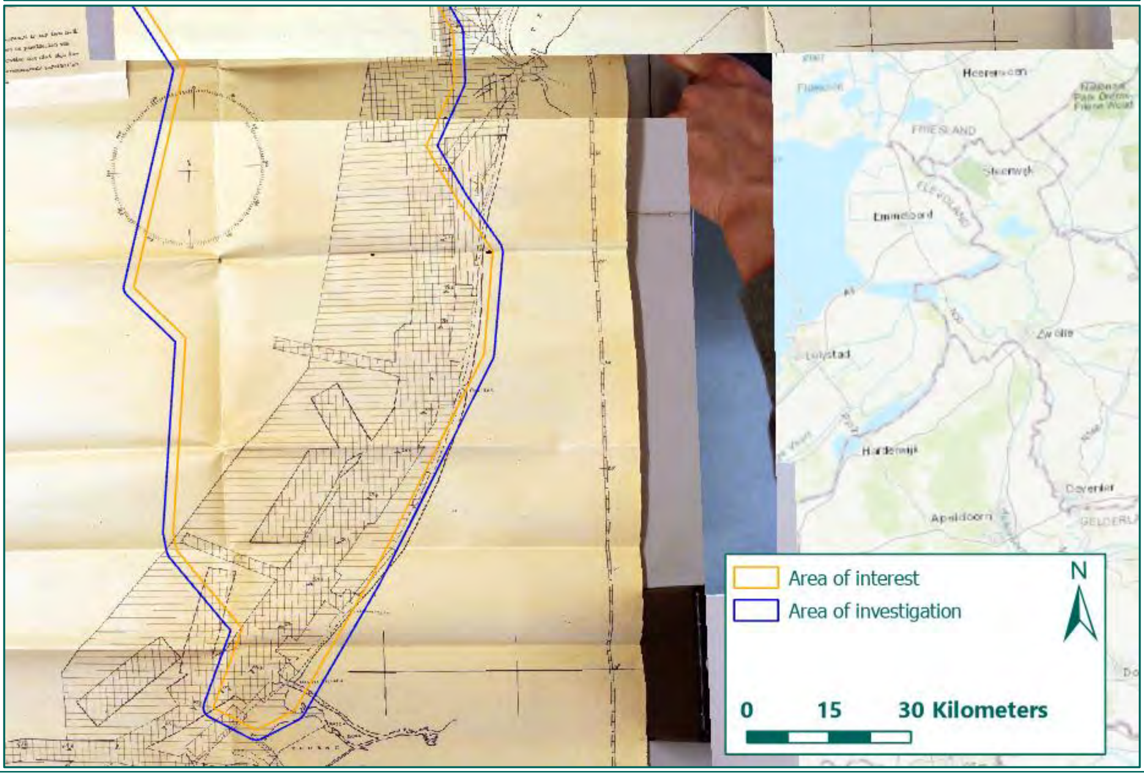
Een sector uit de positie 52.09.48 N — 04.20.45 O, in de richting 300° rechtwijzend door 315° naar 330° rechtwijzend, met een straal van 1,4 zeemijlen, tot een hoogte van 500 meter.



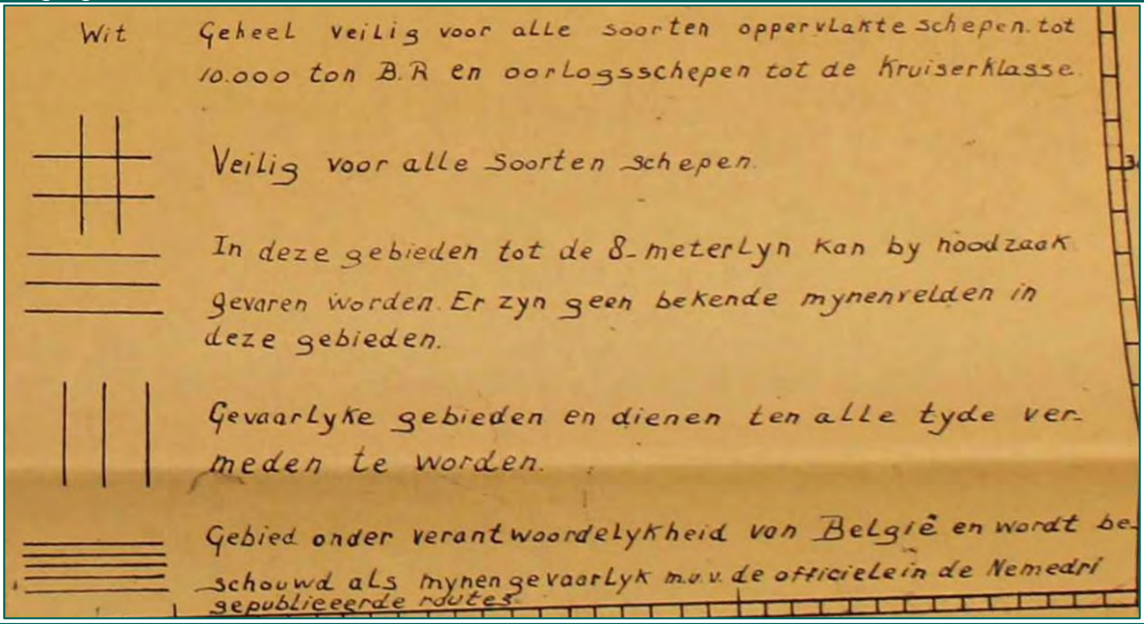
Inventaris 1882	Situatiekaarten van mijnen voor de Nederlandse kust. 1949-1950

Toegang 2.12.56: Marine na 1945





Toegang 2.12.56: Marine na 1945


Wit — Geheel veilig voor alle soorten oppervlakte schepen tot 10.000 ton B.R en oorlogsschepen tot de Kruiserklasse.

Veilig voor alle Soorten schepen.

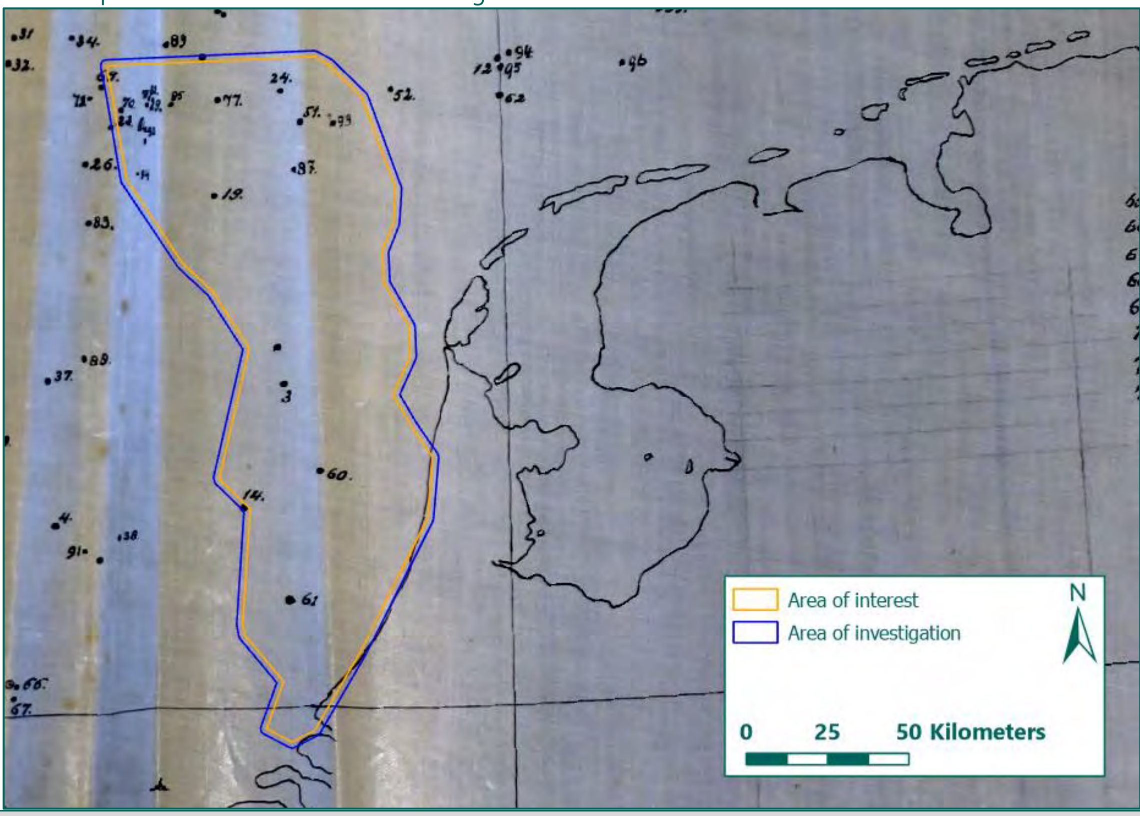
In deze gebieden tot de 8-meterlyn kan by noodzaak gevaren worden. Er zyn geen bekende mynenvelden in deze gebieden.

Gevaarlyke gebieden en dienen ten alle tyde vermeden te worden.

Gebied onder verantwoordelykheid von België en wordt beschouwd als mynengevaarlyk m.u.v. de officiele in de Nemedri gepublieeerde routes.

Toegang 2.05.32.09 BuZa/Zeeoorlogschade	
Inventaris 44	Kaart van de Noordzee met opgave van de plaatsen waar verankerde mijnen lagen, waarop Nederlandse schepen zijn gevaren in de jaren 1914-1916, op linnen, zonder datum

Dutch ships sunk due to contact mines during WW1



Nederlands Instituut voor Militaire Historie (NIMH)

The NIMH is a knowledge and research centre in the field of Dutch military history. The institute houses, amongs others, information about Dutch minefields in the North Sea. Some minefields were laid within the area of investigation.

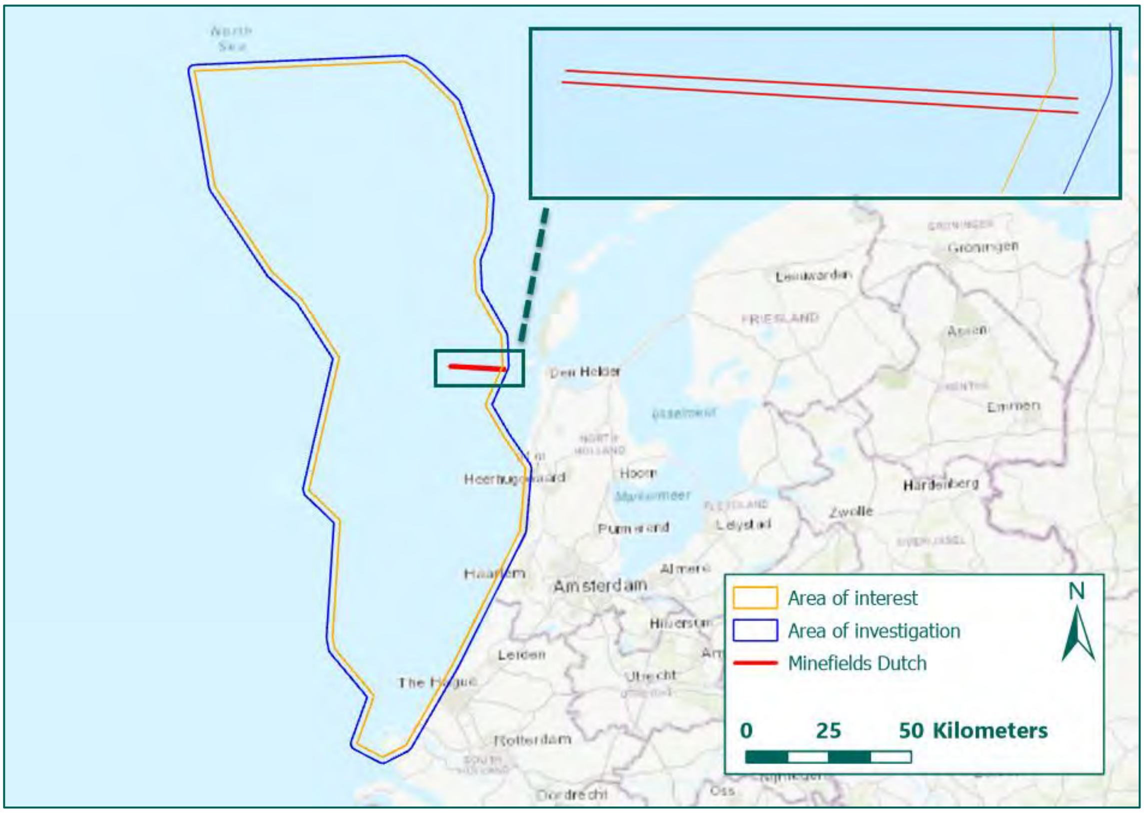


Figure 46: Dutch minefields within the Area of investigation (Source: NIMH 092).

Tactische versperring Middelrug-Haaks
bestaande uit:

Twee rijen mijnen model 1921 2e soort.

Ligging 1e mijnenrij van 52-57-20 N. 04-33-30 E. naar 52-58-00 N. 04-18-40 E. (12 Mei '40 ± 14h30 J.v. Brakel 80 mijnen

aantal mijnen : 120. Onderlinge afstand 150 m. 12 Mei '40 ± 15h00 Nautilus 40 mijnen)

Ligging 2e mijnenrij van 52-57-05 N. 04-33-30 E. naar 52-57-48 N. 04-18-33 E. (12 Mei '40 ± 14h30

aantal mijnen : 120. Onderlinge afstand 150 m. W. v.d. Zaan)

55 mijnen in deze rij zijn voorzien van ontglippers. De mijnen zijn gelegd op 12 Mei 1940.

Figure 47: information about relevant Dutch minefields (Source: NIMH 092).

Marinemuseum (Navy Museum), Den Helder

The map collection of the Marinemuseum (Navy Museum) in Den Helder has been consulted. NEMEDRI-maps were found in this collection. These maps offer information on minesweeping after the Second World War. The NEMEDRI maps show some locations some 'geveegde geulen' (shipping route in which minesweeping took place) within the area of investigation shortly after the war. The area of investigation is consequently shown in a ubiquitous Danger Area, owing to naval mines.

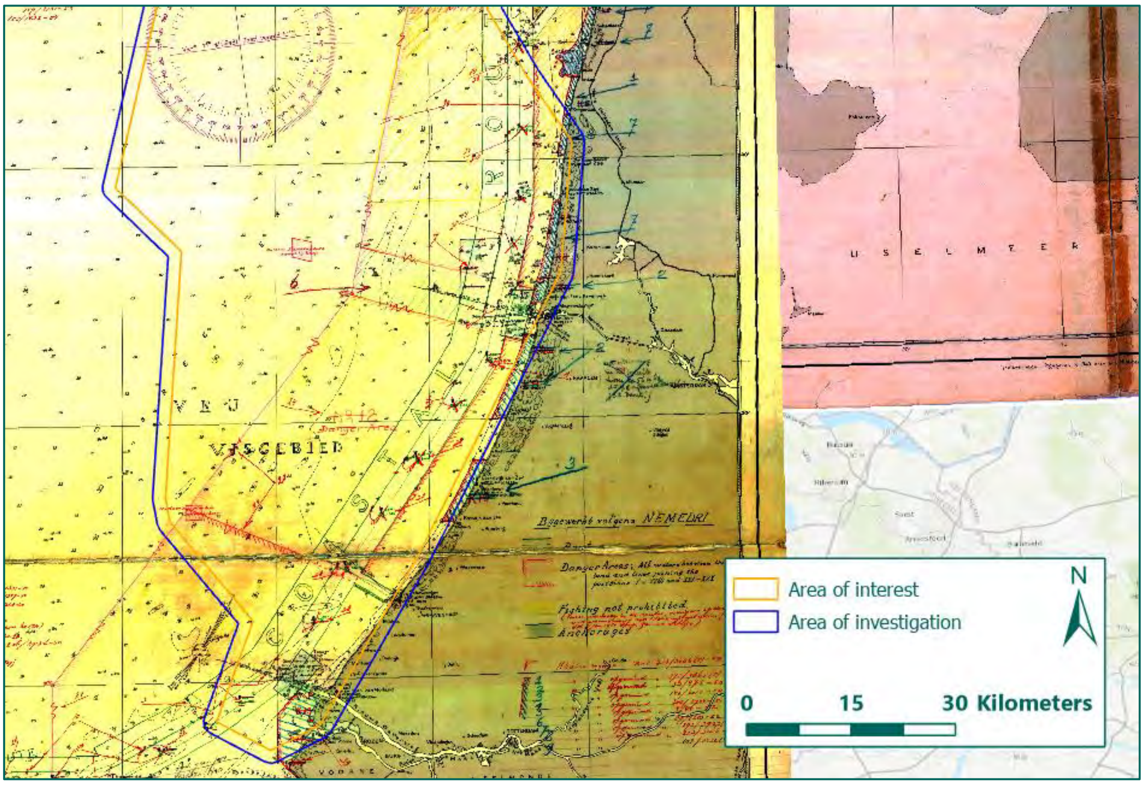


Figure 48: Map offer information on minesweeping after the Second World War (Source: Navy Museum NEMEDRI 227 West-Hinder tot Texel).

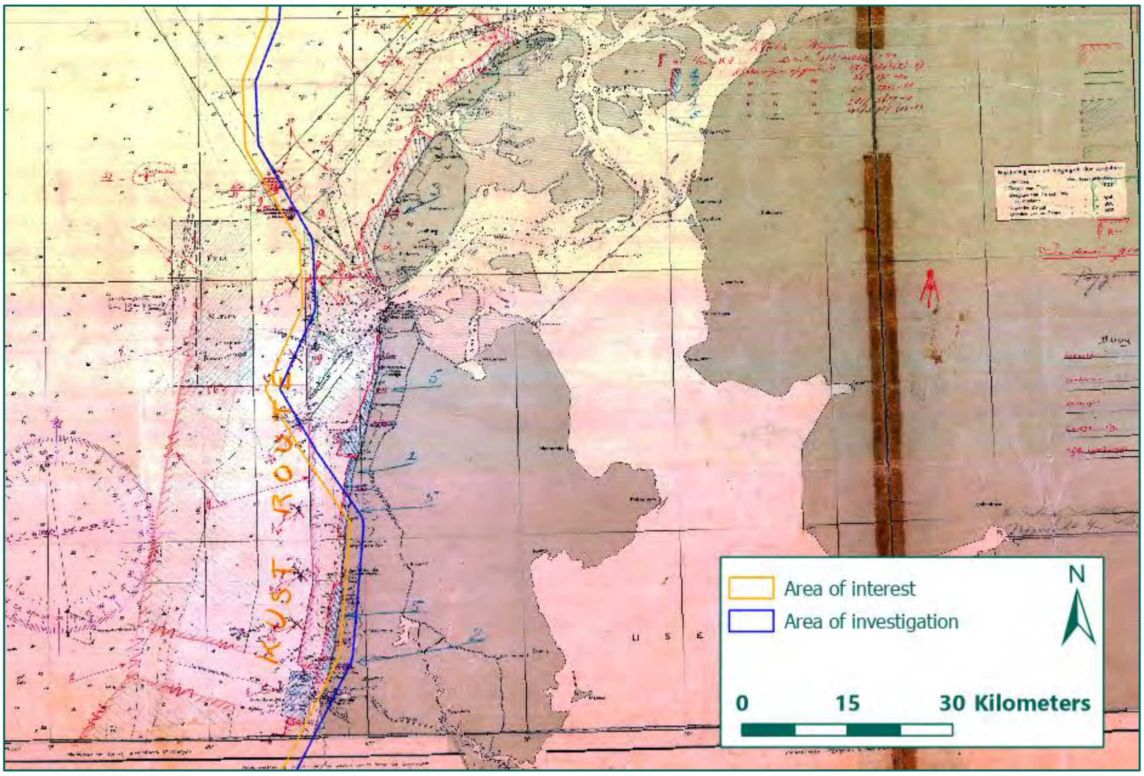


Figure 49: Map offer information on minesweeping after the Second World War (Source: Navy Museum NEMEDRI 226 IJmuiden tot de Weser).

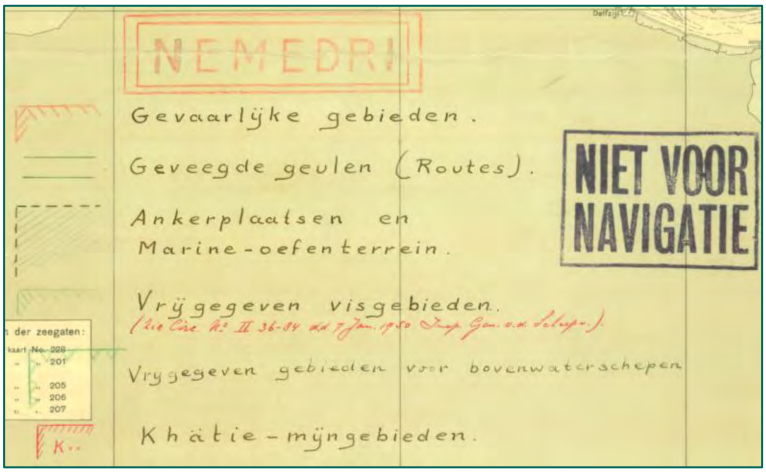


Figure 50: Legend of NEMERDI maps (Source: Navy Museum NEMEDRI 226 IJmuiden tot de Weser).

UK Hydrographic Office (UKHO)

The UK Hydrographic Office has a large amount of historical, maritime maps. This collection also includes maps showing the locations of minefields and shipping routes. These maps have been consulted.

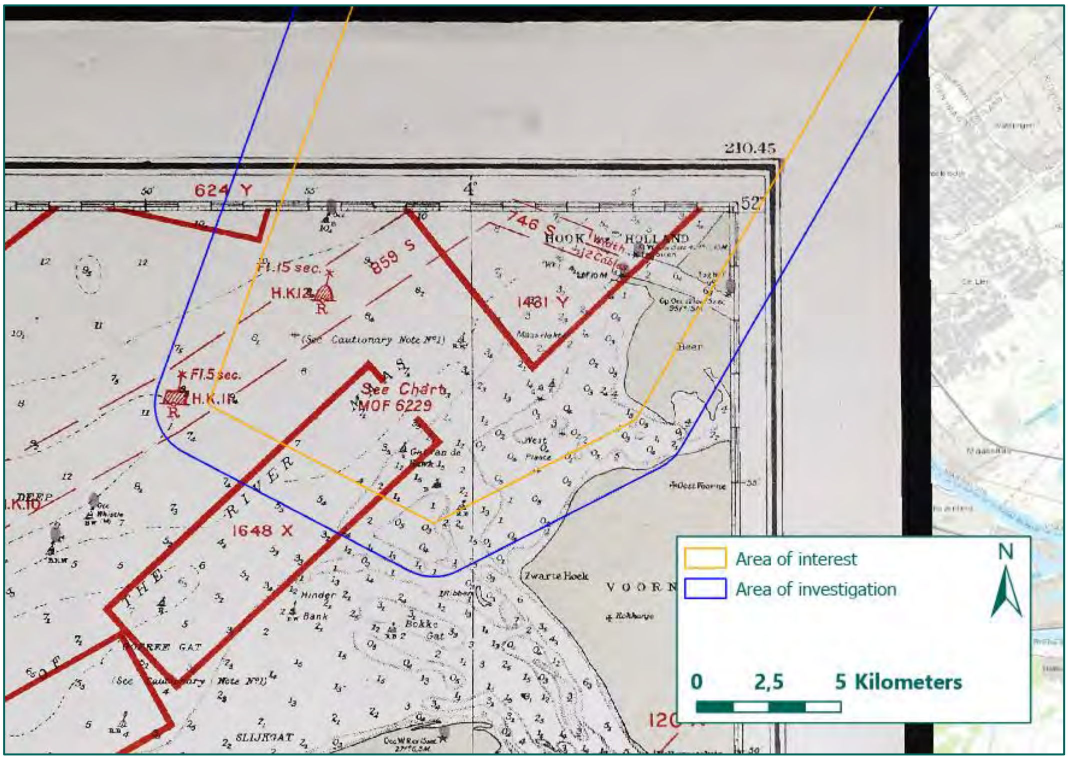


Figure 51: OCB MO F6550 Dunkerque to Hook of Holland, 1945. The red squares indicate minefields (Source: UKHO, Shelf 35).

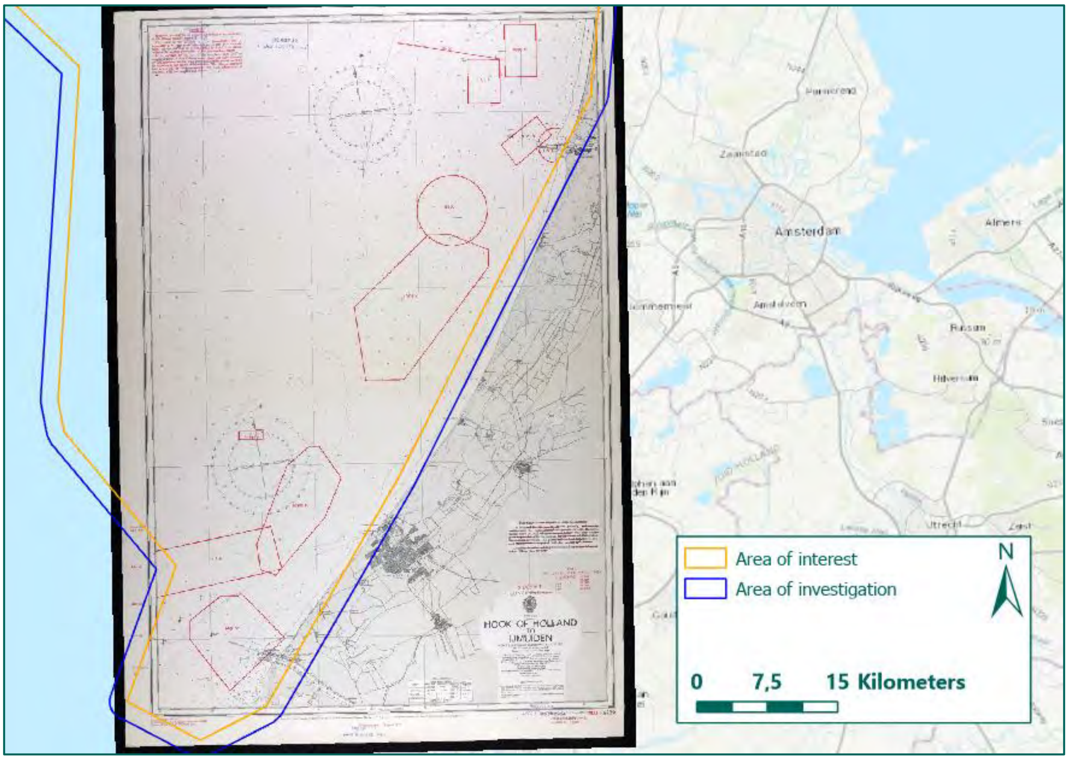


Figure 52: OCB MO F6229 Hook of Holland 1944. The red squares indicate minefields (Source: UKHO, Shelf 35).

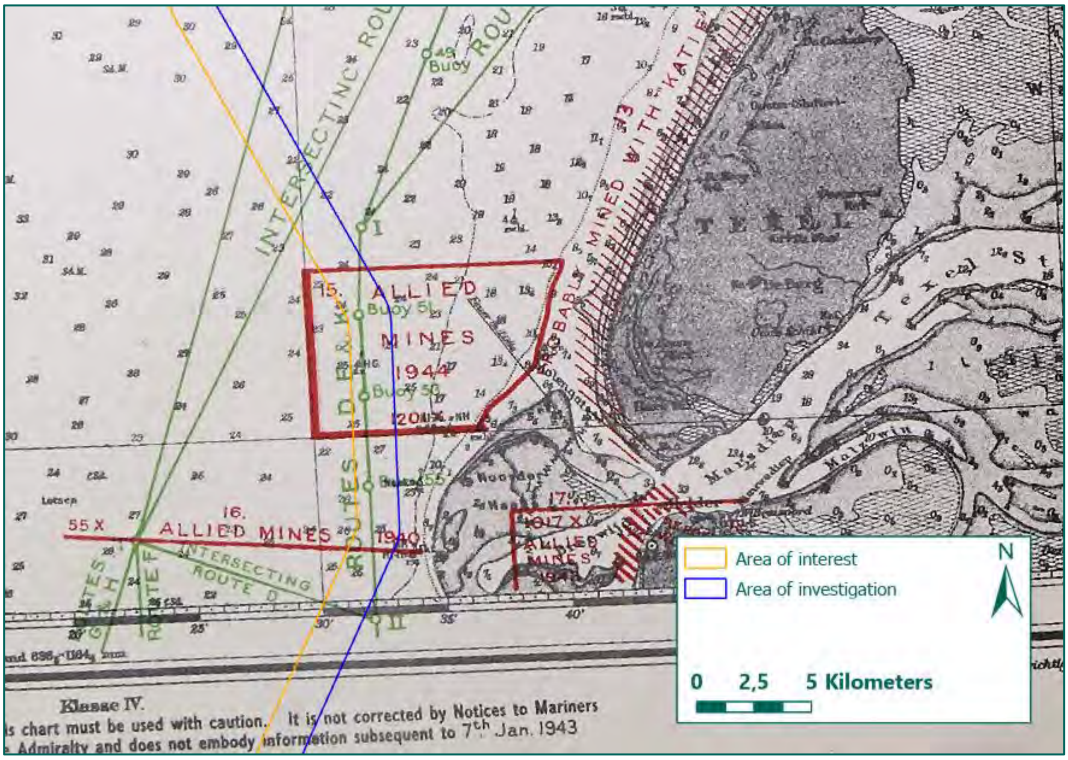


Figure 53: OCB MO 6590 Texel Bis Cuxhaven 1945. The red squares indicate minefields, green lines indicate convoy routes (Source: UKHO, Shelf 35).

Library of Congress

Library of Congress (LOC) has been consulted. Several maps about the First World War have been consulted in the LOC. Relevant maps are shown below.

Figure 54: locations of sunken ships due to submarine attacks between 1 February 1917 – 1 February 1918 (Source basemap: LOC).

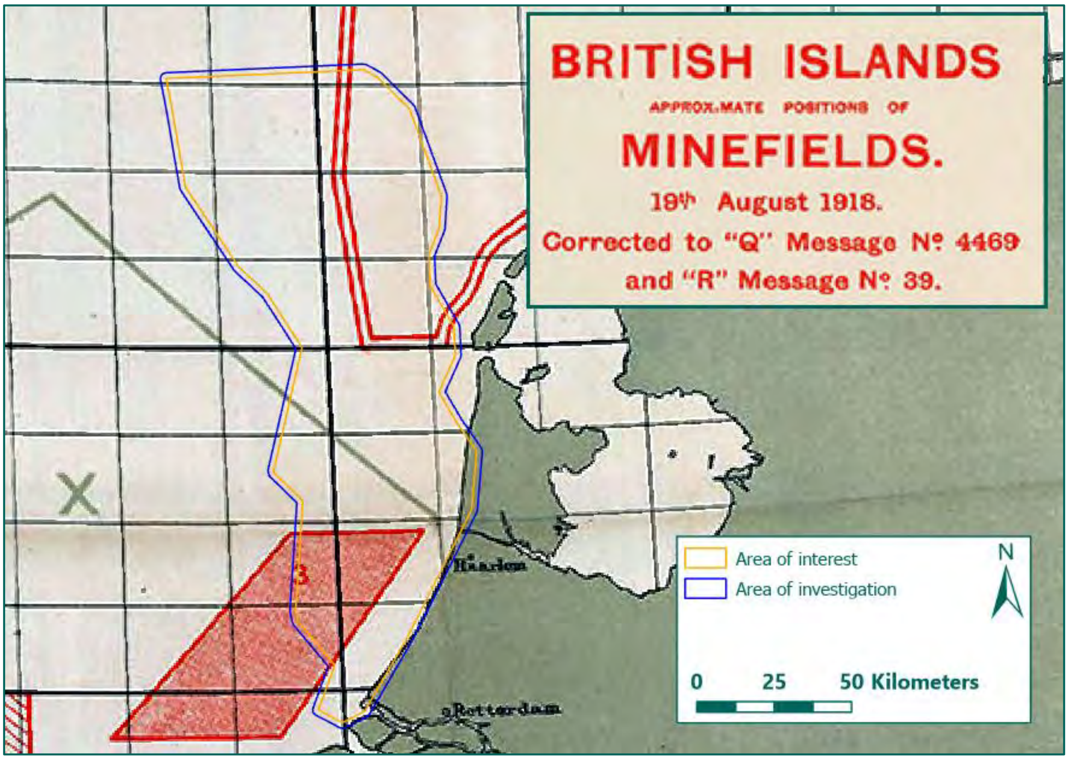


Figure 55: Minefields in the North Sea during 19 August 1918 (Source basemap: LOC).

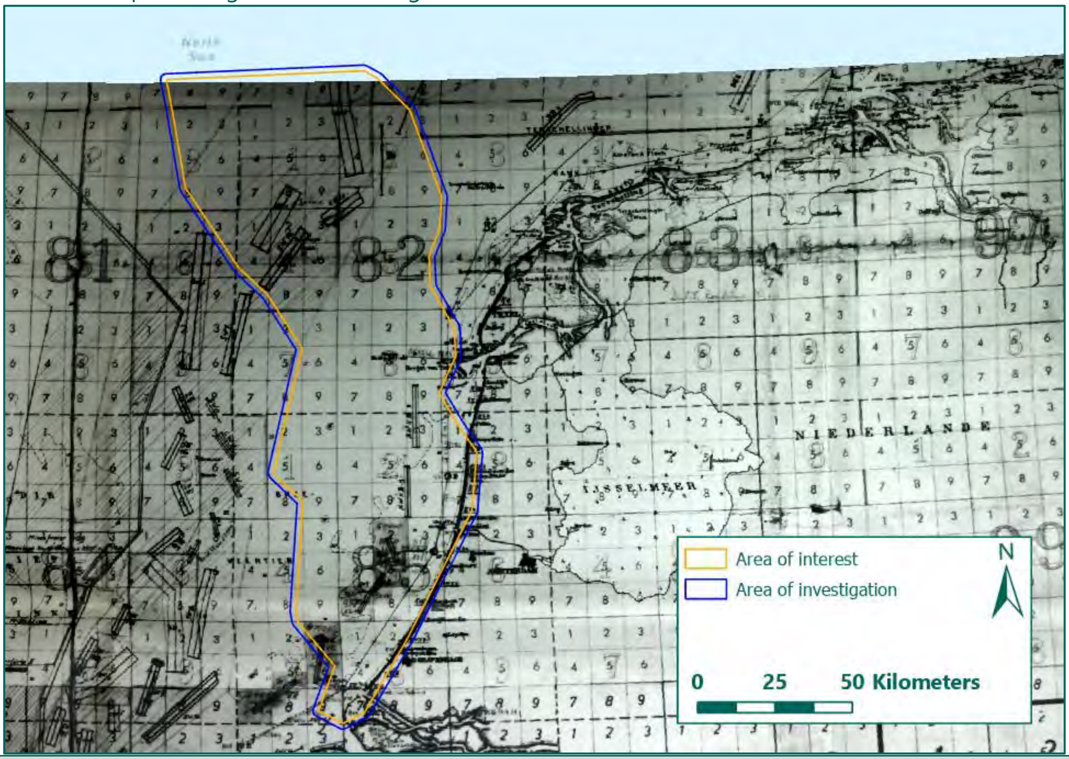
The National Archives

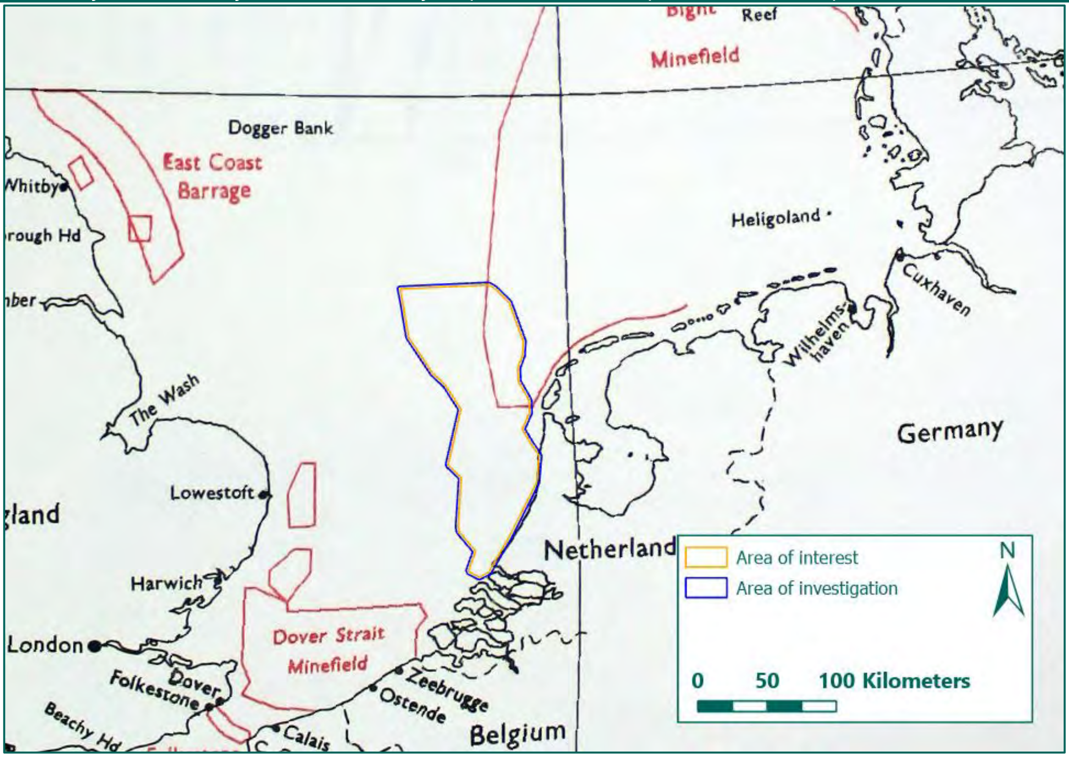
The National Archives (TNA) have been consulted for more information on maritime and aerial warfare in the area of investigation. This annex contains relevant information from TNA. Information regarding maritime and aerial warfare is mentioned consecutively.

Admiralty series

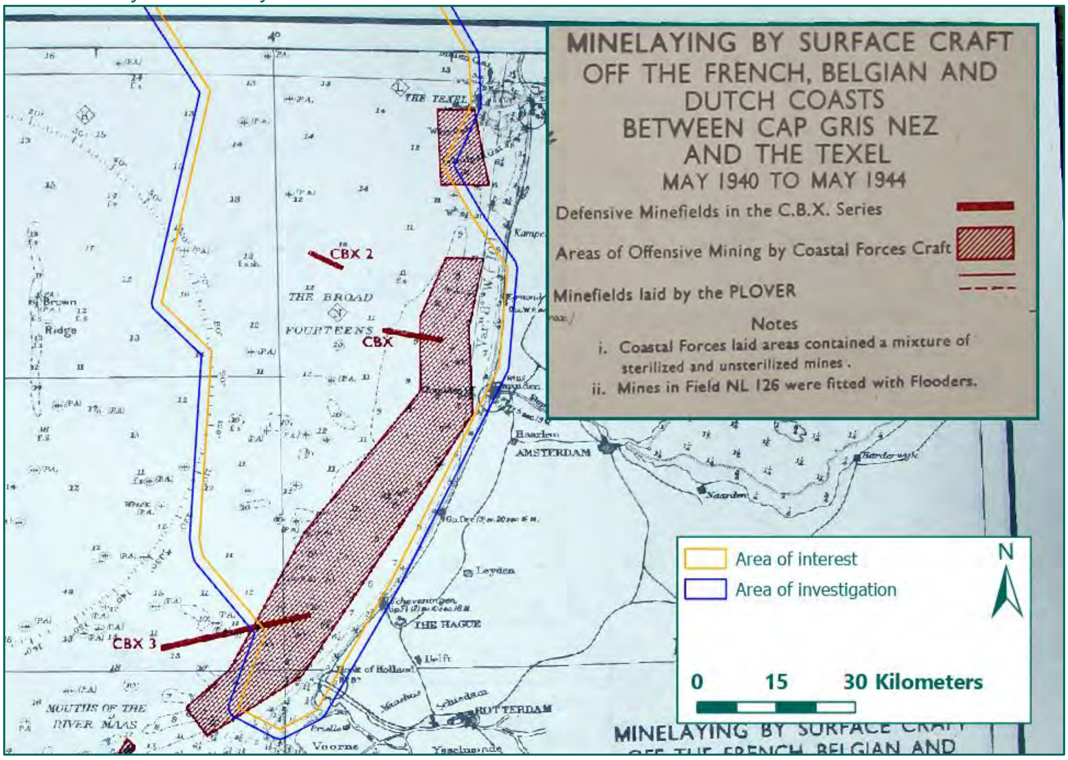
The admiralty series (ADM) have been consulted for information concerning wrecks, naval combat, minefields and air strikes. Consulting these series yielded several files containing relevant information. These files are shown in the tables below.

Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers (ADM)	
ADM 1/18996	Results of British minelaying offensive.
General information about total amount of laid/dropped mines, 3rd September 1939 – 5th May 1945:	
MINES LAID IN ENEMY WATERS By Fast Minelayers and Destroyers 11,100 By M.T.Bs, M.Ls and M.G.Bs 6,450 By Submarines 3,000 By Aircraft 53,100 Total 73,650 Mines	
ADM 1/19745	Post-war mine clearance in European waters: first interim report of International Central Board. With charts, 1946-1947.
Relevant information: o Dangerous areas existing in March 1946.	

Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers (ADM)	
	
ADM 199/154	British mining operations 1939-1945: Vol 1.
Relevant information: o Map showing minefields along the Dutch coast: 	
ADM 234/561	British mining operations 1939-1945: Vol 2.
Relevant information: o Map showing: British Minefields laid in the Chanel, North Sea and Kattegat 1914-1918. No minefields within area of interest.	

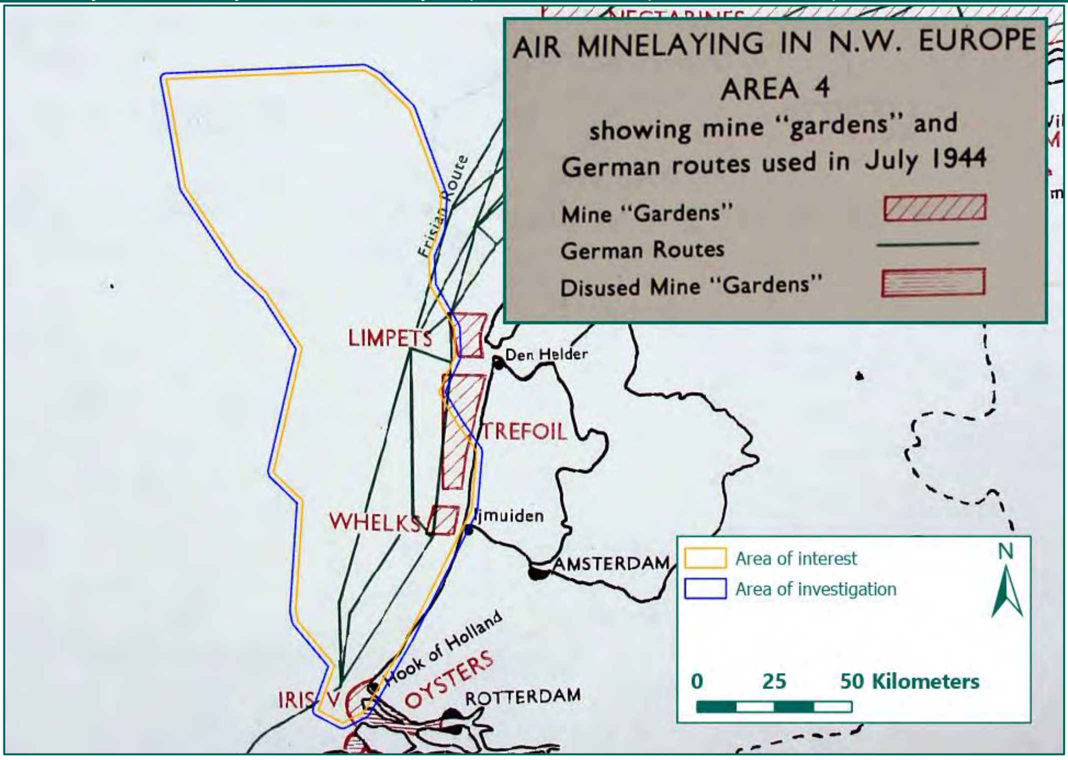


- o Map showing:
  Minelaying by surface craft off the French, Belgian and Dutch Coasts between Cap Gris Nez and The Texel, May 1940 – May 1944:



- o Map showing:
  Air Minelaying in NW Europe:

Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers (ADM)



In ADM 234-560 it is stated that mines were laid within the Minefields limpets, Trefoil, Whelks, Iris V and Oyster:

AREA 4

ANALYSIS OF OPERATIONS

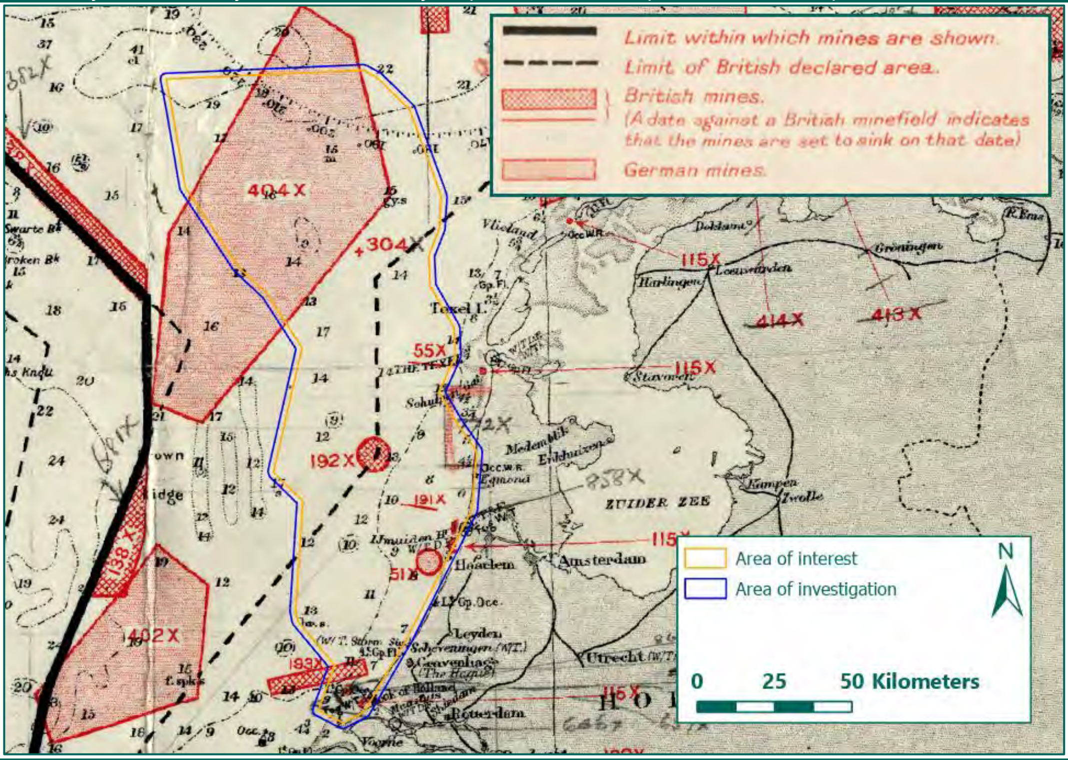
		DANISH COAST Hawthorn Rosemary	ELBE & WESER Eglantine Yams	GERMAN COAST & FRISIAN Is. Xeranthemum Zinnia Mussels Nectarine	DUTCH WEST COAST Limpets Whelks Trefoil	HOOK OF HOLLAND Oysters Iris V	SCHELDT Newts Juniper Iris II Flounders	ALL AREAS
1940	Mines Casualties Ratio	- - -	139 8 1:17	127 10 1:13	45 10 1:4.5	60 7 1:8.5	70 5 1:14	441 40 1:11
1941	Mines Casualties Ratio	37 1 1:37	116 11 1:10.5	268 18 1:15	- 4 ∞	2 2 1:1	- - -	423 36 1:11.7
1942	Mines Casualties Ratio	698 18 1:39	133 10 1:13	3,921 67 1:58	170 4 1:42	- - -	- - -	4,922 99 1:49.5
1943	Mines Casualties Ratio	156 12 1:13	63 4 1:16	6,288 32 1:197	372 - ∞	- - -	- - -	6,879 48 1:143
1944	Mines Casualties Ratio	1,800 53 1:34	150 11 1:13.6	1,468 19 1:77	491 8 1:61	88 5 1:18	252 8 1:31	4,249 104 1:41
1945	Mines Casualties Ratio	296 1 1:296	361 14 1:26	- - -	- 2 ∞	- - -	- - -	657 17 1:39
OVERALL	Mines Casualties Ratio	2,987 85 1:35	962 58 1:16.6	12,072 146 1:83	1,078 28 1:38.5	150 14 1:10.7	322 13 1:25	17,571 344 1:51

ADM 239/304	North Sea: chart 736 showing position of British and German minefields.

Relevant information:

- British map showing German and British minefields. There are two German minefields within the area of interest:

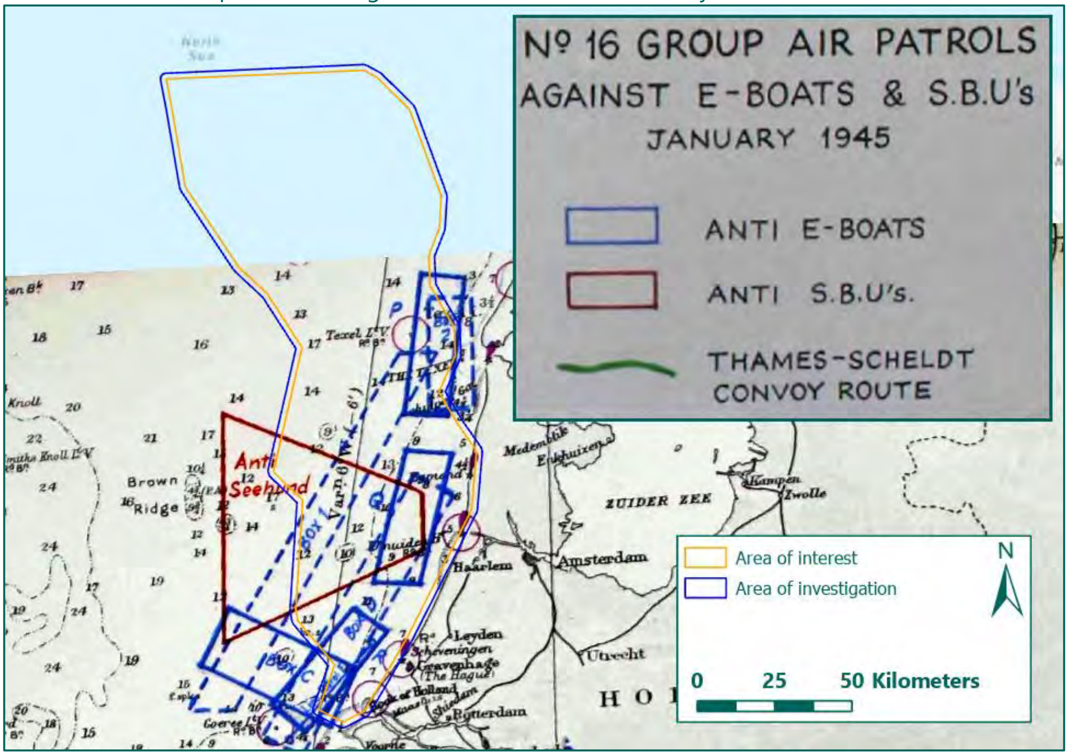
Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers (ADM)



Cabinet and its committees (CAB)	
CAB 101/324	Air Offensive Against Enemy Shipping and Bomber Command Minelaying Operations, 1 September 1944 - 5 May 1945

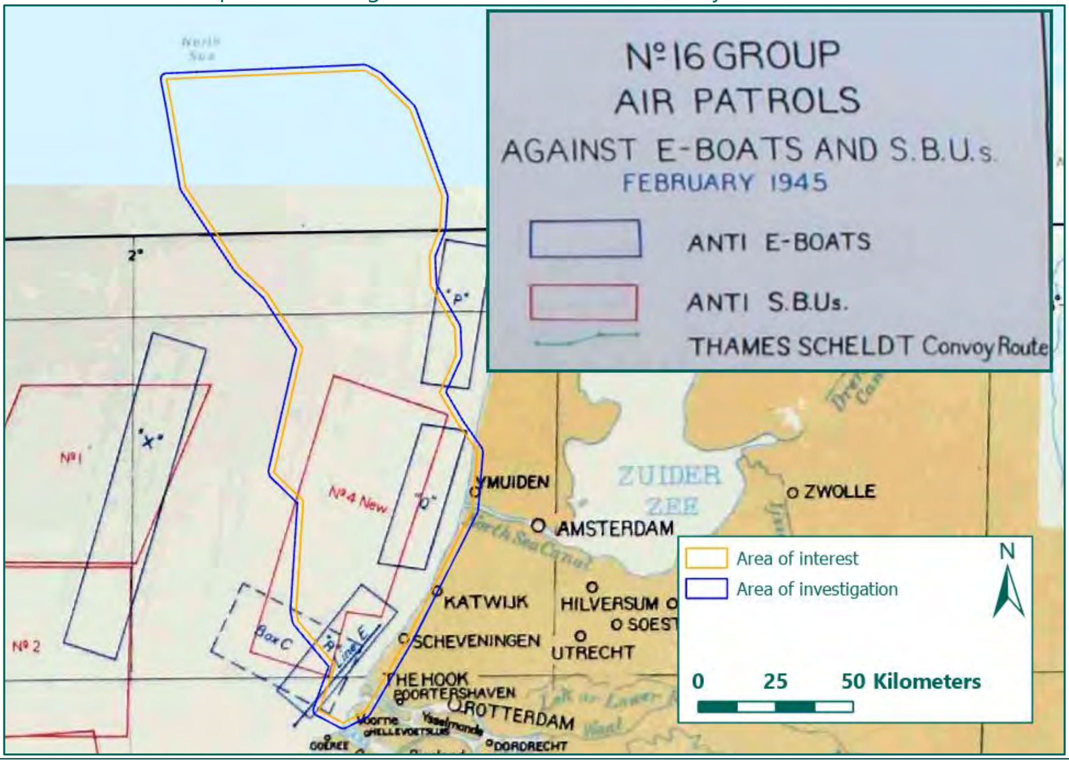
Relevant information:

- No.16 Group Air Patrols against E-Boats & S.B.U.'s January 1945.



Relevant information:

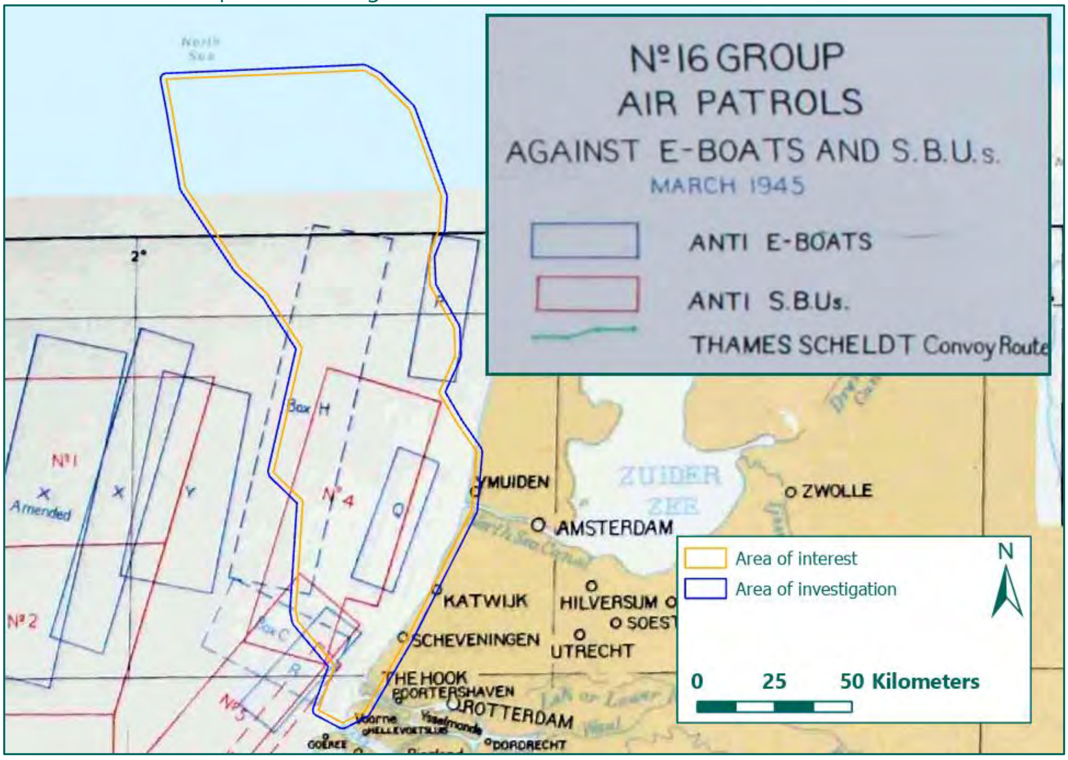
- No.16 Group Air Patrols against E-Boats & S.B.U.'s February 1945.



Cabinet and its committees (CAB)

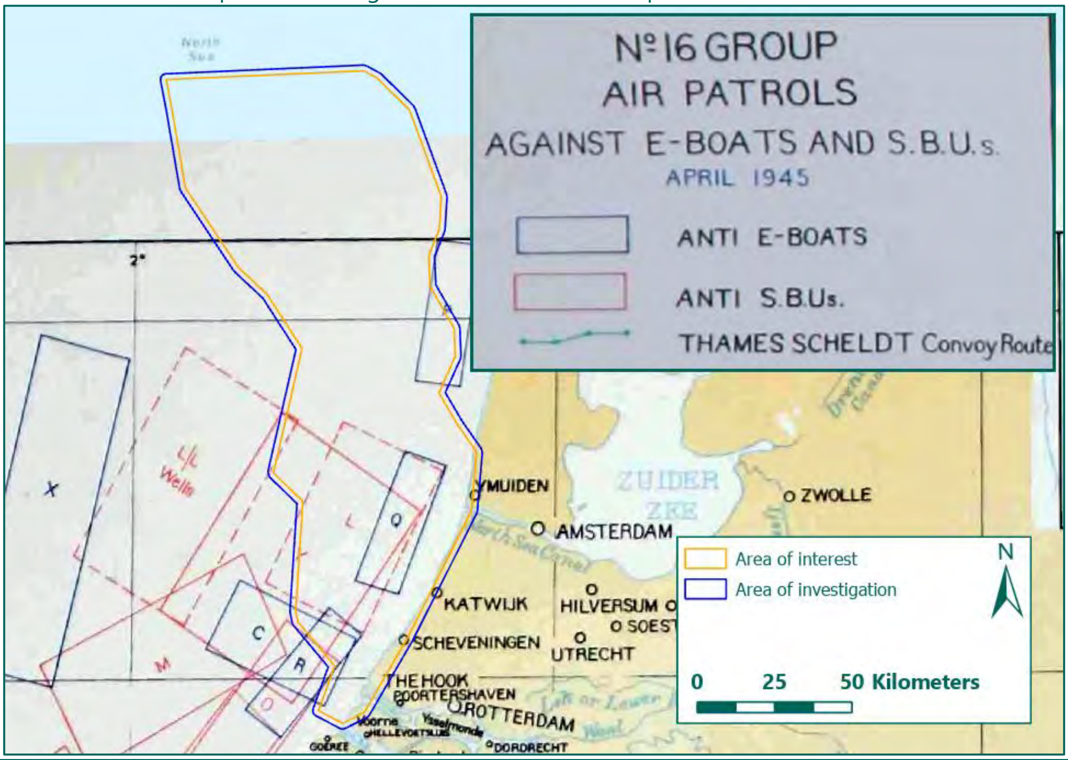
Relevant information:

- No.16 Group Air Patrols against E-Boats & S.B.U.'s March 1945.



Relevant information:

- No.16 Group Air Patrols against E-Boats & S.B.U.'s April 1945.



Air Ministry series
The Air Ministry series (AIR) contain information on aerial warfare during the Second World War. The Operations Record Books (ORBs) of units that operated in or near the area of investigation have been consulted:

- Headquarters Coastal Command, 1940-1945 (AIR 24/372 t/m AIR 24/427)
- 16 Group Coastal Command, 1940-1945 (AIR 25/313 t/m AIR 25/374)
- Headquarters Bomber Command, 1940-1945 (AIR 24/217 t/m AIR 24/319)
- Intelligence on USAAF missions (AIR 40)

16 Group Coastal Command patrolled the North Sea, attacking German shipping and conducting rescue operations. ORBs from this unit contain locations of air strikes, jettisoning, aircraft wreckages and Anti-Aircraft Artillery (AAA). Until halfway through 1942 the locations were noted in Coastal Command cypher which has only partially been decrypted by REASeuro. From 1942 onwards the ORBs mention locations in coordinates, based on decimal degrees. One must take into account that Coastal Command operated during the night as well, severely hampering navigational accuracy. When possible, war related events mentioned in the Coastal Command records have been coupled with records from the German point of view, resulting in more accurate positioning based on multiple sources.

Bomber Command, Coastal Command's famous land-based counterpart, was also active against German shipping during the first years of the war. Besides intentional bombing, Bomber Command aircraft also jettisoned bombs when in trouble. The jettisoning preferably took place over sea, since this dramatically reduced the chance of collateral damage.

In the figure below the attacks, jettisons, crashes and relevant observations from Bomber Command and Coastal Command are shown. Each feature refers to a passage of a primary source.

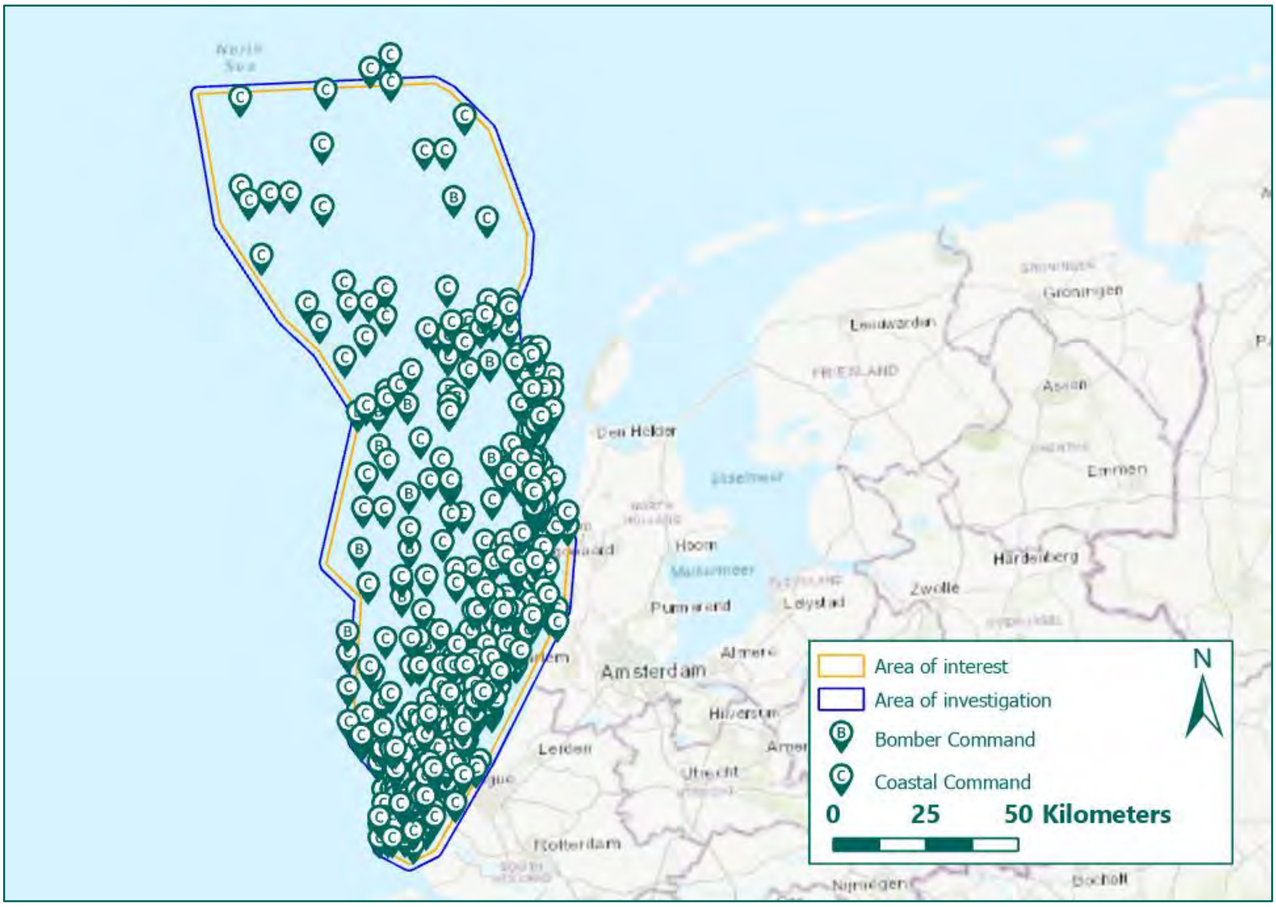


Figure 56: Locations of attacks, jettisons, crashes and relevant observations from Bomber Command and Coastal Command (Source basemap: ESRI).

The North Sea theatre of war saw also action of fighter planes of Fighter Command and 2nd Tactical Air Force (2TAF). Fighter Command patrolled the sea in order to intercept German planes heading for Britain and escorted bombers. From 1944 onward Fighter Command was involved in the war against the German V1 and V2 weapons. 2TAF mainly supported the ground forces by carrying out attacks on tactical ground targets, but also enemy shipping near the shores was attacked. No locations have been found of Fighter Command's and 2TAF's attacks within the area of interest.

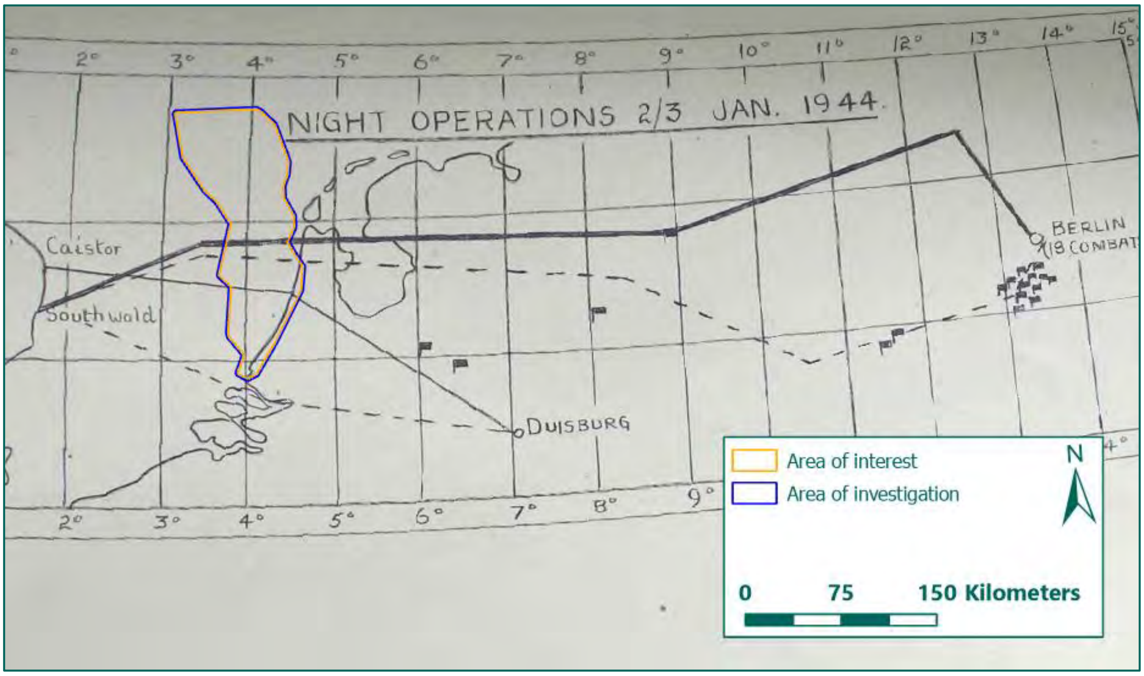


Figure 57: Example of a flight path over the area of investigation of bombers from Bomber Command, 2/3 January 1944 (Source, TNA, AIR 24/264).

Remark on jettisoning and flight paths
Related to the air war are jettisoning of bombs and the numerous flight paths of incoming and outgoing bombers above the North Sea. During bombing raids, allied bombers followed certain routes towards their target and backwards to base. In case of emergency or to avoid landing with the bomb load, the bombs were often released above the North Sea. The figure underneath is a document from The National Archives (AIR 14/110 Disposal of bombs not dropped on allotted targets) that describes what to with the remaining bomb load. It is stated that a captain could decide where ever the bombs are dropped, as long as they are dropped in safe condition. Despite this document, the logs of Coastal and Bomber Command prove that bombs were also jettisoned in live condition.

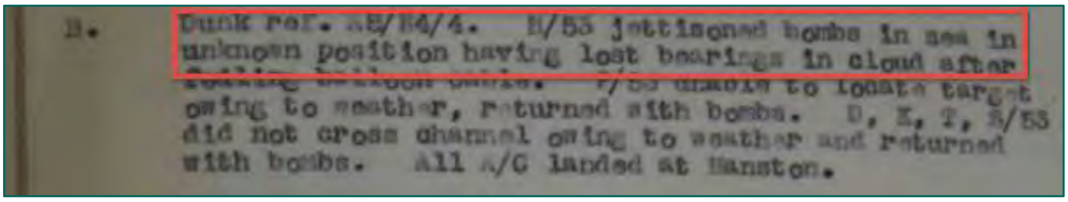

B. Dunk ref. AB/B4/4. B/53 jettisoned bombs in sea in unknown position having lost bearings in cloud after ... balloon cable. ?/53 unable to locate target owing to weather, returned with bombs. D, X, T, S/53 did not cross channel owing to weather and returned with bombs. All A/C landed at Manston.

Figure 1: Blenheim Bomber jettisoned its bombs at an unknown position in the Northsea (Bron: TNA, AIR 24/375).

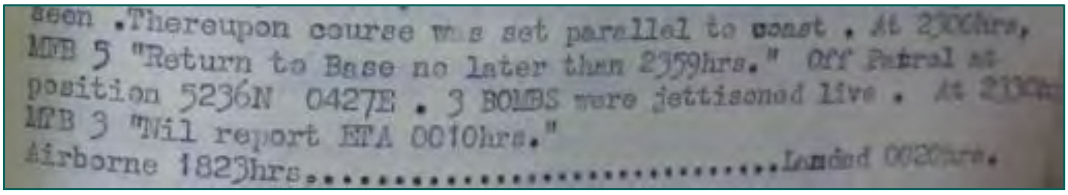

seen .Thereupon course was set parallel to coast . At 2300hrs, MTB 5 "Return to Base no later than 2359hrs." Off Patrol at position 5236N 0427E . 3 BOMBS were jettisoned live . At 2300hrs MTB 3 "Nil report ETA 0010hrs."
Airborne 1823hrs.................................Landed 0020hrs.

Figure 58: Example of a live jettison within the area of investigation, night 12/13 October 1944. (Source: TNA, AIR 25/367).

Spitfires found 10/10th cloud over target. 1 Sqdn jettisoned bombs in sea, 1 Sqdn brought bombs back.

Figure 2: A Squadron of Spitfires jettison their bombs in sea after being unable to locate the assigned target (Bron: TNA, AIR 37/713).

[redacted] WELLINGTONS FROm Bircham Newton to be arm ed with 5 x 500lb bom bs and 25 flares and to reconnoitre enemy inner convoy route from 5335N 0620E to 0800E and back to 5335N 0630E and to R/V with Beaus in this position at 0300. Wellington to be at 5335N 0620E at 0230. W/T Org 1a R/T Org 4 . TOrbeaus to be arm ed with torpedoes 10ft setting.
Patrol carried out. At 0250 MTB 1 'Nil sighting' and VHF MT Beaufighters 'Nothing'. At 0258 2 bom bs were jettisoned safe but one exploded. [redacted]

Figure 3: Wellington bombers jettisoned two bombs at an undisclosed location at sea. Although the bombs are jettisoned "safe", one exploded (Bron: TNA, AIR25/363).

DISPOSAL OF BOMBS NOT DROPPED ON TARGETS.

1. In the event of Captains of Aircraft having to return from a bombing missions without having dropped all bombs, discretion is left to the Captain of the Aircraft as to whether it is wise for him to land with

(i) all bombs
(ii) a portion of bombs
(iii) no bombs.

2. If the Captain of the Aircraft decides to drop his bombs in the sea, they are to be jettisoned "safe".

Figure 4: Extract from AIR 14/110 (Disposal of bombs not dropped on allotted targets) (Source: TNA).

Coastal guns

Coastal guns were traditionally used in strongpoints that had to defend harbours from enemy ships. Shortly before the beginning of World War II, more modern batteries were installed on the Dutch Coast. After the German Occupation the amount of Coastal Guns grew in order to strengthen the *Atlantikwall*. It is known that Coastal guns were active in the area of investigation. In the TNA a photograph showing an explosion of a shell from land battery was consulted. The photograph was dated 4 May 1942 and located at 52 36N, 04 22E (within the area of investigation).

Figure 59: Strike photo showing the impact of a shell, fired by a German coastal battery. 4 May 1942. (Source: TNA, AIR 28/595).

National Archives and Records Administration (NARA)

The following Record Groups have been consulted in the NARA:

- Record Group 18: Mission Reports.
  The mission reports contain detailed information on allied bombing raids, including height, air speed and the deployed munitions.
- Record Group 342: Records of U.S. Air Force Commands, Activities, and Organizations
  Record Group 342 contains additional details not mentioned in Record Group 18.

These Record Groups show several attacks by the USAAF on targets along the Dutch Coast. It is known that these aircraft operated above the area of investigation. No specific targets within the area of investigation were mentioned. It is possible that due to technical or navigational failures war related events took place within the area in investigation. In the figure below an example of a flight path over the area of investigation is shown.

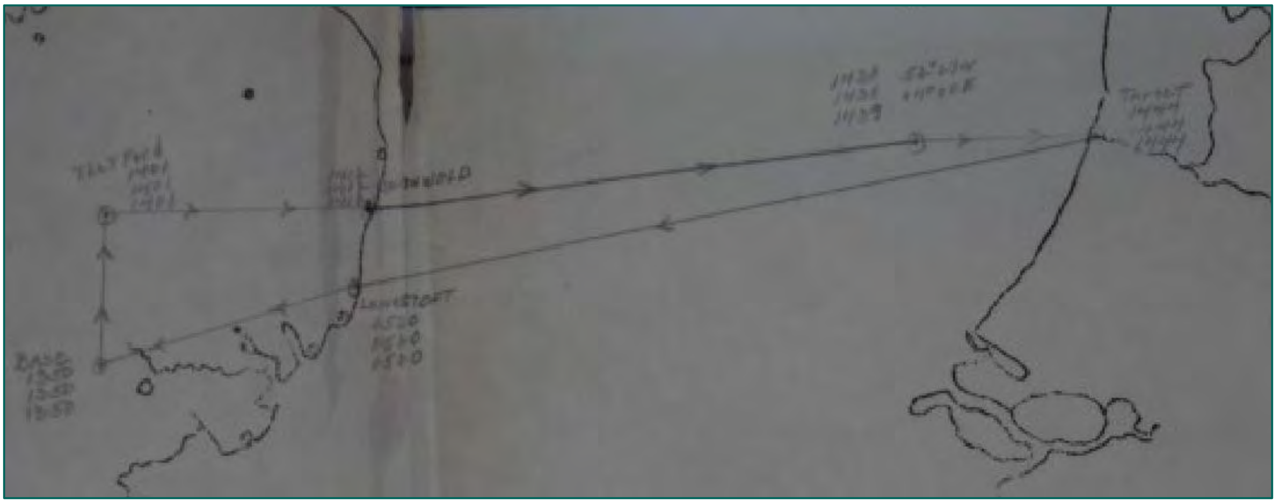


Figure 60: The flightpath of aircraft of USAAF on 26 March 1944 (Source: NARA Box RG18, Box 1388).

No further files have been consulted with regards of the area of investigation. Consulting these sources is outside the scope of this research.

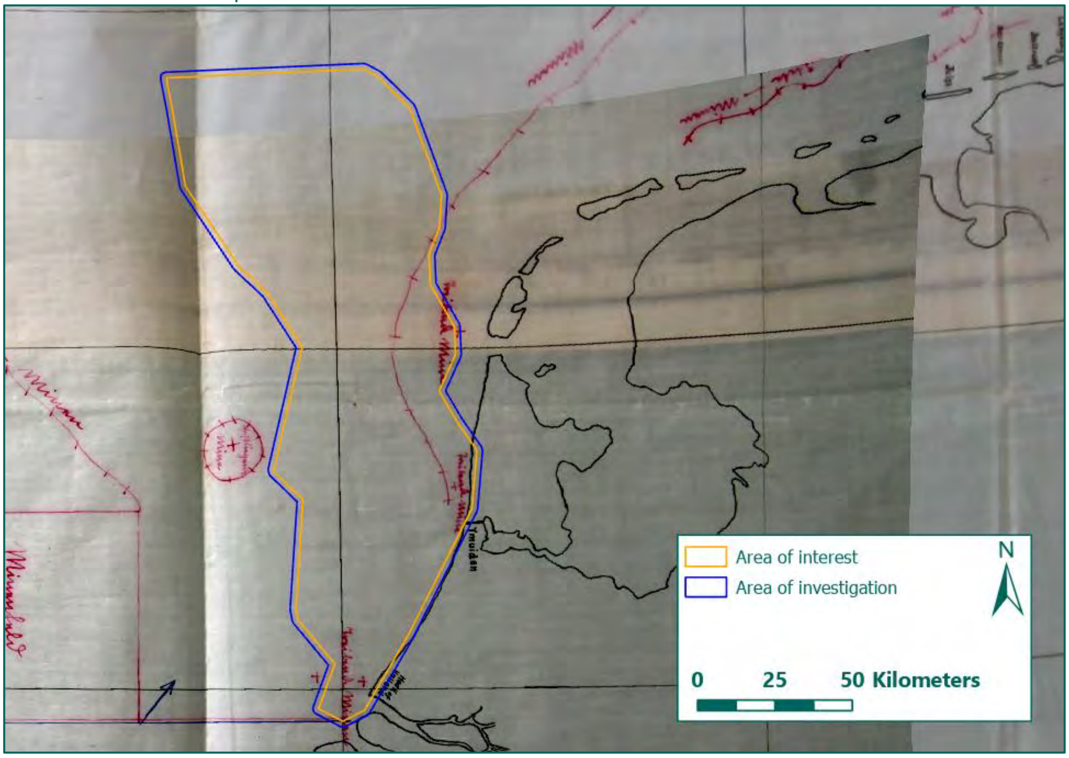
Bundesarchiv-Militärarchiv (BAMA)

The German military archives have been consulted in the BAMA in Freiburg. This archive contains the documents from the German military in the Second World War. The following record groups have been consulted by REASeuro to gain more information about the German perspective of naval warfare in the area of investigation:

- RM 5: Admiralstab der Marine / Seekriegsleitung der Kaiserlichen Marine.
- ZA 5: Deutscher Minenräumdienst (German Minesweeping Administration).

The following documents have been found relevant for the area of investigation:

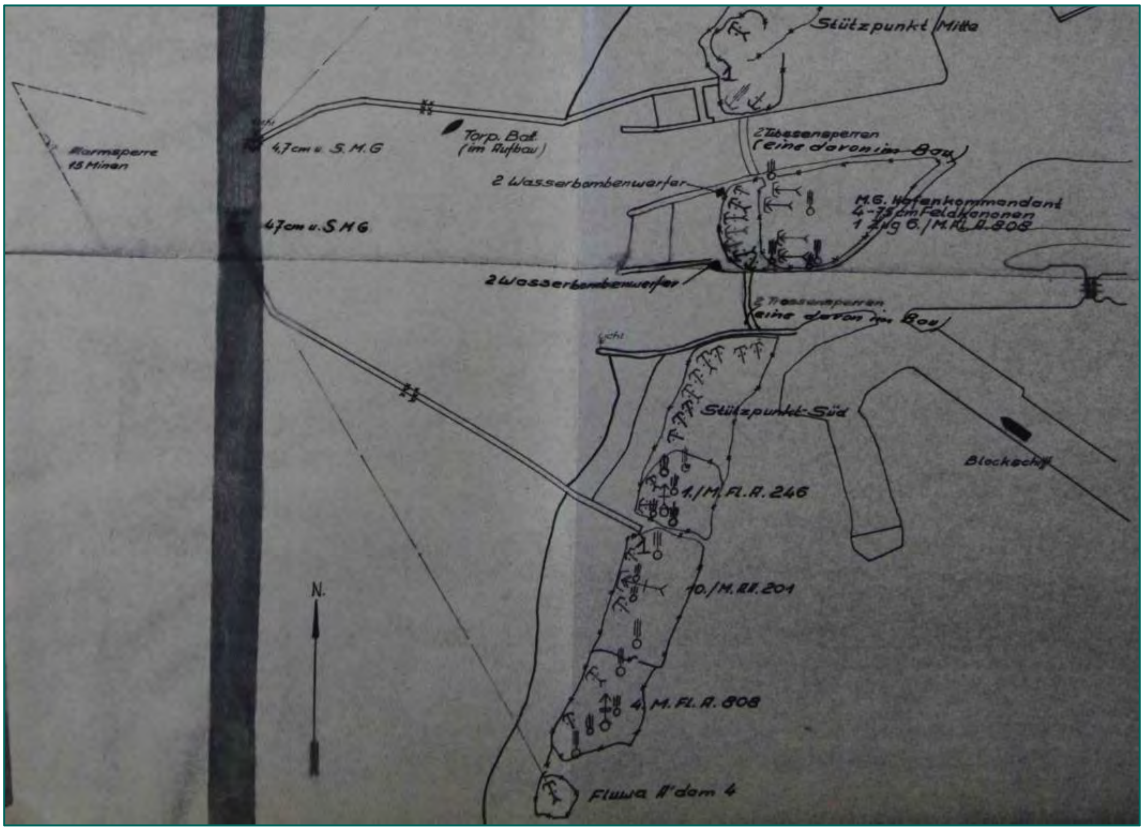
RM 5: Admiralstab der Marine / Seekriegsleitung der Kaiserlichen Marine.	
The Admiralty of the Imperial Navy was the highest level of command of the German Navy during the First World War. Record Group RM5 contains documents from the admiralty. The following documents are considered relevant for the area of investigation.	
RM 5/4721K	Kommando der Hochseestreitkräfte: "Zusammenstellung der bisher bekannten Minensperren und minenverdächtigen Gebiete". Druck, 3.3.1915
Map showing known and suspected allied minefields, situation March 1915. The area of interest has no overlap with an area which was suspected to be mined.	

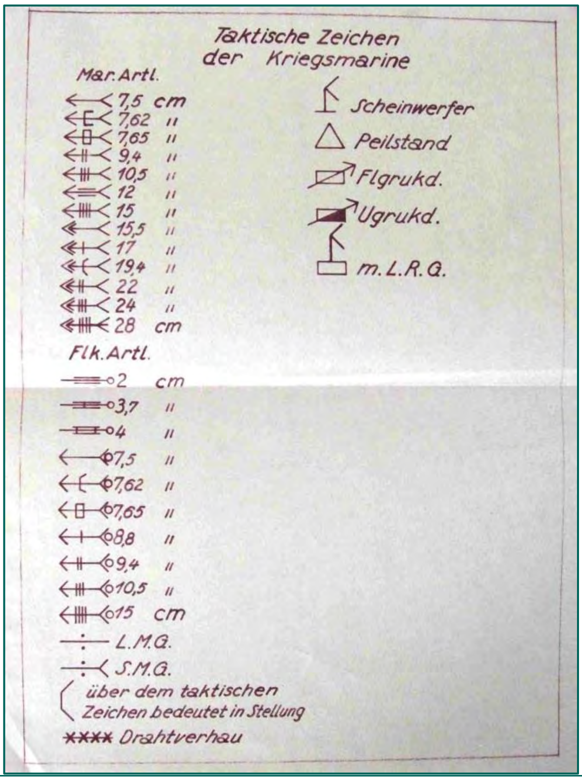


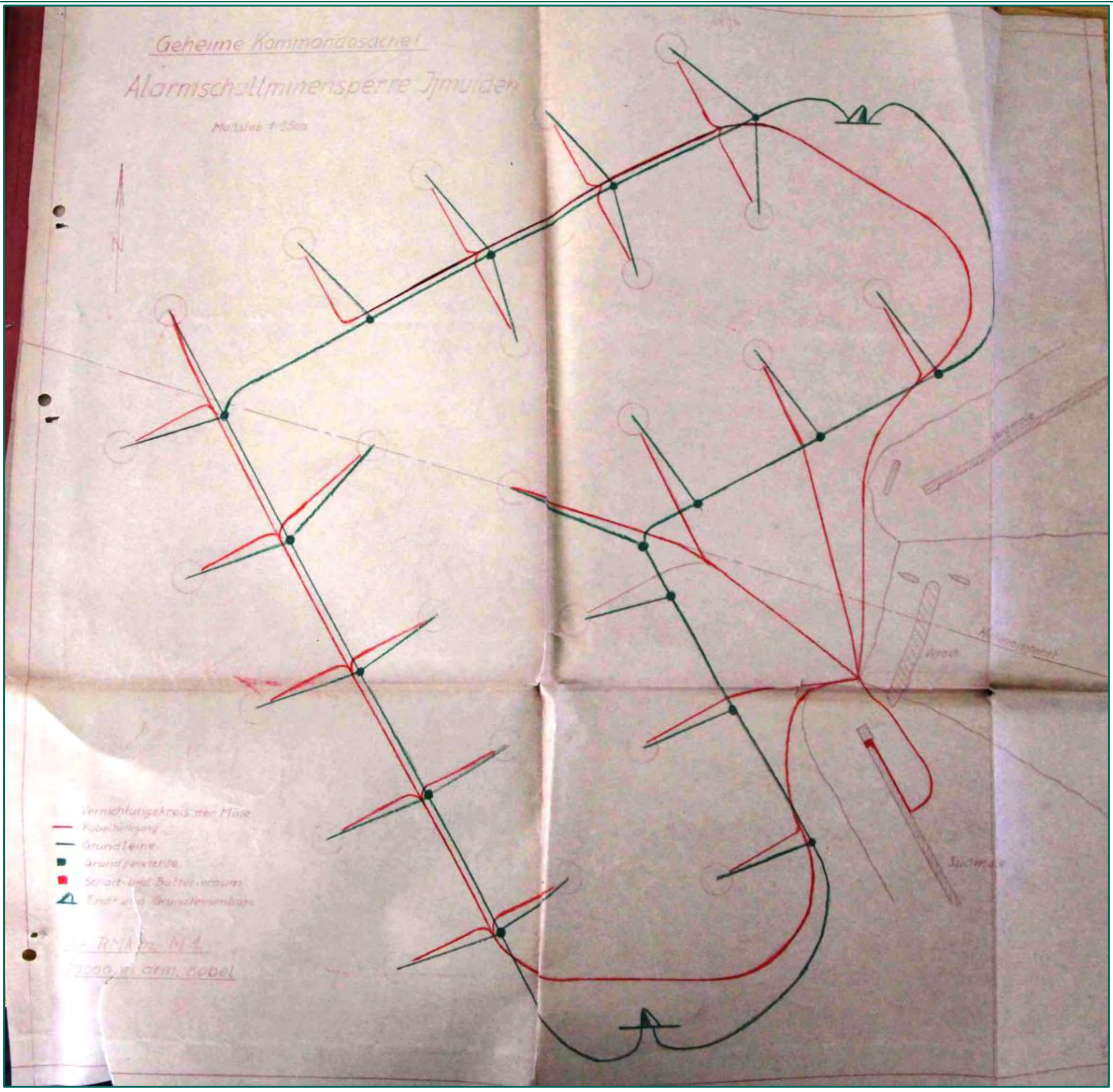
Within the area of investigation the map shows 'Treibende Minen' (Contact mines).

RM 35-I: Marinegruppenkommando Ost – Nord der Kriegsmarine.	
The *Marinegruppenkommando Ost – Nord* operated as the commander of the units that had to secure the East and North Sea.	
RM 35-I/277	Minenlage Nord (M.L.N.) 1. Mai 1942 - 1. Okt. 1943

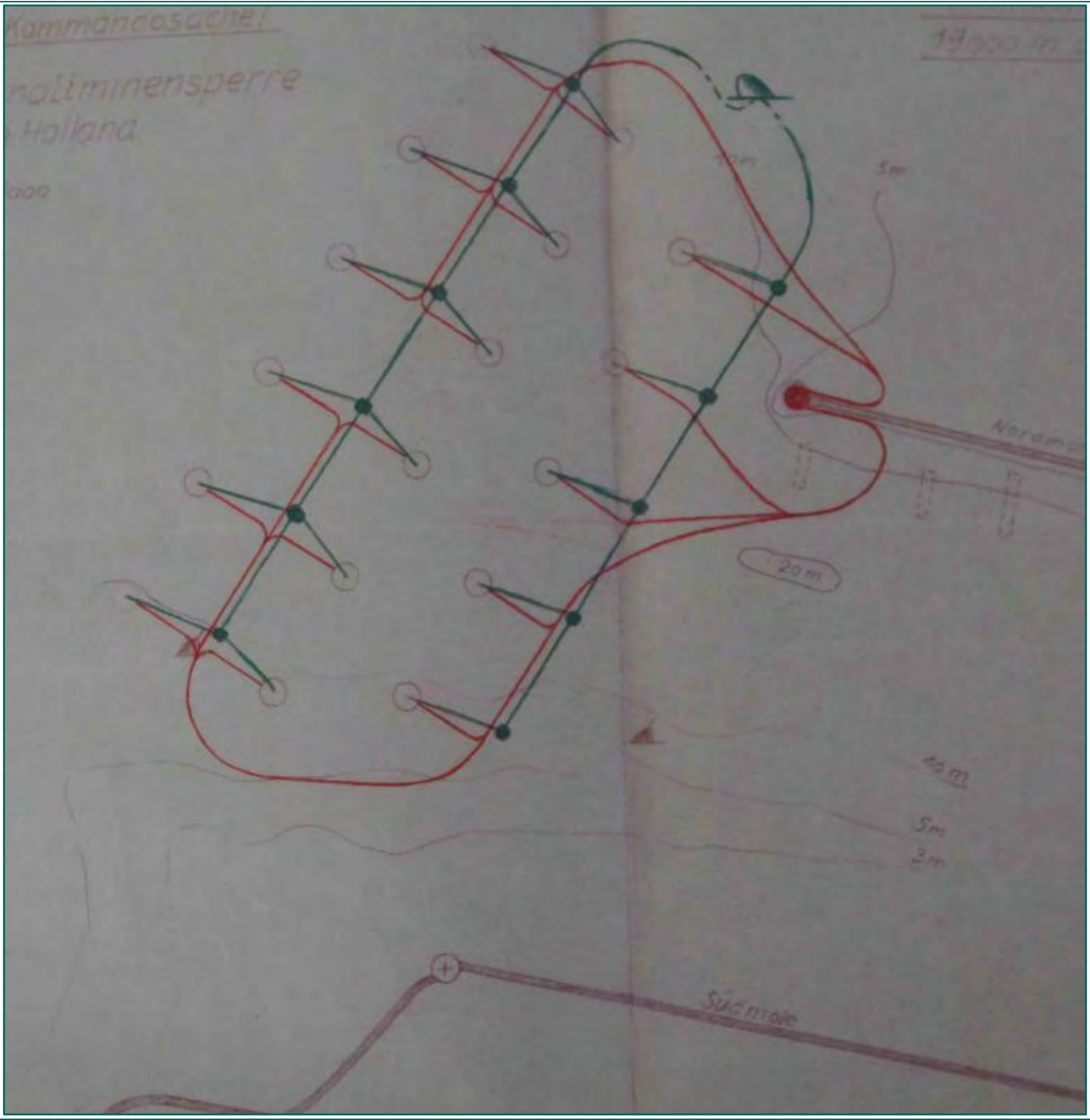
Map showing the defences of IJmuiden harbour. A warning minefield is situated in front of the port entrance. The minefield consisted of 24 RMA magnetic ground mines. The mines had a remote controlled detonator and each mine was coupled to a device on land. This gave the German defender the option to turn the mines on and off.



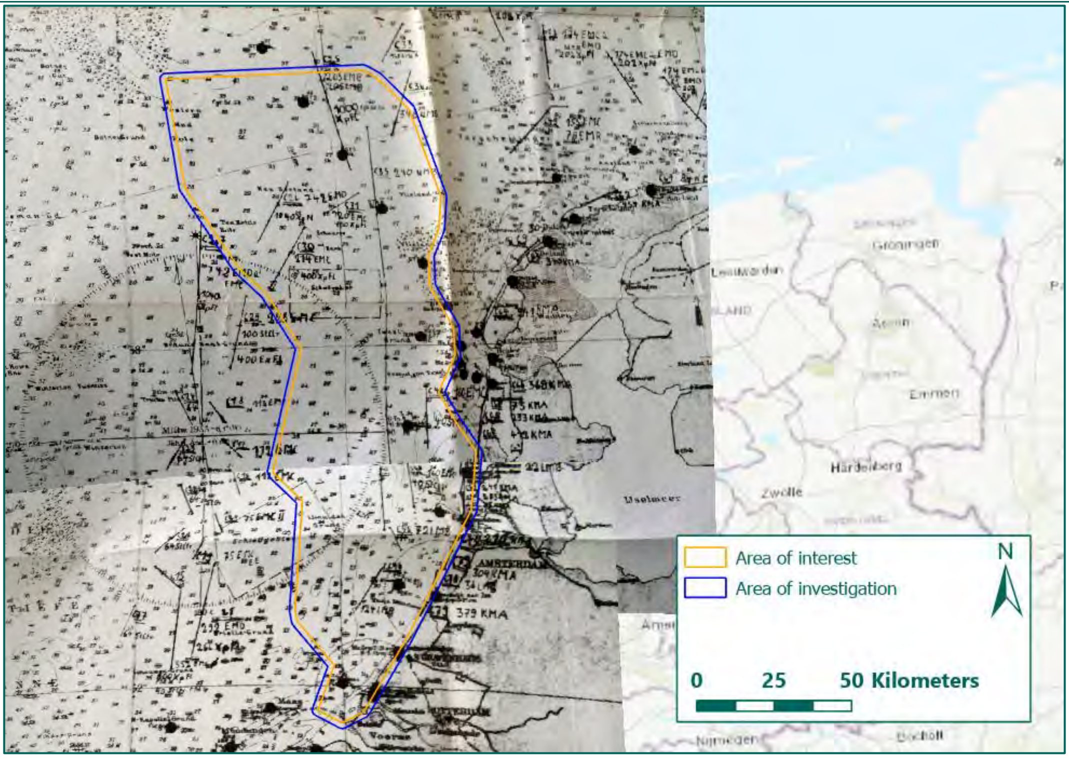




Map showing a minefield consisted of 17 RMA magnetic ground mines at the Hoek van Holland.



ZA 5 Deutscher Minenräumdienst (German Minesweeping Administration)	
The German Minesweeping Administration was responsible for post-war mine clearance of German waters. This administration also summarized and mapped all German minefields laid during the Second World War.	
ZA 5/27	Im Kriege geworfene Minensperren in der Ost- und Nordsee etc.
Naval chart showing numbered German minefields. Multiple minefields are present in the area of interest. For a more detailed map, see ZA 5/47.	



A large amount of minefields were present in the area of investigation:
- C25
- C26
- C27
- C29
- C30
- C31
- C35
- C36
- C44
- C45
- C46
- C47
- C48
- C67
- C69
- C70
- C71
- C72
- C73
- C78
- C79
- E25
- E26
- E38
- E41
- E42
- E43
- E44
- E45
- E46
- E47

- E69

ZA 5/44	Chart B: The North Sea – Central Sheet

C25-C27

C25	SW-0	9/40	53 30.0 N 04 05.0 E 53 49.5 N 03 58.0 E	.5	205 EMB 205 EMB 1000 XpFl		M M M	8 8 17		1) 1)	220-300	With AE Switch. Without AE Switch. To west of mines. Considered safe.
C26	SW-1	8/40	53 27.8 N 03 46.5 E 53 17.5 N 03 36.5 E	1	742 EMD 1040 XpFl		M M	7 16	65	3	50	AE Switch "OFF" Considered safe.
C27	SW-2	8/40	53 20.0 N 03 21.0 E 52 56.0 N 03 17.5 E	1	742 EMD and EMC 1040 XpFl		M M	7 17	65 50	3		AE Switch "OFF" Considered safe.

C29-C31

C29	SW-9	7/42	53 08.5 N 03 33.1 E 52 56.3 N 03 28.2 E	2	226 EMC 100 StCtr 400 ExFl		M M M	10 20 20		2 1		With 50 feet lower antenna. The 400 Ex-Floats are for lines C.29, C.30 and C.31. They are in the space between the mine lines.
C30	SW10	7/42	53 20.0 N 03 49.7 E 53 10.0 N 03 38.9 E	2	214 EMC 400 XpFl		M M	10 20		2		With 50 feet lower antenna. The 400 Ex-Floats are for lines C.29, C.30 and C.31. They are in the space between the mine lines.
C31	SW11	7/42	53 26.0 N 04 06.0 E 53 22.1 N 03 56.8 E	2	120 EMC 400 XpFl		M M	8 20		2		With 50 feet lower antenna. The 400 Ex-Floats are for lines C.29, C.30 and C.31. They are in the space between the mine lines.

C35-C36

C35	4c	10/43	53 26.0 N 04 12.0 E 53 38.2 N 04 12.0 E	.25	240 UMB		M	12		3	160	(Comment-another version shows 340 UMB). With SNAG LINES. Eight mines are missing from S. end of centre row.
C36	4d	10/43	53 36.6 N 04 17.8 E 53 48.0 N 04 25.7 E	.4	348 UMB		M	12		3		With SNAG LINES.

C44-C48

C44	SWK3	6/44	52 37.5 N 04 36.0 E 52 39.0 N 04 36.3 E	.25	22 LMB		G	30	250	2	165	Mean MINE spacing 125 yds.
C45	SWKA-1b	9/44	52 26.5 N 04 13.5 E 52 22.8 N 04 16.6 E	.5	72 LMB	DM-1	G		240	2	165	Mean MINE spacing 120 yds. Arming delay 24 hours (?)
C46	SWKA-2	9/44	52 20.2 N 04 12.5 E 52 13.6 N 04 05.5 E	.5	124 LMB	DM-1	G		260	2	165	Mean MINE spacing 130 yds. Arming delay 24 hours.
C47	SWKB-1	11/44	52 30.0 N 04 20.0 E 52 39.0 N 04 20.0 E	1	160 EMC 40 StCtr		M) M)	10	270	3	220	With chain 4 mines to 1 obstructor. Mean spacing 135 yards.
C48	SWKB-2	11/44	52 42.0 N 04 23.0 E) 52 53.0 N 04 23.0 E)	½-1	160 EMC) 40 StCtr)		M	10	330	3	330	Mines with chain. Four mines to one obstructor. Mean spacing 150 yards.

C67

C67	K-6	5-7 1944	52 46.0 N 04 39.1 E 52 40.2 N 04 37.5 E	Fairly accurate	412 KMA		G		58	2	33-66	Mean mine spacing 29 yards.

C69-C73

C69	K-7	7-8 1944	52 33.4 N. 04 36.2 E 52 36.7 N 04 37.0 E	Fairly accurate	241 KMA		G	3-8ø	56	2	43-55	ø Below HIGH water springs Mean mine spacing 28 yards.
C70	K-8	5/44	52 28.9 N 04 34.5 E 52 29.9 N 04 35.0 E	Exact	75 KMA		G	7ø	55	2	43-55	ø Below HIGH water springs. Mean mine spacing 27.5 yards.
C71	K-8a	5-7 1944	52 29.9 N 04 35.0 E 52 33.4 N 04 36.2 E	Exact	285 KMA		G	5-11ø	52	2	43-66	ø Below mean HIGH water springs. Mean mine spacing 26 yards.
C72	K-9	5-8 1944	52 24.0 N 04 31.7 E 52 20.0 N 04 29.1 E	Fairly accurate	304 KMA		G	5-8ø	55	2	43-55	ø Below high water springs. Mean mine spacing 27.5 yards.
C73	K-9a	5/44	52 26.4 N 04 33.7 E 52 24.0 N 04 31.7 E	Exact	210 KMA		G		55	2	43	Mean mine spacing 27.5 yards.

C78-C79

C78	SWK-6	6/44	52 17.3 N 04 26.4 E 52 19.3 N 04 27.8 E	.25	36 LMB		G	28	246	2	165-190	Mean mine spacing 123 yards.
C79	K10	8/44	52 16.7 N 04 27.0 E 52 12.0 N 04 22.6 E	Fairly accurate	379 KMA		G	5-10	55		44-55	Mean mine spacing 27½ yards. Below HIGH water springs.

E25-E26

E25	SWK7	6/44	52 08.2 N 04 17.1 E 52 11.4 N 04 21.1 E	.125	78 LMB	M1	G	23-30	210	2	165	Mean mine spacing 105 yds.
E26	SWK9	4/44	51 55.5 N 03 57.1 E 51 52.4 N 03 52.5 E	.25	90 LMB	M1	G		190	2	220	Mean mine spacing 95 yds.

E38

E38	SWK A3	9/44	52 09.2 N 03 55.0 E 52 01.2 N 03 51.7 E	.5	90 LMB	DM1	G		180	1	165	Mean mine spacing 90 yds. Arming delay 24 hours. EMC with chain.
					90 EMC		M	10	180	1		

E41-E47

E41	K10	8/44	52 16.7 N 04 27.0 E 52 12.0 N 04 22.6 E	Fairly exact	739 KMA		G	5-10	55		44-55	Mean mine spacing 27½ yards. Below HIGH water springs.
E42	K11	5-8 1944	52 05.0 N 04 14.0 E 52 07.5 N 04 16.7 E	Exact	179 KMA		G	6-13	55		44	Mean mine spacing 27½ yards. Below HIGH WATER springs.
E43	K12	5/44	51 59.6 N 04 06.8 E 52 01.1 N 04 08.5 E	Exact	135 KMA		G		55	2	44	Mean mine spacing 27½ yards.
E44	K12A	4/44	52 01.1 N 04 08.5 E 52 04.8 N 04 13.6 E	Exact	334 KMA		G		55	2	44	Mean minespacing 27½ yards.
E45	K13	7-8 1944	51 58.4 N 04 04.2 E 51 56.7 N 04 01.8 E	Exact	134 KMA		G	6-8 below H.W.S.	66		44	Mean mine spacing 33 yards.
E46	K14	8/44	51 54.5 N 04 00.1 E 51 55.7 N 04 00.3 E 51 56.7 N 04 01.8 E	Exact	164 KMA		G	6-7 below H.W.S.	55	2	44	Mean mine spacing 27½ yards. (Comment: Alternative version gives 182 KMA).
E47	K15	8/44	51 54.3 N 04 00.1 E 51 52.3 N 04 02.5 E	Exact	162 KMA		G	6 below H.W.S.	55	2	44	Mean mine spacing 27½ yards.

E69

E69		11/44	Brielschegat from net barrage at Seeberg to 04 10E.	Exact	147 KMA		G	to 13 below H.W.S.	70	2	55	Mines scattered.

The information from ZA 5/27 and 5/44 is shown in the figure and table below.

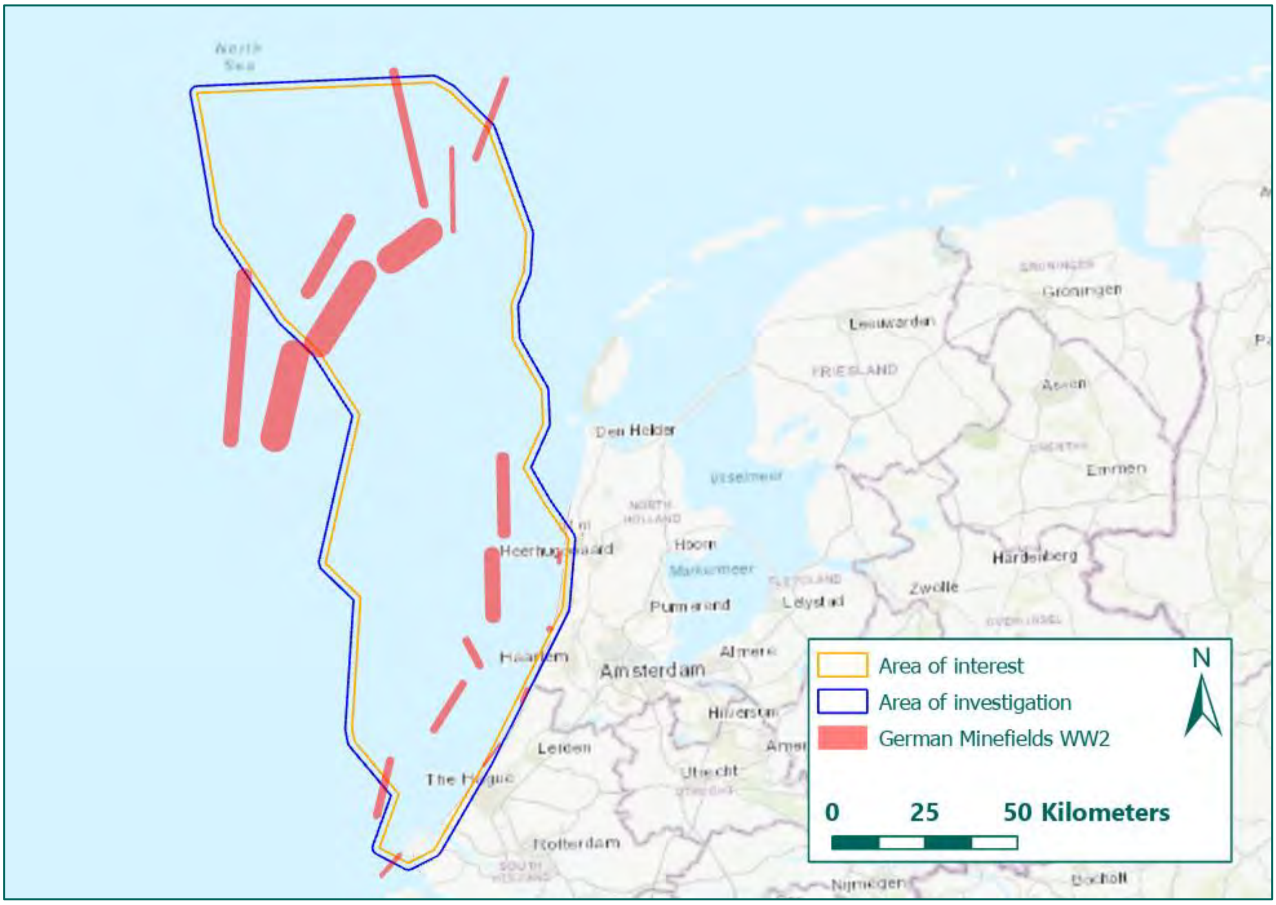


Figure 61: German Minefields within the Area of investigation (Source basemap: ESRI).

Number	Amount of mines	Rows	
		Amount	Spacing
C25	205 x EMB[7], 205 x EMB, 1000 x XpFl[8]	2	220/300 yards
C26	742x EMD[9], 1040 x XpFl	3	65 yards
C27	742 x EMD/EMC[10], 1040 x XpFl	3	65 yards
C29	226 x EMC, 100 x StCtr[11], 400 x XpFl	2, 1	Unknown
C30	214 x EMC, 400 x XpFl	2	Unknown
C31	120 x EMC, 400 x XpFl	2	Unknown
C35	240 x UMB[12]	3	Unknown
C36	348 x UMB	3	Unknown
C44	22 x LMB[13]	2	Unknown
C45	72 x LMB	2	Unknown

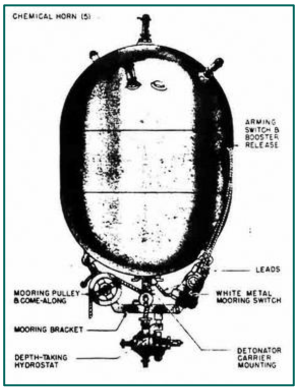
[7] *Einheidsmine* – Type B, Contact mine
[8] Exploding floats, *Sprengboje*
[9] *Einheidsmine* – Type D, Contact mine
[10] *Einheidsmine* – Type C, Contact mine
[11] Static cutters/Static Conical Sweep Obstructor, *Reisboje*
[12] *U-Bootabwehrmine* – Type B, Contact Mine
[13] *Luft Mine* – Type B, Influence Mine

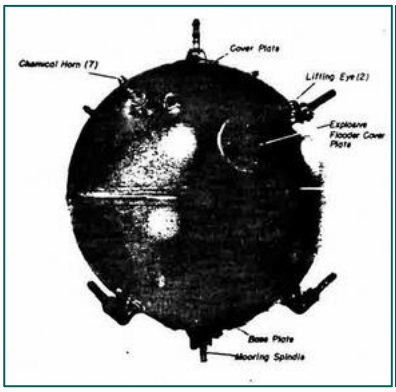
Number	Amount of mines	Rows	
		Amount	Spacing
C46	124 x LMB	2	Unknown
C47	160 x EMC, 40 x StCtr	3	Unknown
C48	160 x EMC, 40 x StCtr	3	Unknown
C67	412 x KMA[14]	2	Unknown
C69	KMA (unknown amount)	2	Unknown
C70	75 x KMA	2	Unknown
C71	285 x KMA	2	Unknown
C72	304 x KMA	2	Unknown
C73	210 x KMA	2	Unknown
C78	36 x LMB	2	Unknown
C79	379 x KMA	Unknown	Unknown
E25	78 x LMB	2	Unknown
E26	90 x LMB	2	Unknown
E38	90 x LMB, 90 x EMC	2	Unknown
E41	739 x KMA	Unknown	Unknown
E42	179 x KMA		Unknown
E43	135 x KMA	2	Unknown
E44	334 x KMA	2	Unknown
E45	134 x KMA	Unknown	Unknown
E46	164 x KMA	2	Unknown
E47	182 x KMA	2	Unknown
E69	147 x KMA	2	Unknown
Unknown, Harbour Hoek of Holland	17 x RMA[15]	-	-
Unknown, Harbour IJmuiden	24 x RMA	-	-
Unknown, Harbour IJmuiden	LMB (unknown amount)	Unknown	Unknown

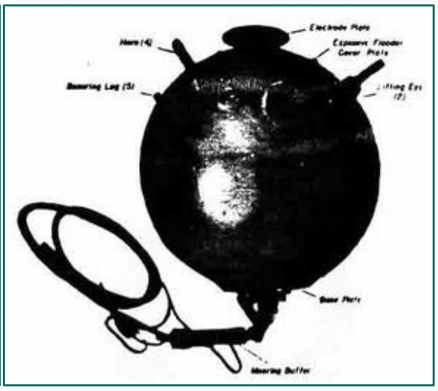
[14] Küstenmine – Type A, Contactmine
[15] Regulare Mine – Type A, Contactmine

German Mines (and sweep obstructors) within the area of investigation)

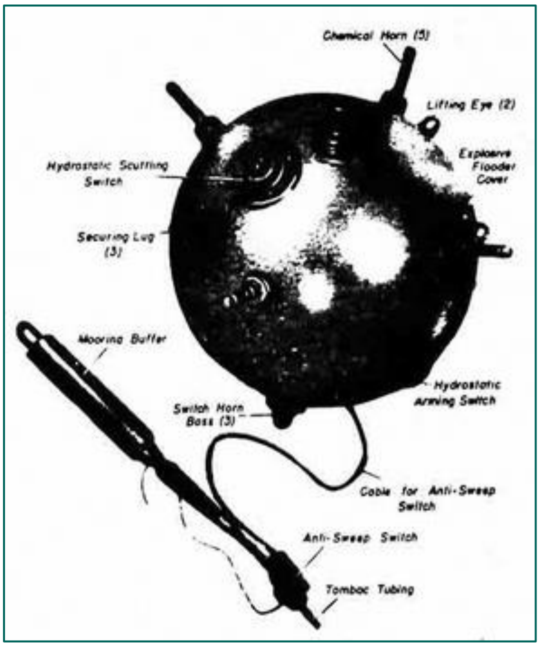
Einheidsmine – Type B, C and D Contact mine



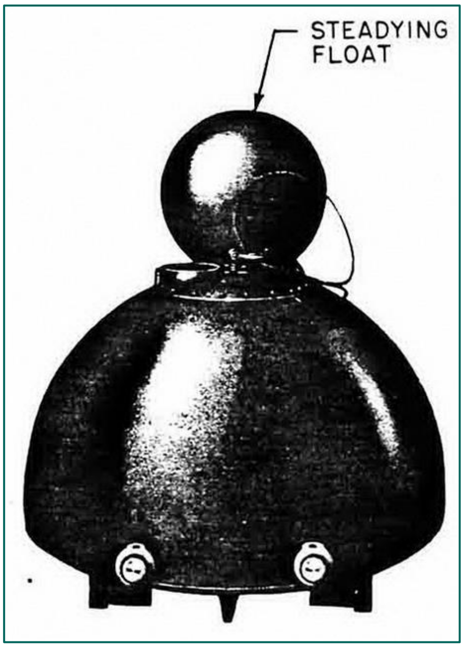




U-Bootabwehrmine – Type A, Contact Mine



Regulare Mine – Type A, Contactmine



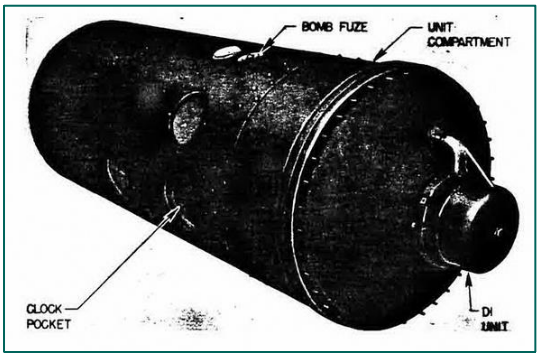
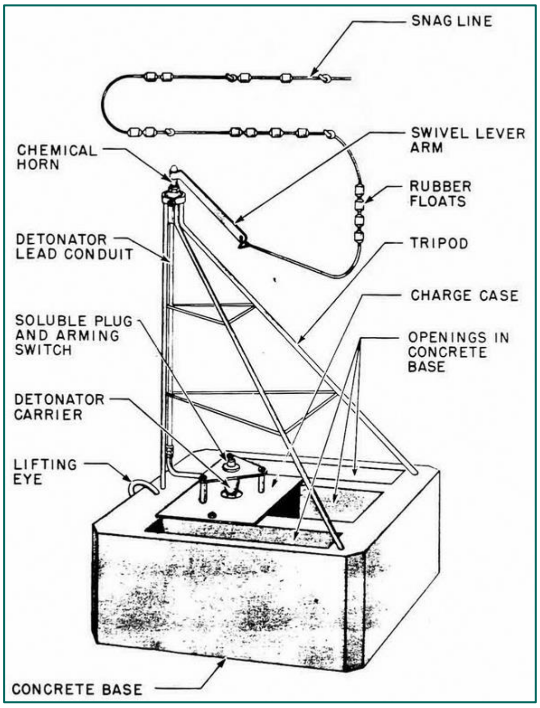
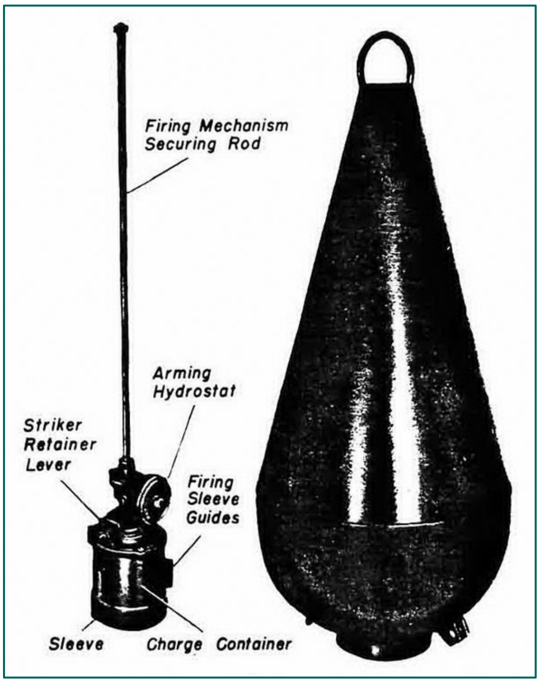
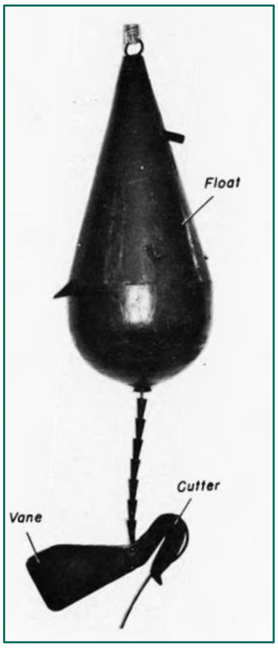
German Mines (and sweep obstructors) within the area of investigation	
Luft Mine – Type B, Influence/Ground Mine  	Küstenmine – Type A, Contactmine 
Exploding floats, *Sprengboje* (Explosive) 	Static cutters/Static Conical Sweep Obstructor, *Reisboje* (Non explosive) 

Table 6: German Mines (and sweep obstructors) within the area of investigation.

ANNEX 4 WRECKS WITHIN THE AREA OF INTEREST

The website ‘Wrecksite’ and the book ‘HP39 Wrakkenregister, Nederlands Continentaal Plat en Westerschelde’ (abbreviated to HP39), drawn up by the Dutch navy, show an abundance of wrecks (ships and aircraft) within the area of interest. In HP39 no details are given about the reason/cause of the sinking of the ships or aircraft. However. An overview of all wrecks according to this book is shown below.

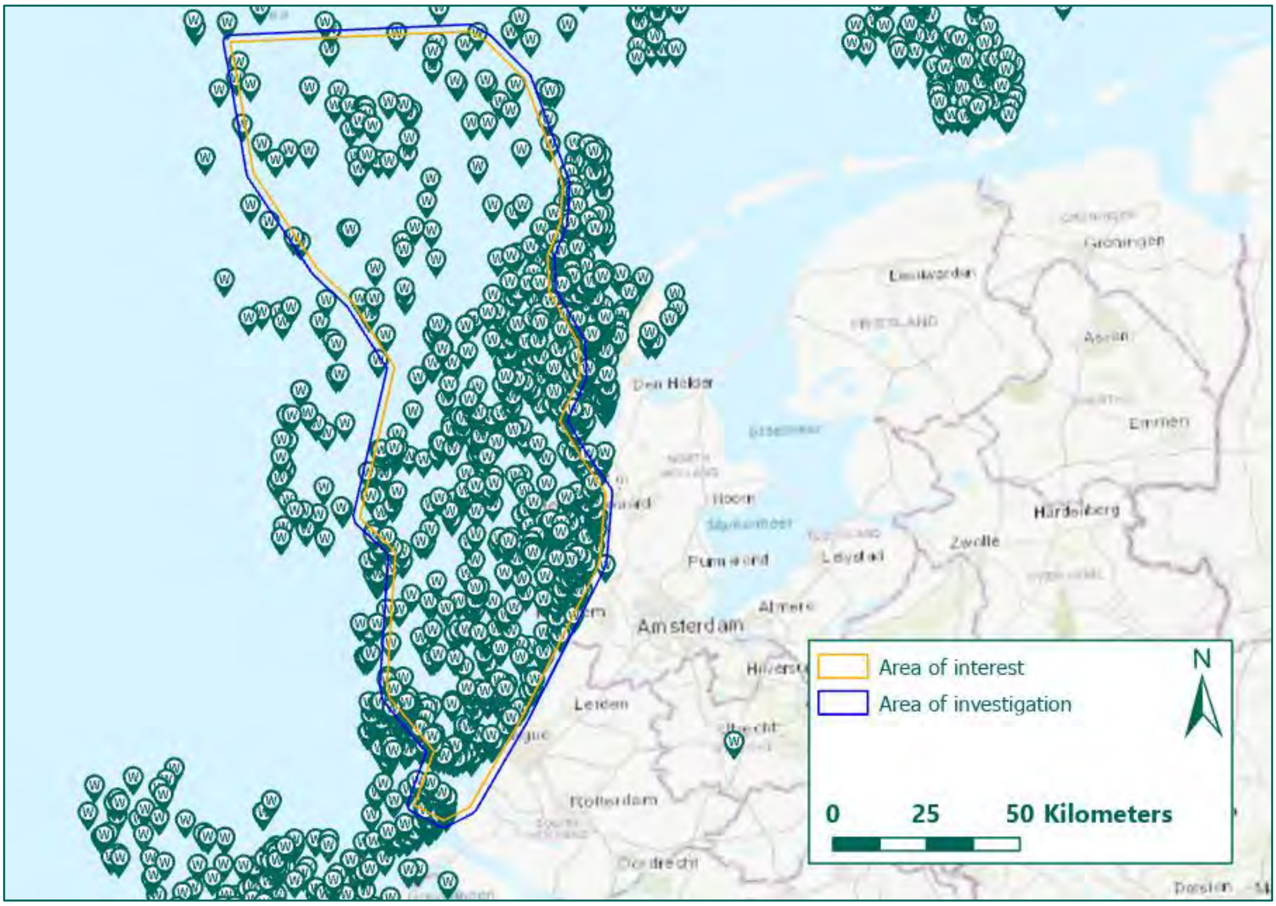


Figure 62: Overview of wrecks within the area of interest according to HP39 (Source: HP39).

The Website ‘Wrecksite’ shows more details with regards to the wrecks in the North Sea. The website shows a total of more than 1800 wrecks within and near the area of interest. Plotting all these wrecks in the GIS-system would be too comprehensive and would outside the scope of this report. In the table below a list war related causes of sinking of ships/aircraft within the area of interest is shown.

Cause of sinking	Total number sunk
Airplane crashes, WW2	75
Air raids, WW2	19
Charges/explosives, WW1 and WW2	8
Depth charges , WW2	2
Explosions, WW2 and after WW2	4
Gunfire – shelled, WW1 and WW2	152
Mine, WW1 and WW2	39
Naval battles, WW1 and WW2	10
Torpedo, WW1 and WW2	21
War loss (Not specified), WW1	1

Table 7: Listing of ships/aircraft sunk by war related events.

ANNEX 5 POST-WAR UXO CLEARANCE

OSPAR Commission

OSPAR is the mechanism by which 15 governments and the European Union cooperate to protect the marine environment of the North-East Atlantic. Since 1972 the OSPAR Convention has worked to identify threats to the marine environment and has organised, across its maritime area, programmes and measures to ensure effective national action to combat them. One of the Policy Issues of the OSPAR Convention is to report encounters with conventional and chemical munitions in the OSPAR maritime area. These encounters are kept in a database[16]. The munition encounters from 1999 onwards within the area of interest are rendered in Figure 63. Multiple UXOs were lifted from the area of interest. The exact type of UXO lifted is not mentioned in all cases. However, it is known that several aerial bombs, flares, mines, torpedo's and shells were lifted.

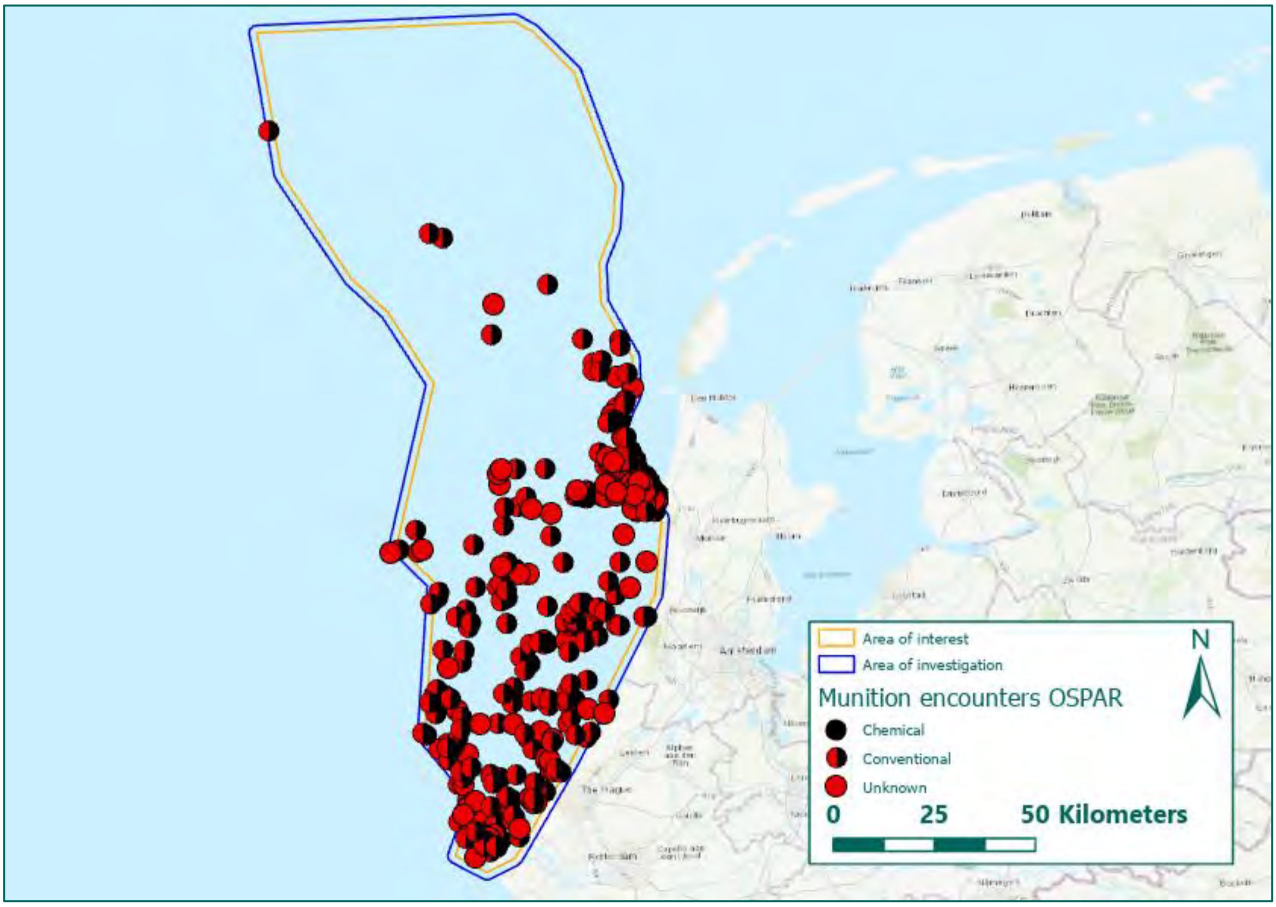


Figure 63: Overview OSPAR ammunition encounters within the area of interest (Source: OSPAR).

Dutch Coastguard (Nederlandse Kustwacht) and Beneficial Cooperation

The Dutch Coastguard (Nederlandse Kustwacht) cleared hundreds of UXO in the North Sea. Coordinates were used to keep track of the locations of encountered UXO. The Dutch Coastguard also cooperated with the Belgian Navy in clearing ammunition. This joint venture operates under the name Beneficial Cooperation.

The Dutch Coastguard manufactured lists that could help citizens (mainly citizens active in the fishing industry) identify any UXO found at sea. This additional information helped the Coastguard to be better prepared. These lists are shown at the end of this annex for clarification. When known, the numbers referring to the different types of UXO are shown in the GIS-shapefiles of the Dutch Coastguard and

[16] This database can be consulted at http://odims.ospar.org/layers/?limit=100&offset=0.

Beneficial Cooperation. The figures below respectively show cleared UXO reported by the Dutch Coastguard and Beneficial Cooperation.

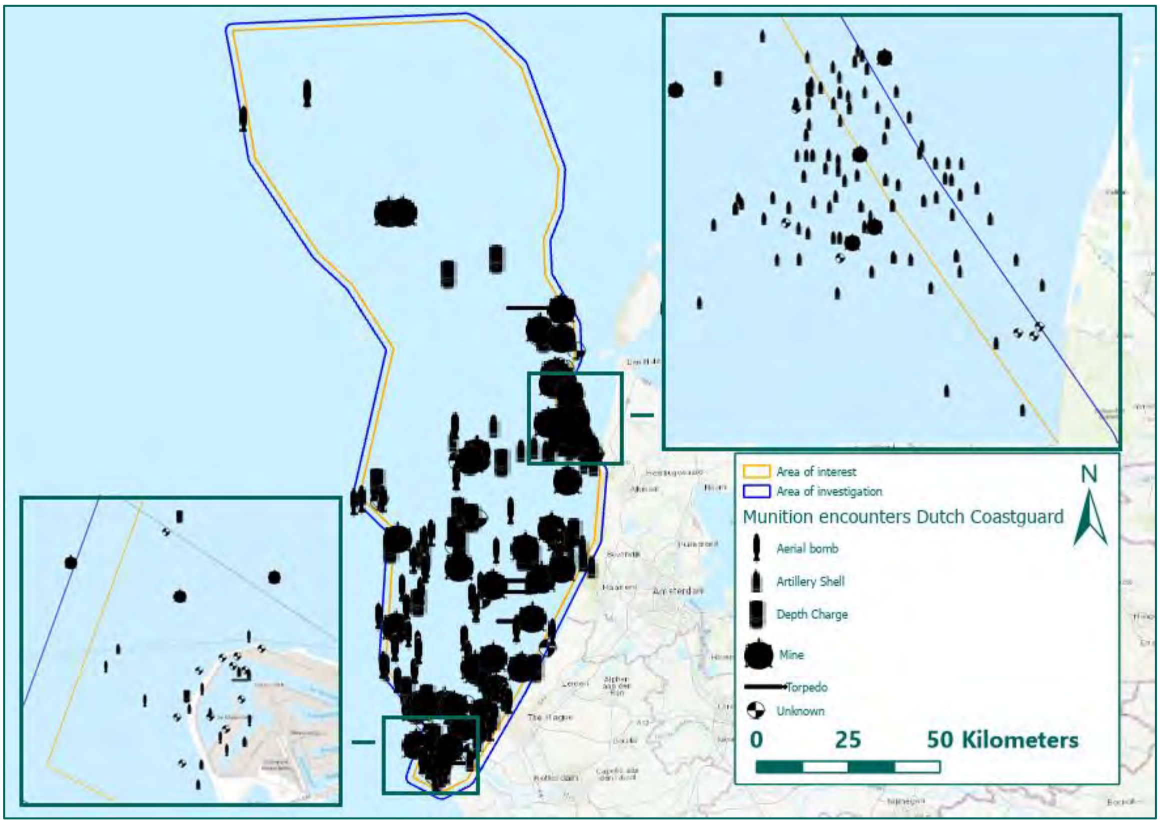


Figure 64: Overview of UXO lifted by the Dutch Coastguard (Source basemap: ESRI).

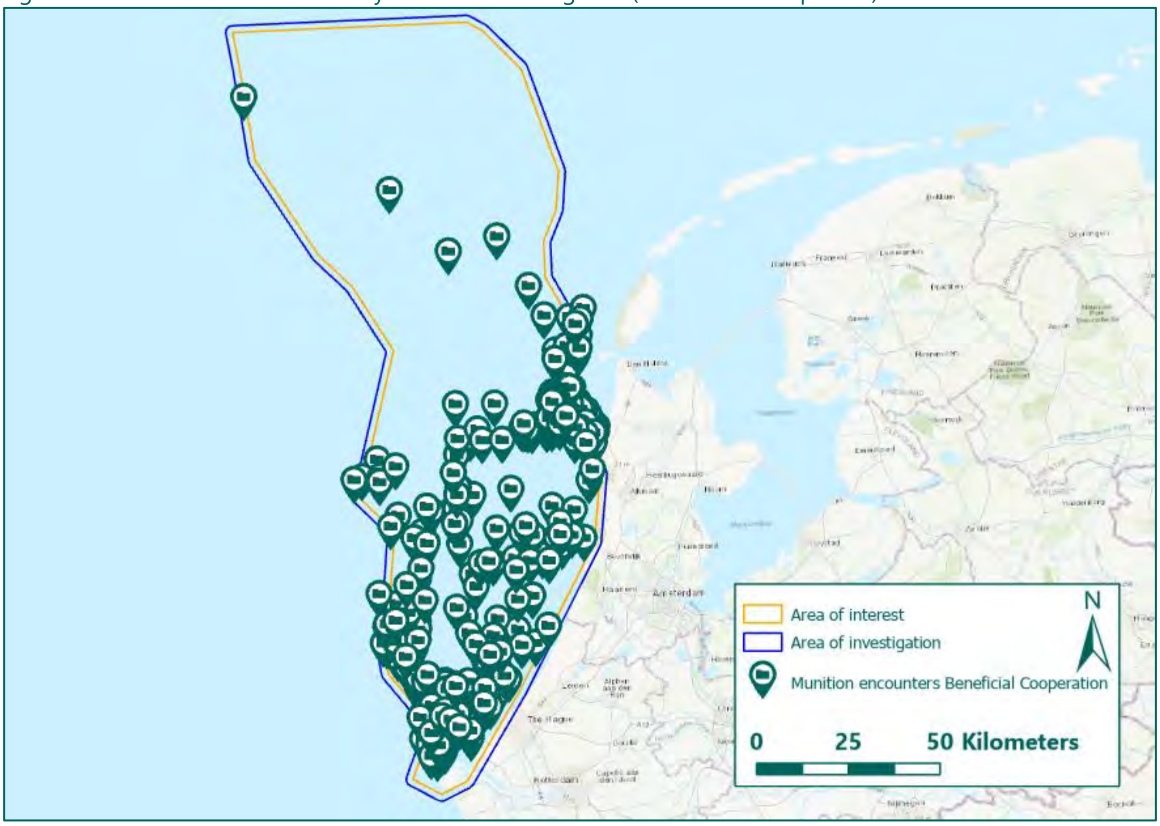
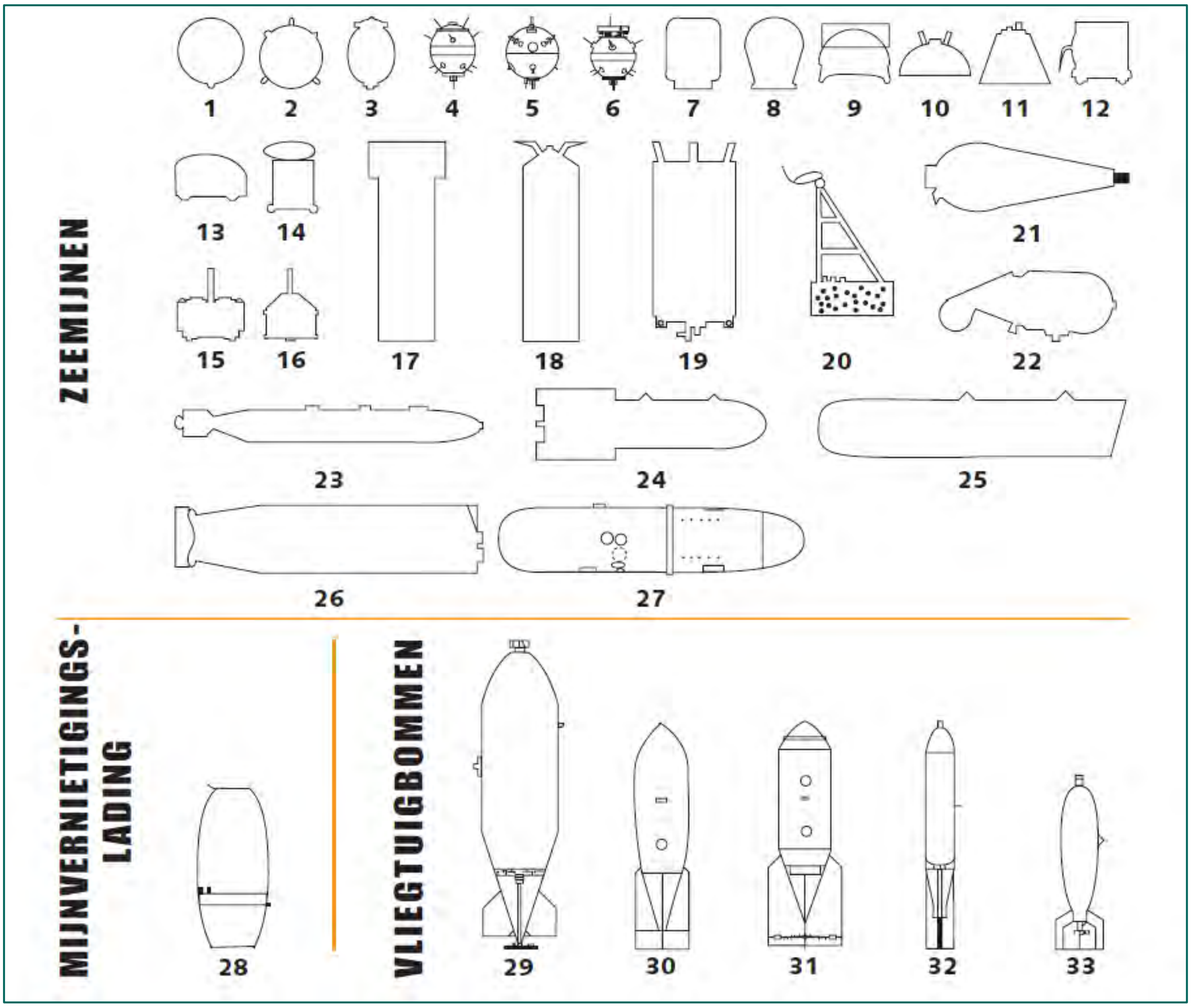


Figure 65: Overview of UXO lifted by the Beneficial Cooperation (Source basemap: ESRI).



ZEEMIJNEN
MIJNVERNIETIGINGS-
LADING
VLIEGTUIGBOMMEN
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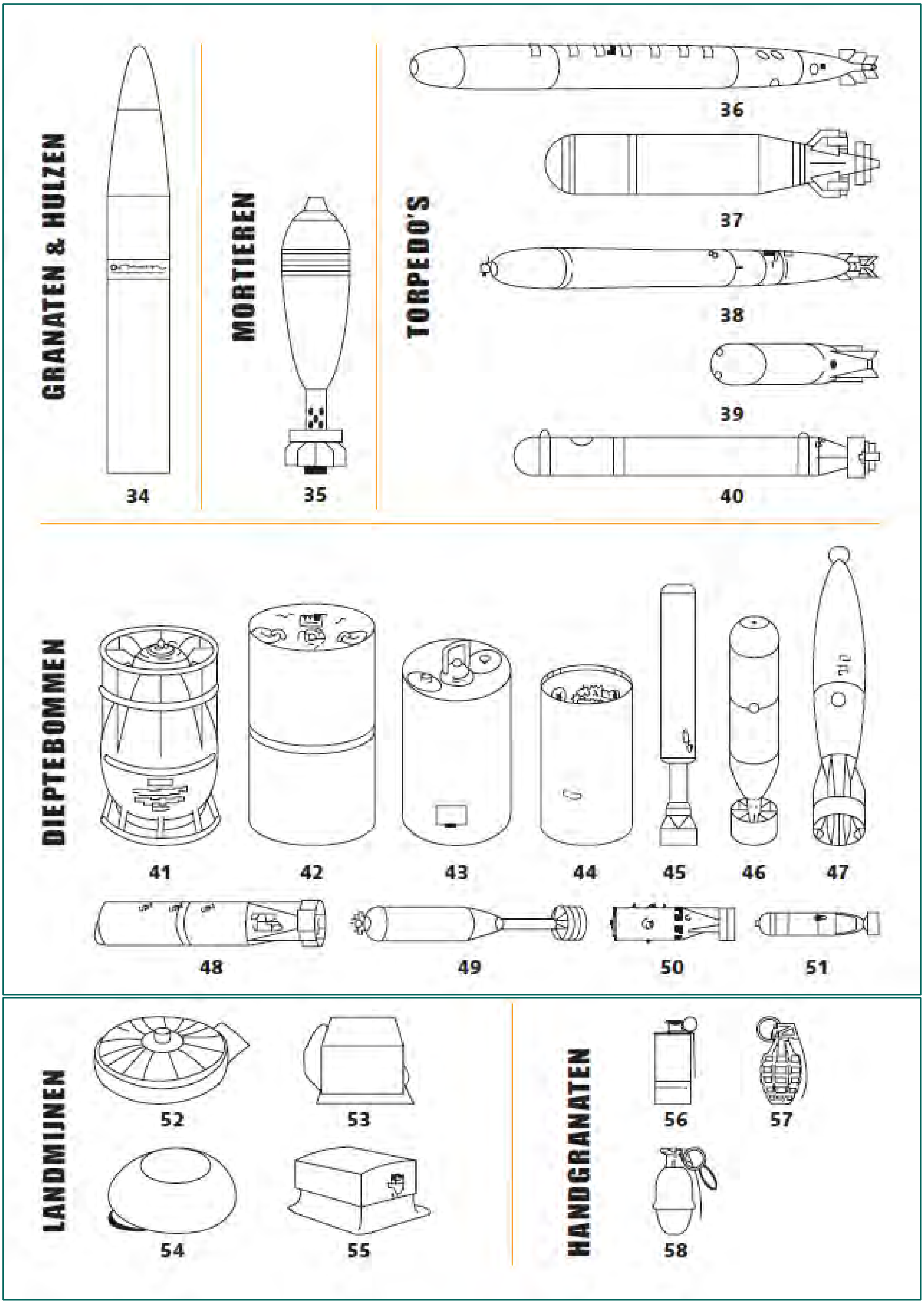

Figure 66: 'Explosievenkaart' (Explosives chart) of the Dutch Coastguard. This chart is used to help identify UXO (Source: Dutch Coastguard).

Dutch 'Explosieven Opruimingsdienst' (EOD)

Every year, the Dutch EOD clears an average of 2,500 explosives from the Second World War in the Netherlands. Most of these clearances take place onshore. However, the Dutch Navy does assist the Coastguard with offshore UXO encounters. In the figure below the locations of multiple UXO encounters are shown. The same 'Explosievenkaart' (Explosives chart) is used to identify these UXO. When known, the numbers referring to the different types of UXO are shown in the GIS-shapefiles of the EOD.

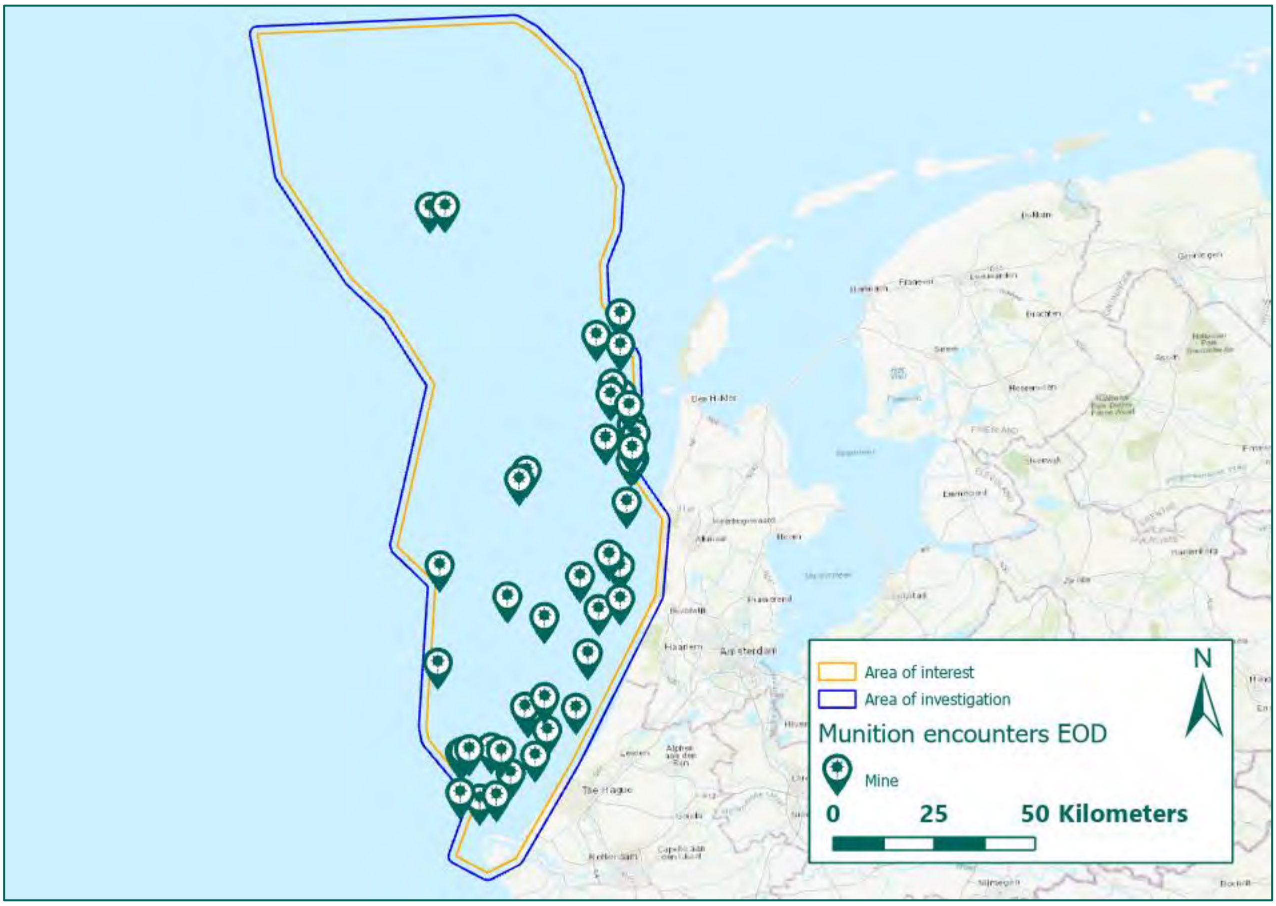

Figure 67: Overview of UXO lifted by the Dutch EOD (Source basemap: ESRI).

PARTICIPATIEPLAN

ARAMIS-INITIATIEF

Fase milieueffectrapportage t/m voorkeursalternatief

Herziene versie

Oktober 2023

Documentnummer

NL-ARM-PFE-B10-ENV-GEA-0299

INHOUDSOPGAVE

ALGEMEEN

Voor u ligt het geactualiseerde participatieplan van het Aramis-initiatief (hierna: Aramis). Het plan is opgesteld door Aramis in afstemming met CO_2next en het ministerie van Economische Zaken en Klimaat (EZK). In het participatieplan leest u hoe u en andere belanghebbenden worden geïnformeerd over en betrokken bij het Aramis-project.

Bij elke fase van het project actualiseren initiatiefnemers TotalEnergies, Shell, Energie Beheer Nederland (EBN) en Gasunie het participatieplan. Dat doen zij op basis van voortschrijdend inzicht, ontwikkelingen in het project, gesprekken met stakeholders, reacties op het participatieplan en een evaluatie van de voorgaande periode.

- De eerste versie van het participatieplan is samen met de kennisgeving *Voornemen en Voorstel Participatie voor het project Aramis* (kennisgeving van het V&P)[1] gepubliceerd in januari 2022.
- Naar aanleiding van gesprekken met stakeholders en reacties op de kennisgeving van het V&P is in juni 2022 een tweede versie van het plan gepubliceerd, gelijktijdig met de publicatie van de conceptversie van de Notitie Reikwijdte en Detailniveau (concept-NRD).
- In november 2022 werd de derde versie uitgebracht, die in het teken stond van de definitieve Notitie Reikwijdte en Detailniveau (NRD).
- Deze vierde versie van het participatieplan omvat het tijdvak juni 2023 tot eind 2023. In deze periode wordt de Integrale Effectenanalyse (IEA) opgesteld (onder behoud van het concept-milieueffectrapport (MER) fase 1), die de basis vormt voor de keuze van een voorkeursalternatief (VKA).

Het MER wordt medio 2024 samen met de ontwerpbesluiten ter inzage gelegd. Dan is er weer mogelijkheid tot reageren. Begin 2024 zal het participatieplan opnieuw worden geüpdatet, waarbij de mogelijkheid van reageren en de wijze waarop dit kan expliciet worden vermeld.

De invoering van de nieuwe Omgevingswet per 1 januari 2024 is een van de aanleidingen van deze nieuwe update. Aangezien de vergunningaanvragen na 1 januari 2024 worden ingediend, verandert de RCR-planning (Rijkscoördinatieregeling) en wijzigen daarmee ook de inspraakmomenten en de bijbehorende terminologie. Met deze update wordt u hiervan op de hoogte gebracht.

LEESWIJZER

- Hoofdstuk 1 introduceert het Aramis-project en de rol van EZK in de te volgen procedure.
- Hoofdstuk 2 licht de doelen, uitgangspunten en het kader van het participatieplan toe.
- Hoofdstuk 3 beschrijft hoe de participatie aan het MER en de IEA tot en met de VKA er concreet uitziet.
- Hoofdstuk 4 geeft een overzicht van alle geplande participatiemomenten.

Voor aanvullende informatie ziet u een verwijzing naar websites en documenten.

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[1] https://www.rvo.nl/sites/default/files/2021/12/Notitie-Voornemen-en-Voorstel-Participatie-CCS-Aramis.pdf

1. INLEIDING

1.1 OVER ARAMIS

Het klimaat verandert snel door de toename van CO_2- en andere broeikasgassen in de atmosfeer. In het Klimaatakkoord van Parijs zijn ambitieuze doelen vastgelegd om de CO_2-uitstoot te verlagen. Hierin is afgesproken de opwarming van de atmosfeer te beperken tot maximaal 2°C, maar bij voorkeur onder 1,5°C te houden. Het vormt een grote uitdaging om de uitstoot zodanig te verlagen dat de klimaatdoelstellingen voor 2050 worden behaald.

Verduurzaming van de industrie is een van de maatregelen om CO_2-uitstoot te verminderen. De komende decennia wordt het aandeel van fossiele brand- en grondstoffen in productieprocessen afgebouwd. Voor deze transitie is tijd nodig: het is niet mogelijk in één keer volledig fossielvrij te worden en alle industriële processen om te zetten naar groene waterstof en/of groene stroom.

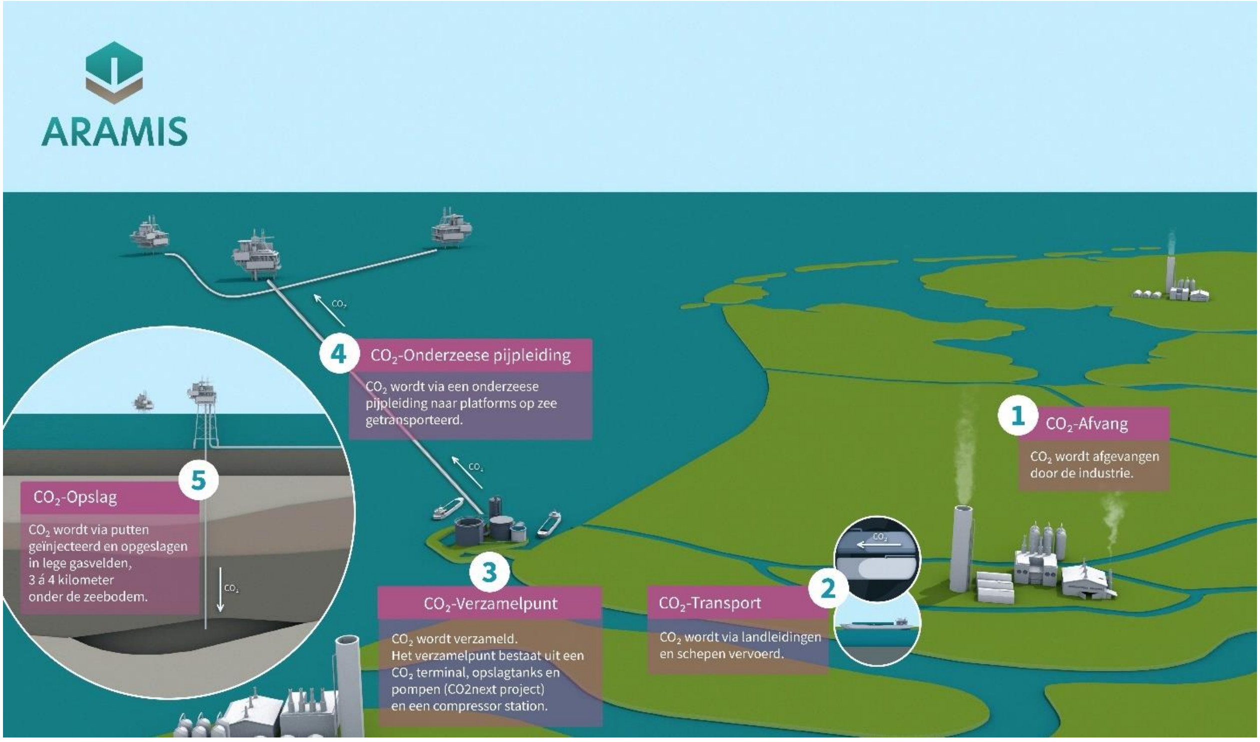
Totdat het gebruik van fossiele brandstoffen in industriële processen tot nul is gereduceerd, kan CO_2-uitstoot fors worden verminderd door afvang en ondergrondse opslag van vrijkomende CO_2. Deze techniek wordt Carbon Capture and Storage (CCS) genoemd en vermindert de hoeveelheid broeikasgassen die in de atmosfeer terechtkomt.

Rapportages van het Intergovernmental Panel on Climate Change (IPCC) en het Internationale Energie Agentschap (IEA)[2] laten zien dat – zolang er onvoldoende alternatieven zijn – permanente CO_2-opslag noodzakelijk is voor moeilijk te verduurzamen industrie. In de Klimaatnota 2022 en de Klimaat- en Energieverkenning (KEV) 2023 staat aangegeven dat het grootste gedeelte van de industriële CO_2-reductie tot 2030 uit CCS zal komen. De overheid ziet het afvangen en opslaan van CO_2 als een belangrijke (overgangs)technologie en stimuleert daarom CO_2-opslag onder de Noordzee.

De opslag van de afgevangen CO_2 is voorzien in lege gasvelden diep onder de zeebodem. Om de bij de industrie afgevangen CO_2 naar deze opslaglocaties te brengen, wordt een nieuwe, open transportinfrastructuur ontwikkeld. ‘Open’ betekent dat andere partijen de mogelijkheid hebben om op de CCS-keten aan te sluiten, zowel aan de voorkant (de afvang) als aan de achterkant (de opslag).

Bij een open CO_2-transportinfrastructuur zijn veel verschillende partijen betrokken, elk met een eigen rol en elk met een eerder of later moment waarop zij aansluiten. Samen vormen deze partijen de integrale CCS-keten: van de afvang van CO_2 tot permanente opslag in lege gasvelden diep onder de Noordzee. De keten bestaat veelal uit zelfstandige onderdelen, die voor een goed functionerend geheel nauw op elkaar moeten zijn afgestemd (zie afbeelding 1).

[2] IPPC rapportage 2022, Mitigation of Climate change



Afbeelding 1. Overzicht componenten van de CCS-keten, waar het Aramis-initiatief onderdeel van uitmaakt.

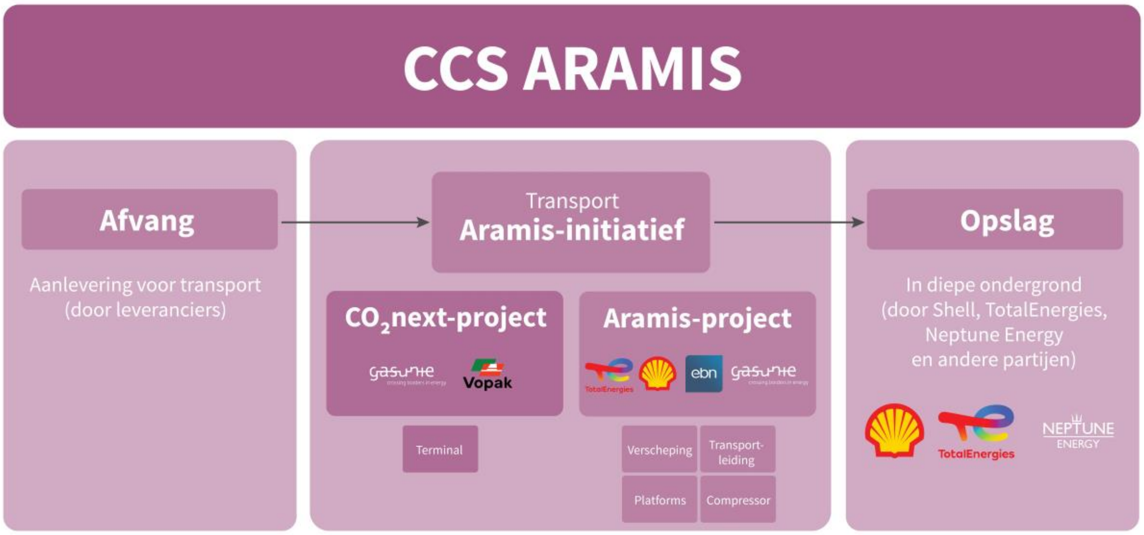
1. CO_2-afvang bij industrie en geschikt maken voor transport;
2. CO_2-transport naar de Maasvlakte via Porthos-landleiding, binnenvaart en zeevaart;
3. CO_2-verzamelpunt op de Maasvlakte met terminal en compressorlocatie. De terminal omvat steigers, tanks voor tijdelijke opslag van per schip aangevoerde CO_2, en hogedrukpompen voor levering aan de zeeleiding (CO_2next-project). De compressorlocatie ontvangt CO_2 via de landleiding en brengt dit op druk voor het transport per zeeleiding;
4. CO_2-transport door de centrale CO_2-zeeleiding naar platforms op de Noordzee;
5. Platform met leidingen vanaf de centrale CO_2-zeeleiding en met putten naar lege gasvelden diep onder de Noordzee.

Aramis heeft betrekking op het transport van CO_2 (onderdeel 2) naar het CO_2-verzamelpunt (onderdeel 3) en het transport via een zeeleiding naar de platforms op zee (onderdeel 4). In de CCS-keten van afvang, transport en opslag richt Aramis zich op het transportdeel: de CO_2-transportinfrastructuur. De CO_2-afvang (onderdeel 1) en de CO_2-opslag (onderdeel 5) vallen weliswaar buiten Aramis, maar vormen een samenhangend geheel met Aramis. Zodoende worden deze onderdelen in het verlengde van Aramis beschreven.

De transportinfrastructuur biedt andere partijen de mogelijkheid om op de CCS-keten aan te sluiten, zowel aan de voorkant (de afvang) als aan de achterkant (de opslag). Aramis voorziet daarmee in een cruciaal onderdeel van de CCS-keten. Het is niet mogelijk om op voorhand aan te geven welke partijen zich aansluiten en wanneer. Dat is inherent aan de aard van een open infrastructuur, die is gericht op toekomstige uitbreiding en aanpassing.

1.2 PROJECTORGANISATIE EN INITIATIEFNEMERS

Afbeelding 2 geeft weer hoe de verschillende onderdelen van Aramis zich verhouden tot elkaar en tot de Aramis-CCS-keten.



Afbeelding 2. Aramis binnen de Aramis-CCS-keten.

TotalEnergies, Shell, Energie Beheer Nederland (EBN) en Gasunie zijn de initiatiefnemers van de ontwikkeling van de Aramis- CO_2-transportinfrastructuur. Zij zijn zelf verantwoordelijk voor de compressie van CO_2 die afkomstig is van de landleiding, de centrale CO_2-zeeleiding en de platforms.

Door verschillende bedrijven zal CO_2 worden afgevangen. Vervolgens verzorgen verschillende leveranciers de aanlevering van CO_2 via leiding (gas) of schip (vloeibaar) naar het CO_2-verzamelpunt. Op het verzamelpunt worden de terminalfaciliteiten verzorgd door CO_2next. In CO_2next werken Gasunie en Koninklijke Vopak samen aan de bouw van een nieuwe CO_2-terminal op de Maasvlakte.

De aanleg van de centrale CO_2-zeeleiding is onderdeel van het Aramis-project, evenals de bouw van het compressorstation op het verzamelpunt. Voor het overige (steigers, tanks voor tijdelijke opslag van per schip aangevoerde CO_2, en hogedrukpompen voor levering aan de zeeleiding) valt het verzamelpunt onder CO_2next.

De opslagpartijen (onder meer Shell, TotalEnergies en Neptune Energy) zijn verantwoordelijk voor de opslag van CO_2, inclusief het transport vanaf hun platforms naar de ondergrondse reservoirs.

1.3 ROL VAN HET MINISTERIE EN KORTE TOELICHTING OP DE PROCEDURE

Het ministerie van Economische Zaken en Klimaat (EZK) en Aramis werken nauw samen aan dit project en hebben hierin elk een eigen taak en rol.

Rollen van EZK

Voordat Aramis en CO_2next kunnen worden gerealiseerd, is er een ruimtelijk besluit nodig en moeten de vereiste vergunningen zijn verleend. EZK coördineert de besluitvorming van energieprojecten met een nationaal belang. Dit heet nu nog de Rijkscoördinatieregeling (RCR). Onder de nieuwe Omgevingswet die op 1 januari 2024 ingaat heet dit projectprocedure. Aangezien de vergunningaanvragen na 1 januari 2024 worden ingediend, hebben we het hier verder over de projectprocedure.

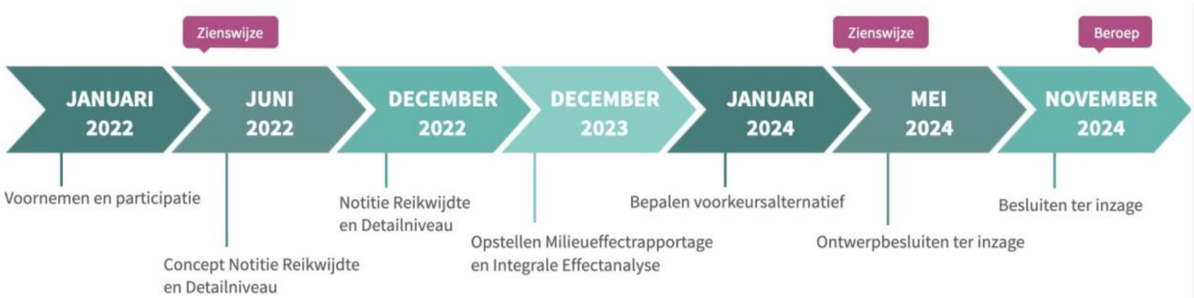
EZK coördineert de projectprocedure, waarbij de verschillende benodigde besluiten (vergunningen en eventueel ontheffingen) gelijktijdig worden genomen in afstemming met de overheden. Het gaat dan om zowel het ruimtelijk besluit als de uitvoeringsbesluiten. De coördinatie betekent ook dat alle stukken tegelijk ter inzage worden gelegd. Tegen de definitieve besluiten kan beroep worden aangetekend. Er is een beperkt aantal momenten waarin om een reactie wordt gevraagd, of men een zienswijze of beroep kan indienen.

Het ruimtelijk besluit wordt genomen door de minister voor Klimaat en Energie in overeenstemming met het ministerie van Binnenlandse Zaken en Koninkrijksrelaties. Het ruimtelijke besluit (in de nieuwe Omgevingswet: projectbesluit) wijzigt de huidige bestemmingen. Ook zijn er omgevingsvergunningen nodig, waaronder bouwvergunningen voor installaties op het verzamelpunt en voor de aanpassingen aan de platforms.

Andere vergunningen vallen onder de verantwoordelijkheid van andere bevoegde gezagen, bijvoorbeeld gemeente Rotterdam, Rijkswaterstaat en het ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV). Vergunningen voor de afvang en opslag van CO_2 vallen buiten Aramis en worden aangevraagd door de opslagpartijen.

Nieuwe Omgevingswet en projectprocedure

Op 1 januari 2024 treedt de nieuwe Omgevingswet in werking. De formele besluiten voor Aramis worden niet voor deze datum genomen. Het ruimtelijk besluit van het Rijk heet onder de Omgevingswet niet meer rijksinpassingsplan (zoals in de Wet ruimtelijke ordening), maar projectbesluit. Aramis doorloopt de projectprocedure zoals weergegeven in afbeelding 3.



Afbeelding 3. Overzicht procedurestappen en tijdlijn.

Voornemen en voorstel participatie

Met de publicatie van de kennisgeving *Voornemen en Voorstel Participatie voor het project Aramis* (kennisgeving van het V&P) in de *Staatscourant* op 6 januari 2022 ging de projectprocedure officieel van start. EZK ontving zes reacties naar aanleiding van de kennisgeving. Op 19 en 24 januari 2022 heeft Aramis werksessies georganiseerd voor stakeholders van de Maasvlakte en de Noordzee. Bijlage 1 beschrijft de reacties en op welke manier die zijn gebruikt voor het actualiseren van dit participatieplan.

Concept-NRD

Bijlage 2 bevat het verslag van de stakeholdersessie op 21 juni 2022 waar de inhoud van de concept-NRD (Notitie Reikwijdte en Detailniveau) is besproken. In reactie op dit concept zijn acht zienswijzen ingediend. Op basis van deze zienswijzen is bekeken welke aanvullingen er nodig waren in de definitieve NRD. De definitieve NRD is in december 2022 vastgesteld.
Zowel de beantwoording van de vragen als de definitieve NRD is terug te vinden op de website van de RVO (https://www.rvo.nl/sites/default/files/2022-11/Vaststelling-NRD-en-Nota-van-Antwoord-concept-NRD-Aramis.pdf).

De inspraakprocedure heeft geresulteerd in twee aanpassingen aan de concept-NRD:

1. Als gevolg van de zienswijze van Neptune Energy worden de opslagfaciliteiten en bijbehorende infrastructuur van Neptune Energy als gelijkwaardig meegenomen in het MER, conform de opslagfaciliteiten voor TotalEnergies en Shell;
2. Het tracé van de zeeleiding is verder geoptimaliseerd, wat heeft geleid tot drie alternatieven en een variant, die alle in het MER worden getoetst.

IEA en MER

De volgende stap in het proces vindt momenteel plaats en behelst de voorbereidingen voor één integraal MER (fase 1 en fase 2 in één MER): een inventarisatie van de milieueffecten aan de hand van bureaustudies, onderzoeken en surveys. Op basis van de eerste resultaten van de milieuonderzoeken, evenals de aspecten kosten, omgeving, techniek en toekomstvastheid, stelt Aramis een Integrale Effectenanalyse (IEA) op. Deze analyse van de effecten van de verschillende routealternatieven en -varianten biedt tevens een uitgebreide analyse van zaken als de ruimtelijke inpassing. De resultaten van alle milieuonderzoeken worden samengevoegd in het MER, die naar verwachting in december 2023 gereed is. Het MER onderbouwt zowel de vergunningaanvragen als het projectbesluit en wordt in 2024 bij de ontwerpbesluiten ter inzage gelegd.

In overeenstemming met de minister van Binnenlandse Zaken en Koninkrijksrelaties kiest de minister voor Klimaat en Energie op basis van de IEA het voorkeursalternatief (VKA). Over het VKA vindt afstemming plaats met andere overheden en belangenorganisaties. Het VKA wordt gepubliceerd op de website van de RVO: Bureau Energieprojecten. Het VKA vormt de grondslag voor het ruimtelijk besluit (projectbesluit) en de vergunningen. Naar verwachting worden in het derde kwartaal van 2024 alle besluiten in ontwerp ter inzage gelegd, waarop ieder die dat wenst een zienswijze kan indienen. De zienswijzen worden betrokken bij het opstellen van de definitieve besluiten, waartegen beroep openstaat.

2 DOELEN EN KADER VAN PARTICIPATIE

2.1 DOELEN VAN PARTICIPATIE

Participatie gaat in brede zin over het betrekken van belanghebbenden en belangstellenden bij een project (zie de uitleg van de participatieladder in paragraaf 2.3). Dit participatieplan loopt vooruit op de nieuwe Omgevingswet door naast de wettelijk geregelde inspraak op het projectbesluit (formele procedure) een bredere betrokkenheid te organiseren. Aramis betrekt ieder die dat graag wil bij het project en handelt daarmee nu al in de geest van de aankomende wet. Hiermee hebben wij de volgende doelen voor ogen:

1. We willen burgers, bedrijven en maatschappelijke organisaties op een passende wijze bereiken;
2. We willen hun vragen, kansen en zorgen kennen en begrijpen;
3. We willen bij de ontwikkeling van het project rekening houden met ieders belangen;
4. We willen heldere keuzes maken en daarbij duidelijk laten zien hoe we omgaan met belangen, aandachtspunten, kansen en zorgen vanuit de omgeving.

Bij het behalen van deze doelen zijn we altijd bereid tot een constructieve dialoog. Onze projectorganisatie gaat uiteraard zorgvuldig om met persoonsgegevens, conform de AVG.

2.2 UITGANGSPUNTEN VAN PARTICIPATIE

We vinden het belangrijk dat participatie met betrekking tot Aramis begrijpelijk, betrouwbaar en toegankelijk is. Om te zorgen dat onze participatieaanpak zo goed mogelijk aansluit op de informatiebehoefte en wensen van belanghebbenden en belangstellenden, hanteren we de volgende uitgangspunten:

- We communiceren duidelijk, begrijpelijk en op maat;
- We bieden verschillende communicatiemiddelen aan, zodat iedereen de mogelijkheid heeft om onze informatie tot zich te nemen en indien gewenst met ons in dialoog te gaan;
- We communiceren tijdig en proactief;
- We kiezen voor een toegankelijke vorm die interactie en deelname aan inspraak stimuleert;
- We zijn goed bereikbaar en we reageren snel op vragen, klachten en verzoeken;
- We koppelen inhoud, toon en vorm aan elkaar, zodat we iedereen zo passend mogelijk bereiken.

2.3 KADER VAN PARTICIPATIE: HIER GAAT HET WEL/NIET OVER

Voor geslaagde participatie moet het duidelijk zijn waar belanghebbenden en belangstellenden wel en niet over kunnen meepraten en waar zij wel en geen invloed op hebben. De volgende drie vragen spelen hierbij een belangrijke rol: *waarom* we dit project willen doen, *waar* we dit project willen doen en *hoe*. Dit participatieplan maakt onderscheid tussen deze vragen en geeft per vraag de mate van participatie aan. Participatie kent namelijk verschillende gradaties, zoals hierna weergegeven in de participatieladder. Hoe hoger op de ladder, hoe meer invloed. Toch is ook op de onderste trede (informeren) sprake van participatie. Participatie is dus een heel breed concept.

Afbeelding 4. Participatieladder.

Waarom we dit willen doen?
De vraag waarom we Aramis willen uitvoeren is een vraag over nut en noodzaak van het initiatief. Aramis sluit aan op het regeringsbeleid, zoals geformuleerd in de brief van het kabinet aan de Tweede Kamer van 10 december 2021. In deze brief staat dat het afvangen, transporteren en opslaan van CO_2 een belangrijke (overgangs)technologie vormt voor de verduurzaming van Nederland en essentieel is om de CO_2-reductiedoelstelling voor 2030 te halen[3]. Ook in het Klimaatakkoord wordt verwezen naar CCS als een van de oplossingen om deze reductiedoelstelling te halen. Zie de Notitie Reikwijdte en Detailniveau (NRD) voor meer informatie over het Europese en Nederlandse klimaatbeleid en de rol van CCS hierin.

PARTICIPATIENIVEAU: INFORMEREN

Waar we dit willen doen?
De vraag waar we Aramis willen uitvoeren heeft betrekking op alternatieven en varianten van onder andere het tracé. De procedure voor de ruimtelijke inpassing, evenals de voorbereiding van het voorkeursalternatief, krijgt vorm in nauwe cocreatie met bevoegde instanties en betrokkenen bij andere activiteiten en ontwikkelingen in de buurt van Aramis. Met hen wordt ook gesproken over de gevolgen van de aanleg van onderdelen van het initiatief. Dit participatieplan beschrijft de verschillende manieren die belanghebbenden en belangstellenden hebben om hun suggesties kenbaar te maken. Ieder heeft de mogelijkheid om alternatieven aan te dragen, waarna deze worden afgewogen en mogelijk meegenomen. De uiteindelijke besluitvorming over het voorkeursalternatief is een taak van de ministers van EZK en BZK.

PARTICIPATIENIVEAUS: CONSULTEREN EN ADVISEREN

Hoe we dit willen doen?
De vraag hoe we Aramis willen uitvoeren is met name relevant in de dialoog met belanghebbenden en betrokkenen in de buurt van het project. Participatie draait hier om de gevolgen voor enerzijds de directe leef- en werkomgeving van mensen, en anderzijds de bedrijfsvoering van ondernemingen op de Maasvlakte en de Noordzee. Het gaat dus vooral om de impact van Aramis tijdens de uitvoering en ingebruikname. Naarmate het project zich verder ontwikkelt, concreter wordt en de uitvoering nadert, neemt de betrokkenheid van stakeholders in de directe omgeving toe. Gesprekken verplaatsen we dan naar lokaal niveau. Onderwerpen die hierbij aan bod komen zijn bijvoorbeeld de planning (start en duur) en uitvoering (tijdelijke overlast van bouwactiviteiten en veiligheid).

PARTICIPATIENIVEAU: CONSENSUS

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[3] https://open.overheid.nl/repository/ronl-8fded76b-4d2c-4e79-817d-06bb14d9bb3a/1/pdf/kamerbrief-over-stand-van-zaken-ccs.pdf

3 PARTICIPATIEAANPAK

We betrekken graag personen en partijen bij Aramis wanneer het project hun belangen beïnvloedt, wanneer zij zich inhoudelijk betrokken voelen en/of wanneer zij belangrijk zijn voor de realisatie van Aramis. Hierbij onderscheiden we de volgende groepen:

- Burgers: mensen die dicht bij het project wonen of verblijven en om die reden vragen of zorgen hebben of anderzijds geïnteresseerd zijn. Wij denken dan vooral aan omwonenden;
- Bedrijven in de omgeving: bedrijven die dicht in de buurt van het project gevestigd zijn of daar werkzaamheden uitvoeren, zoals buurbedrijven op de Maasvlakte en op de Noordzee;
- Inhoudelijk betrokkenen: maatschappelijke organisaties en stakeholders die zich, los van de locatie, inhoudelijk betrokken voelen. Dit zijn bijvoorbeeld vertegenwoordigers van de scheepvaart, kustwacht, visserij, kabelexploitanten en operators van windparken. Wij denken verder aan ngo's die zich sterk maken voor natuur en milieu. Ook kennisinstellingen en organisaties die zich bezighouden met klimaat en CCS horen hierbij;
- Bestuursorganen: overheden op landelijk, provinciaal en lokaal niveau, zoals de provincie Zuid-Holland, gemeenten, Rijkswaterstaat (kruising zeewering, zandwinning, scheepvaart) en het waterschap Hollandse Delta. Ook semipublieke instellingen zoals ProRail, TenneT en Havenbedrijf Rotterdam zijn belangrijke stakeholders;
- Offshore storage-operators: operators van platforms op de Noordzee die in de toekomst wellicht toegang willen tot de CO_2-transportinfrastructuur van Aramis.

Deze personen en partijen hebben keuze uit individuele gesprekken en groepsbijeenkomsten, zowel online als live. De mate van participatie (informeren, consulteren, adviseren of verkrijgen van consensus) wordt vastgelegd en duidelijk gecommuniceerd. Zo willen wij een brede vertegenwoordiging van de samenleving bereiken en iedereen passend bedienen. Het is onze hoop dat deze werkwijze leidt tot meer betrokkenheid en meer waardering voor en acceptatie van Aramis.

We bieden de volgende informatiekanalen om geïnformeerd te blijven (informeren):

- Publicaties in de *Staatscourant* en huis-aan-huisbladen;
- Informatie op de websites van Aramis, CO_2next en Bureau Energieprojecten;
- (In)formele bijeenkomsten: (online) informatiebijeenkomst/seminar/kennissessie;
- Digitale nieuwsbrief;
- Persoonlijke of geclusterde gesprekken.

We bieden de volgende manieren om betrokken te blijven (consulteren of adviseren):

- (Online) informatiebijeenkomst;
- Bestuurlijke, regionale en landelijke overleggen;
- Persoonlijke of geclusterde gesprekken;
- Schriftelijke reactie op plannen.

Hieronder lichten we deze kanalen toe voor de periode vanaf het vaststellen van het milieueffectrapport (MER) en de Integrale Effectenanalyse (IEA) tot de publicatie van de ontwerpbesluiten.

3.1 MANIEREN OM GEÏNFORMEERD TE BLIJVEN (INFORMEREN)

In deze en de volgende paragraaf leest u hoe wij personen en partijen in de komende periode bij Aramis willen betrekken. Bijlage 3 beschrijft welke stappen in eerdere fases zijn genomen.

a. Publicaties Staatscourant en huis-aan-huisbladen
Formele stappen in de projectprocedure worden vooraf gepubliceerd in de *Staatscourant* en in huis-aan-huisbladen. Naar verwachting wordt in het derde kwartaal van 2024 de terinzagelegging van de ontwerpbeschikkingen in de *Staatscourant* gepubliceerd, waarop zienswijzen kunnen worden ingediend. Eind 2024/begin 2025 volgt naar verwachting de publicatie in de *Staatscourant* dat de definitieve besluiten op de vergunningaanvragen ter inzage liggen voor beroep.

b. Websites Aramis, CO_2next en Bureau Energieprojecten
Iedereen heeft toegang tot onze websites www.aramis-ccs.com/nl en CO2next.nl. Hier delen wij regelmatig updates en mijlpalen, waarbij we verwijzen naar de officiële documenten op de website van Bureau Energieprojecten. Het is voor iedereen mogelijk om een reactie achter te laten. De websites vermelden ook de e-mailadressen en telefoonnummers voor rechtstreeks contact. Wanneer het MER, de IEA en de (ontwerp)besluiten gereed zijn, worden die op de website van Bureau Energieprojecten gepubliceerd.

c. (In)formele bijeenkomsten: (online) informatiebijeenkomsten en symposia
In de komende periode worden de milieuonderzoeken uitgevoerd. Tijdens eerdere sessies hebben verschillende stakeholders aandachtspunten (eisen en wensen) aangedragen. Op basis van deze aandachtspunten bespreken we de tussentijdse resultaten van de milieuonderzoeken met de stakeholders. Zo kunnen we stakeholders met zorgen en vragen, bijvoorbeeld over geluid, Natura 2000-gebieden, veiligheid, gezondheid of de impact op de omgeving, specifiek en gedetailleerd informeren. Eventueel vindt er een informatiebijeenkomst of symposium plaats. Vooraf peilen we hiervoor de interesse en informatiebehoefte bij stakeholders. Bij voldoende interesse bepalen we een datum, die we tijdig aan de stakeholders kenbaar maken.

d. Digitale nieuwsbrief
Zo'n vier tot vijf keer per jaar verschijnt een nieuwsbrief waarvoor iedereen zich via onze website kan aanmelden. De aankomende nieuwsbrieven staan gepland voor september en november. Deze planning staat niet vast en hangt onder andere af van de vraag of er voldoende nieuws is om te communiceren.

e. Persoonlijke of geclusterde gesprekken
De komende periode vinden zowel individuele als geclusterde gesprekken plaats met de diverse stakeholders. Deze gesprekken kunnen het gehele Aramis-initiatief tot onderwerp hebben, dus inclusief het onderdeel waarvoor CO_2next verantwoordelijk is. Maar het is ook mogelijk dat het gesprek zich beperkt tot uitsluitend het deel waarvoor Aramis of CO_2next verantwoordelijk is. Dit is afhankelijk van het onderwerp en de organisatie waarmee het gesprek plaatsvindt, bijvoorbeeld omliggende bedrijven, gemeenten, ngo's, Kamerleden enzovoort.

Tijdens deze gesprekken worden de eisen en wensen van de gesprekspartners zo concreet mogelijk gemaakt. Eisen en wensen die betrekking hebben op het tracé en de exacte ligging worden in deze fase meegenomen, eisen en wensen die betrekking hebben op de uitvoering volgen in een later realisatiecontract.

De Integrale Effectenanalyse (IEA) brengt de effecten in kaart die de verschillende alternatieven hebben op milieu, kosten, omgeving, techniek en toekomstvastheid. Hier krijgen de opgehaalde eisen en wensen hun beslag. Belanghebbenden worden geïnformeerd over de uitkomsten van de IEA en geconsulteerd over de beoogde voorkeursalternatieven voor het Aramis initiatief.

3.2 MANIEREN OM BETROKKEN TE BLIJVEN (CONSULTEREN/ADVISEREN)

a. (Online) informatiebijeenkomst
In de komende periode vinden de milieuonderzoeken plaats. Aramis organiseert dan een of meer MER-kennissessies met als onderwerp: wat houden deze milieuonderzoeken precies in en wat zijn de eerste bevindingen?

b. Bestuurlijke, regionale en landelijke overleggen
Aramis en EZK vinden het belangrijk om direct betrokken overheden, adviesorganen en belangenorganisaties te betrekken bij de besluitvorming over het project. Voor zowel de ruimtelijke procedure als de uitvoeringsvergunningen vinden afstemmingsoverleggen plaats. Zo wordt in het Noordzeeoverleg met enige regelmaat een update gegeven van de onderzeese routealternatieven van Aramis en het overleg dat daarover heeft plaatsgevonden. Deze updates hebben tot doel de aanwezige organisaties mee te nemen in de totstandkoming van de IEA en het VKA, de basis voor het (ruimtelijk) projectbesluit. Daarnaast worden ook andere regionale overheden en belangenorganisaties geïnformeerd over het project.

c. Stakeholders
Aramis is in een eerder stadium geïntroduceerd bij onder meer programmamanagers, regioadviseurs, beleidsadviseurs en projectleiders van ministeries (EZK Wind-op-zee, Landbouw, Natuur en Voedselkwaliteit (LNV), Defensie, Binnenlandse Zaken en Koninkrijksrelaties (BZK), Infrastructuur en Waterstaat (IenW)), de Rijksdienst voor het Cultureel Erfgoed (RCE), lokale gemeenten (Rotterdam, Voorne aan Zee), de provincie (Zuid-Holland), Veiligheidsregio Rotterdam-Rijnmond (VRR), water(veiligheid)beheerders (waterschap Hollandse Delta, RWS Zee & Delta, Kustwacht), omgevingsdiensten (DCMR, ODH), wegbeheerder (RWS WNZ), railbeheerder (ProRail), belangengroepen (Deltalinqs, KVNR, Element NL, Nexstep, de Nederlandse Vissersbond, Nederlands Loodswezen, H-vision, NWEA, Verontruste Burgers van Voorne), ngo's (Bellona, Stichting de Noordzee, Natuur & Milieu, Greenpeace, Milieufederatie Zuid-Holland, Vogelbescherming, WNF), raakvlakprojecten (Porthos, Eneco), kabel- en pijpleidingeigenaren (TenneT, Stedin), offshore operators (o.a. Neptune Energy, Petrogas) en bedrijven op de Maasvlakte (Havenbedrijf Rotterdam, MOT, Euromax). Met deze stakeholders worden een-op-een- of clustergesprekken gevoerd.

d. Schriftelijke reactie op plannen
Iedereen krijgt in 2024 de mogelijkheid om schriftelijk een reactie te geven op het ontwerpbesluit en op het MER. De publicatie van het ontwerpbesluit staat gepland voor het derde kwartaal van 2024 en men heeft dan zes weken de tijd om te reageren. Aramis brengt de stakeholders te zijner tijd op de hoogte van de publicatie, zodat zij in de gelegenheid zijn om tijdig een zienswijze op het ontwerpbesluit (inclusief het MER) in te dienen.

4. PARTICIPATIEKALENDER

4.1 PARTICIPATIEKALENDER

De onderstaande tabel geeft op hoofdlijnen de stappen van besluitvorming en participatie weer conform de projectprocedure (zie paragraaf 1.3 hierboven). In de tabel staat wanneer officiële documenten worden gepubliceerd en ter inzage worden gelegd, en wanneer ieder die dat wil kan meedenken, bijdragen en inspreken.

PROCESSTAP	WIJZE VAN PARTICIPATIE	STATUS
Voornemen en voorstel participatie (januari 2022)	**Informeren, consulteren en adviseren** EZK en Aramis hebben de brede omgeving van overheden, bevoegde instanties, inwoners, bedrijven en professionele stakeholders geïnformeerd over het projectvoornemen en de voorgestelde invulling van participatie. Iedereen kon een formele reactie geven met betrekking tot: 1. andere oplossingen voor de geschetste opgave, bijvoorbeeld andere manieren om CCS toe te passen (denk aan alternatieven en varianten); 2. andere voorstellen voor de wijze waarop derden worden betrokken. Alle verzamelde reacties zijn waar mogelijk verwerkt in de concept-NRD (Notitie Reikwijdte en Detailniveau). Participatie-instrumenten: • Publicatie in Staatscourant en huis-aan-huisbladen; • Openbare informatiebijeenkomst.	**Gereed**
Inventarisatie alternatieven en varianten en het beoordelingskader (januari-mei 2022)	**Consulteren en adviseren** EZK en Aramis hebben andere overheden, bevoegde instanties en belangenorganisaties geconsulteerd om op verschillende manieren mee te denken, informatie aan te leveren over tracé-alternatieven, en varianten en aandachtspunten aan te dragen voor de NRD en het MER. Participatie-instrumenten: • Geïntegreerde interactieve werksessies; • Een-op-een- of clustergesprekken; • Nieuwsbrief Aramis.	**Gereed**
Concept Notitie Reikwijdte en Detailniveau (concept-NRD) (juni 2022)	**Informeren, consulteren en adviseren** Iedereen kon een formele zienswijze indienen over de vragen: • of de participatie beter kan; • of er iets ontbreekt bij de onderzoeken; • of de juiste onderdelen worden onderzocht; • of er andere tracé-alternatieven en/of -varianten onderzocht moeten worden. Waar relevant zijn deze meegenomen in de definitieve NRD. Participatie-instrumenten: • Publicatie in Staatscourant en huis-aan-huisbladen; • Publicatie op www.rvo.nl/onderwerpen/bureau-energieprojecten;	**Gereed**

	• Websites Aramis en CO_2next; • Raadpleging Commissie MER; • Een-op-een- of clustergesprekken; • Formele en informele informatiebijeenkomst op 21 juni 2022; • Nieuwsbrief Aramis.	
Vaststellen definitieve NRD (december 2022)	**Informeren** EZK en Aramis hebben de brede omgeving geïnformeerd over de definitief vastgestelde NRD. Participatie-instrumenten: • Publicatie op www.rvo.nl/onderwerpen/bureau-energieprojecten; • Websites Aramis en CO_2next; • Nieuwsbrief Aramis.	**Gereed**
Integrale Effectenanalyse (IEA) (december 2023)	**Informeren, consulteren en adviseren** EZK en Aramis consulteren de brede omgeving over de afwegingen van de IEA op basis van de aspecten milieu, kosten, omgeving, techniek en toekomstvastheid. Participatie-instrumenten onder andere: • Publicatie op www.rvo.nl/onderwerpen/bureau-energieprojecten; • Websites Aramis en CO_2next; • Overleggen (door EZK); • Een-op-een- of clustergesprekken; • Nieuwsbrief Aramis.	*Gepland*
Keuze voorkeursalternatief (VKA) (januari 2024)	**Informeren, consulteren en adviseren** EZK en Aramis raadplegen decentrale overheden en andere departementen over het VKA. De minister van EZK bepaalt op basis van dit advies het voorkeursalternatief. Participatie-instrumenten onder andere: • Een-op-een- of clustergesprekken met belanghebbenden; • Overleggen (door EZK); • Websites Aramis en CO_2next; • Nieuwsbrief Aramis.	*Gepland*

Milieueffectrapport (MER) als onderdeel van de vergunningaanvragen (eind 2024)	**Informeren, consulteren en adviseren** EZK en Aramis consulteren de brede omgeving over het MER. Reageren op het MER is mogelijk bij de terinzagelegging van de ontwerpbesluiten (zie de stap Publicatie ontwerp-projectbesluit en ontwerp-vergunningen hieronder). Participatie-instrumenten onder andere: • Resultaten van het MER zullen aan het eind worden gedeeld; • Een-op-een- of clustergesprekken met belanghebbenden; • Websites Aramis en CO_2next; • Nieuwsbrief Aramis.	*Gepland*
Publicatie ontwerp-projectbesluit en ontwerp-vergunningen (eind 2024)	**Informeren en horen** De bevoegde instanties stellen op basis van de aanvragen van Aramis het ontwerp-projectbesluit en de ontwerp-vergunningen op. EZK publiceert het ontwerp-projectbesluit en de ontwerp-vergunningen, inclusief het MER. Iedereen die dat wil kan een formele zienswijze indienen. De commissie van de m.e.r. geeft een advies over het MER. Participatie-instrumenten onder andere: • Publicatie in Staatscourant en huis-aan-huisbladen; • Publicatie op www.rvo.nl/onderwerpen/bureau-energieprojecten; • Openbare informatiebijeenkomst(en); • Een-op-een- of clustergesprekken met belanghebbenden; • Websites Aramis en CO_2next; • Nieuwsbrief Aramis.	*Gepland*
Publicatie definitief projectbesluit en definitieve vergunningen (eind 2024/begin 2025)	**Informeren en beroep** EZK publiceert het definitief projectbesluit en de definitieve vergunningen. Iedereen kan reageren op het projectbesluit en de vergunningen door hiertegen beroep in te stellen. Participatie-instrumenten onder andere: • Publicatie in Staatscourant en huis-aan-huisbladen; • Publicatie op www.rvo.nl/onderwerpen/bureau-energieprojecten; • Hoger beroep; • Websites Aramis en CO_2next; • Nieuwsbrief Aramis.	*Gepland*
Onherroepelijk projectbesluit en vergunningen (zonder beroep)	Uitspraak Raad van State na behandeling van mogelijke beroepen.	n.t.b.

4.2 WE HOREN GRAAG UW REACTIE OP DIT PARTICIPATIEPLAN

Zoals in paragraaf 1.1 aangeven, actualiseren we het participatieplan minstens eenmaal per projectfase. Het volgende participatieplan verschijnt naar verwachting in het voorjaar van 2024, voorafgaand aan de publicatie van het projectbesluit.

Heeft u vragen of suggesties voor verbetering van dit plan? Wij horen graag van u!
U kunt uw reactie per e-mail sturen naar: info@aramis-ccs.com.

BIJLAGES

BIJLAGE 1 SAMENVATTING INBRENG STAKEHOLDERS

Het doel van de stakeholderparticipatie is het ophalen van informatie, gebiedskennis, aandachtspunten, ideeën en kansen uit de omgeving. Zo hebben er sinds zomer 2021 kennismakingsgesprekken met stakeholders, één-op-één overleggen en persoonlijk contact met verschillende belanghebbenden plaatsgevonden. Van 7 januari tot 17 februari 2022 heeft de notitie 'Voornemen en Voorstel Participatie' ter inzage gelegen. In die periode was het mogelijk om te reageren door een schriftelijke reactie te geven op deze notitie. Er zijn zes reacties binnengekomen bij EZK. Er is formeel een antwoord gegeven op deze reacties via de nota van antwoord die is opgesteld door EZK in afstemming met het Aramis initiatief. Deze nota van antwoord is tegelijkertijd met de concept NRD en dit Participatieplan gepubliceerd.

Daarnaast werden er op 19 en 24 januari 2022 werksessies met verschillende stakeholders op respectievelijk 'land' en op 'zee' georganiseerd en heeft het ministerie van Economische Zaken en Klimaat op 26 januari 2022 een informatieavond gehouden. Een aantal aanwezigen bij de informatieavond heeft aangegeven de Aramis nieuwsbrief te willen ontvangen: zij hebben inmiddels de eerste Aramis nieuwsbrief ontvangen en worden op de hoogte gehouden door volgende nieuwsbrieven. Tijdens de verschillende gesprekken en werksessies zijn de plannen toegelicht en is er veel gebiedskennis verzameld. In het onderstaande wordt een samenvatting van aandachtspunten gegeven die door stakeholders zijn benoemd. Hierbij is onderscheid gemaakt tussen het onderdeel 'aanlanding en landdeel' (A) en het onderdeel 'zeedeel' (B). Daarnaast volgt een lijst van geraadpleegde stakeholders per onderdeel.

1 Samenvatting aandachtspunten Maasvlakte – aanlanding en landdeel

Omgevingsveiligheid, geluid & stikstof depositie
Veel partijen stellen vragen over omgevingsveiligheid, geluid en stikstofdepositie door de aanleg en aanwezigheid van de terminal en het compressor station, pompen en andere installaties. Ook over het 'entry' punt van de micro-tunnel (één van de twee voorlopige aanlandingslocaties op de Maasvlakte) stellen partijen vragen met het oog op het risico op calamiteiten, aangezien de 'vuurwerk ompak' locatie op de Prinses Maximaweg zich nabij bevindt. Verder wordt voor de stikstofdepositie in relatie tot scheepvaartbewegingen (ten behoeve van de vloeibare intake van CO_2) aandacht gevraagd.

Overslag CO_2 na aanlanding per schip
De terminalfaciliteiten, bestaande uit de overslag van CO_2 van schepen, tijdelijke opslag en verpomping van vloeibaar CO_2 naar de zeeleiding worden door CO_2next uitgevoerd.

Aanlanding vanuit zee op Maasvlakte
Voor de aanlanding van de pijpleiding vanuit zee naar de Maasvlakte zijn twee opties in beeld. Ten eerste via een Horizontale boring (HDD) onder de harde zeewering of ten tweede via een micro-tunnel die op diepte ligt onder de Maasgeul. De stakeholders vragen aandacht voor het feit dat beide aanlegmethodes ook op het land van de Maasvlakte permanente ruimte en werkterreinen behoeven. Hiervoor is tijdige afstemming met meerdere stakeholders, onder meer Port of Rotterdam van belang.

De suggestie wordt gedaan om een overleg te hebben met de stakeholders die gebiedskennis hebben over de aanlanding middels een HDD op de Maasvlakte. De beschikbare ruimte is beperkt gezien de ligging van TenneT kabels (Net op zee HKZ), de voorziene ligging van de Porthos CO_2 leiding, de aanwezige leidingenstrook op de Maasvlakte en het voorziene windpark van Eneco op de zeewering.

Een van de opties, een microtunnel, zou mogelijkheden en kansen kunnen bieden voor medegebruik zoals het ‘Net op zee’ van TenneT voor nog toekomstige windparken.
Ongeacht de aanlandingsopties wordt aandacht gevraagd voor dat de scheepvaart in de Maasgeul geen hinder mag ondervinden.

Andere functies en industrie op de Maasvlakte
In veel gesprekken komt naar voren dat de industrie volcontinu in bedrijf is. De dagelijkse werkzaamheden moeten 24/7 door kunnen gaan tijdens de aanlegfase van de projecten. Ook dient de toegang van hulpdiensten te allen tijde zijn gegarandeerd. Eveneens dient de bereikbaarheid van de kazerne van de Gezamenlijke Brandweer aan de Prinses Maximaweg 24/7 gegarandeerd te blijven.
De leiding komt deels binnen en buiten de leidingenstrook te liggen. Dit vergt afstemming met zowel Port of Rotterdam als het Leidingenbureau van gemeente Rotterdam. De krappe ligging in de leidingenstrook en de drukte in de ondergrond zijn aandachtspunten.

Autoriteiten en andere stakeholders – aanlanding en landdeel
Autoriteiten: Het Ministerie van EZK, DCMR, ProRail regio Randstad-Zuid, Gemeente Rotterdam (RO, leidingenbureau Rotterdam), Veiligheidsregio Rotterdam-Rijnmond, Rijkswaterstaat (WNZ, Zee & Delta), Omgevingsdienst Haaglanden, Provincie Zuid-Holland
Ngo’s: Vereniging Natuurmonumenten Zuid Holland, Natuur- en Milieufederatie Zuid-Holland
Kabel en pijplijn eigenaren: TenneT
Industrie & Business & andere projecten Maasvlakte: Deltalinqs, Havenbedrijf Rotterdam, Divisie Havenmeester van het Havenbedrijf Rotterdam, Eneco, Euromax, Gate terminal, Porthos , MOT, ProRail, ECT Rotterdam
Scheepvaart: het Nederlands Loodswezen
Overige: Gezamenlijke brandweer Prinses Maxima kazerne

1 Samenvatting aandachtspunten - zeedeel

Zeeleiding op of in de zeebodem
Partijen hebben vragen over de installatie van de zeeleiding op of in de zeebodem. Dit heeft te maken met verschillende belangen van verschillende stakeholders. Zo dient de leiding overvisbaar te zijn en moet scheepvaartveiligheid gegarandeerd zijn in geval van (nood)ankeren boven de leiding. Daarnaast zijn er vragen over de gevolgen van meerdere leidingen en kabels die gekruist worden in de aanlooproute voor de scheepvaart; ontstaan er dan niet lokale verondiepingen op de zeebodem als gevolg van de kruisingsconstructies op de zeebodem? Nautische partijen vragen verder om het beperken van hinder voor de scheepvaart door het vermijden van ankergebieden en het zoveel mogelijk haaks kruisen van hoofdvaarroutes en geulen. Daarnaast wordt er aandacht gevraagd voor het mogelijke effect van CO_2 lekkage op het milieu. Ook is er sprake van de aanwezigheid van mogelijke obstakels op de zeebodem (zoals wrakken en mogelijk WO II resten).

Andere functies op de Noordzee
Partijen geven aan dat er nieuwe windparken op zee worden gepland. Dit heeft mogelijk ook gevolg voor een militair oefengebied op zee dat verplaatst moeten worden. Partijen vragen of er bij de tracering van de leiding rekening wordt gehouden met deze ontwikkelingen. Dit betekent ook nieuwe hoogspanningskabels van het net op zee, waarin in de tracering rekening gehouden moet worden (t.a.v. minimumafstanden en kruisingen).
Andere olie- en gasoperators hebben interesse getoond voor het eveneens aansluiten op de centrale leiding, zodat ook van hun opslagmogelijkheden gebruik gemaakt kan worden. Voor deze groep van stakeholders is op 9 maart 2022 een aparte bijeenkomst georganiseerd.
Partijen vragen aandacht voor andere gebruiksfuncties op de drukke Noordzee; zoals zandwinning. Deze gebieden dienen zo veel mogelijk vermeden te worden.
Met de stakeholders zijn twee tracé opties (Opties A en B) in het noordelijke deel op zee besproken. Alleen vanuit de toekomstige windpark belangen is er een voorkeur uitgesproken voor route-optie A omdat deze route-optie minder impact heeft op het toekomstige windenergiegebied. Overige partijen hebben geen onderscheidende aandachtspunten per tracé optie aangegeven.

Natuurversterkende maatregelen en andere kansen
In de contacten met partijen werden ook kansen benoemd voor de Noordzee; zoals het natuur-inclusief aanleggen van de benodigde infrastructuur op de zeebodem en een eventuele koppeling met andere CCS projecten.

Autoriteiten en andere stakeholders - zeedeel
Autoriteiten: Ministerie van EZK, Rijkswaterstaat (Zee & Delta), Ministerie van LNV, Ministerie van Defensie/ Dienst der Hydrografie, Ministerie van I en W
Ngo’s: Vereniging Natuurmonumenten Zuid Holland, Natuur- en Milieufederatie Zuid-Holland, Stichting de Noordzee, Natuur & Milieu
Kabel en pijplijn eigenaren: TenneT, Stedin
Industrie & Business: Divisie Havenmeester van het Havenbedrijf Rotterdam
Scheepvaart: het Nederlands Loodswezen, Scheepvaart Adviesgroep Noordzee, KVNR
Visserij: Nederlandse Vissersbond, Voormalig VisNED
Olie en gas: Element NL
Zandwinning: LaMER
Overig: Kustwacht

Terugkoppeling werksessies
In de terugkoppeling naar deze stakeholders hebben we initieel een korte reactie gegeven op alle aandachtspunten. Hierin is aangeven dat we contact opnemen om een afspraak te maken en in individuele gesprekken hun aandachtspunten verder willen bespreken. Het Aramis initiatief heeft na de werksessie contact gehad met het Havenbedrijf Rotterdam, Euromax, Deltalinqs (bij de Klimaattafel) en DCMR. Op 7 april 2022 is er ook een gezamenlijk gesprek geweest met de gemeente Rotterdam, EZK, Gate terminal, MOT, Aramis en CO_2next over de aanpak voor het wijzigen van het huidige bestemmingsplan van Gate terminal en MOT en de rol van de bevoegde gezagen. Er is een vervolgoverleg ingepland om helderheid te verschaffen aan de te volgen procedure. Alle reacties zijn als input meegewogen voor de concept NRD en het technisch ontwerp waar we momenteel mee bezig zijn.

BIJLAGE 2 VERSLAG STAKEHOLDERSESSIE 21 JUNI 2022

Onderwerp	Stakeholderbijeenkomst Aramis en CO_2next
Project	Aramis
Datum bijeenkomst	21 juni 2022
Plaats	Hoek van Holland
Bijlage(n)	Presentatie Aramis
Aanwezig	Ministerie van EZK, EZK Wind-op-zee, TenneT, RWS, Koninklijke Vereniging van Nederlandse Reders, Kustwacht, Neptune, Carbon Collectors, Noordgastransport, Porthos, AECOM, Buis Consultancy, TNO, Port of Rotterdam (nautisch beheer), Omgevingsdienst Haaglanden, DCMR, Provincie Zuid- Holland, RWS (WNZ), LNV, Veiligheidsregio Rotterdam -Rijnmond.

Verslag stakeholderbijeenkomst

Algemeen

Op 21 juni jl. heeft een stakeholderbijeenkomst plaatsgevonden. Het doel van de bijeenkomst was het ophalen van informatie, gebiedskennis, aandachtspunten voor het MER ideeën, zorgen, wensen en kansen uit de omgeving. Onderstaand het verslag van de bijeenkomst.

Plenaire opening

Er wordt gestart met een toelichting op de concept Notitie Reikwijdte en Detailniveau en de stand van zaken van Aramis. Er wordt aangegeven wat de planning is en op welke momenten er nog ruimte is voor participatie.

Thematafels

Na het plenaire gedeelde wordt er uiteen gegaan in drie thematafels: de Maasvlakte, de Aflanding en de Noordzee.

Samenvatting aandachtspunten Maasvlakte

Aan deze tafel gingen vragen onder meer over:

- technisch gerelateerde zaken zoals de aanleg van pijpleidingen: land-trace's en de constante flow van de CO_2 in relatie tot een flexibel aanbod van de CO_2
- de schepen: emissieloos bouwen, stikstofdepositie en duur van het bouwen, soort schepen, capaciteit steigers, en aanbod walstroom
- het bevoegd gezag voor het deel van de aanlanding en de Maasvlakte (in dit geval gecoördineerd door EZK).
- de situatie met betrekking tot het compressorstation en de relatie tussen Aramis, Porthos en CO_2next.
- de scope tussen Aramis emitters en andere emitters, als ook over de capaciteit en prioritering voor de opslagvelden en voldoende beschikbaarheid van schepen voor de aan- en afvoer van vloeibare CO_2.
- punten in relatie tot de veiligheid, zoals het meenemen van de windturbines in de risicoanalyse, de gevolgen voor Hoek van Holland, aanvaringsrisico's, tankrisico's, de ligging van de brandweer kazerne bij een verkeerde wind.

Samenvatting aandachtspunten Aflanding
Aan deze tafel is onder andere gevraagd naar de technische uitdaging in dit project, en de beschikbare ruimte in relatie tot de beoogde Porthos leiding. Verder hebben TenneT en Porthos vooral hun ervaringen gedeeld, opgedaan bij eerdere aanleg van leidingen in het gebied, respectievelijk bij de voorbereiding daarop. Zo is uitdrukkelijk meegegeven aandacht te hebben in het vervolgtraject voor aanwezige niet gesprongen explosieven, archeologische waarden, bodemgesteldheid, stabiliteit van de zeewering, en beschermde soorten. Dit zowel uit technisch oogpunt als voor wat betreft de benodigde vergunningen en toestemmingen en de tijd die daarmee gemoeid is. Aangeboden wordt waar mogelijk gegevens van bijvoorbeeld boringen te delen, zonder daarbij de eigen verantwoordelijkheid van Aramis uit het oog te verliezen. Vanuit Nautisch Beheer van Port of Rotterdam wordt aandacht gevraagd voor het veilig en ongestoord doorgang vinden van de scheepvaart en de eisen die daaraan worden gesteld. In dat kader is als aandachtspunt meegegeven dat het Port of Rotterdam niet altijd duidelijk is op welke wijze de verschillende initiatiefnemers in de Maasmond met elkaar samenwerken.

Samenvatting aandachtspunten Noordzee
Aan deze tafel werd de ligging van de leiding toegelicht aan de hand van een tracétekening. Daarna is er de mogelijkheid gegeven aan de aanwezigen om te reageren op deze tekening.

Veel van de ingebrachte punten waren suggesties ter verbetering van de ligging van de leiding en het kaartmateriaal.

- EZK Wind-op-zee merkt op dat de zoekgebieden voor Hollandse Kust Zuidwest en Noordwest vervallen. Deze moeten nog van de tracétekening worden afgehaald.
- De Kustwacht geeft aan dat in de bepaling van de tracékeuze aandacht moet zijn voor multifunctioneel ruimtegebruik, bijvoorbeeld gaswindgebieden en bijbehorende aanvliegroutes en defensie oefengebied.
- De Kustwacht geeft als suggestie dat bestaande pijpleidingen gevolgd kunnen worden om een corridor te creëren.
- Neptune Energy geeft aan dat de Riser Tower of site tap op ‘gelijke’ afstand van hun velden moet liggen als van de velden van TotalEnergies en Shell.
- De Kustwacht geeft aan dat de leiding overvisbaar moet zijn, geen ankerplekken mag kruisen en zoveel mogelijk parallel moet liggen aan de vaarroutes.
- EZK Wind-op-zee ziet graag dat de leiding wordt gelegd buiten de (beoogde) windgebieden.

Daarnaast worden er verschillende punten ingebracht ter verbetering van de c-NRD en om mee te nemen in het MER:

- EZK Wind-op-zee vindt dat de ruimtelijke keuzes voor de ligging van het tracé nog beter omschreven mogen worden in de c-NRD.
- Neptune Energy voegt daaraan toe dat ze graag nog beter de mogelijkheden voor toekomstige aan- en aftakkingen op de leiding omschreven zien.
- De Kustwacht geeft aan dat er in het MER onderzocht moet worden wat het effect van lekkage is.

KNVR geeft tot slot de tip om MARIN te benaderen voor meer informatie over hun onderzoek naar de mogelijkheden om windmolens te beschermen tegen op drift geraakte schepen, omdat de uitkomsten hiervan ook nuttig voor Aramis kunnen zijn.

De middag is afgerond met een plenaire terugkoppeling, waarbij de gevoerde gesprekken per thematafel zijn samengevat, en is benadrukt dat op meerdere momenten in het vervolg van het proces participatie mogelijk is. Aramis zal de opgehaalde informatie verwerken in het MER en zal het gesprek van de thematafels voort zetten met de verschillende stakeholders.

BIJLAGE 3 AFGERONDE ACTIES VAN PARTICIPATIE (UIT H3)

MANIEREN OM GEÏNFORMEERD TE BLIJVEN (INFORMEREN)

a. Publicaties Staatscourant en huis-aan-huis bladen
Op 9 juni 2022 is in de Staatscourant (en in diezelfde week ook in huis-aan-huis bladen) gepubliceerd dat de concept NRD en dit participatieplan ter inzage lagen voor reacties. Op 2 december 2022 is in de Staatscourant gepubliceerd dat de definitieve NRD is vastgesteld.

b. Websites projecten Aramis, CO_2next en Bureau Energieprojecten
Op 10 juni 2022 is de concept NRD gepubliceerd op de website van Bureau Energieprojecten. Hierop kon iedereen de concept NRD en het geactualiseerde participatieplan inzien. Iedereen had de mogelijkheid tot het indienen van een zienswijze. Er zijn acht zienswijze ingediend die formeel zijn beantwoord. Op 2 december 2022 is de definitieve NRD inclusief de nota van antwoord gepubliceerd op de website van Bureau Energieprojecten.

c. (In)formele bijeenkomsten: Informatiebijeenkomst, symposium en kennissessies
Op 21 juni 2022 hebben EZK en het Aramis initiatief een formele informatiebijeenkomst gehouden, ten tijde van de terinzagelegging van de concept NRD. We hebben de concept NRD toegelicht, welke alternatieven en varianten we in het MER gaan onderzoeken, hoe we dat gaan doen en in welk detailniveau. Tijdens deze bijeenkomst waren projectleden van het Aramis initiatief aanwezig om vragen over het project en de concept NRD te beantwoorden. Medewerkers van EZK waren ook aanwezig om vragen over de procedure te beantwoorden.

Naast de formele bijeenkomst heeft Aramis een informele bijeenkomst georganiseerd voor alle (zakelijke) stakeholders. Doel was om de deelnemers van deze bijeenkomst te informeren over de status van het project aan de hand van de concept NRD en om alle vragen die er leven te beantwoorden. Met deze bijeenkomst heeft het Aramis initiatief ook voldaan aan de verplichting van een openbare raadpleging die volgt uit de PCI-status (Project of Common Interest).

d. Digitale nieuwsbrief
We hebben eind april 2022 de eerste nieuwsbrief en in juli 2022 de tweede nieuwsbrief uitgebracht. De eerste twee nieuwsbrieven waren in het Nederlands. De derde nieuwsbrief (in het Engels) is in november 2022 verspreid en de vierde in april 2023. Alle nieuwsbrieven zijn toegankelijk via de Aramis website.

e. Persoonlijk of geclusterde gesprekken
Afgelopen periode zijn individuele en ook geclusterde gesprekken met de diverse stakeholders gevoerd. Uitkomsten daarvan zijn en worden verwerkt in Dialog.

MANIEREN OM BETROKKEN TE BLIJVEN (INFORMEREN/CONSULTEREN/ADVISEREN)

a. Informatiebijeenkomst
Tijdens de informatiebijeenkomst op 21 juni 2022 konden de aanwezigen op een laagdrempelige manier in gesprek gaan met projectmedewerkers van het Aramis initiatief en het ministerie van EZK. Ook was het voor de aanwezigen mogelijk tijdens deze bijeenkomst een mondelinge reactie (zienswijze) in te dienen. Uiteindelijk zijn er acht schriftelijke reacties ingediend op de concept NRD.

b. Bestuurlijke en landelijke overleggen
Het Aramis initiatief en het ministerie van EZK vinden het belangrijk om gemeenten, provincie en andere bestuursorganen actief te betrekken bij de besluitvorming over het project.

Het Aramis initiatief en het ministerie van EZK betrekken bestuurlijke partners van de gemeenten, de provincie Zuid-Holland en andere departementen met betrekking tot de Noordzee actief bij het besluitvormingsproces van het projectbesluit. Bestuurders van deze partners worden bij elke formele zienswijze periode op de hoogte gehouden van de voortgang in een op te richten Bestuurlijk Overleg (BO), geïnitieerd door EZK.

Op 15 november 2022 heeft het eerste coördinatieoverleg vergunningen plaatsgevonden. Dit is een tweemaandelijks overleg met alle bevoegde gezagen in het kader de vergunningen onder de Rijkscoördinatieregeling (RCR).

c. Persoonlijke of geclusterde gesprekken
Wij hebben het project al eerder geïntroduceerd o.a. aan programma-managers, regioadviseurs, beleidsadviseurs en projectleiders van ministeries (EZK Wind, Landbouw, Natuur en Voedselkwaliteit (LNV), Rijksdienst voor het Cultureel Erfgoed (RCE) , Defensie, Binnenlandse Zaken en Koninkrijksrelaties (BZK), Infrastructuur en Waterstaat (IenW)), lokale gemeenten (Rotterdam, Brielle, Westvoorne), Provincie (Zuid-Holland), VRR, water(veiligheid)beheerders (Waterschap Hollandse Delta, RWS Zee & Delta, Kustwacht), omgevingsdiensten (DCMR, ODH), wegbeheerder (RWS WNZ), railbeheerder (ProRail), belangengroepen (Deltalinqs, KVNR, Element NL, Bellona, Nexstep, de Nederlandse Vissersbond, Stichting de Noordzee, Nederlands Loodswezen, H-vision, NWEA, Verontruste Burgers van Voorne), ngo's (Natuur & Milieu, Greenpeace, Milieufederatie Zuid-Holland), raakvlakprojecten (Porthos, Eneco), kabel- en pijpleiding eigenaren (TenneT, Stedin), offshore operators (o.a. Neptune Energy , Petrogas) en bedrijven op de Maasvlakte (Havenbedrijf Rotterdam, MOT, Euromax). Dit ambtelijke en persoonlijke contact zetten wij voort in deze komende fase.

Hieronder staat een overzicht met welke belanghebbenden en over welke onderwerpen wij spreken.

- Havenbedrijf Rotterdam: de aanlanding, uitwerking verschillende tracés en locatie alternatieven en varianten in het havengebied;
- Provincie Zuid-Holland: de ruimtelijke kwaliteit (o.a. openheid en natuur) van het gebied in relatie tot het tracé en locatiealternatieven en -varianten, vergunningen;
- RWS Zee & Delta en Kustwacht: nautische veiligheid, het kruisen van scheepvaartroutes, de tracering en locatie alternatieven en varianten, vergunningen op zee;
- RWS WNZ: uitwerking van tracé- en locatiealternatieven en varianten bij kruising van waterkeringen, hoofdwatergangen, aandachtspunten van diverse uitvoeringsmethodes en vergunningen;
- Waterschap Hollandse Delta, DCMR en ODH: benodigde water vergunningen, vergunningen in het kader van de wet algemene bepalingen omgevingsrecht en natuurvergunningen en ontheffingen;
- Gemeente Rotterdam: voor de benodigde vergunningenoverzicht en rol van bevoegde gezag en invloed op CCS op de energietransitie;
- TenneT, Stedin: raakvlakken projecten en invloeden van tracé- en locatiekeuzes, met name bij de kruising van de waterkering (TenneT) en energievoorziening en beschikbare ruimte in de Leidingenstrook (Stedin);
- Eneco: raakvlakken en veiligheidsrisico's van windmolens op de Maasvlakte;

- MOT, ECT Rotterdam, Euromax: impact op 24/h bedrijfsvoering en overlast (geluid, trillingen);
- Ministeries: raakvlakken (toekomstige) windparken op de Noordzee zoals Lagelander, impact op het milieu en visserij, raakvlakken (toekomstige) zandwinningsgebieden, gebieden van hoge cultuur-historische waarde en vergunningen;
- Wij informeren de bij ons bekende maatschappelijke organisaties (Milieufederatie Zuid-Holland, Natuur & Milieu, Greenpeace, Milieudefensie en Stichting de Noordzee) rechtstreeks over het project en de procedures. In de studies die we uitvoeren voor de vergunningen en het milieueffectrapport (MER) besteden we nadrukkelijk aandacht aan milieu, natuur en andere belangrijke maatschappelijke waarden. Daarnaast onderzoeken we met Stichting de Noordzee, Natuur & Milieu, het Koninklijk Nederlands Instituut voor Onderzoek der Zee, de Wageningen University & Research en het Nederlandse Organisatie voor Wetenschappelijk Onderzoek of we het project Aramis natuurversterkend kunnen aanleggen;
- Porthos: afstemming omgevingsmanagement en aansluiting op Porthos;
- Commissie MER: afstemming en advies voor concept NRD en MER;
- ProRail: impact op kruising van en werken nabij het spoor (veiligheid en bedrijfsvoering);
- Veiligheidsregio's: veiligheidsrisico's in het havengebied en de nabije omgeving (toegangswegen);
- Het Aramis initiatief is meermalen aangeschoven bij het Noordzeeoverleg (NZO). De NZO-leden zijn: de ministeries (Infrastructuur en Waterstaat, Economische Zaken en Klimaat, en Landbouw, Natuur en Voedselkwaliteit), Energiesector (Nederlandse Wind Energie Associatie, TenneT, Element NL, Energie Beheer Nederland), Zeevaartsector (Branche Organisatie Zeehavens, Koninklijke Vereniging Nederlandse Rederijen, Havenmeesters), natuur en milieuorganisaties (WNF Nederland, Greenpeace (geen permanent lid), Stichting De Noordzee, Vogelbescherming Nederland, Natuur & Milieu) en Voedsel&Visserij (NetVisWerk en Producentenorganisaties Urk & Delta Zuid). Het project Aramis informeert regelmatig over de stand van zaken tijdens dit NZO-overleg. Aanwezigen van dit overleg wordt gevraagd om input te leveren vanuit hun organisatie, bijv. over scheepvaartbelemmering op zee of kruising Maasgeul, gevoelige infrastructuur op de zeebodem, raakvlak (toekomstige) windmolenparken, impact op natuur, onderwater geluid, etc.);
- NEa (Nederlandse Emissieautoriteit): onafhankelijke autoriteit voor toezicht op de uitstoot van broeikasgassen;
- Er is een gezamenlijke bijeenkomst geweest waarin het project Aramis gepresenteerd werd aan alle operators en waar operators kenbaar konden maken of men wilde aansluiten, en zo ja, wanneer. Met operators met concrete belangstelling en betrokkenheid zijn er individuele overleggen gevoerd;
- Eind 2021 is door CO_2next een Open Season proces gestart. Het primaire doel van het Open Season was het verkrijgen van een beter inzicht in het marktpotentieel. Dit is mede van belang voor de vergunningaanvraag waarin de eindsituatie dient te worden omschreven. Bovendien is waardevolle informatie verzameld voor het verdere engineering proces zodat al vroegtijdig kan worden nagedacht over bijvoorbeeld tie-in point en over-dimensionering. Een secundair doel van het Open Season proces was om te voldoen aan de criteria voor Open Access en Non-discriminatory Access. Hierdoor wordt gerechtvaardigd dat er een of enkele launching customers zijn.

In een intensieve samenwerking en onder speciale voorwaarden kan met deze launching customers de keten worden opgezet. In een volgende fase zouden andere partijen dan onder de dan geldende voorwaarden kunnen aansluiten.

d. Schriftelijke reactie op de plannen geven
Iedereen heeft in 2022 de mogelijkheid gehad een schriftelijke reactie te geven op de concept NRD (een zienswijze indienen). Er zijn acht zienswijzen ingediend. Al deze zienswijzen zijn gebundeld (zienswijzebundel) en in de nota van antwoord is een toelichting gegeven of en hoe deze zijn meegenomen bij het opstellen van de definitieve NRD of in het verdere proces.

Het Aramis initiatief heeft advies aan de commissie MER op de concept NRD gevraagd. Dit advies is op de site van de commissie op 18 augustus 2022 gepubliceerd. Het ministerie van EZK heeft op basis van de ingekomen zienswijzen en het advies van de commissie MER de definitieve NRD vastgesteld en gepubliceerd op 2 december 2022.