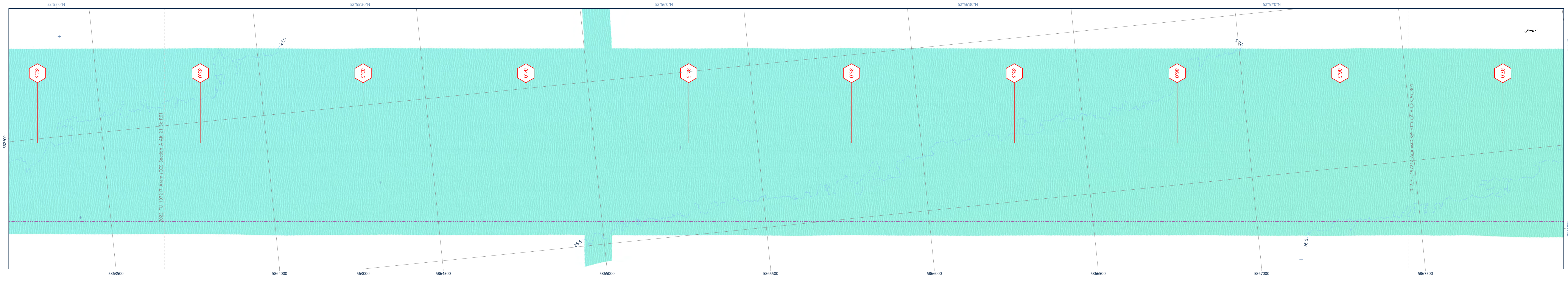
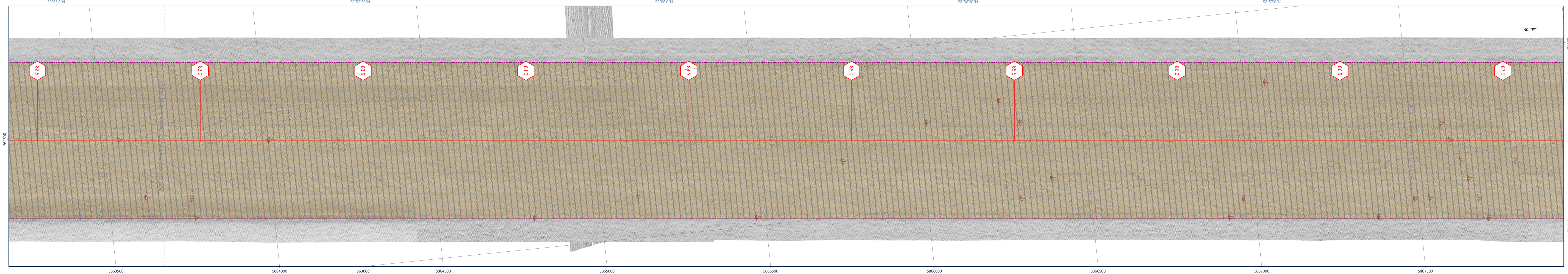


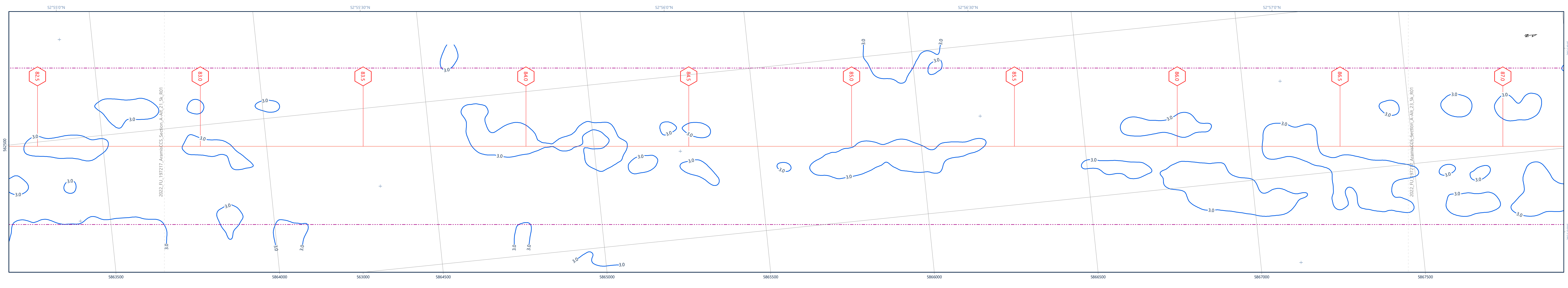
BATHYMETRY



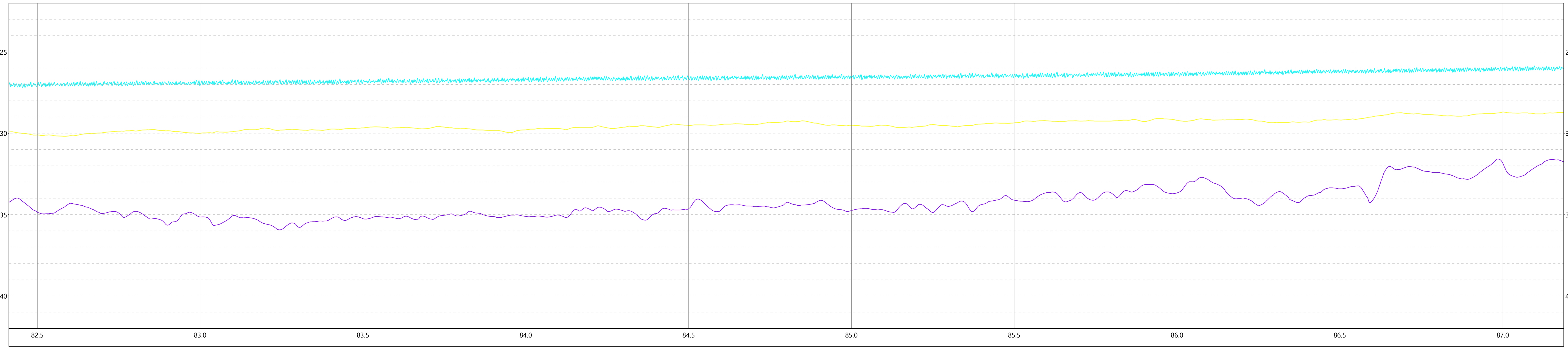
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

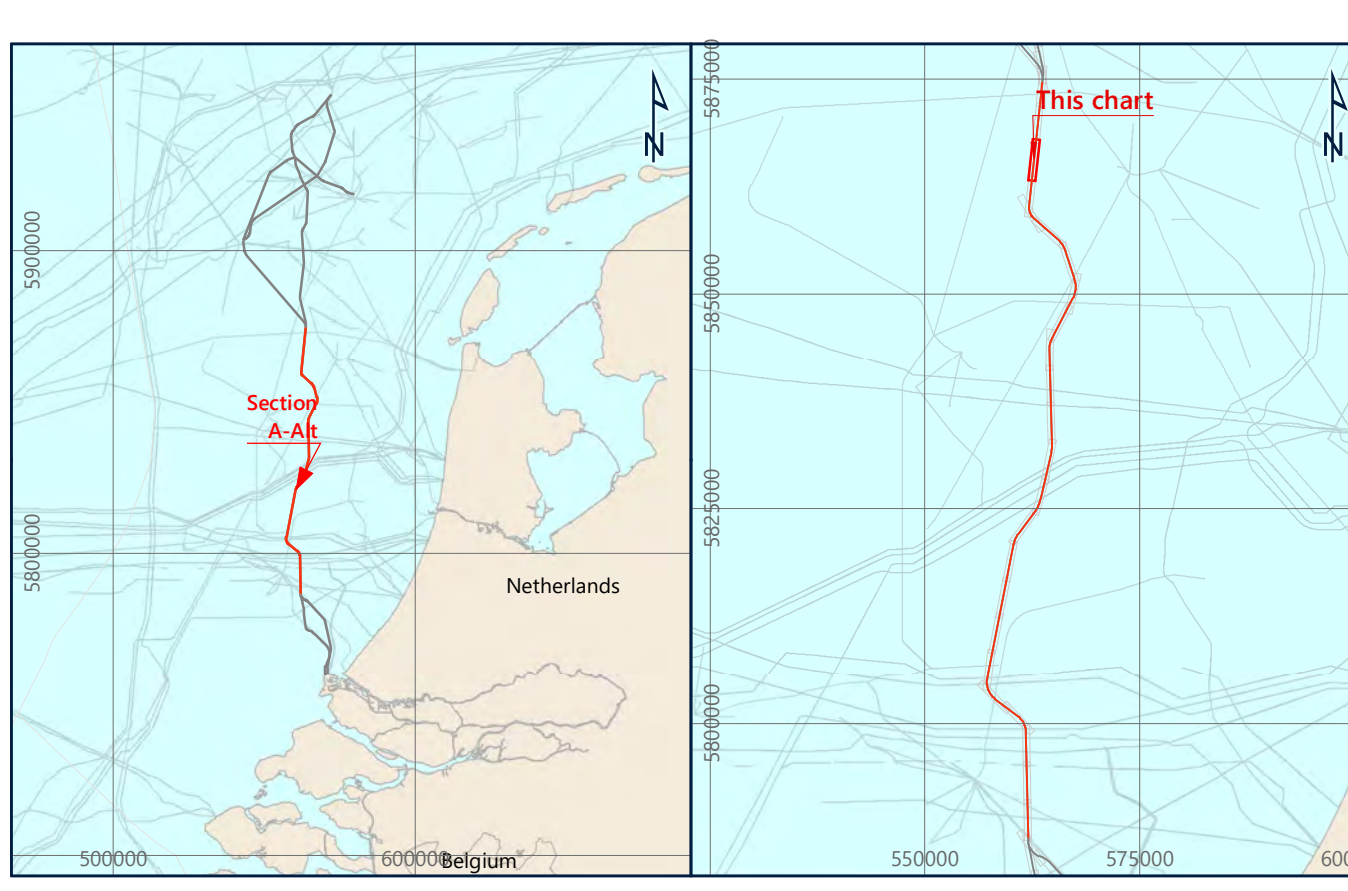
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- This document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for that commission. Unauthorised use of this document in any form whatsoever is prohibited.

**GEODETTIC PARAMETERS**

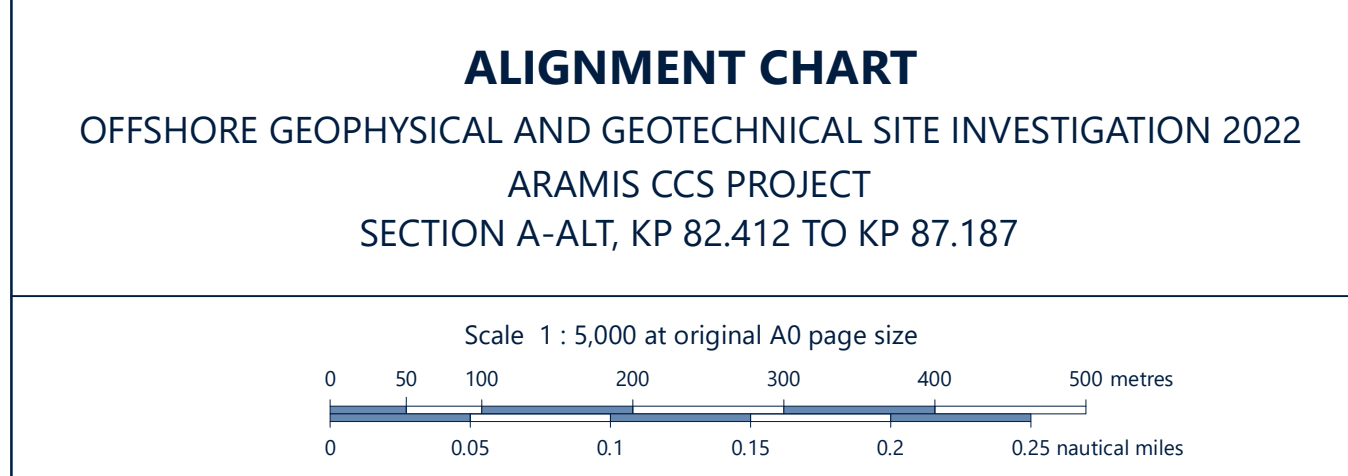
GEODETTIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION A-ALT, KP 82.412 TO KP 87.187



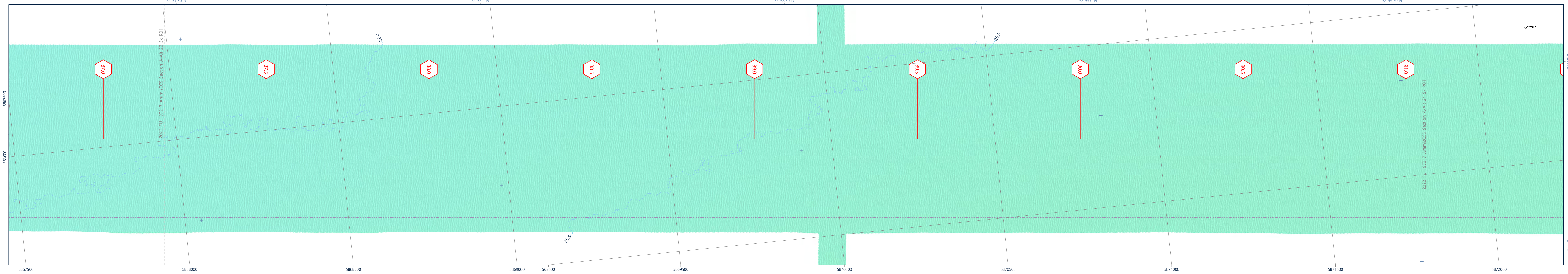
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

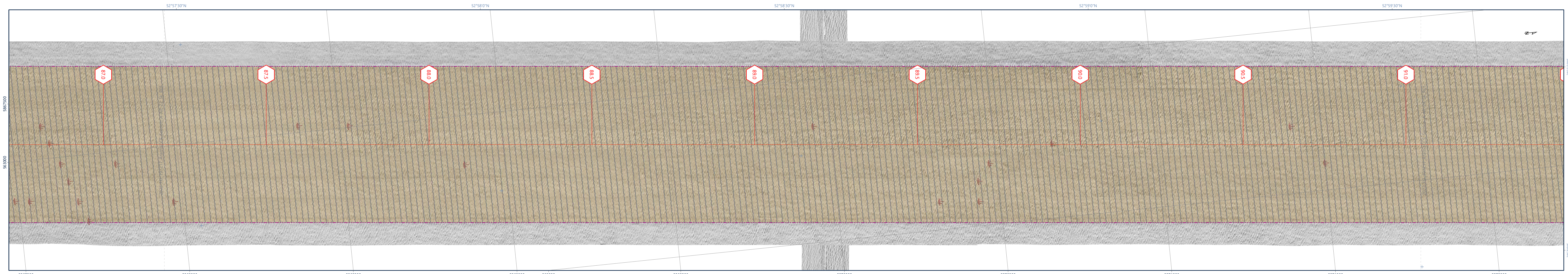
Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_A\_Alt\_22\_5k\_801  
 Chart No. 22 of 24  
 Enclosure 040 of 105



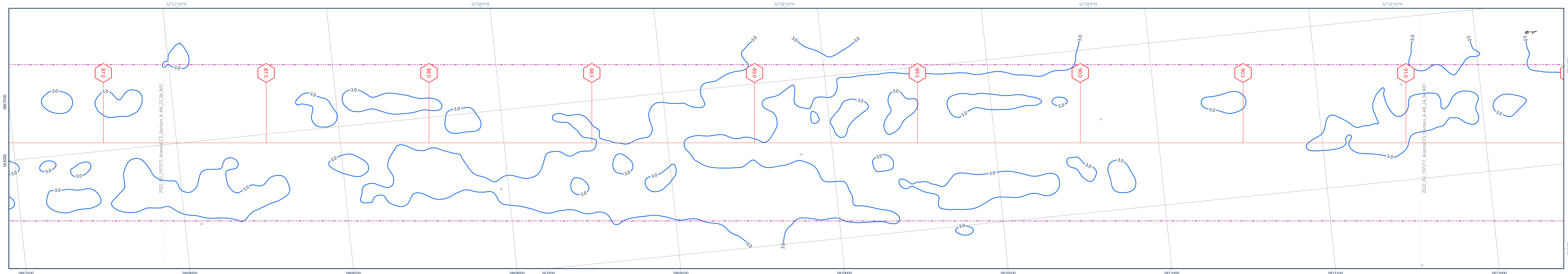
BATHYMETRY



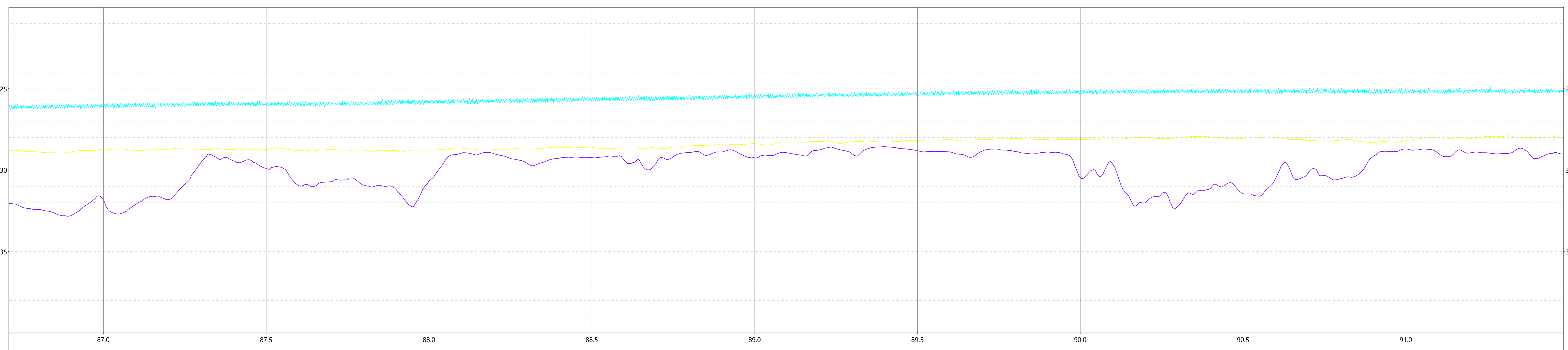
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

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- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

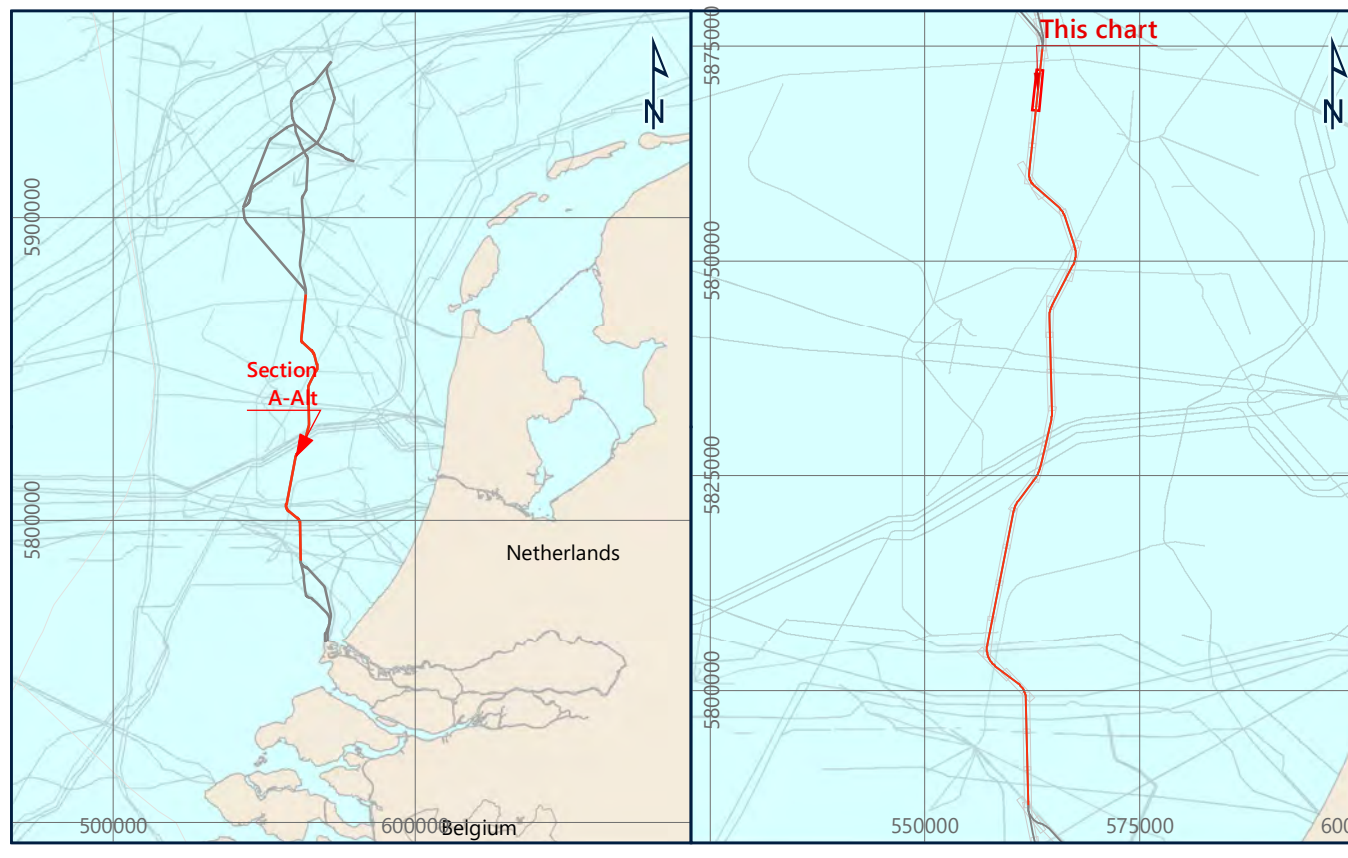
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION A-ALT, KP 86.710 TO KP 91.485

Scale 1 : 5,000 at original A0 page size

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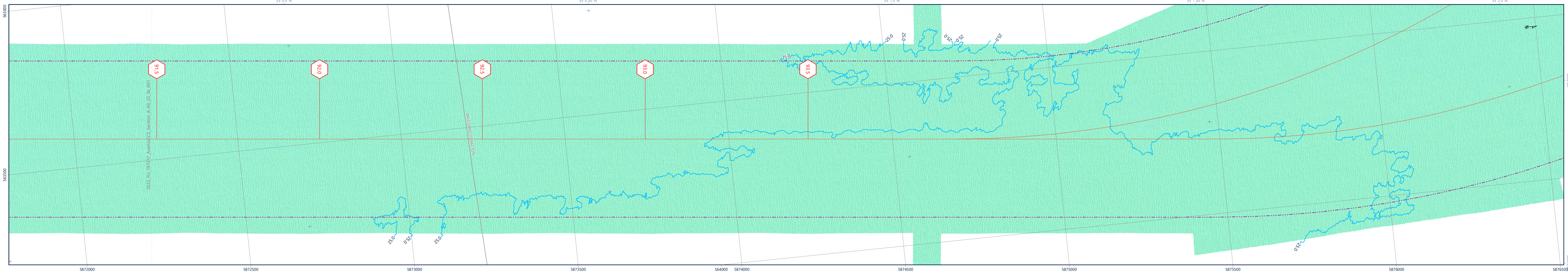
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

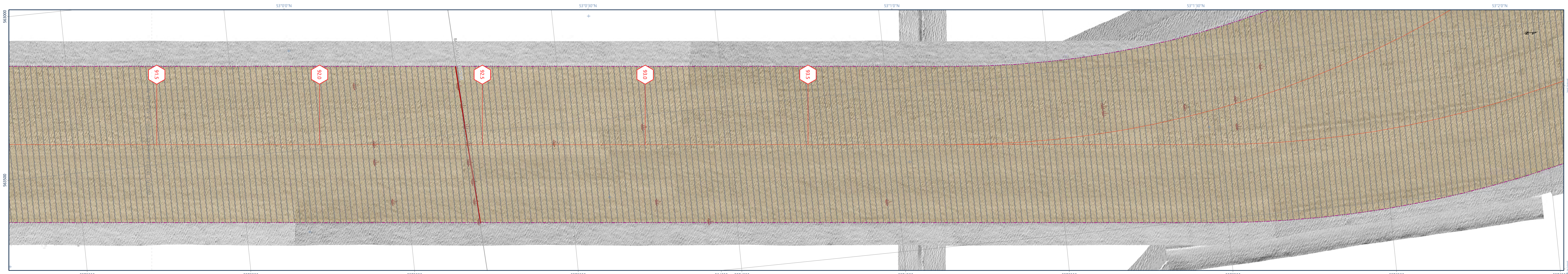
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 Chart No. 23 of 24  
 Enclosure 041 of 105



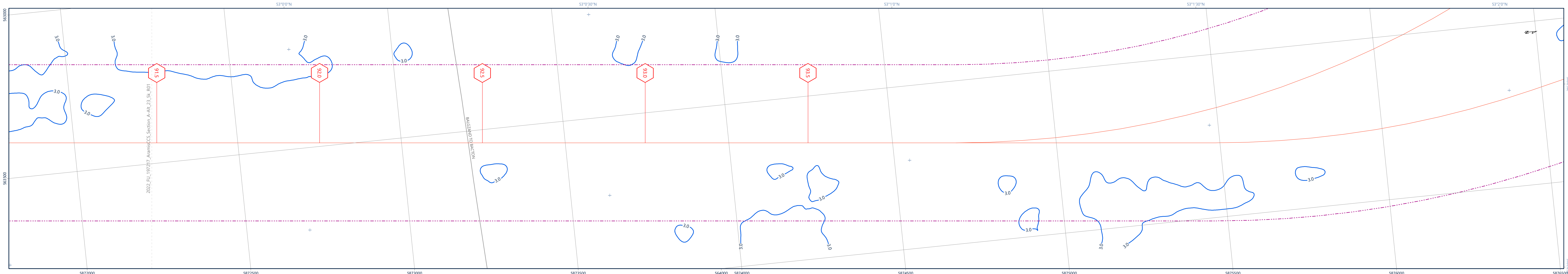
BATHYMETRY



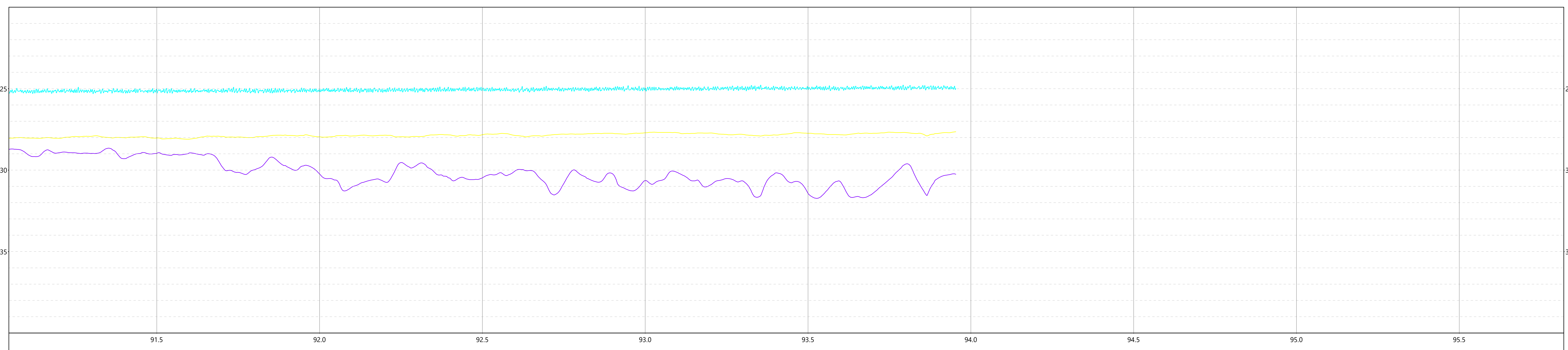
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
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- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

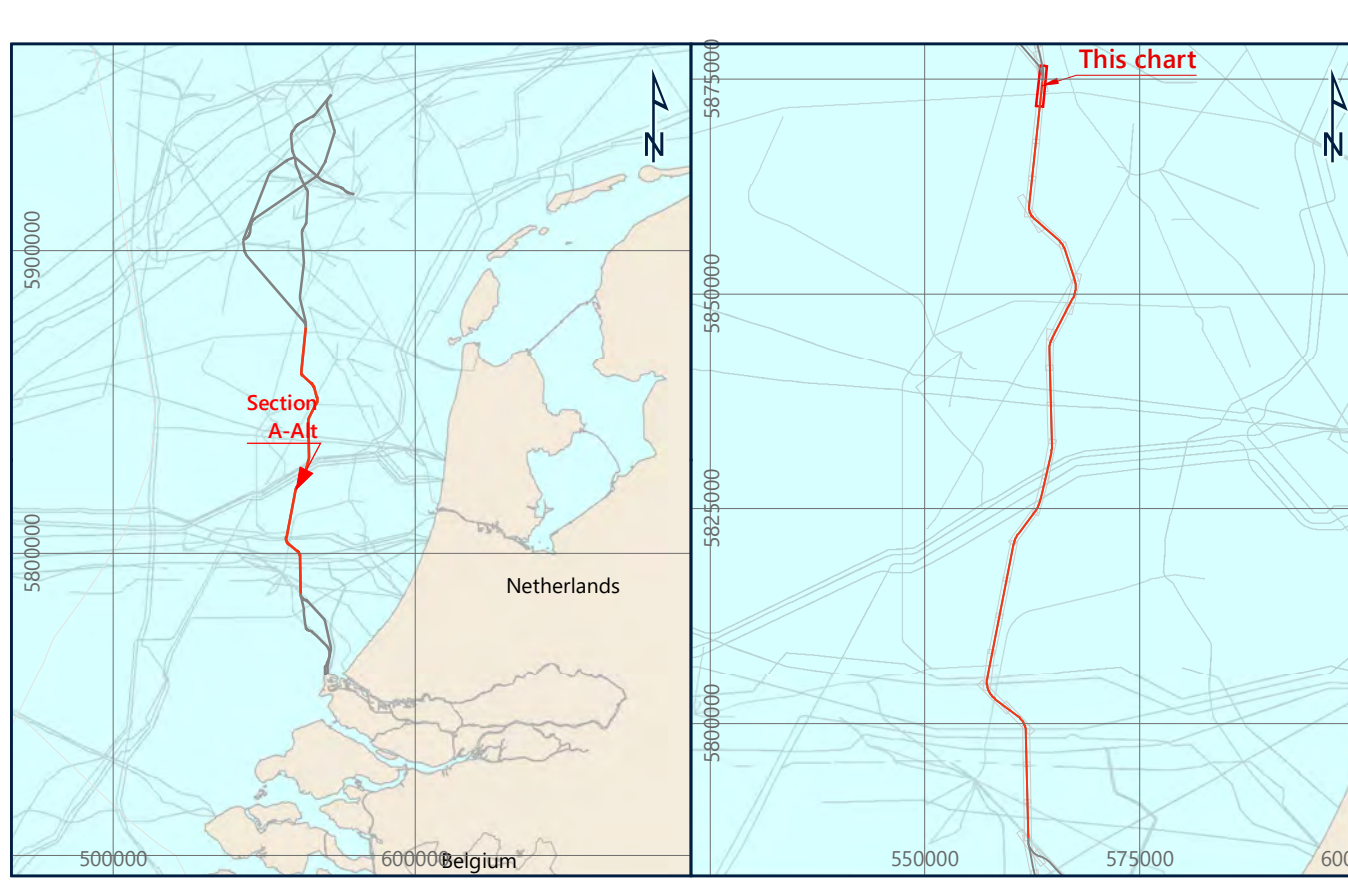
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION A-ALT, KP 91.046 TO KP 93.954

Scale 1 : 5,000 at original A0 page size

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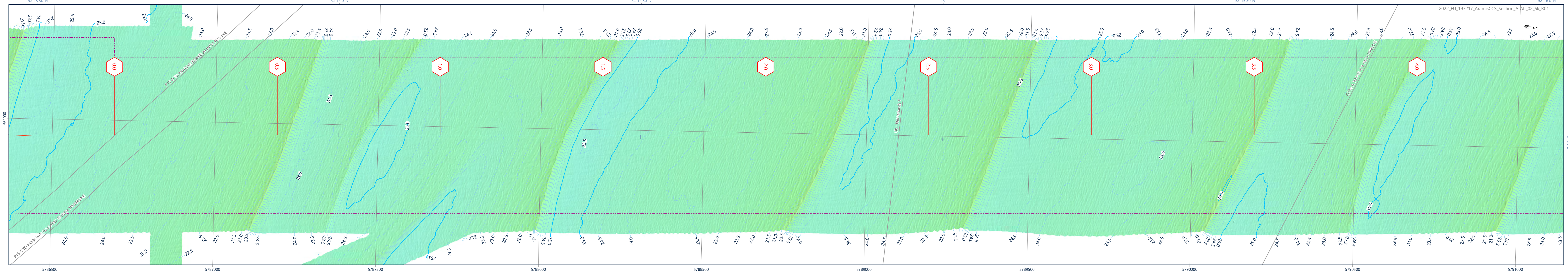
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

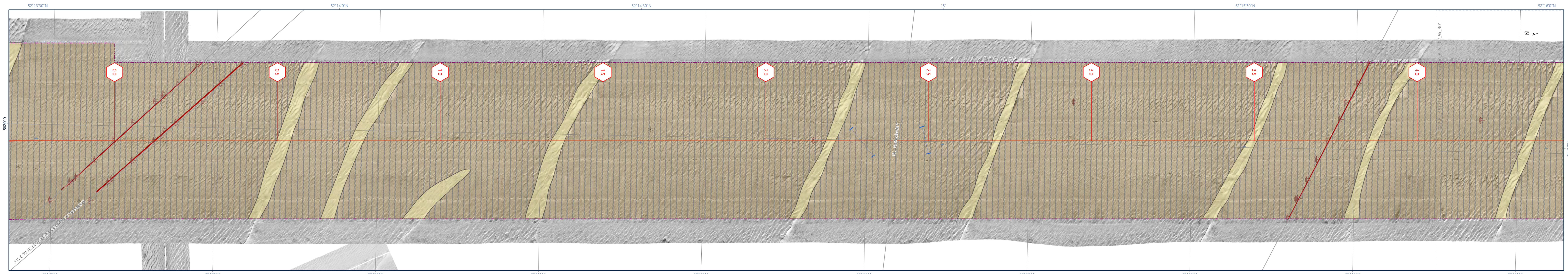
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 Chart No. 24 of 24  
 Enclosure 042 of 105



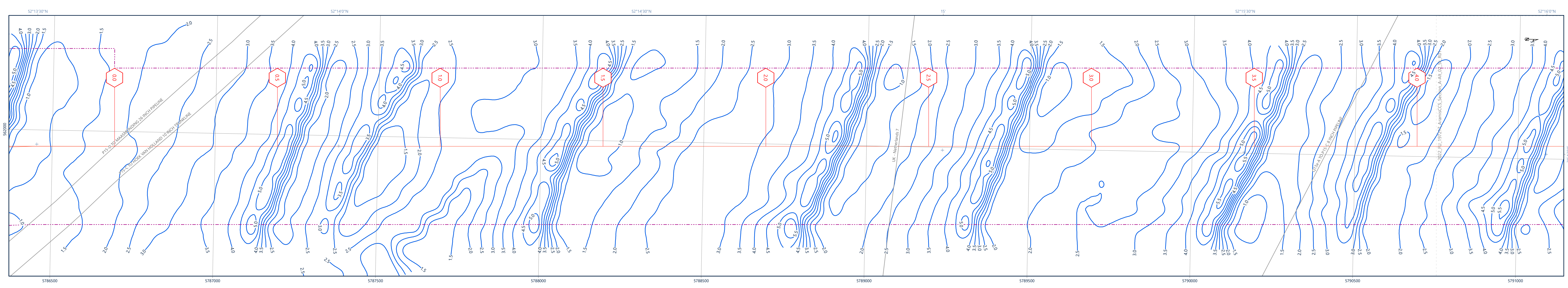
BATHYMETRY



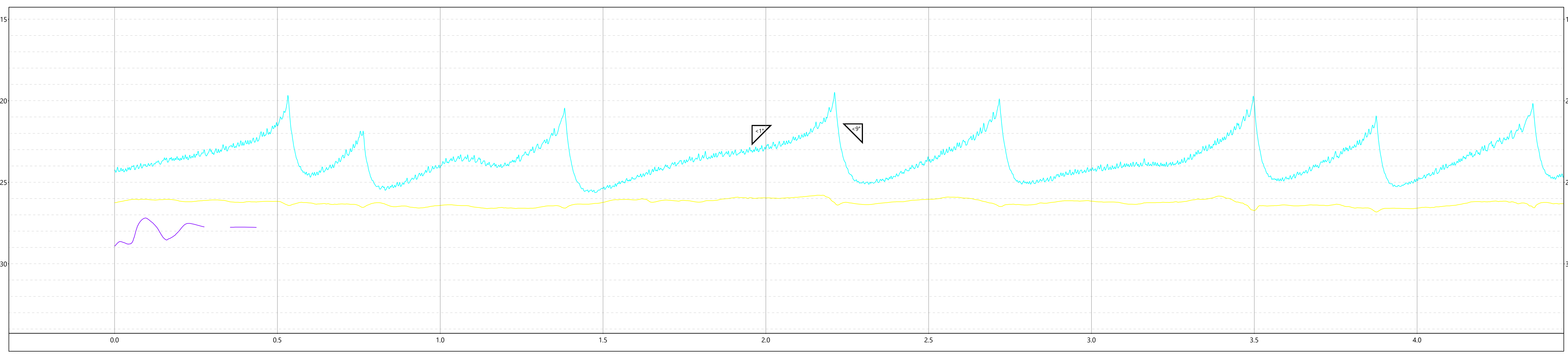
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
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- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isobath Contours of Unit A
- Buried Channels
- Acoustic Diffraction

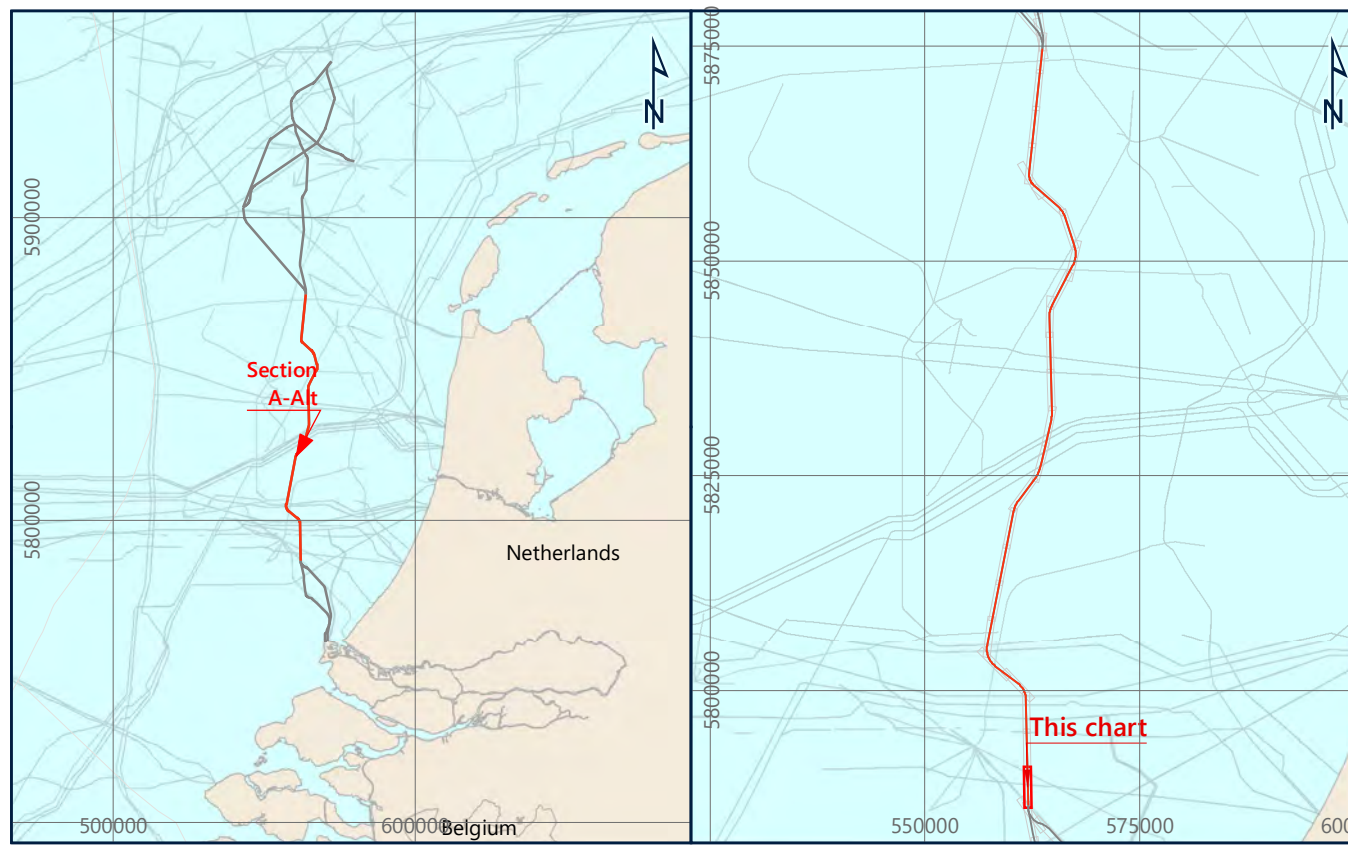
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG:25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION A-ALT, KP 0.000 TO KP 4.450

Scale 1 : 5,000 at original A0 page size

0 50 100 200 300 400 500 metres  
 0 0.05 0.1 0.15 0.2 0.25 nautical miles

Issue	Date	Status	Interpr	Drawn	Chkd	Appr
01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

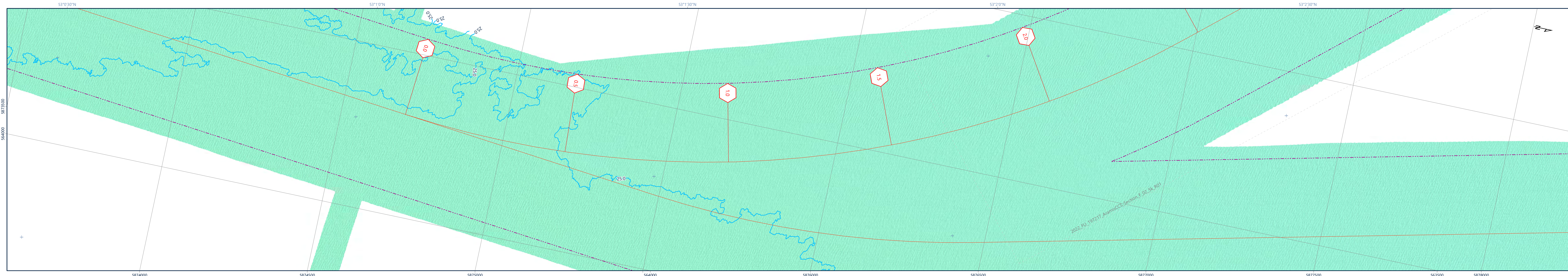
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 Chart No. 01 of 24  
 Enclosure 019 of 105



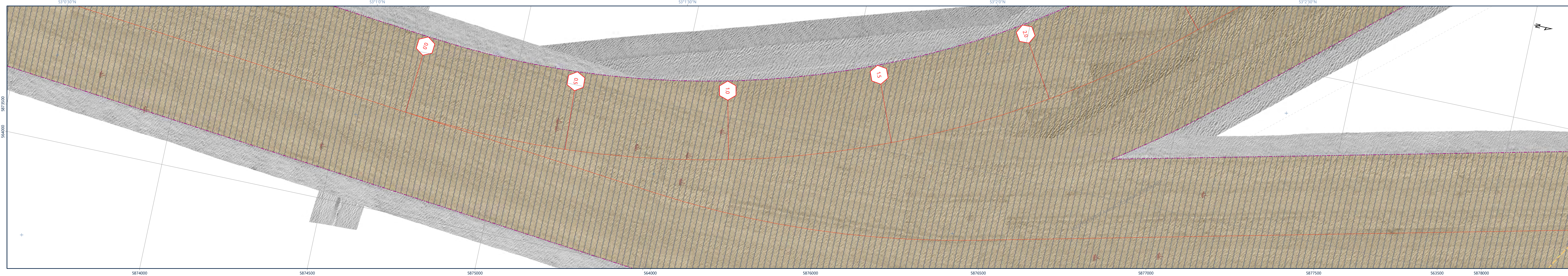
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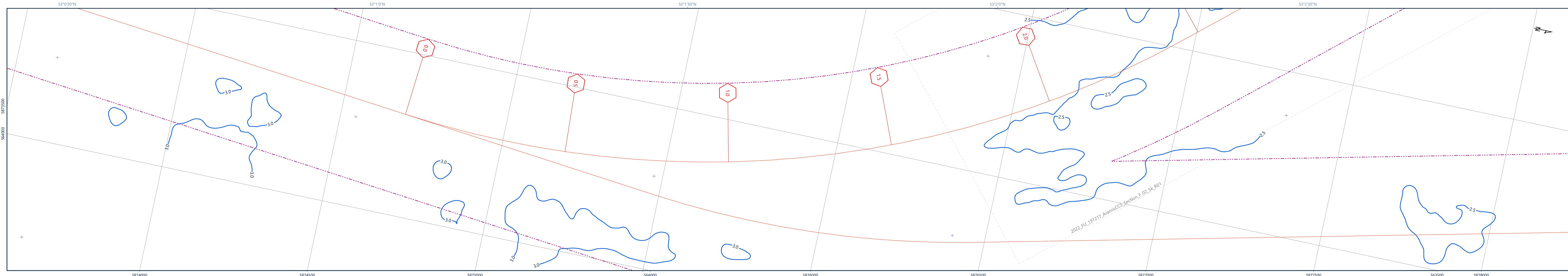
BATHYMETRY



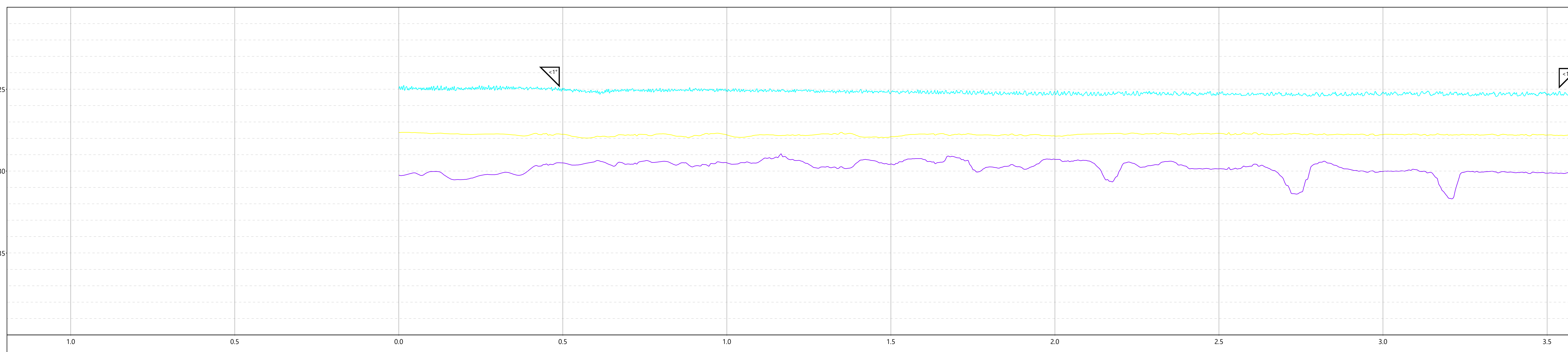
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
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- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**Water Depth [m LAT]**

Color scale from 0.0 to -40.0 meters.

**NOTES**

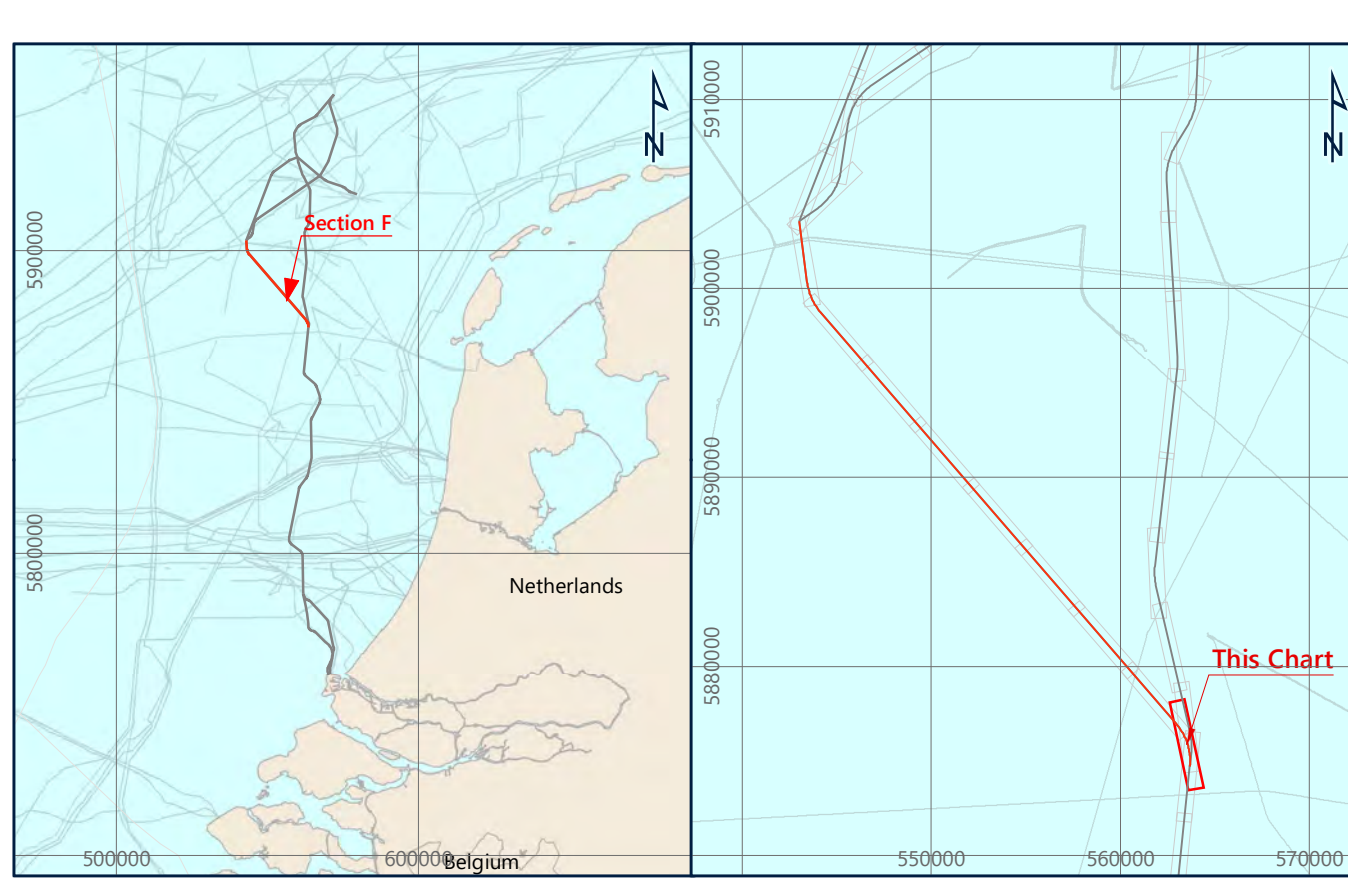
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 0.000 TO KP 2.650

Scale 1 : 5,000 at original A0 page size

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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

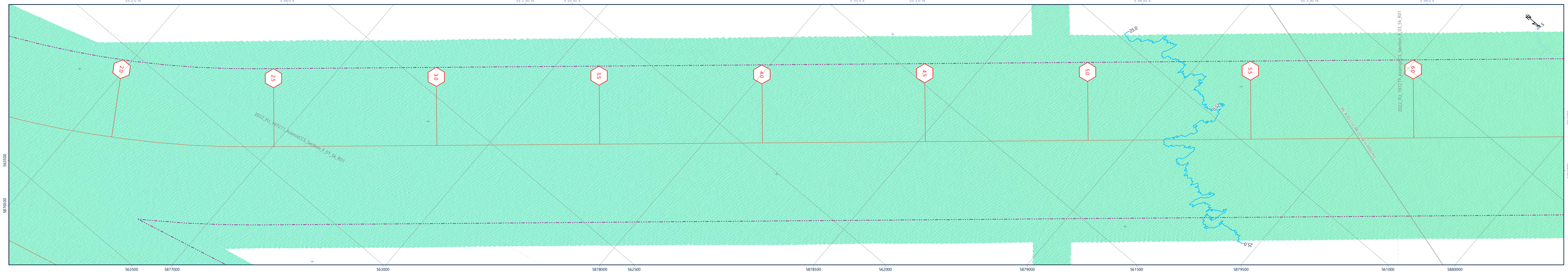
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

Chart Name: 2022\_FU\_197217\_AramisCCS\_Section\_F\_01\_Sk\_R01  
 Chart No. 01 of 09  
 Enclosure 066 of 105



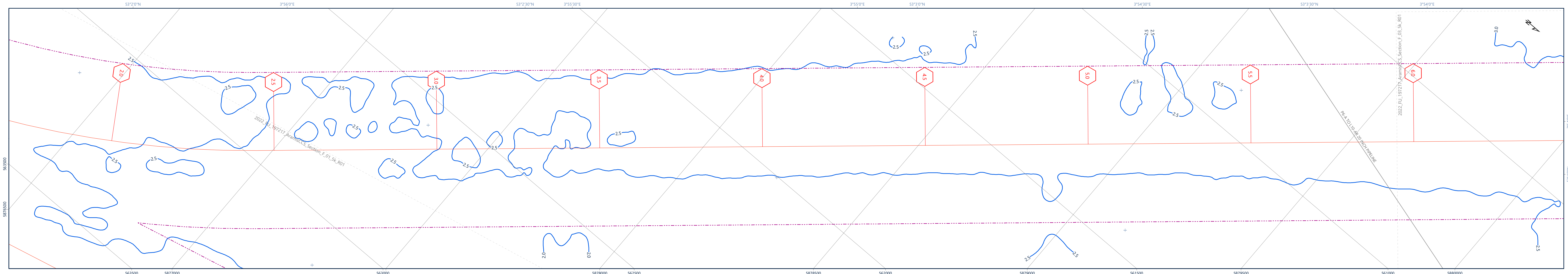
BATHYMETRY



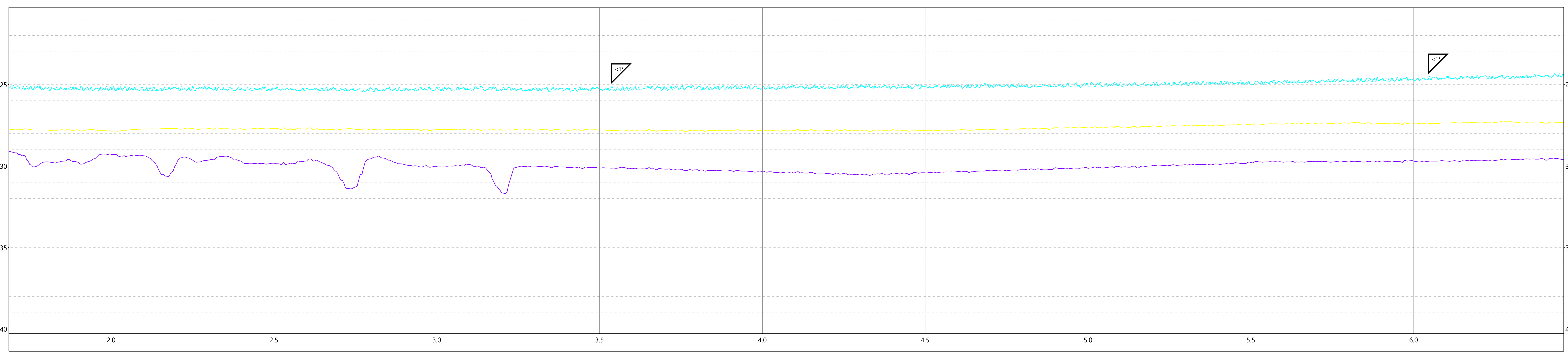
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

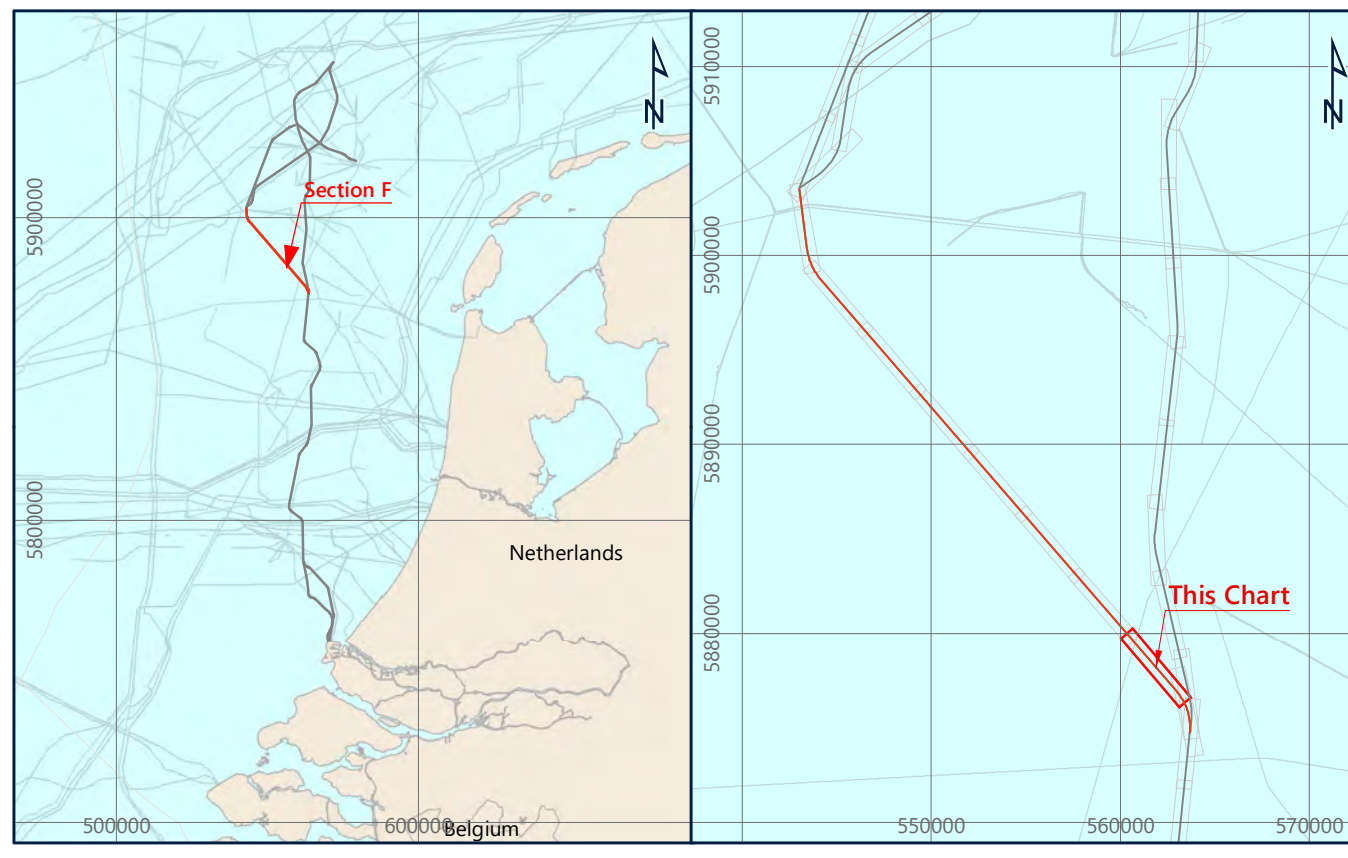
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- Magnetic anomalies measuring at least 10.0 nT in peak to peak amplitude were picked using the Blakely Test.
- The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.

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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

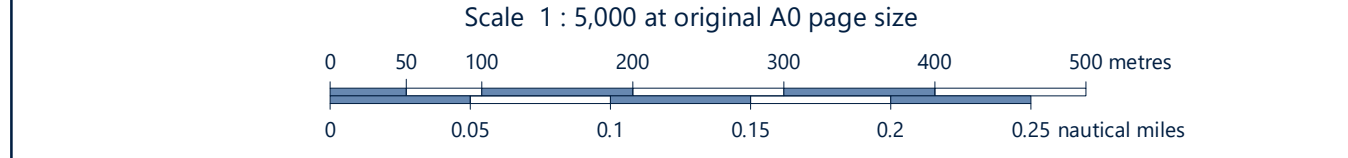
GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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 Avenue Flor 25, 2740 Coenraadsloot, Denmark  
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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 1.678 TO KP 6.461



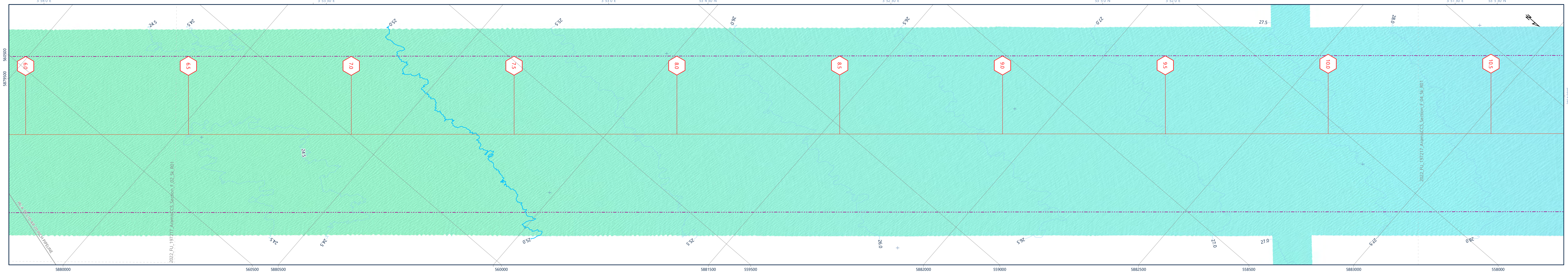
Issue	Date	Status	Interpr	Drawn	Chld	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

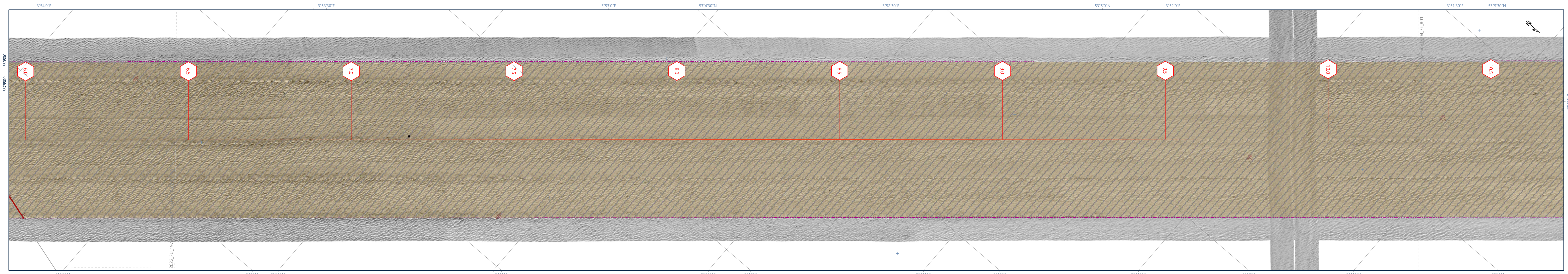
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 Chart No. 02 of 09  
 Enclosure 067 of 105



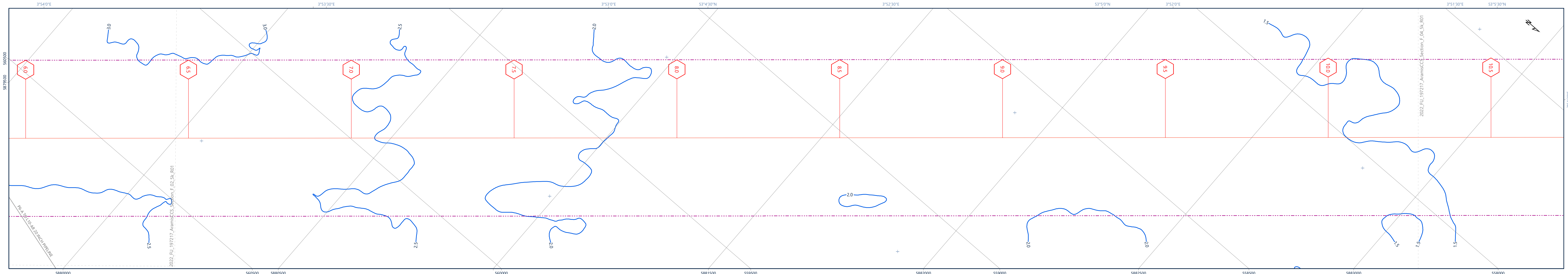
BATHYMETRY



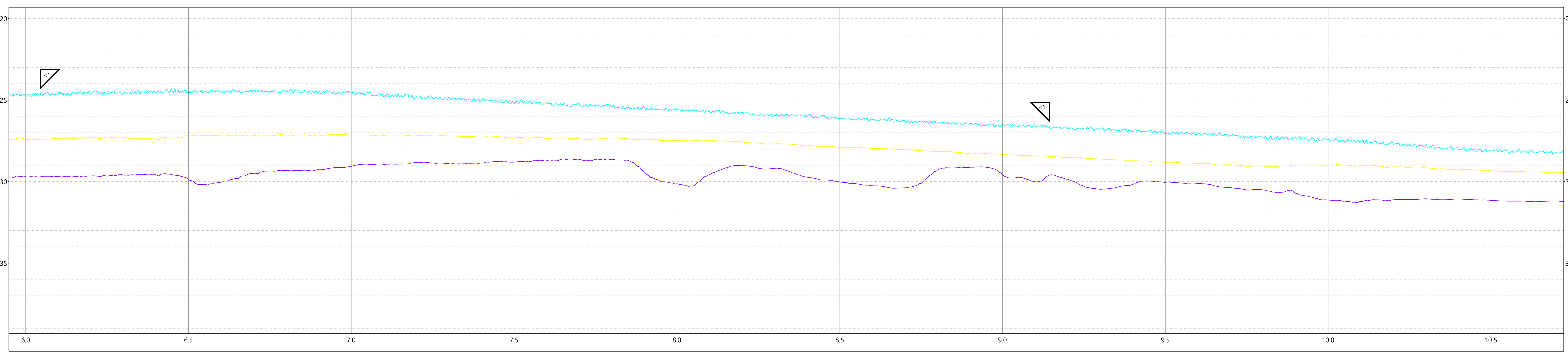
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Other
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

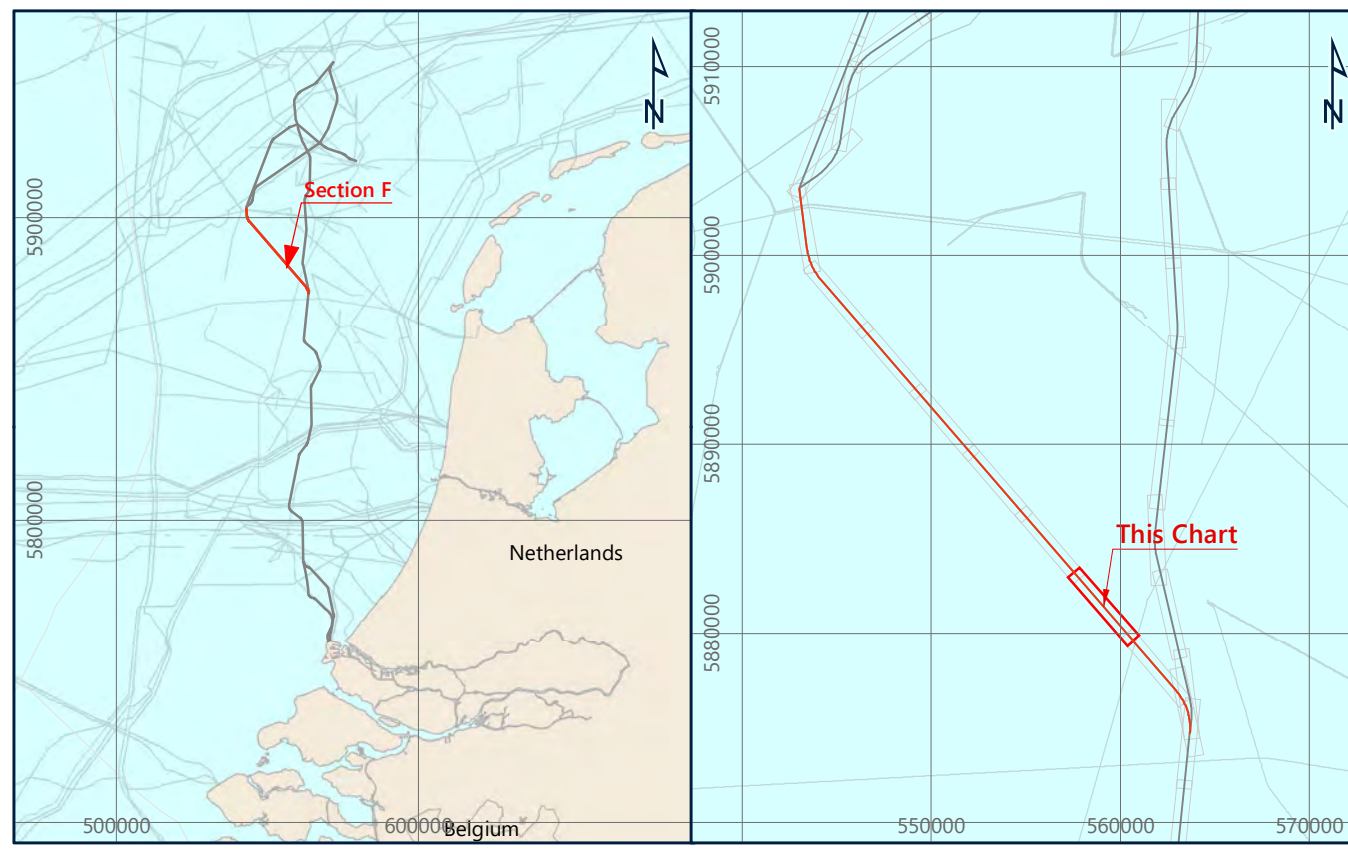
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 5.948 TO KP 10.723

Scale 1 : 5,000 at original A0 page size

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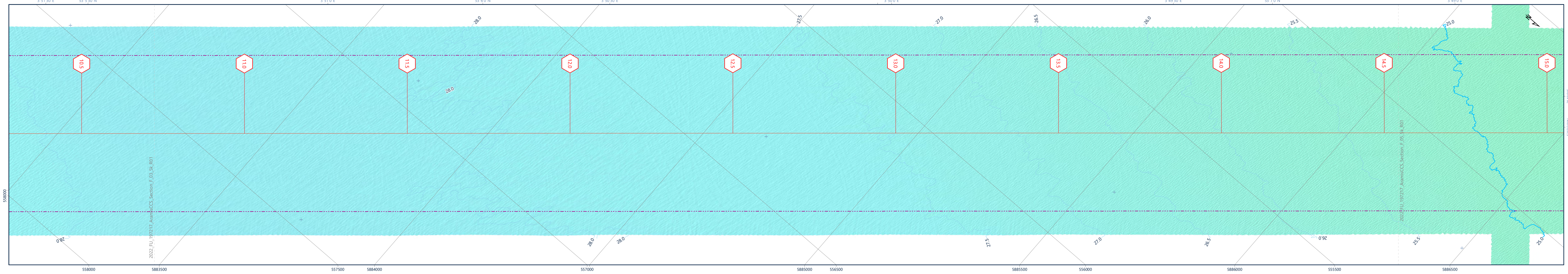
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

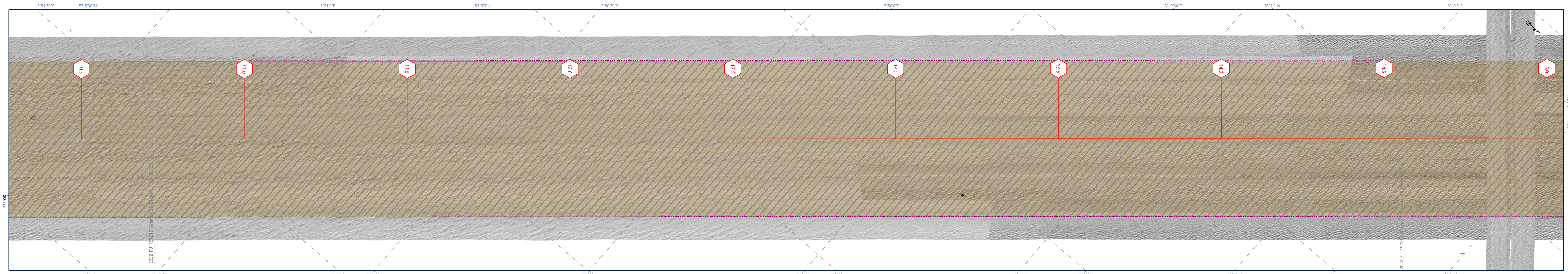
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 Chart No. 03 of 09  
 Enclosure 068 of 105



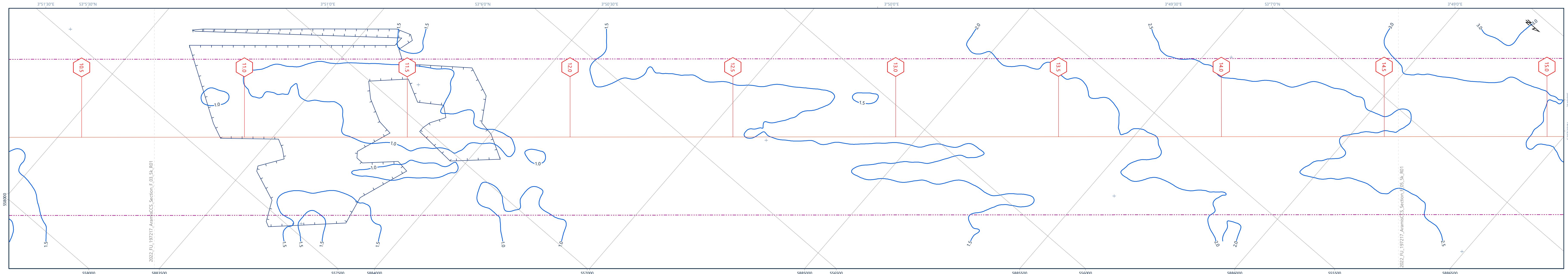
BATHYMETRY



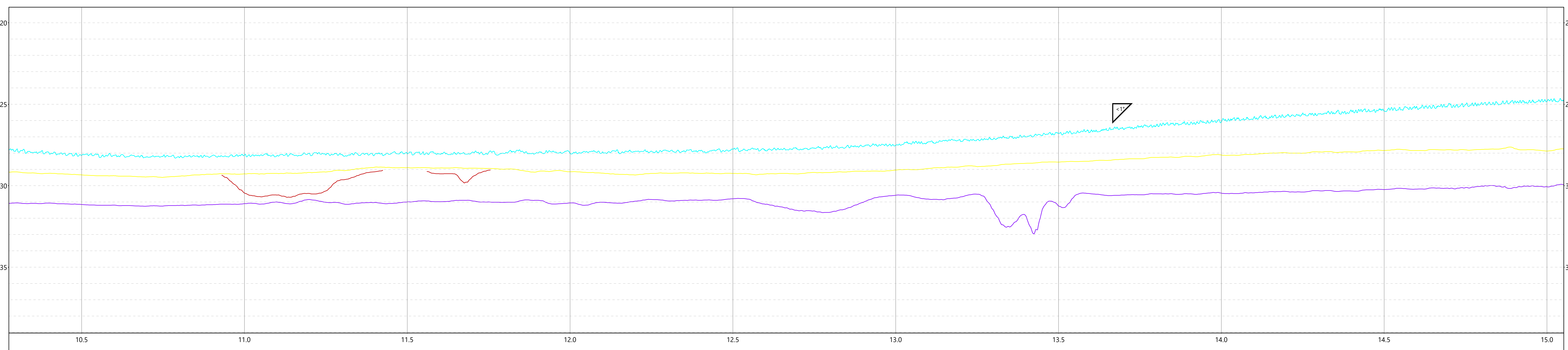
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

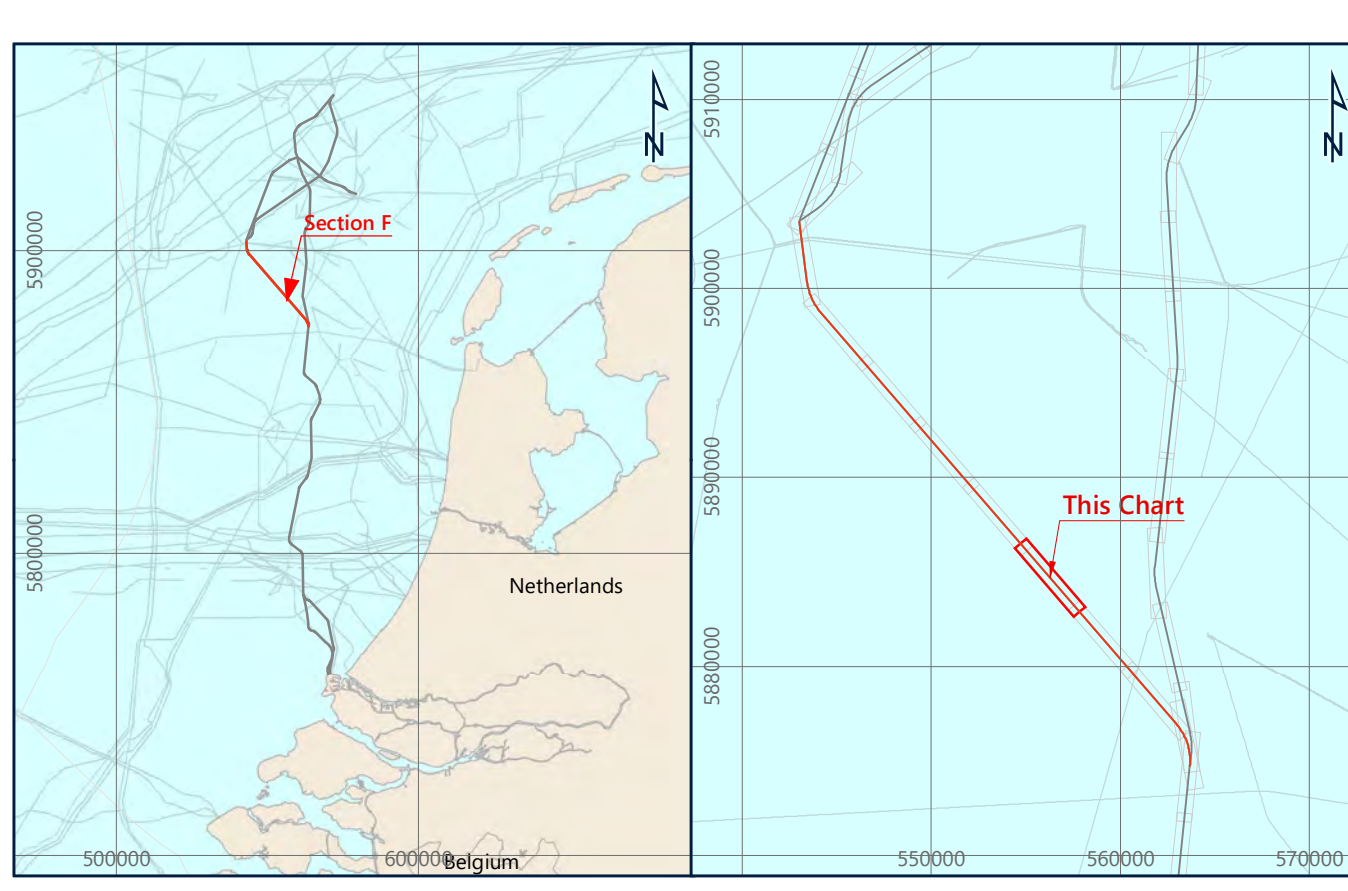
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG:25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 10.276 TO KP 15.051

Scale 1 : 5,000 at original A0 page size

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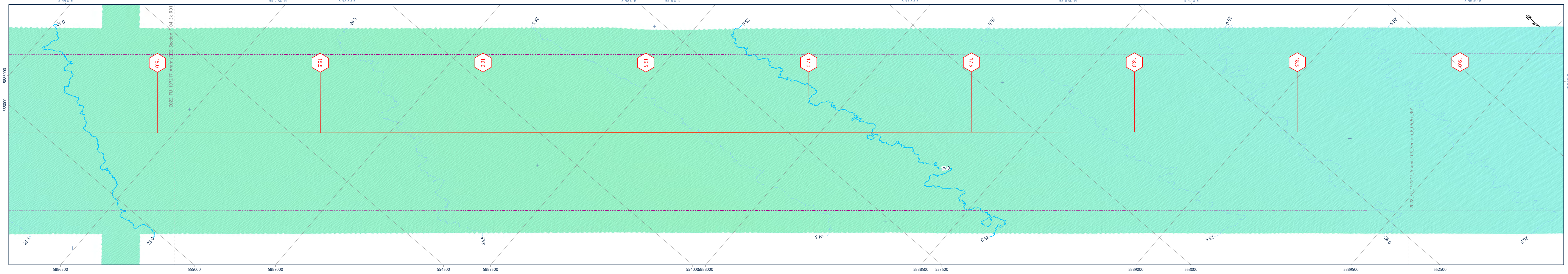
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01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

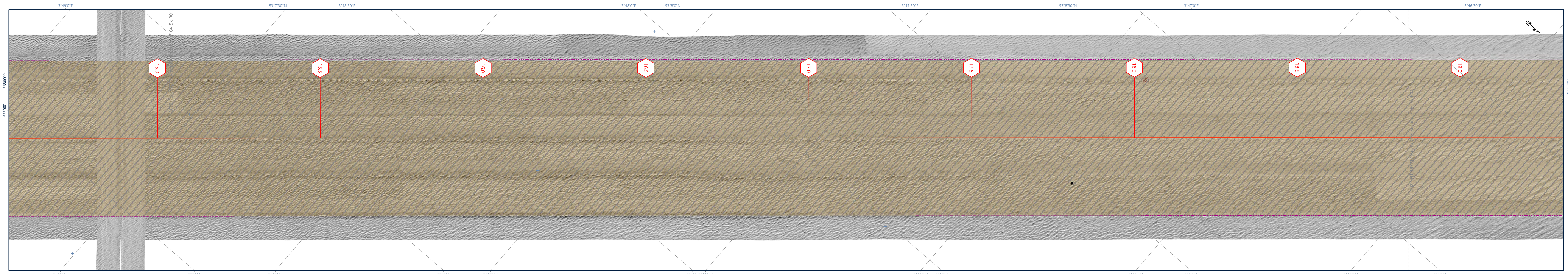
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 Chart No. 04 of 09  
 Enclosure 069 of 105



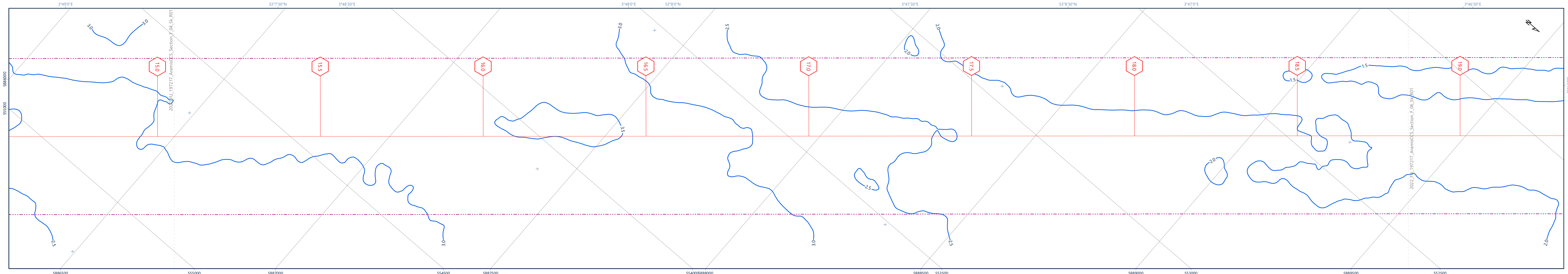
BATHYMETRY



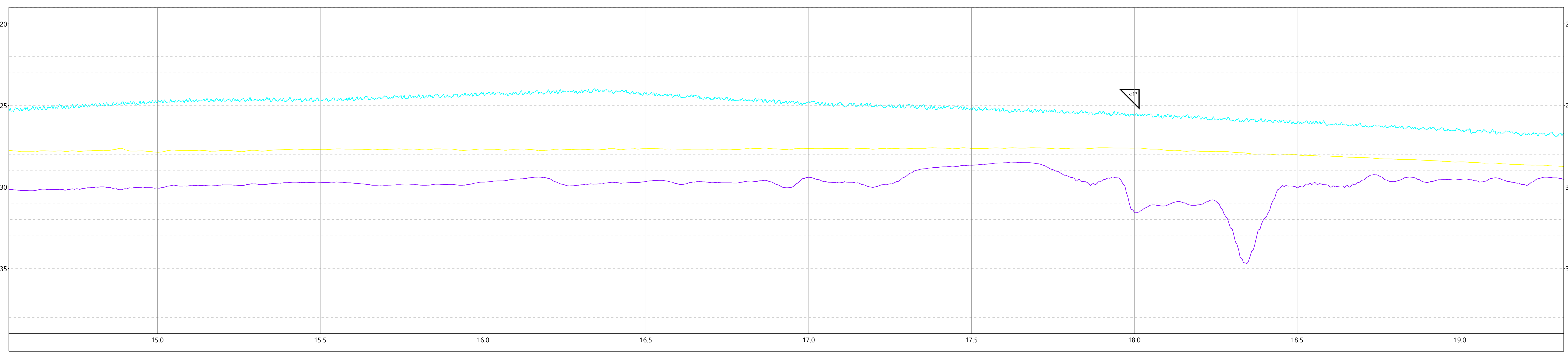
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

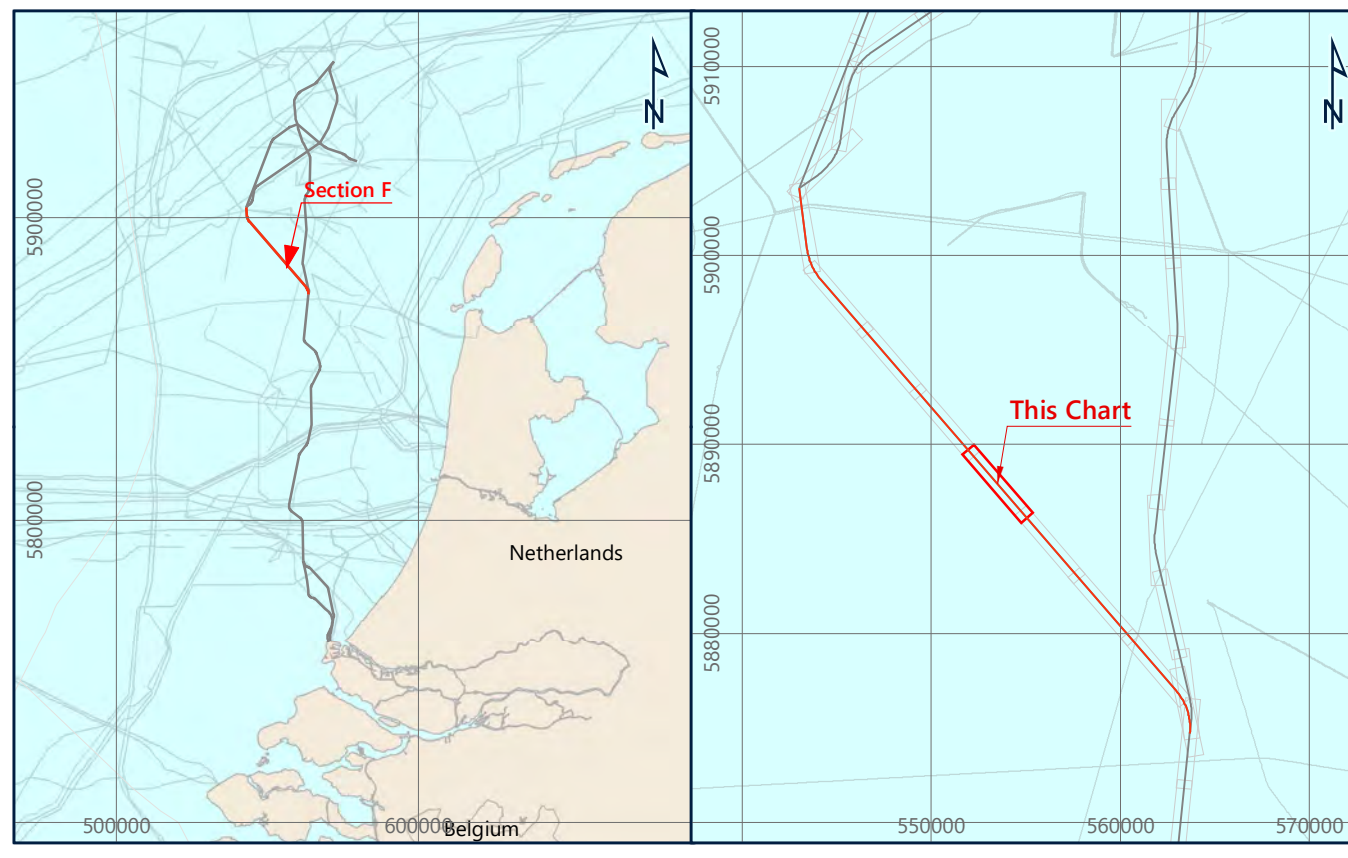
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
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**GEODETTIC PARAMETERS**

GEODETTIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)



**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 14.543 TO KP 19.318

Scale 1 : 5,000 at original A0 page size

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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

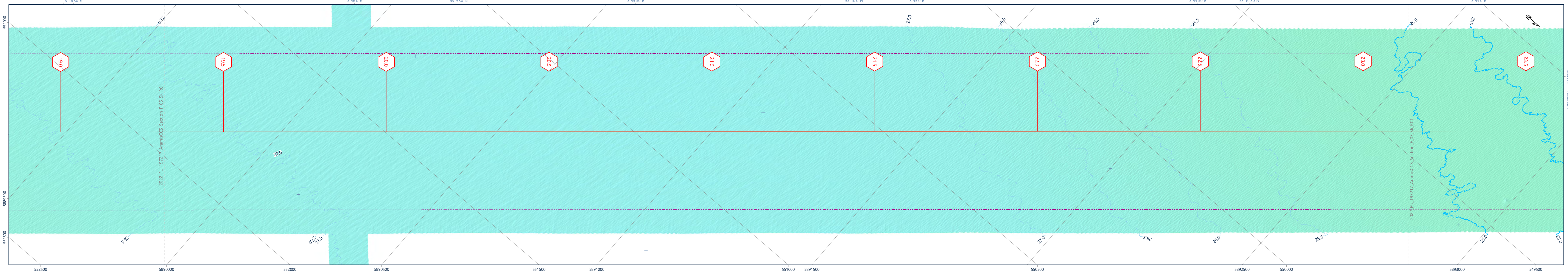
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

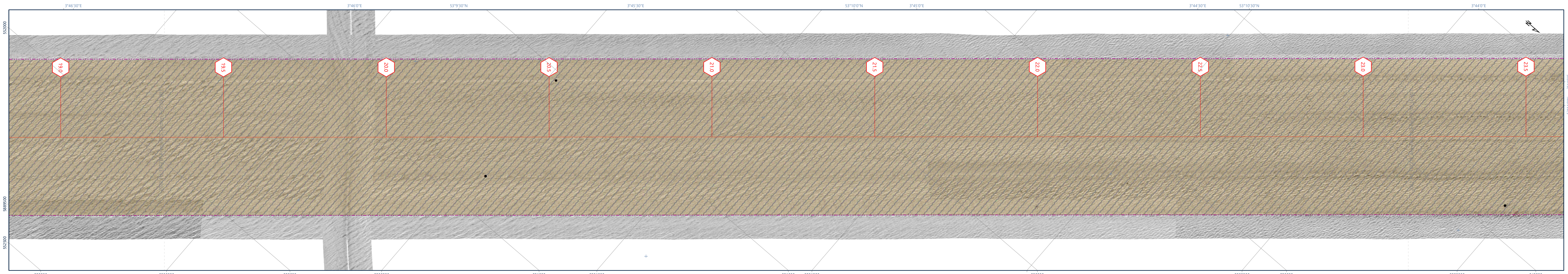
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 Chart No. 05 of 09  
 Enclosure 070 of 105



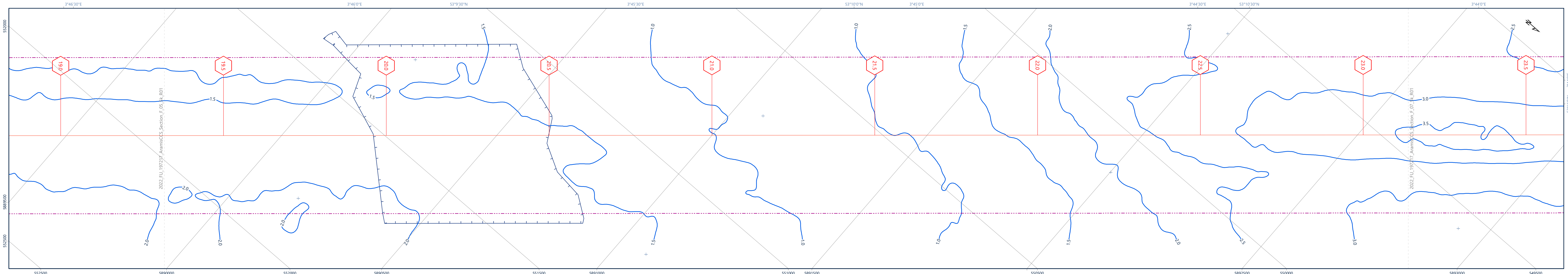
BATHYMETRY



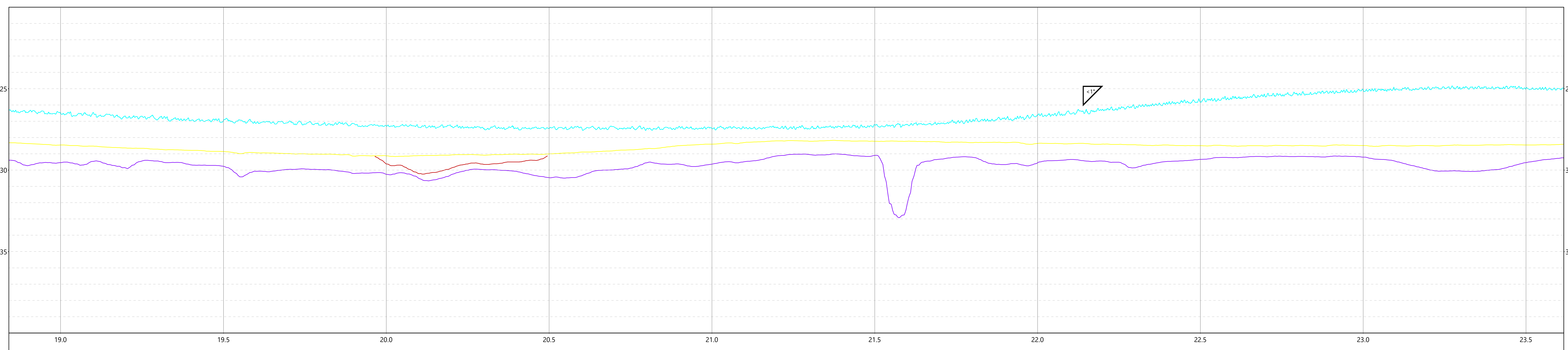
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

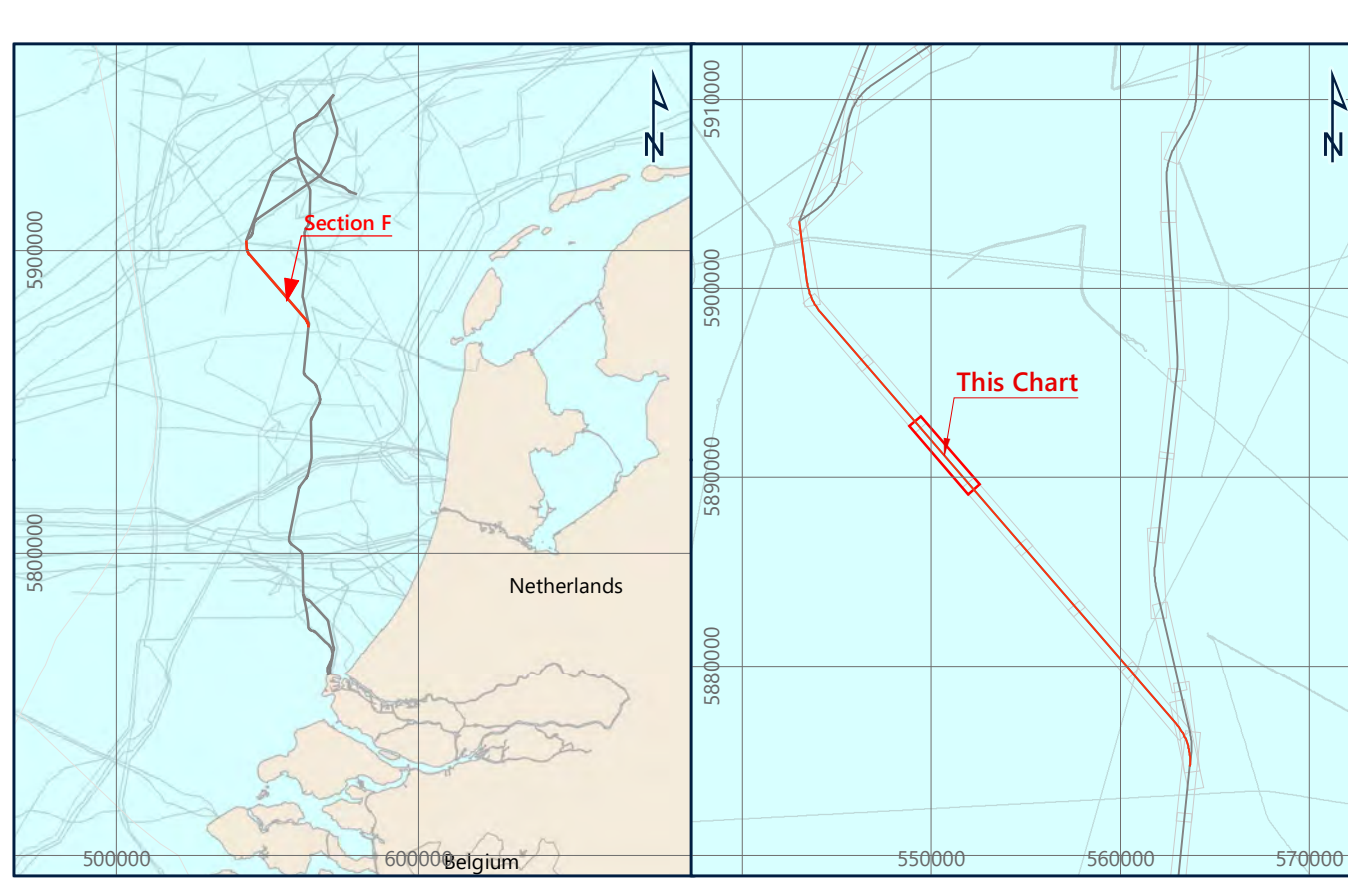
**NOTES**

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**GEODETIC PARAMETERS**

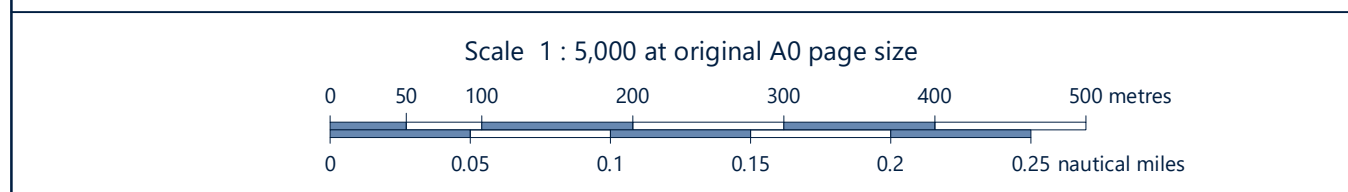
GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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 Aramis Road 25, 2160 Coornwaggen, Denmark  
<https://totalenergies.com/>

**FUGRO**  
 Prinsenvaart 4, 2611 RT Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 18.841 TO KP 23.616



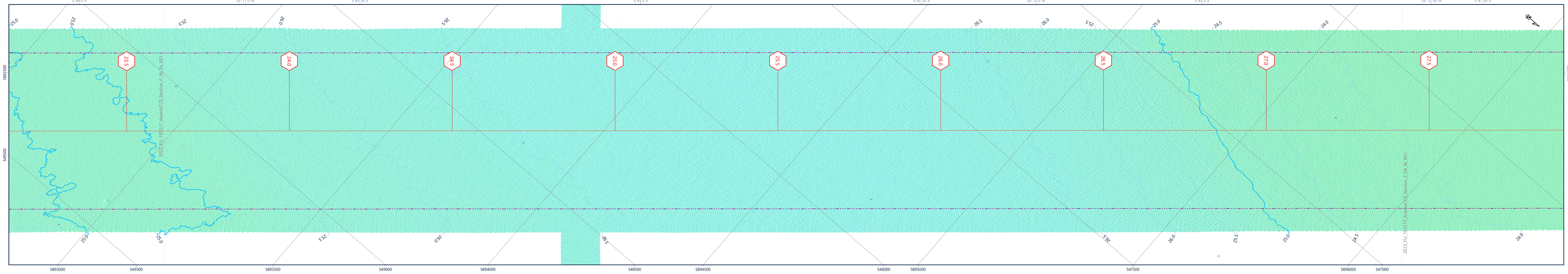
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

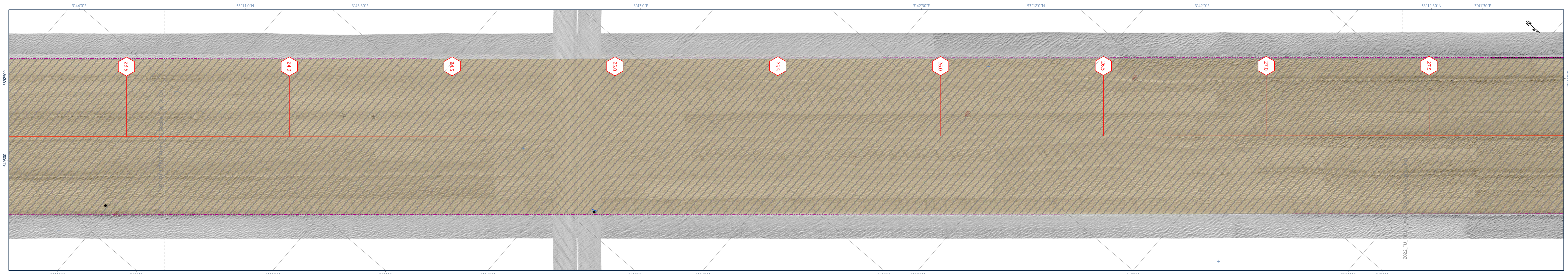
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 Chart No. 06 of 09  
 Enclosure 071 of 105



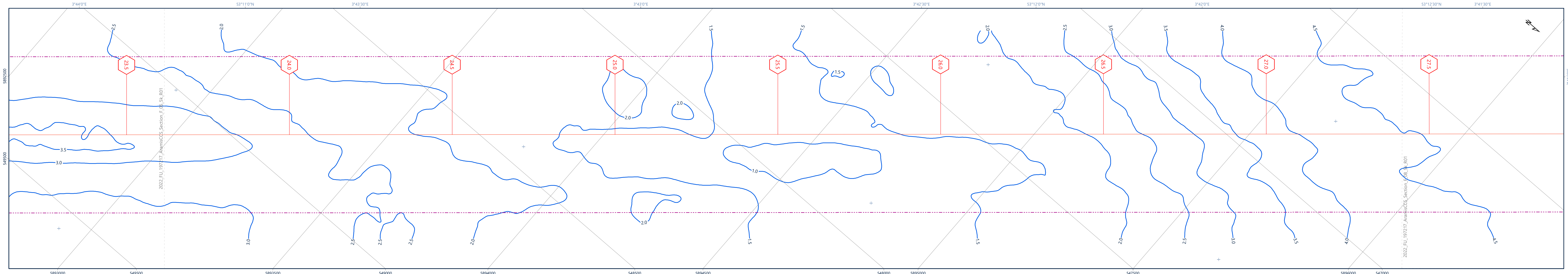
BATHYMETRY



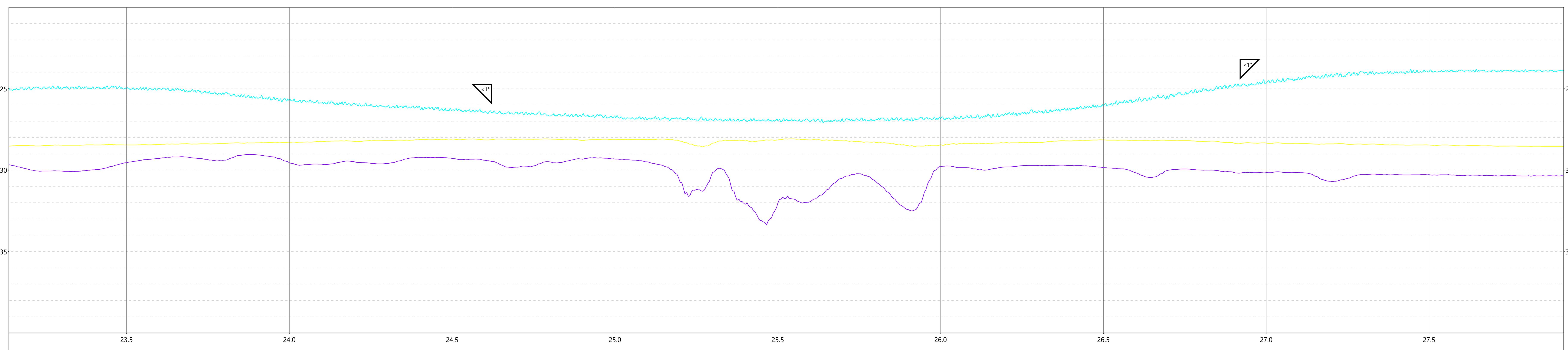
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

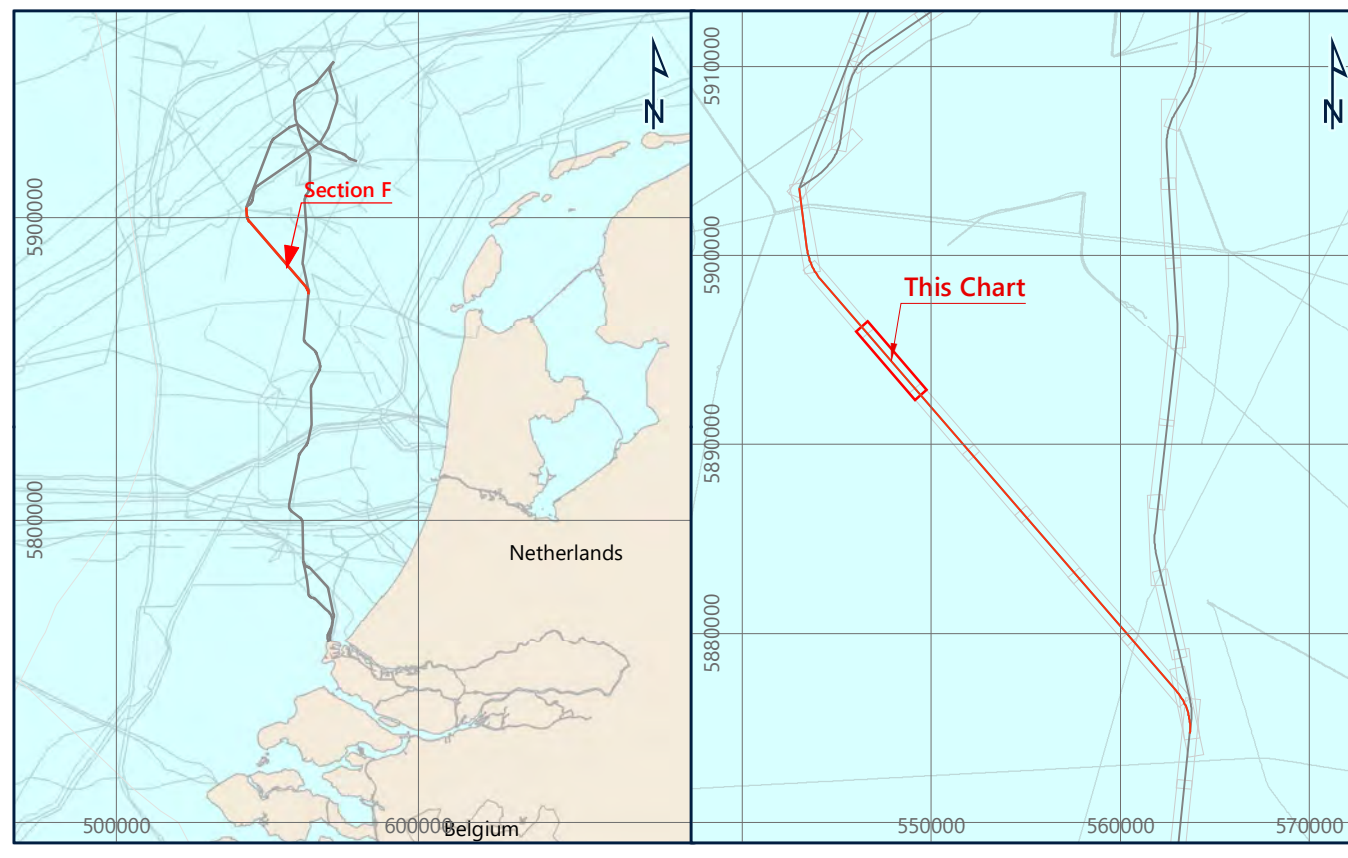
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
  - All depths were reduced to LAT using the NL LAT 2018 model.
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  - All the linear targets of potentially anthropogenic origin were included in the MMO LIN subset. These consist of SSS targets measuring at least 5.0 m in length and MAG anomalies following linear trend.
  - Magnetic anomalies measuring at least 10.0 nT in peak to peak amplitude were picked using the Blakely Test.
  - The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 23.138 TO KP 27.913

Scale 1 : 5,000 at original A0 page size

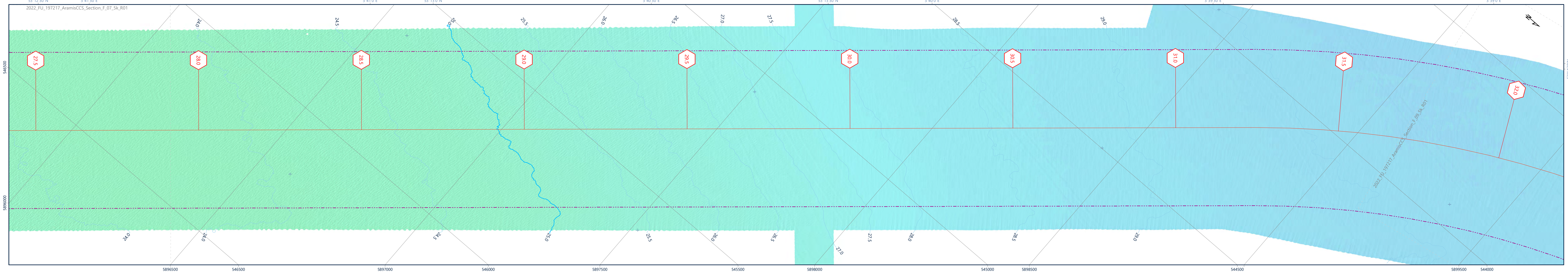
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01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

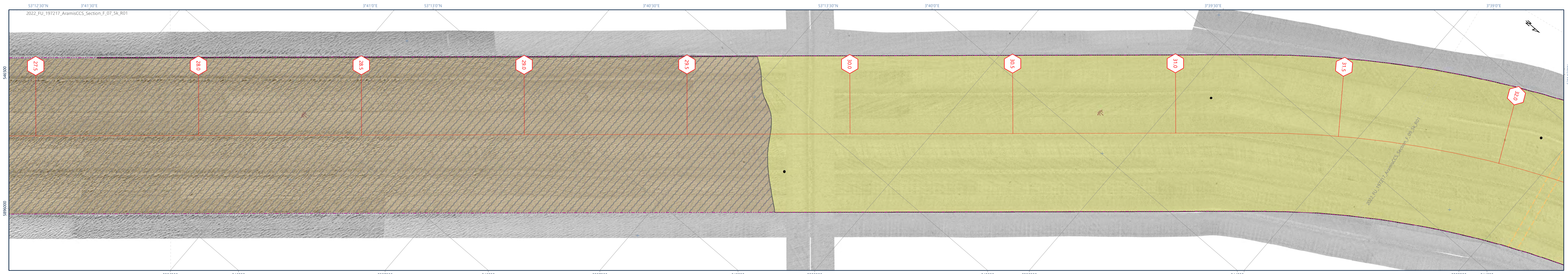
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 Chart No. 07 of 09  
 Enclosure 072 of 105



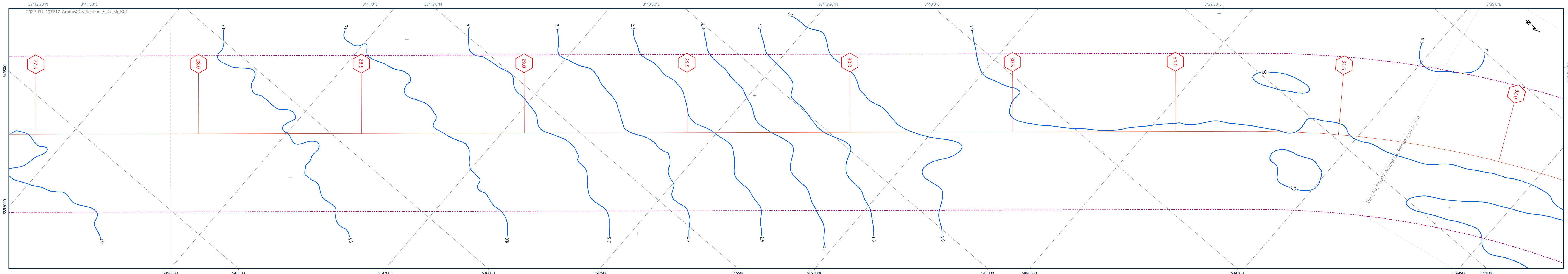
BATHYMETRY



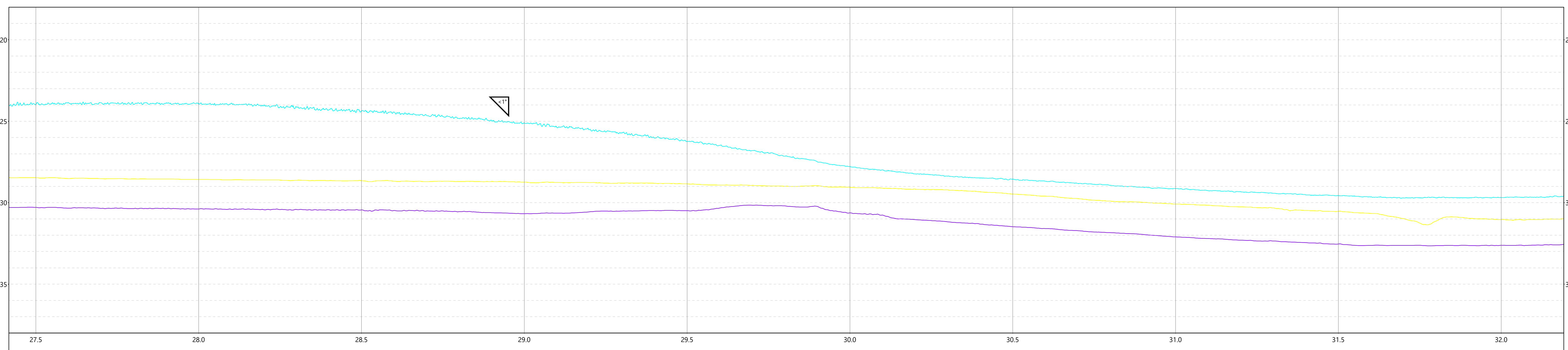
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Water Depth (m LAT)**

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

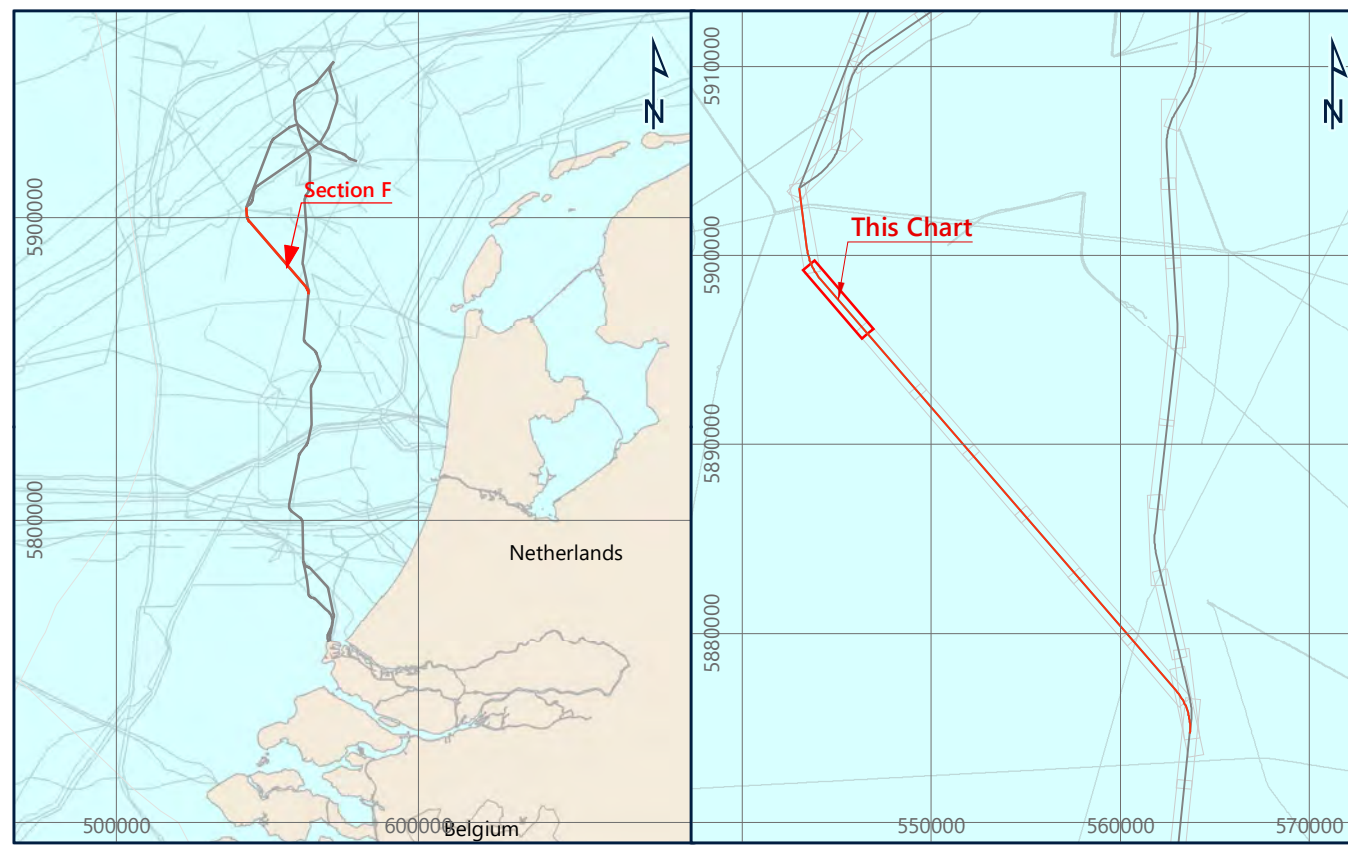
**Other Symbols:**

- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 27.417 TO KP 32.208

Scale 1 : 5,000 at original A0 page size

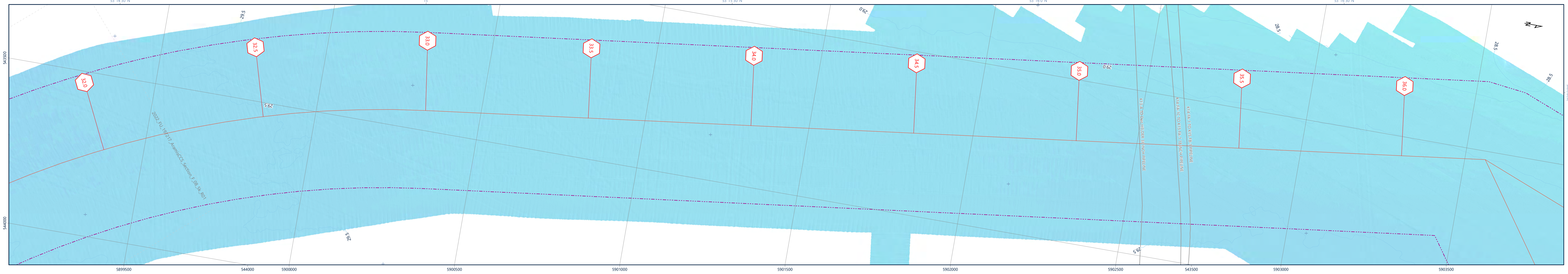
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

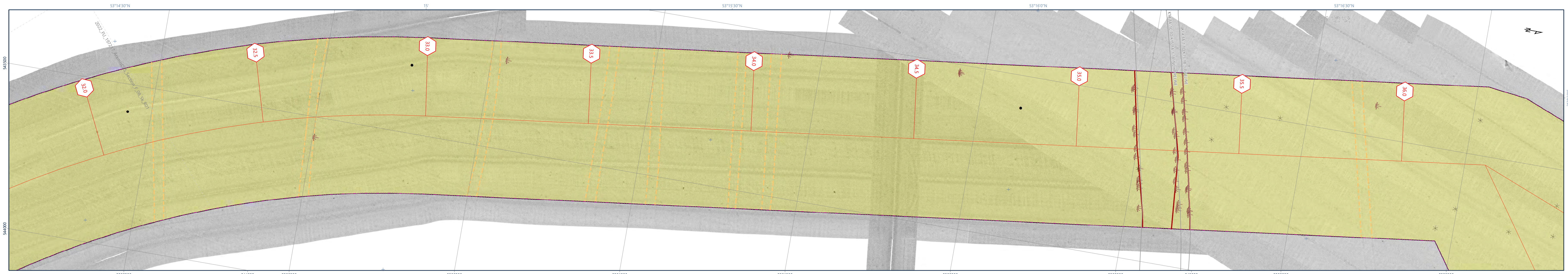
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 Chart No. 08 of 09  
 Enclosure 073 of 105



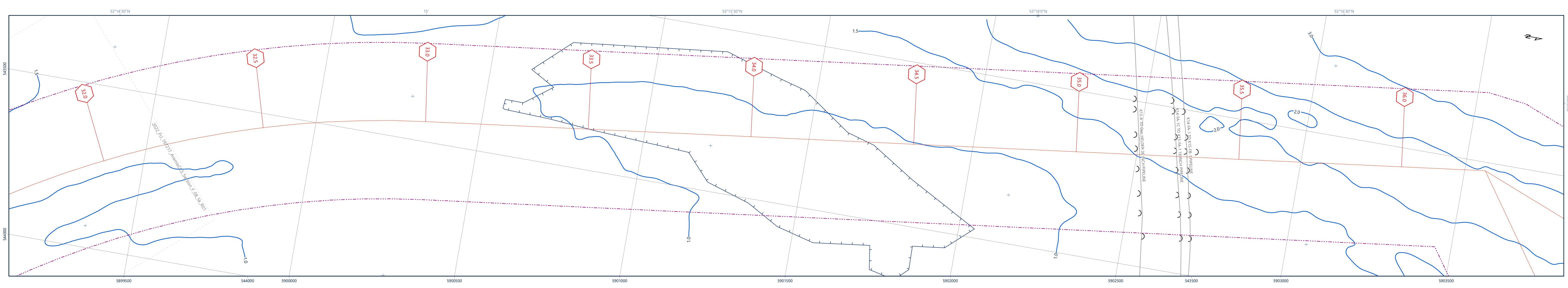
BATHYMETRY



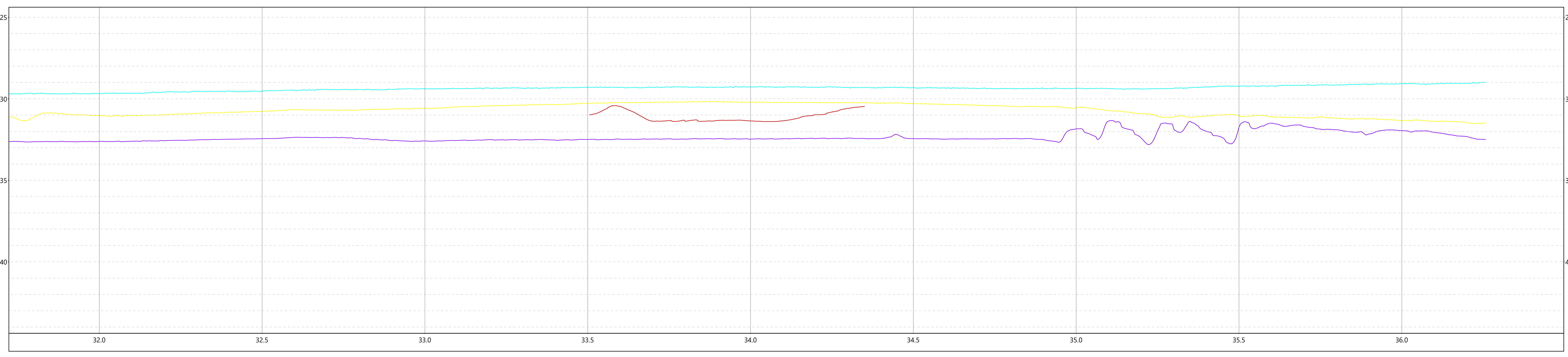
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silt - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

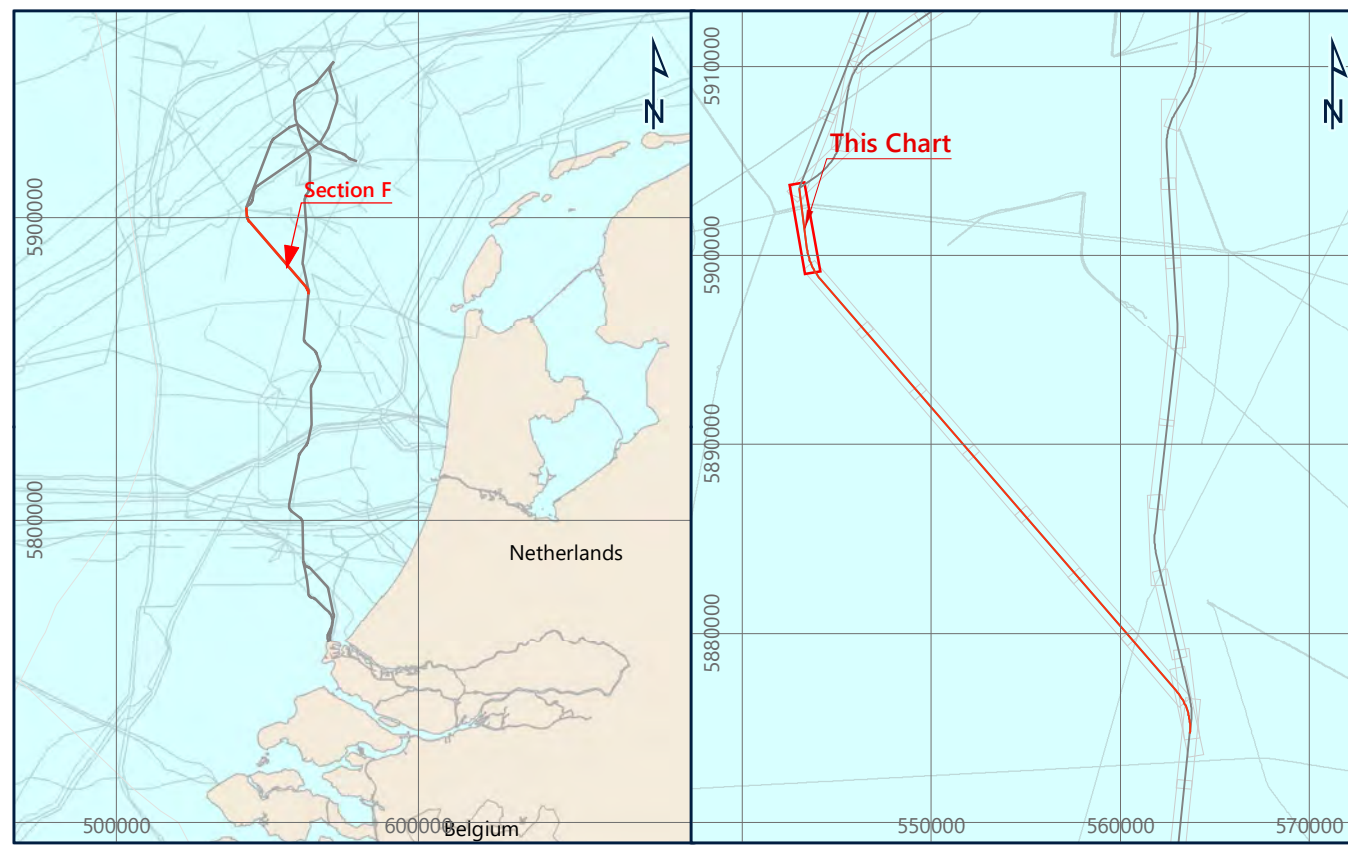
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION F, KP 31.690 TO KP 36.257

Scale 1 : 5,000 at original A0 page size

0 50 100 200 300 400 500 metres  
 0 0.05 0.1 0.15 0.2 0.25 nautical miles

Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

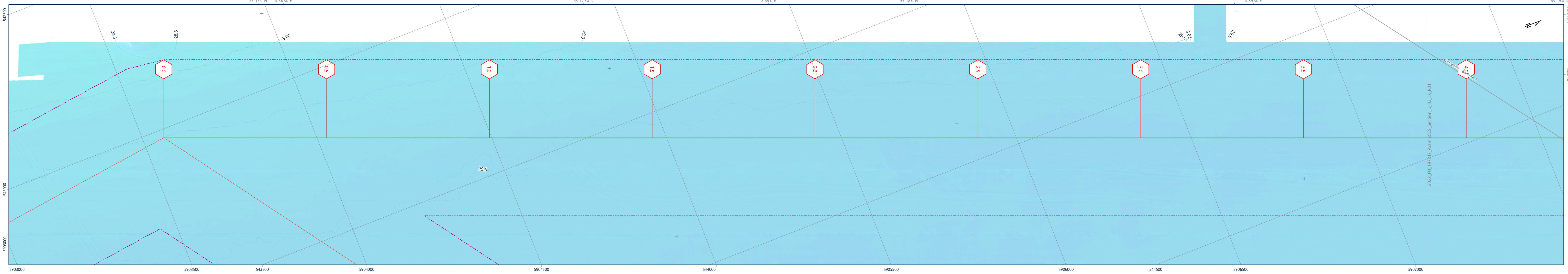
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 Chart No. 09 of 09  
 Enclosure 074 of 105



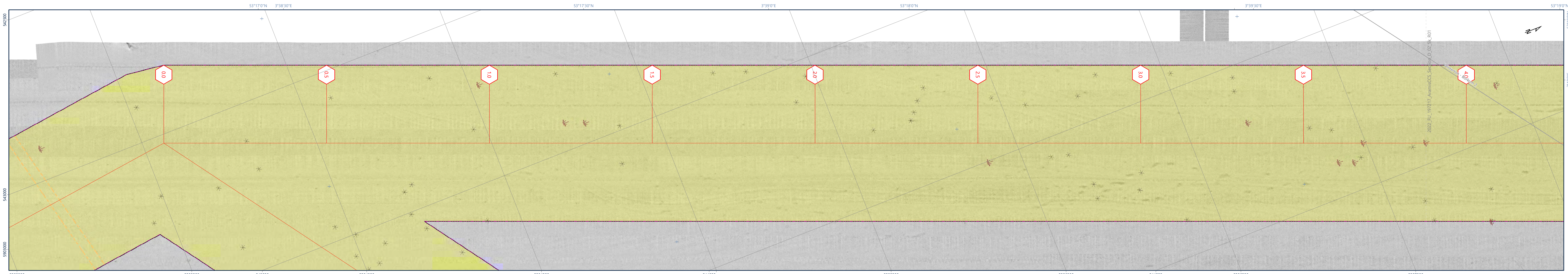
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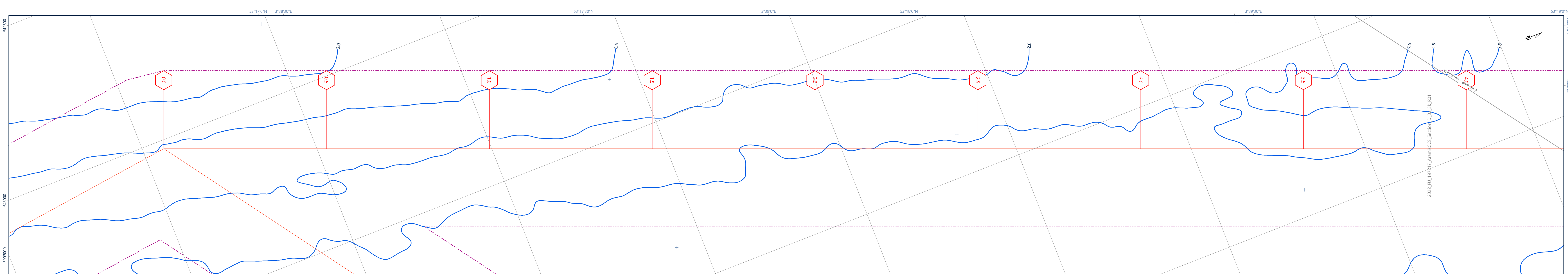
BATHYMETRY



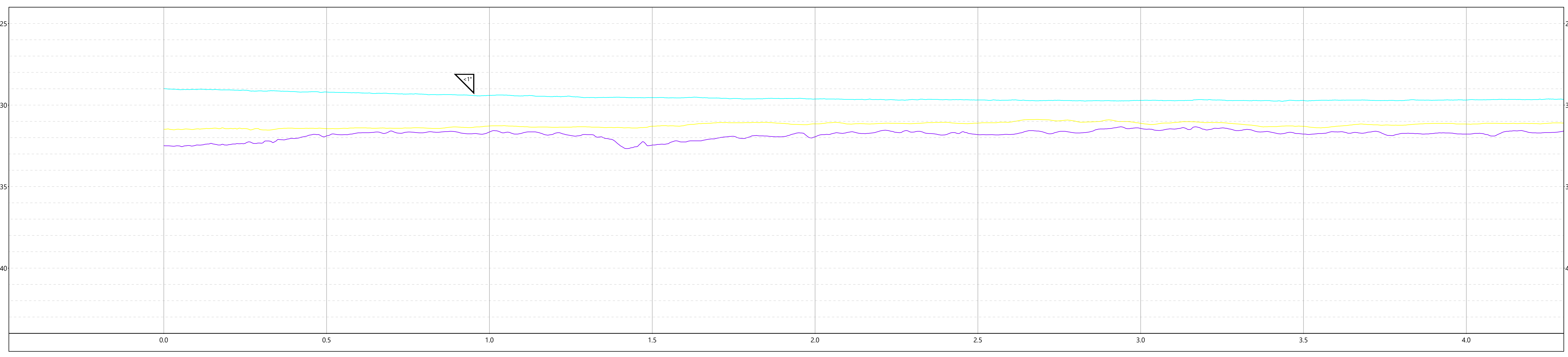
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

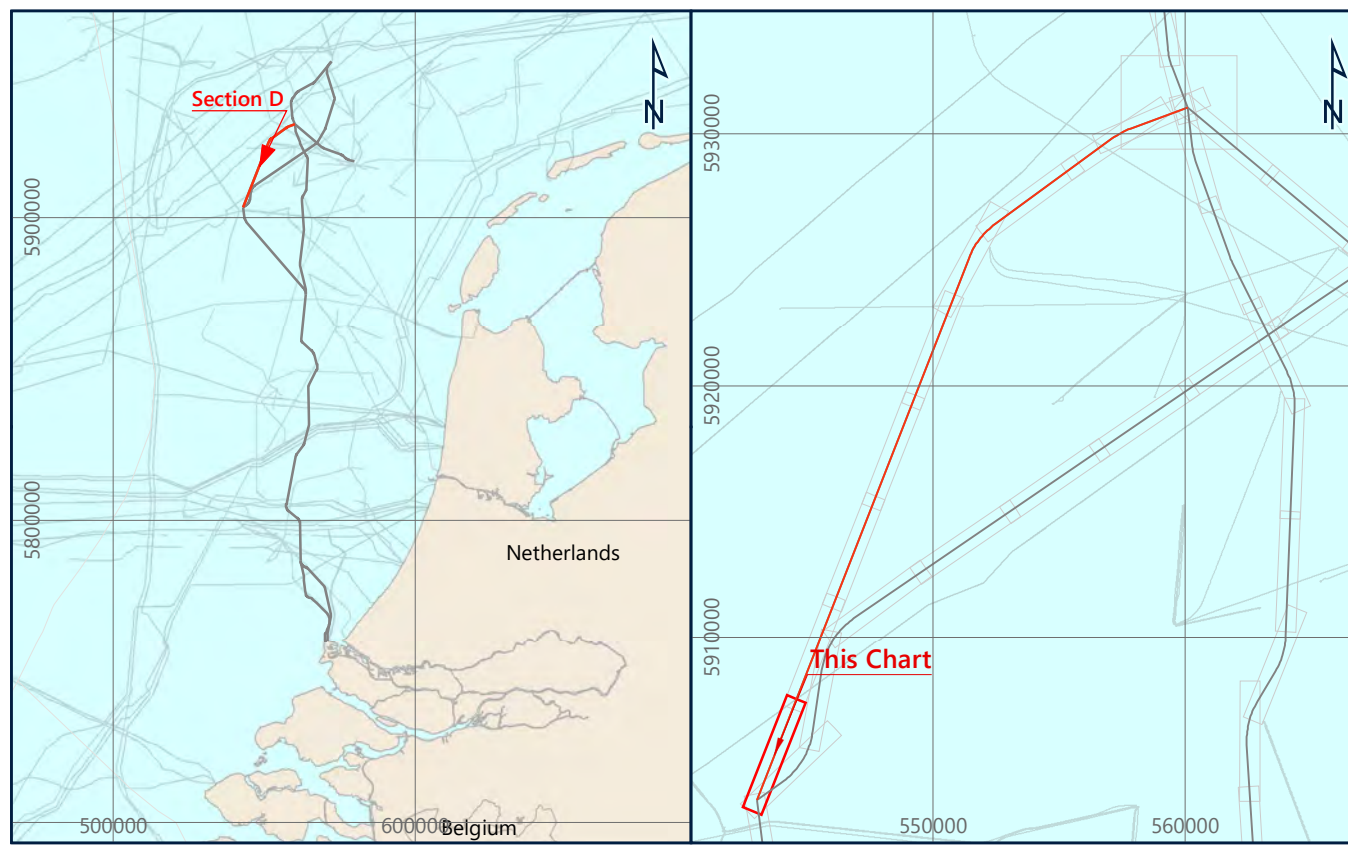
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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<https://totalenergies.com/>

**FUGRO**  
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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 0.000 TO KP 4.299

Scale 1 : 5,000 at original A0 page size

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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

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D1	13/04/2023	Complete	AB	MB	MS	AD

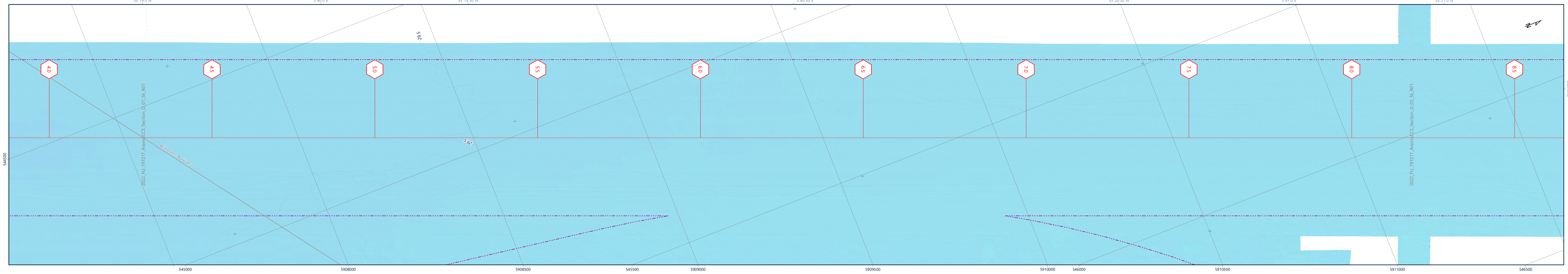
Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

Chart Name: 2022\_FU\_197217\_AramisCCS\_Section\_D\_01\_SK\_R01  
 Chart No. 01 of 09  
 Enclosure 075 of 105

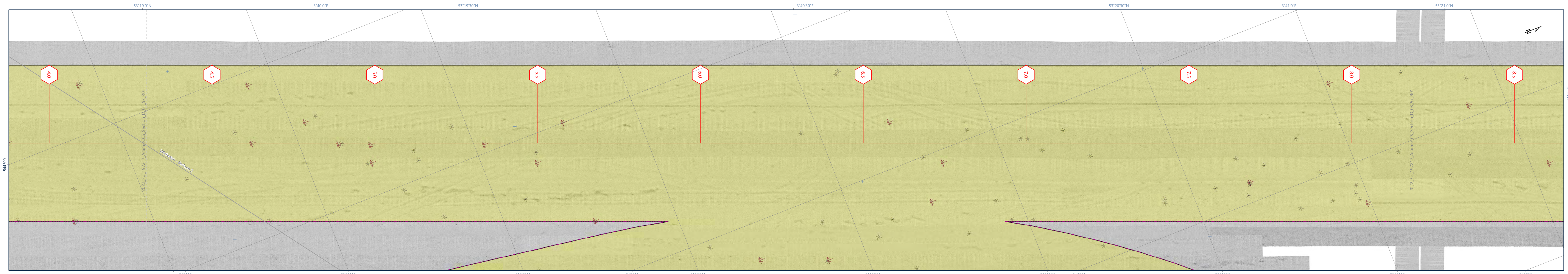
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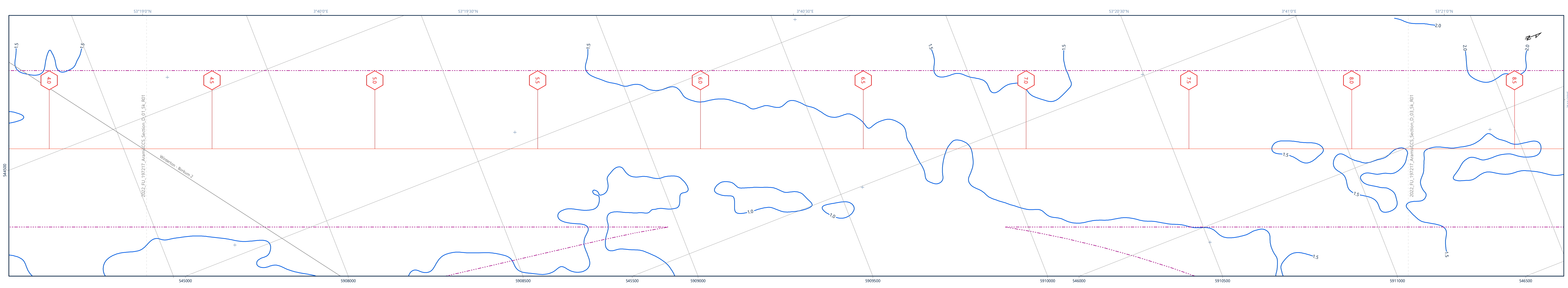
BATHYMETRY



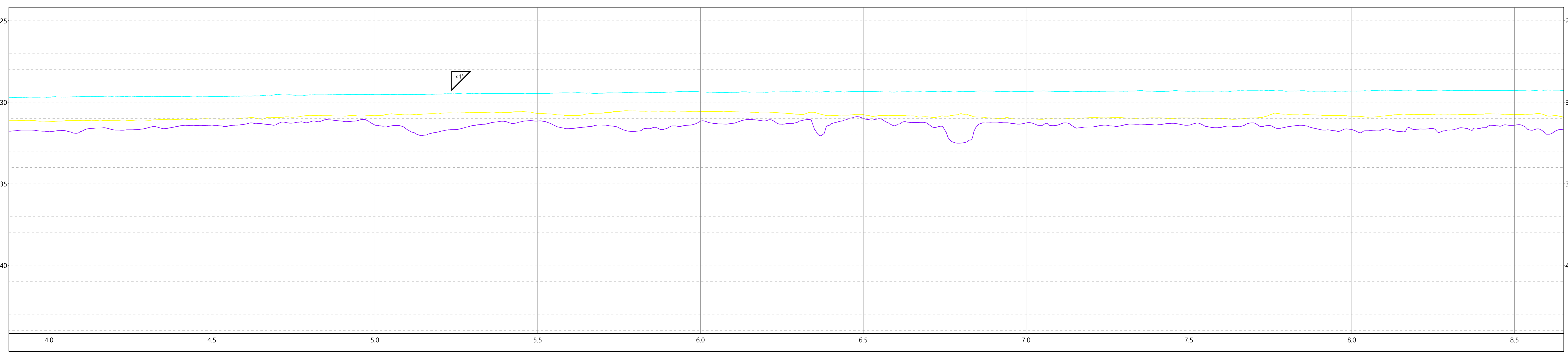
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
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- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Sea-floor Gradient

**NOTES**

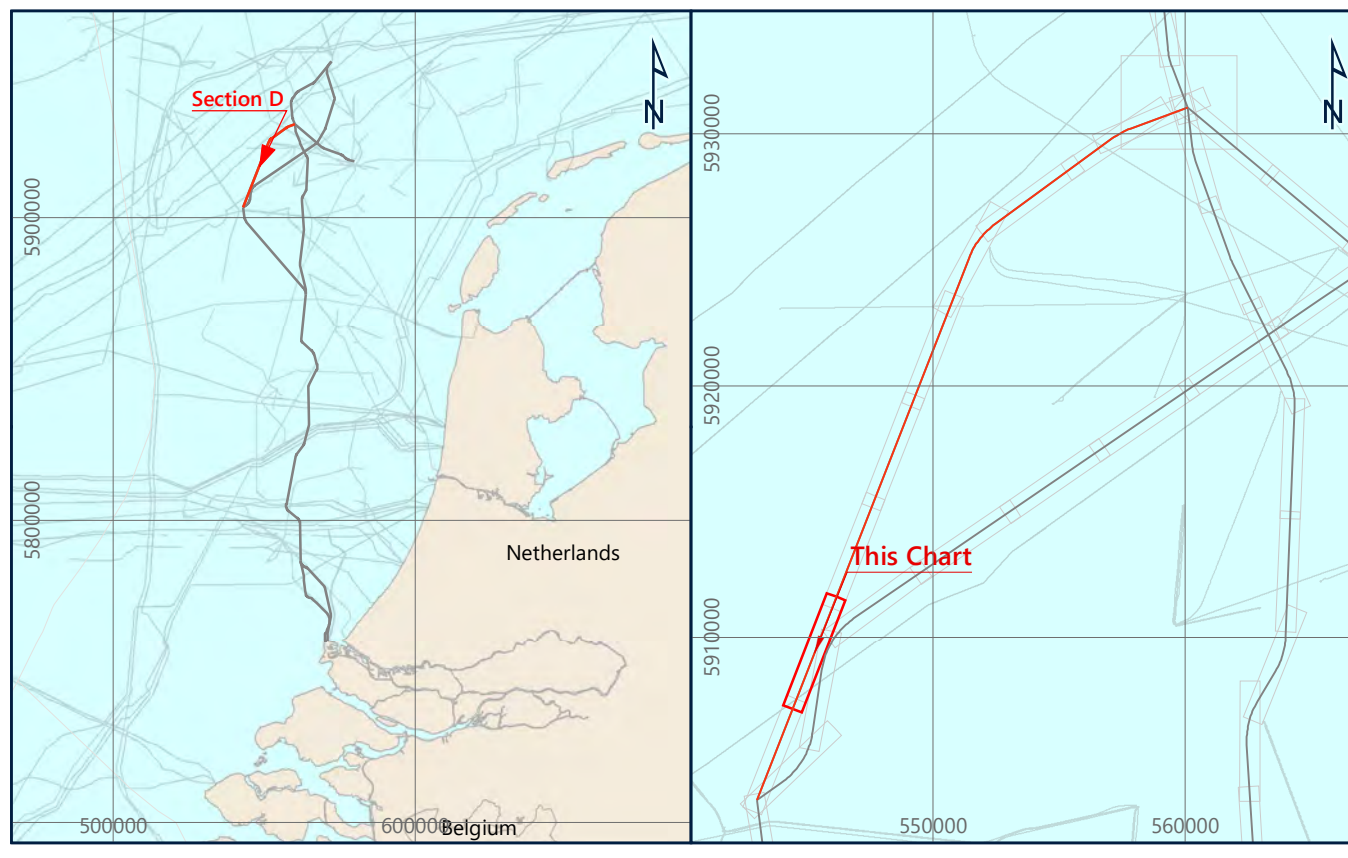
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

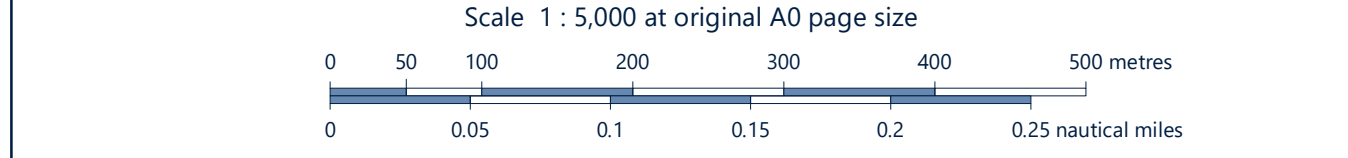
GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



**TotalEnergies Upstream Denmark A/S**  
 Arniebo Havn 25, 7100 Coerntenag, Denmark  
<https://totalenergies.com/>

**FUGRO**  
 Prinsenvaart 4, 2611 RT Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 3.876 TO KP 8.651



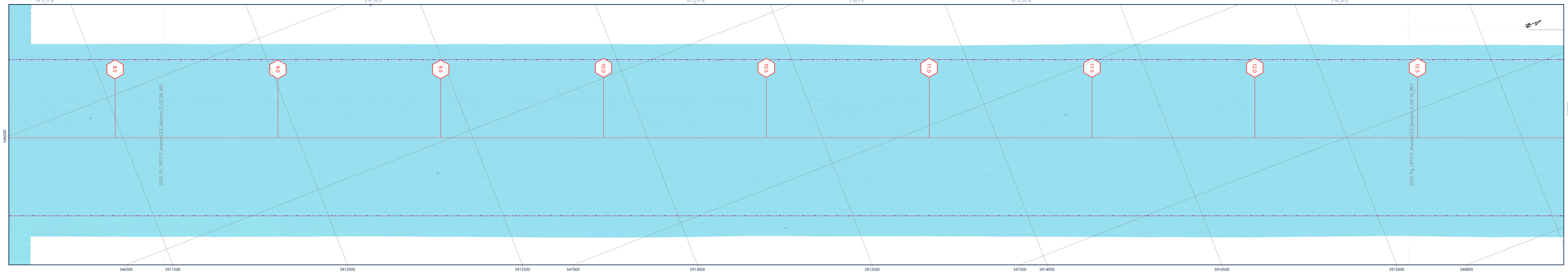
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

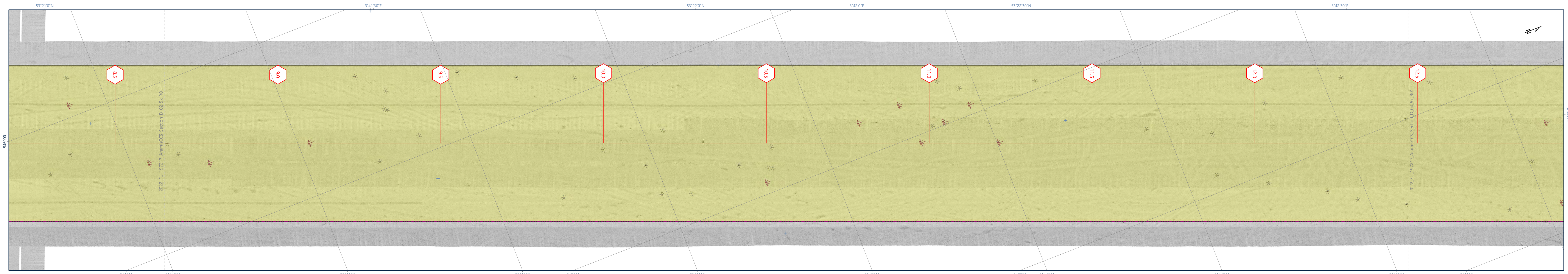
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 Chart No. 02 of 09  
 Enclosure 076 of 105



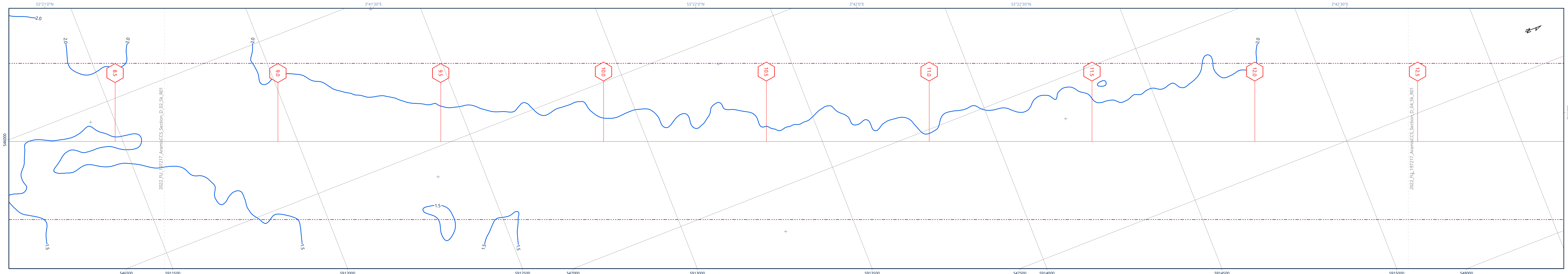
BATHYMETRY



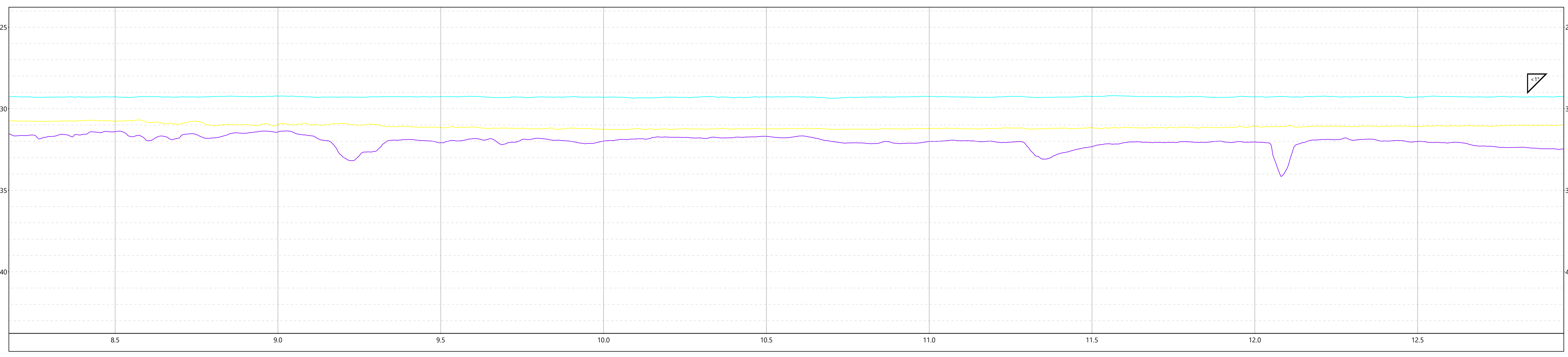
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

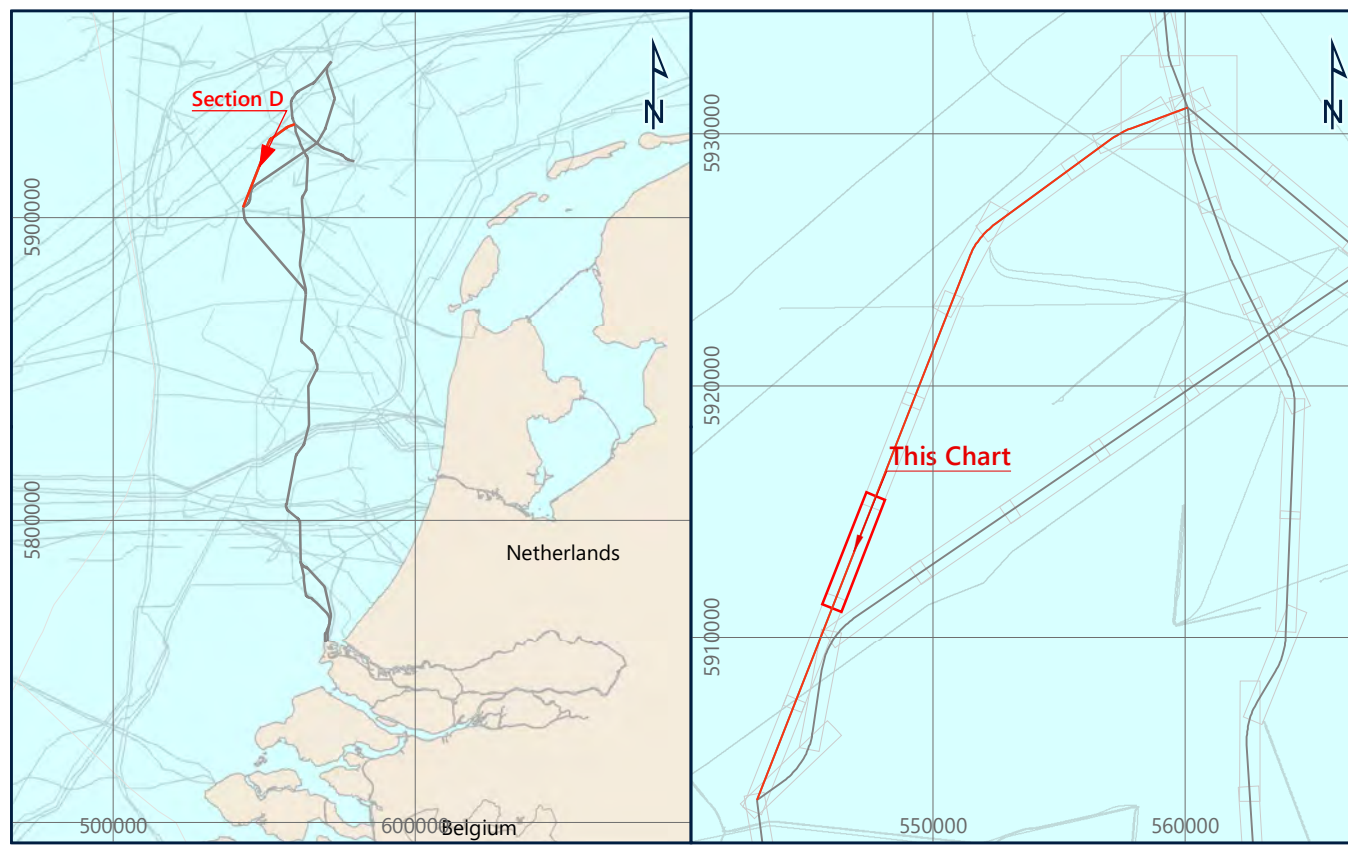
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.

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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 8.174 TO KP 12.949

Scale 1 : 5,000 at original A0 page size

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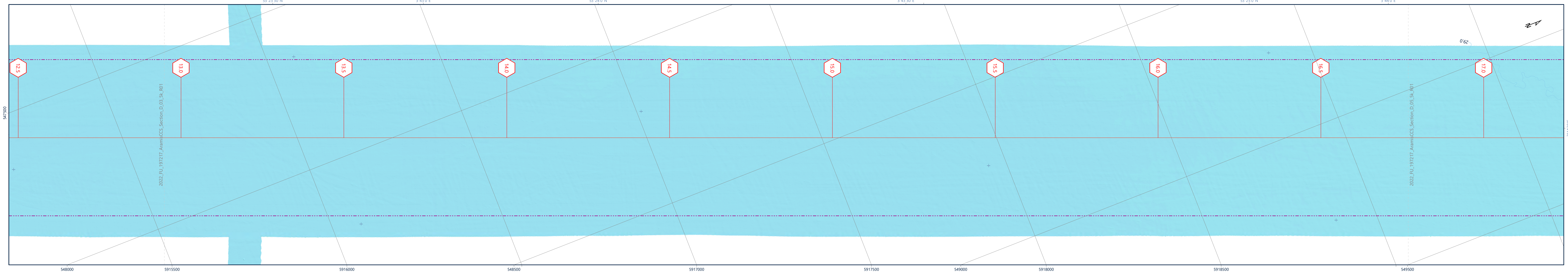
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

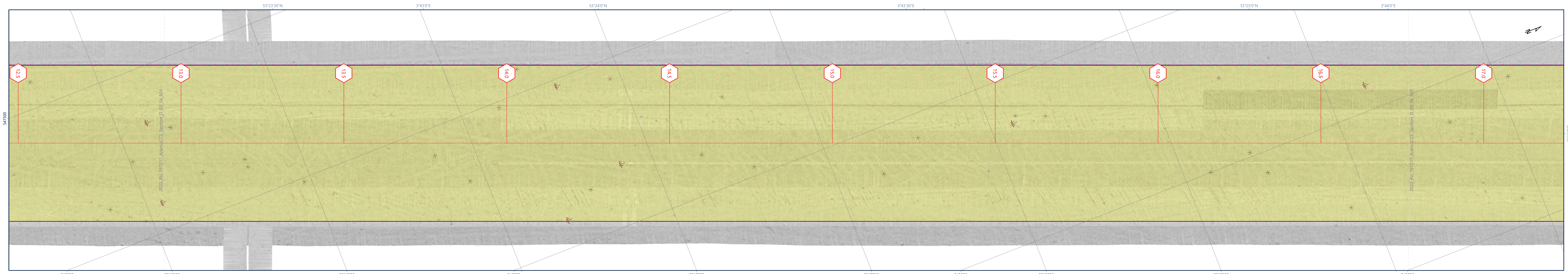
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 Chart No. 03 of 09  
 Enclosure 077 of 105



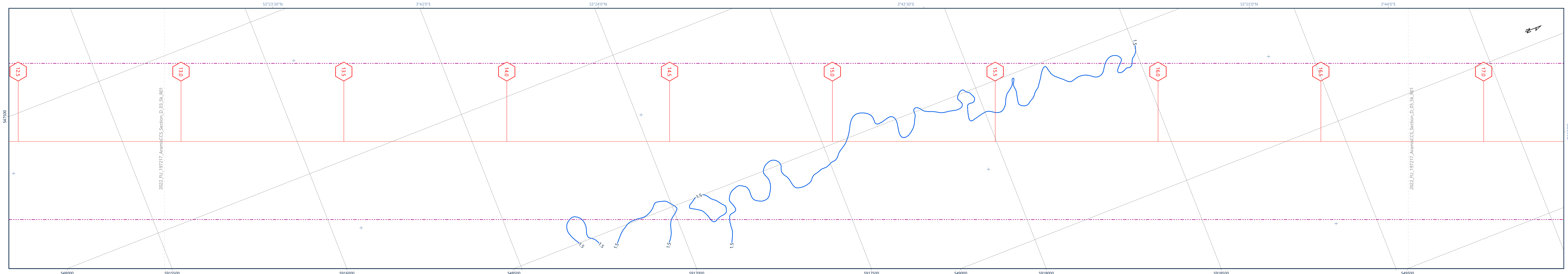
BATHYMETRY



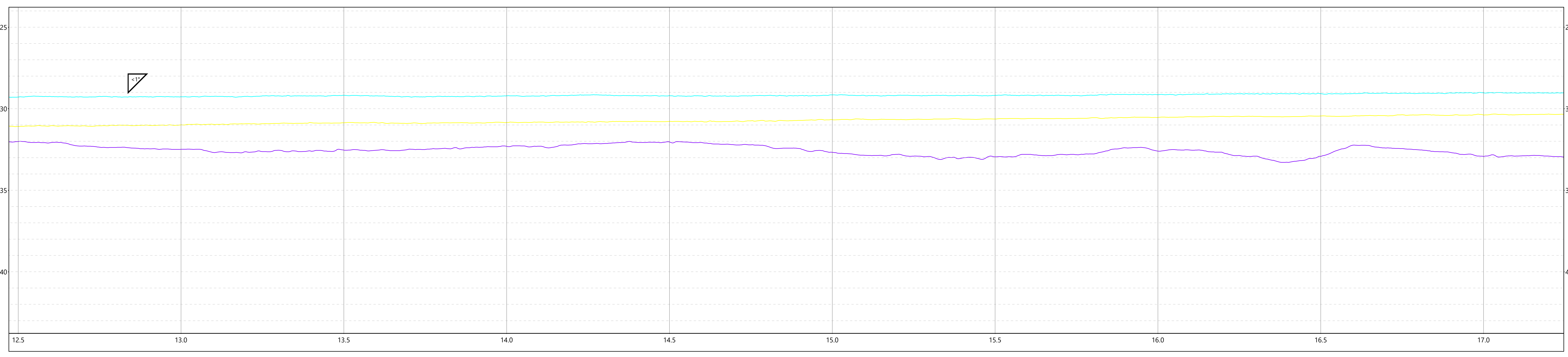
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

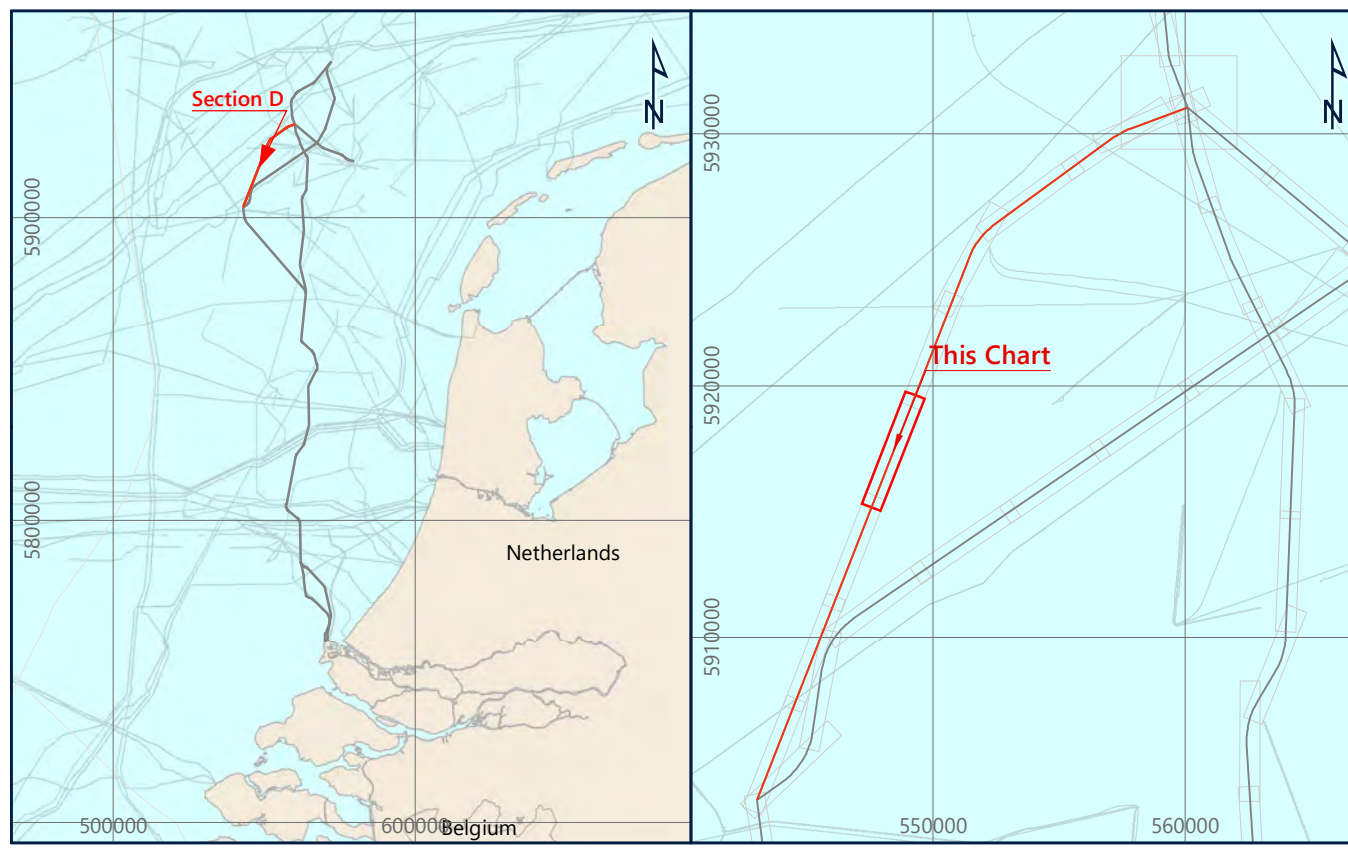
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 12.471 TO KP 17.246

Scale 1 : 5,000 at original A0 page size

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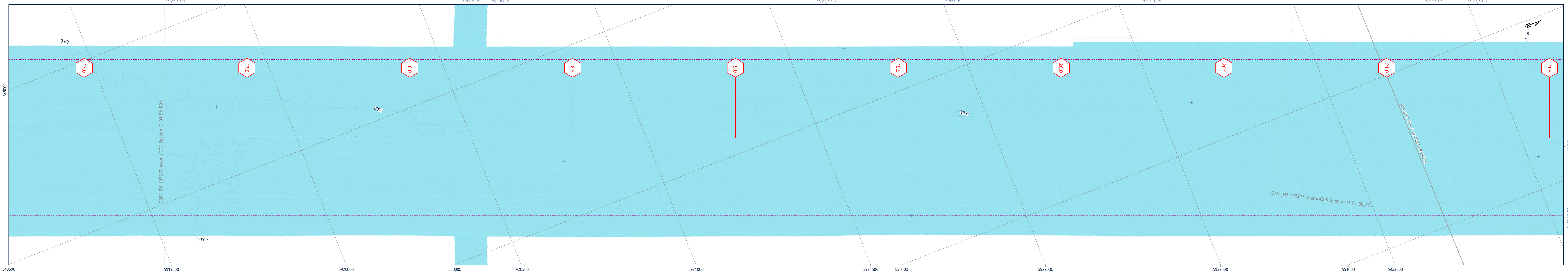
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01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

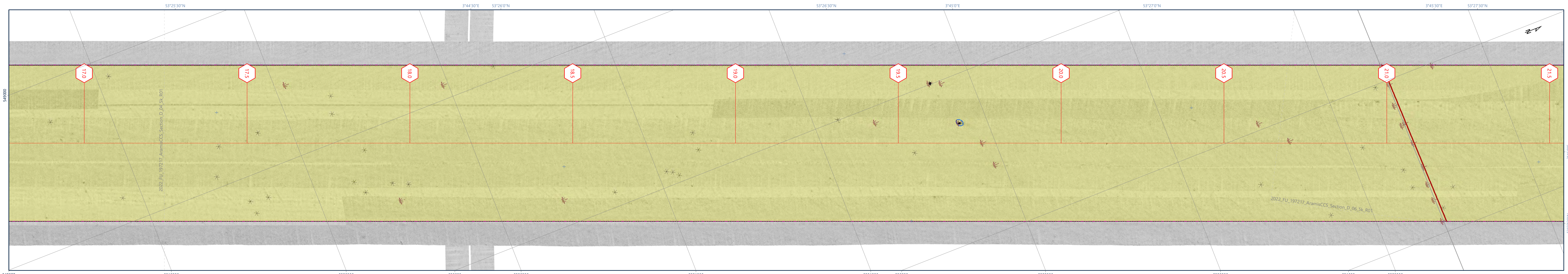
Chart Name: 2022\_FU\_197217\_AramisCCS\_Section\_D\_04\_SK\_R01  
 Chart No.: 04 of 09  
 Enclosure: 078 of 105



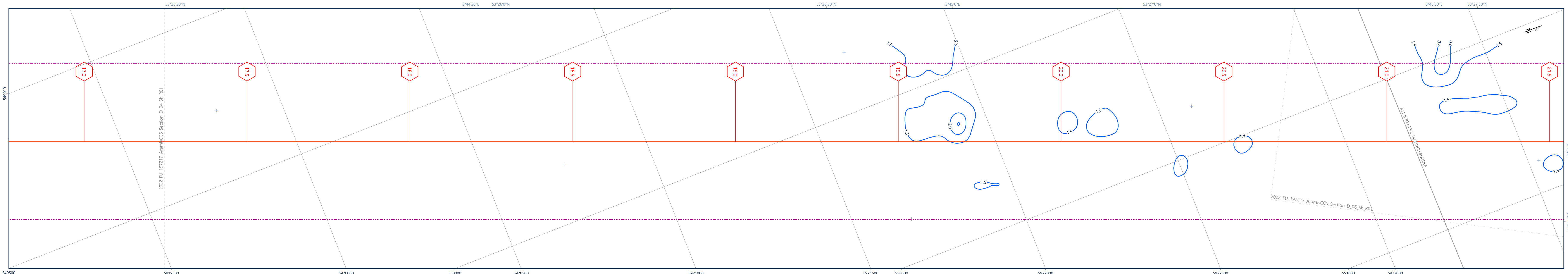
BATHYMETRY



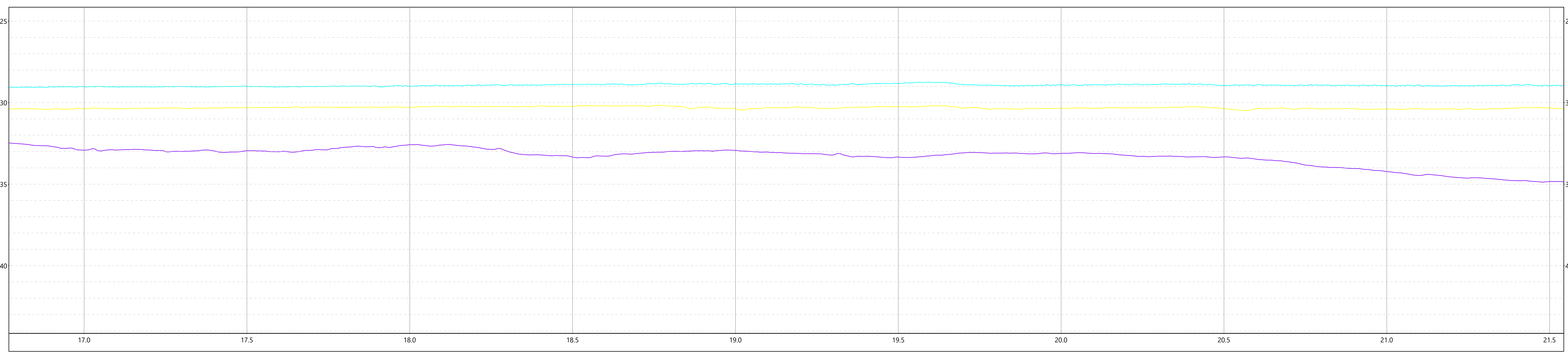
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Other
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

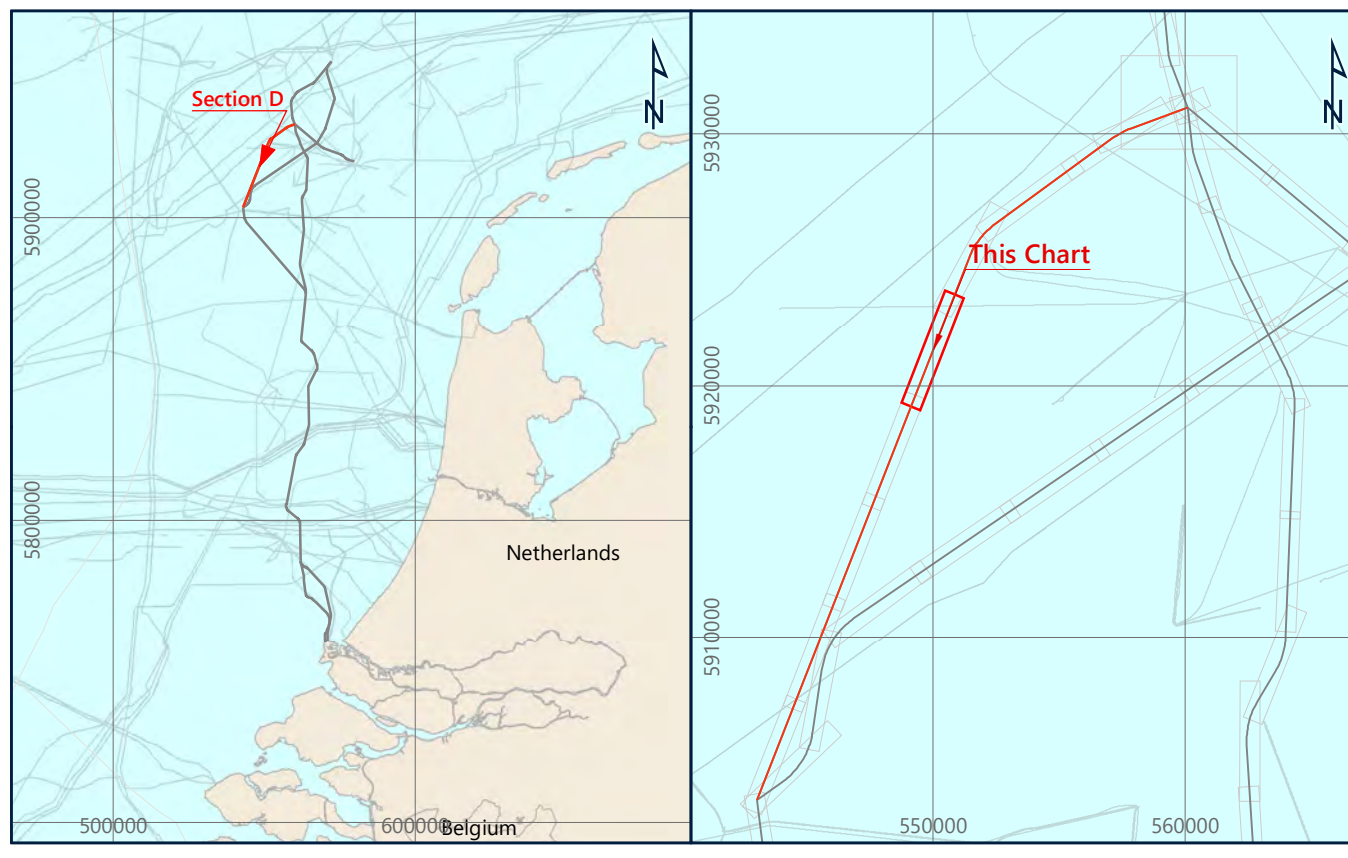
**NOTES**

- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.

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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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 Prinsstraat 4, 2031 RT Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 16.769 TO KP 21.544

Scale 1 : 5,000 at original A0 page size

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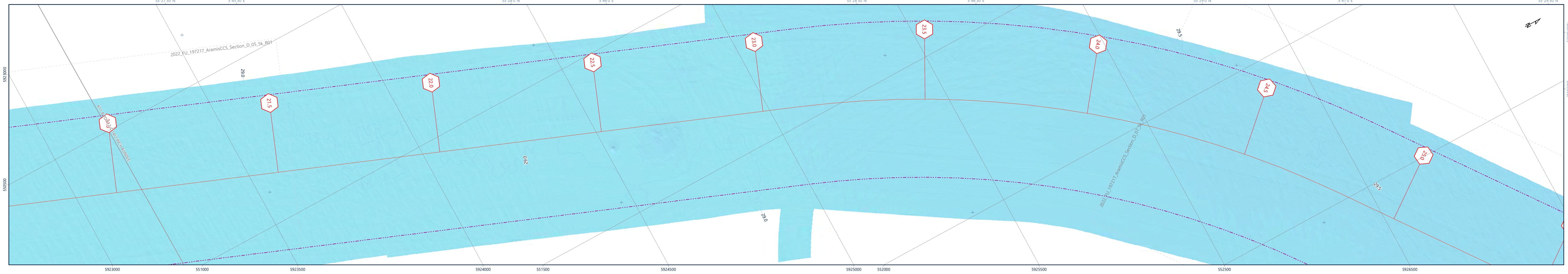
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_D\_05\_SK\_R01  
 Chart No. 05 of 09  
 Enclosure 079 of 105



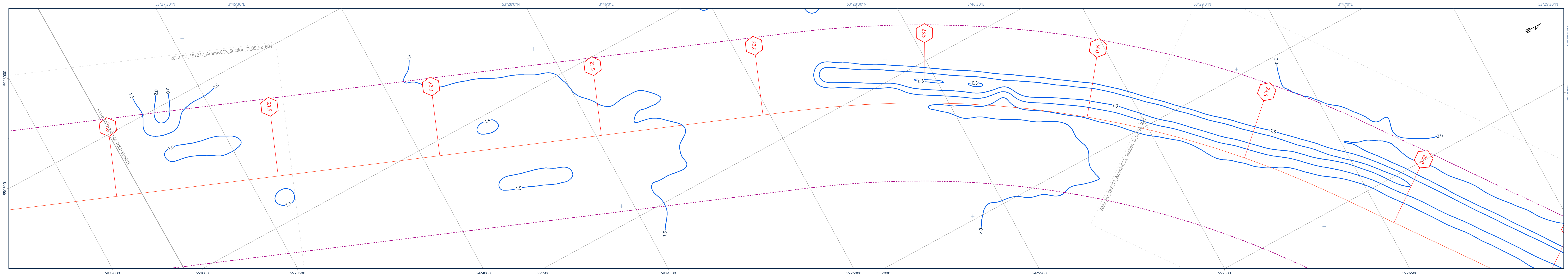
BATHYMETRY



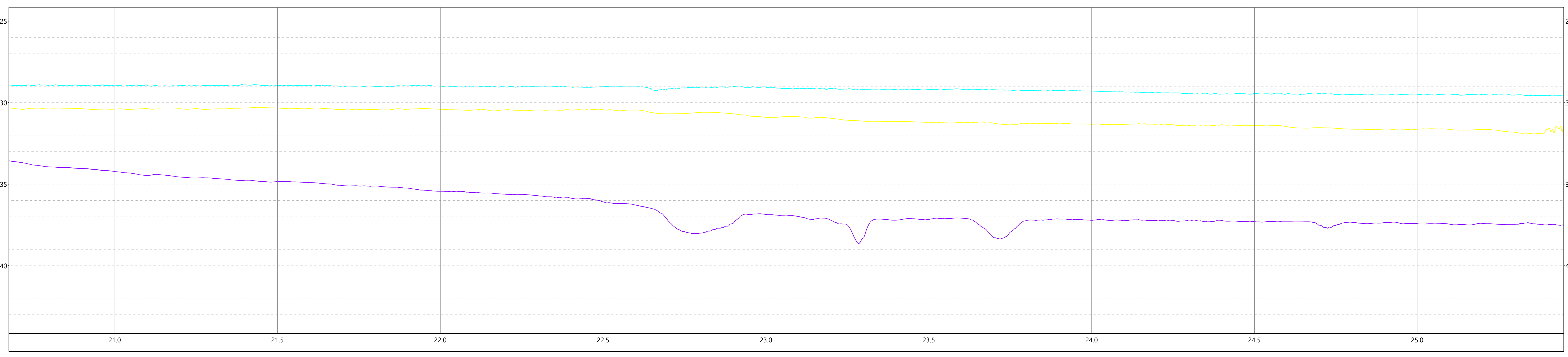
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

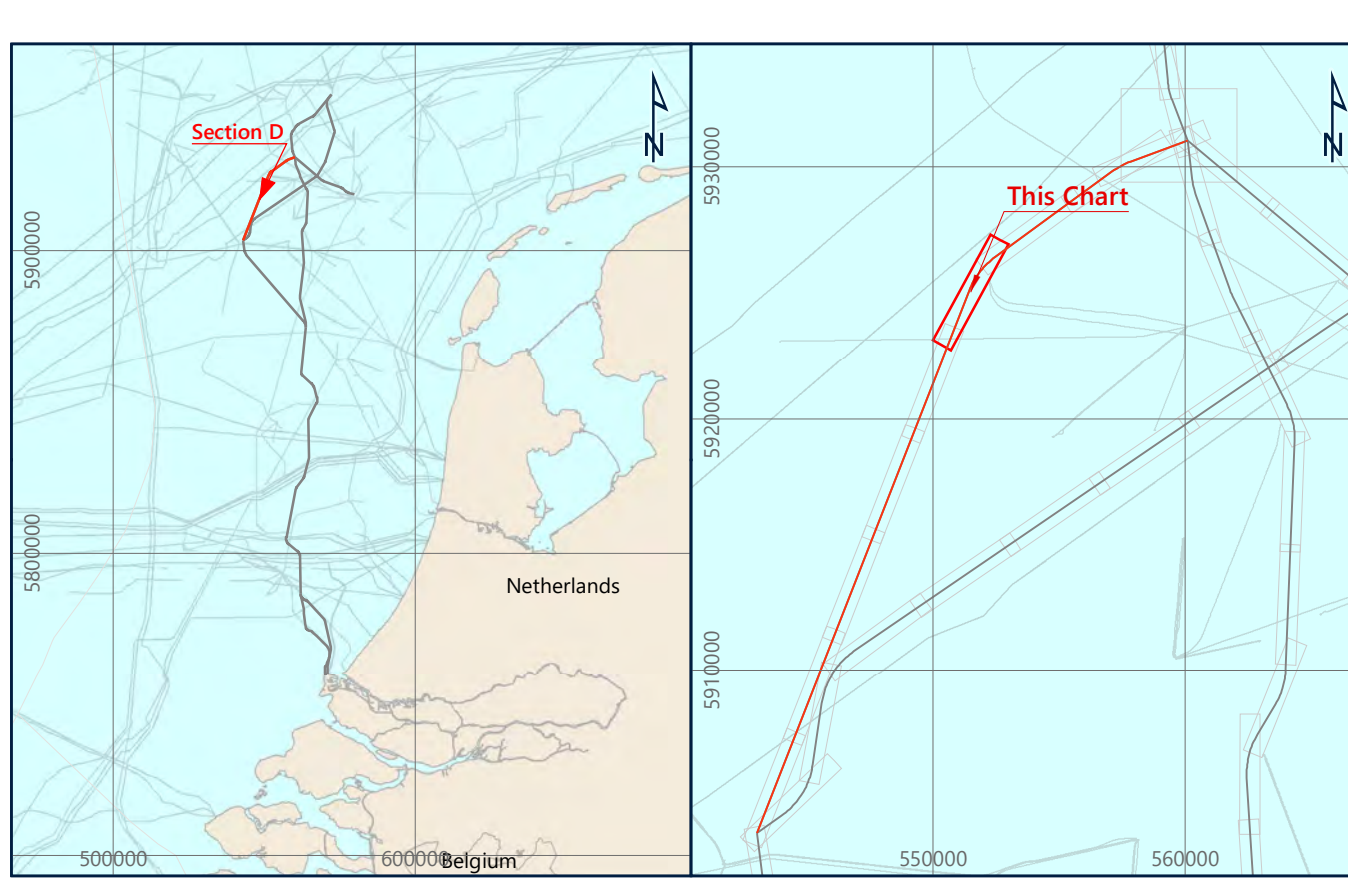
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 20.666 TO KP 25.331

Scale 1 : 5,000 at original A0 page size

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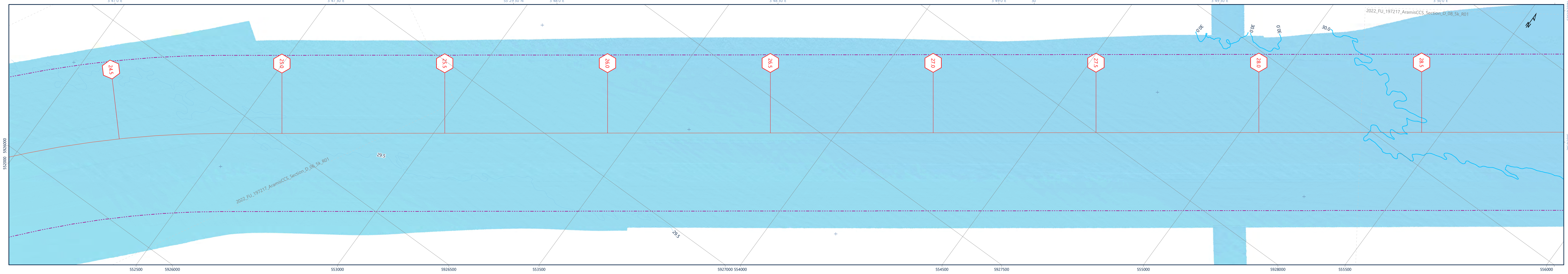
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

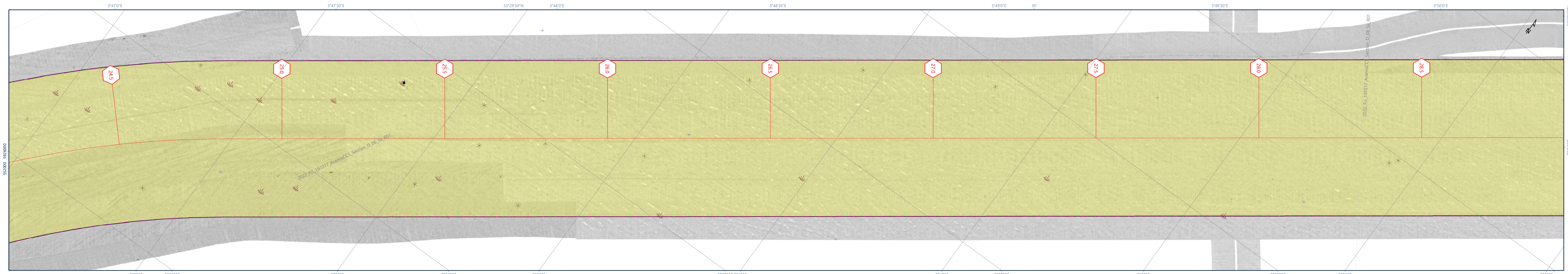
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 Chart No. 06 of 09  
 Enclosure 080 of 105



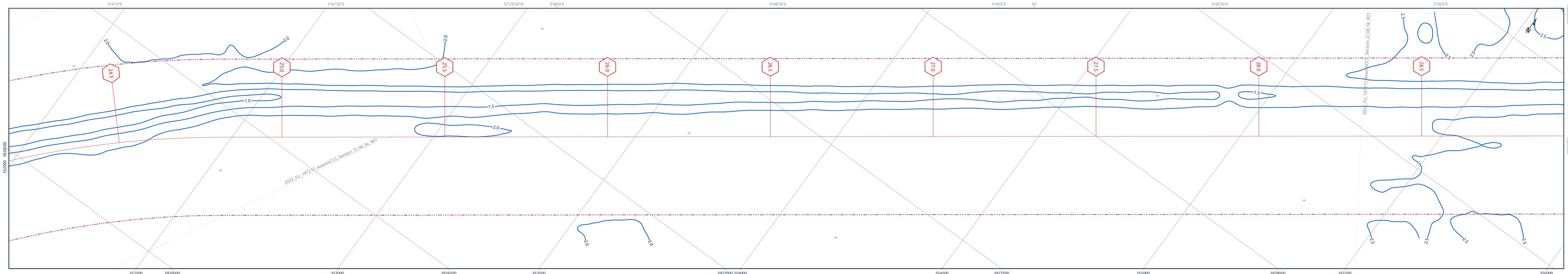
BATHYMETRY



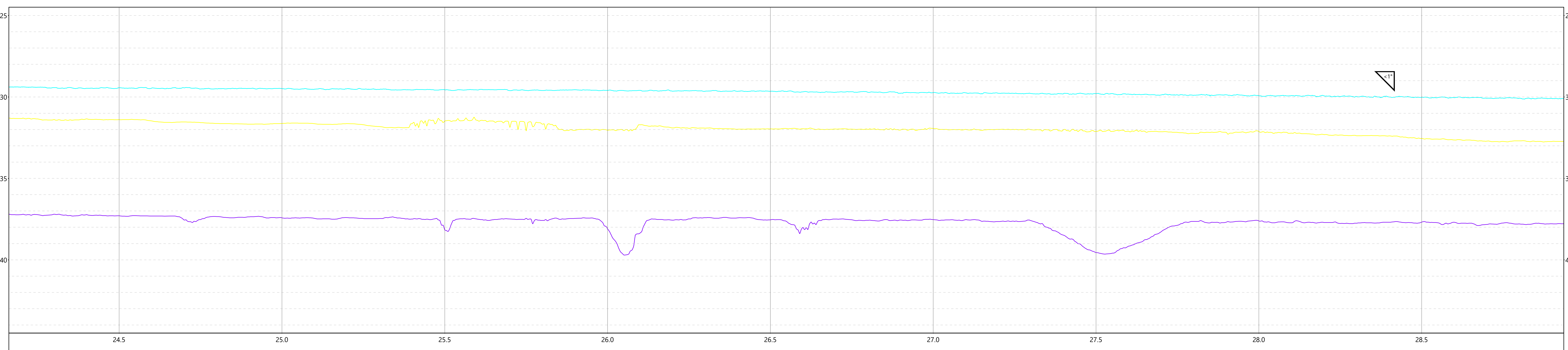
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Water Depth [m LAT]**

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**Other Seafloor Features**

- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**NOTES**

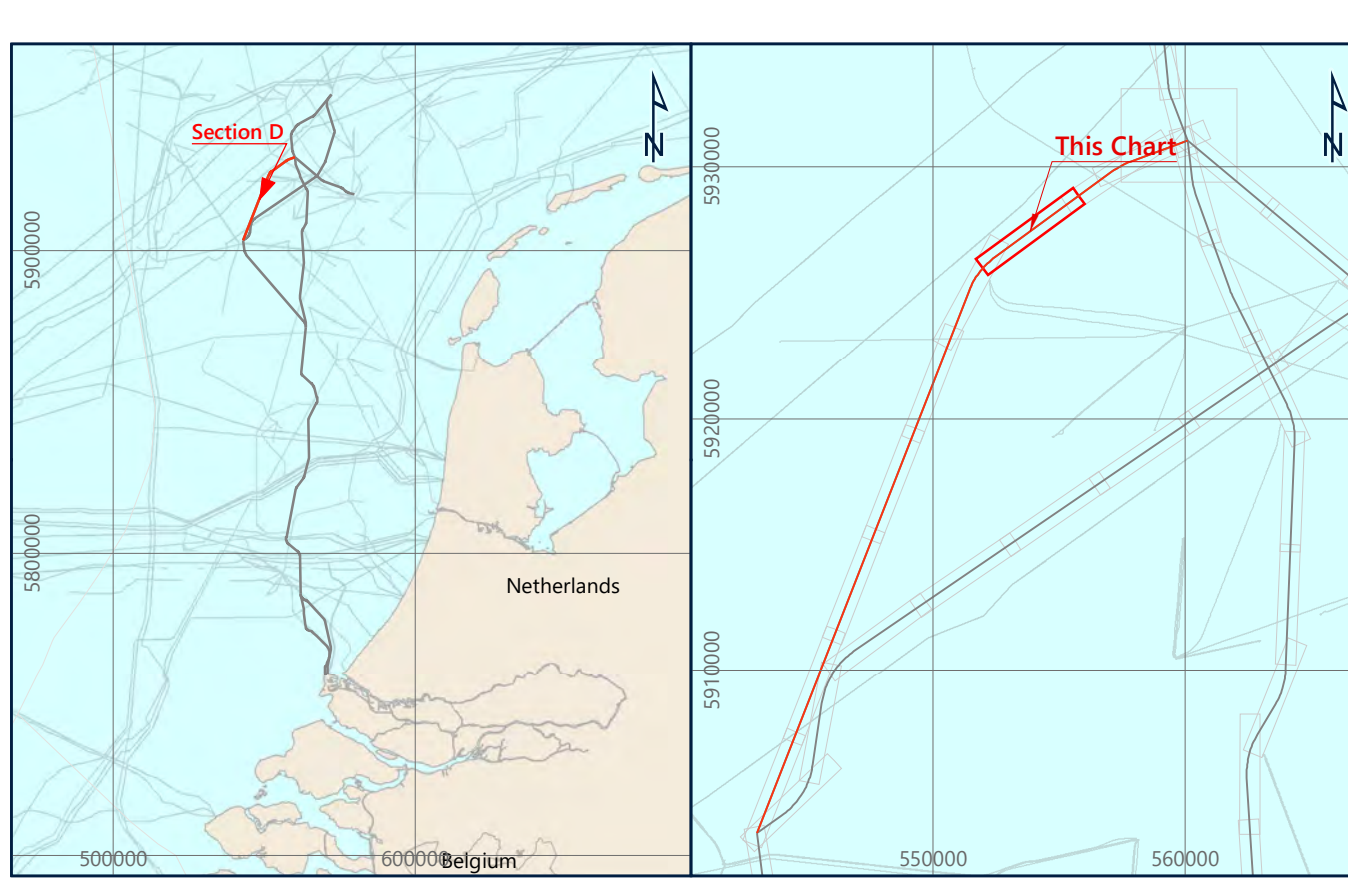
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- The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.

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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

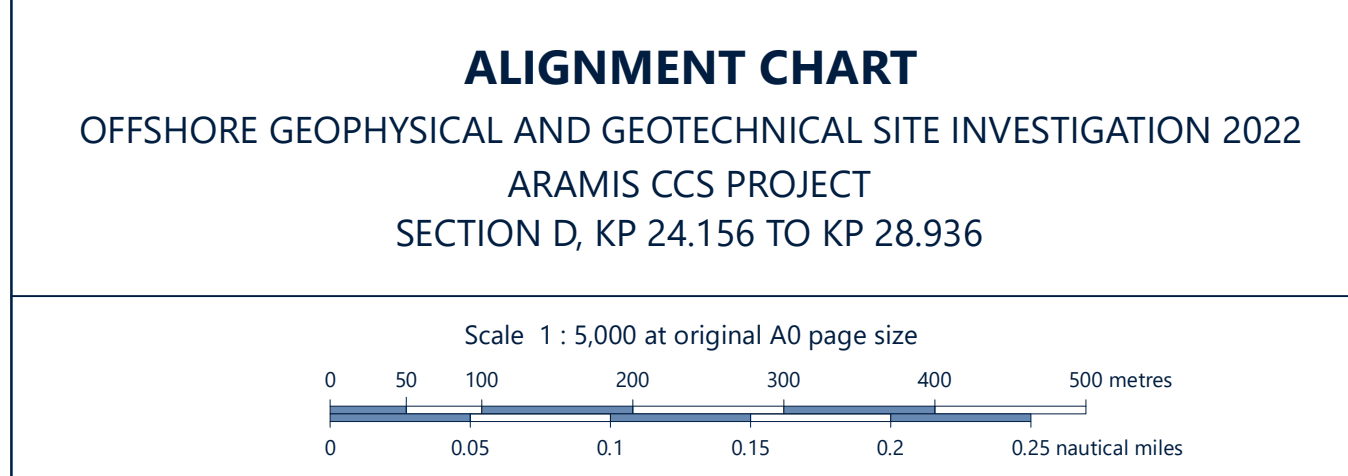
GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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 Arnhem Huis 25, 2132 Coentragen, Den Haag  
<http://totalenergies.com/>

**FUGRO**  
 Prinsstraat 4, 2611 RT Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 24.156 TO KP 28.936

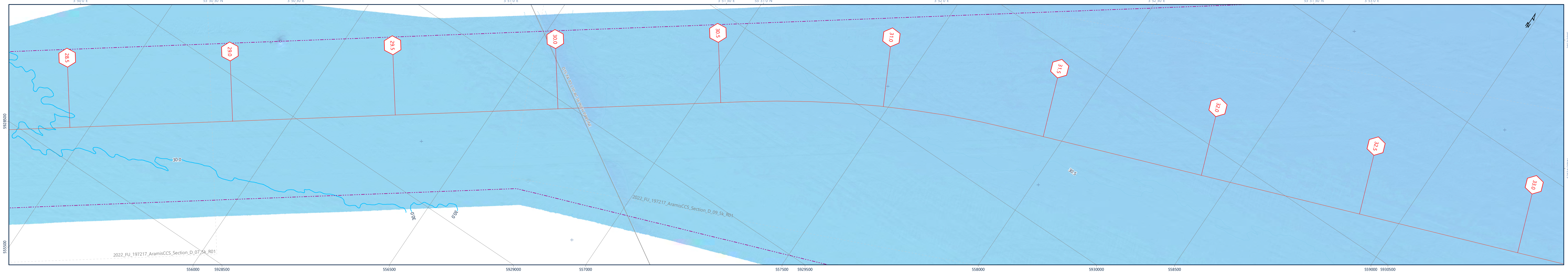


Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

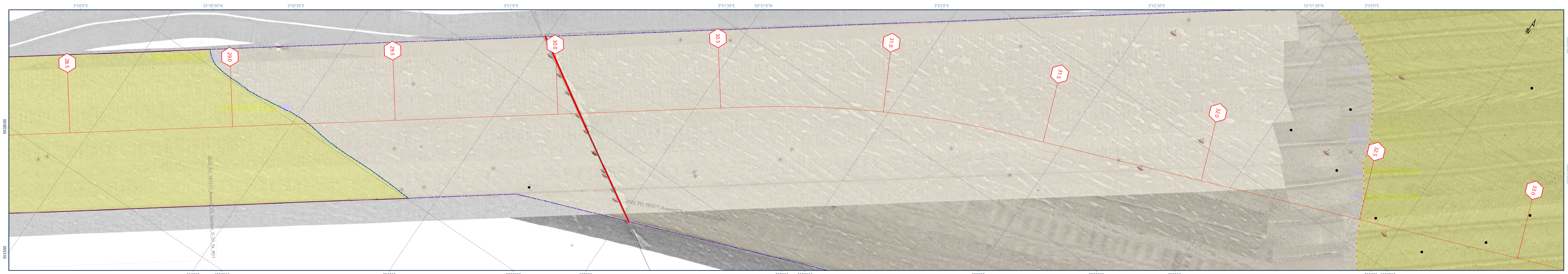
Chart Name: 2022\_FU\_197217\_AramisCCS\_Section\_D\_07\_5k\_R01  
 Chart No. 07 of 09  
 Enclosure 081 of 105



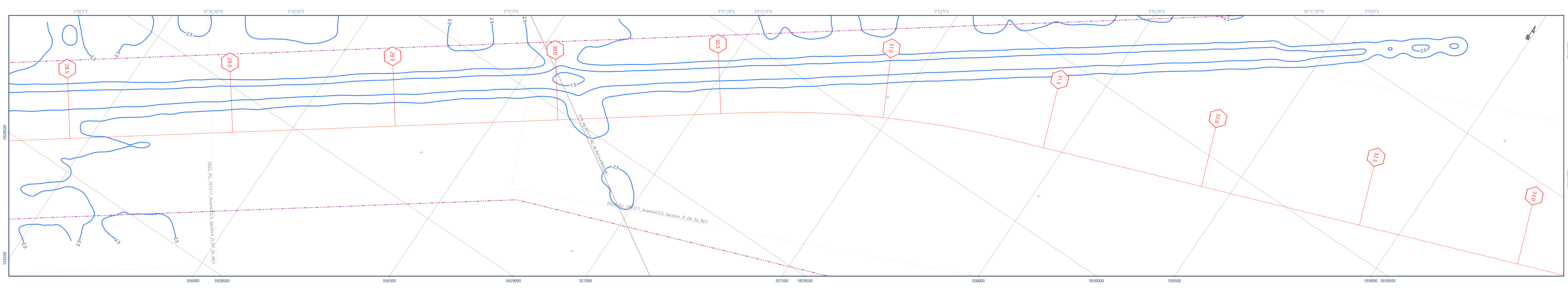
BATHYMETRY



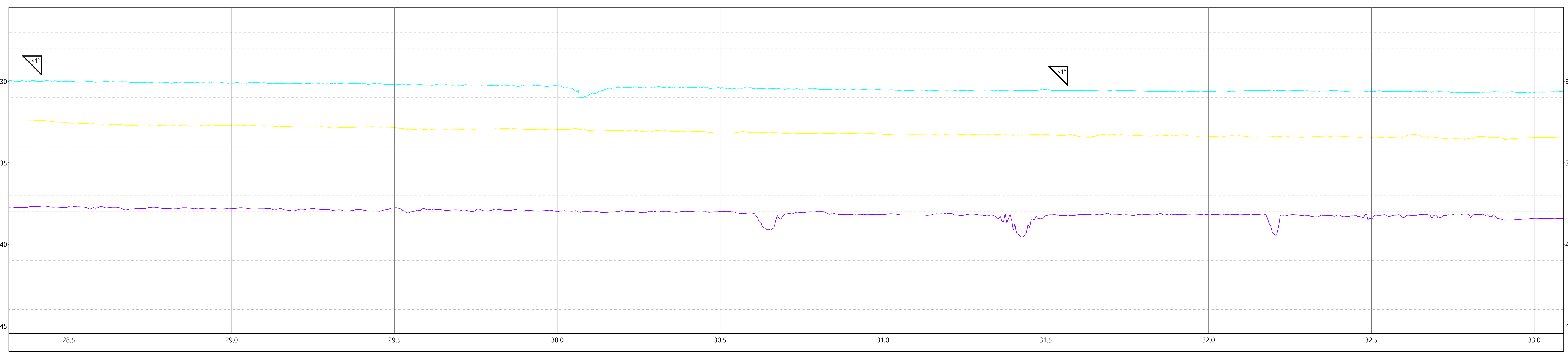
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silt - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

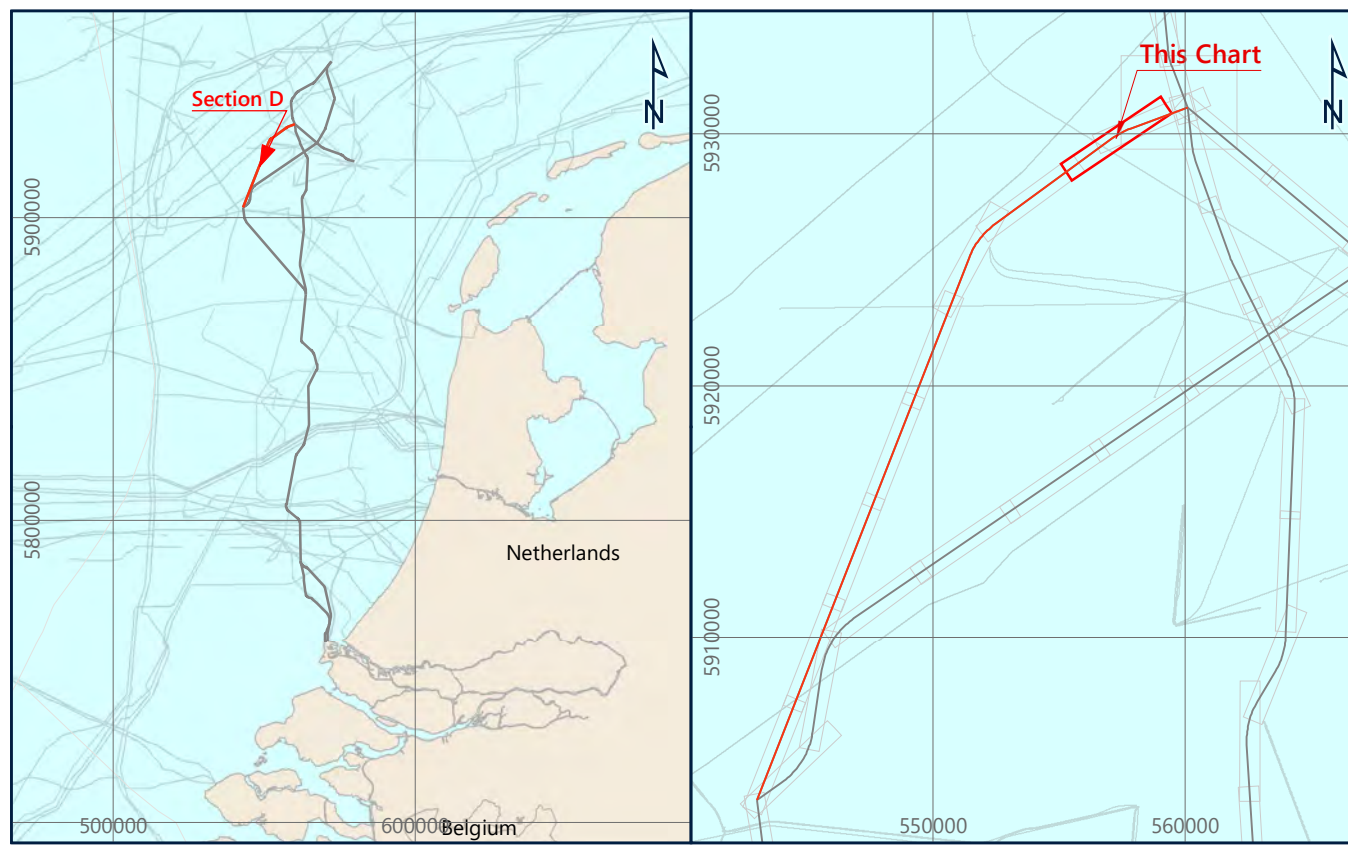
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETTIC PARAMETERS**

GEODETTIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 28.312 TO KP 33.146

Scale 1 : 5,000 at original A0 page size

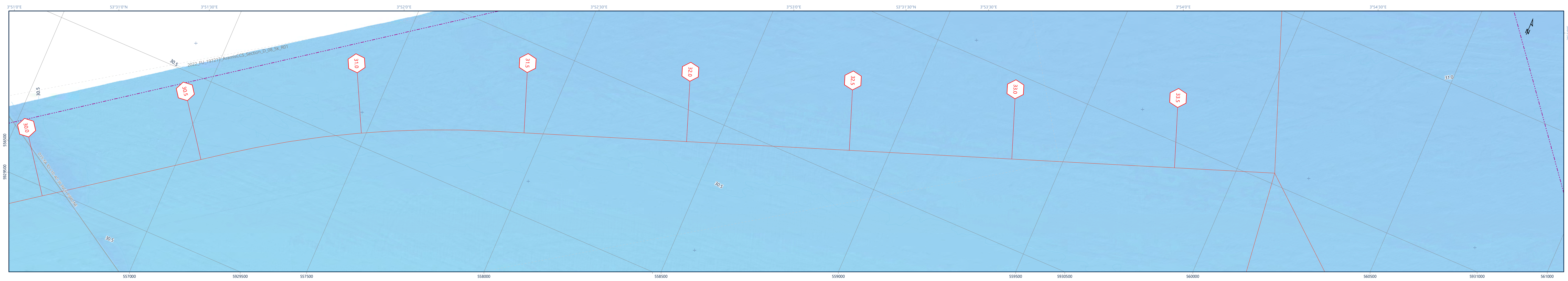
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001 | Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery | Survey Date July - December 2022

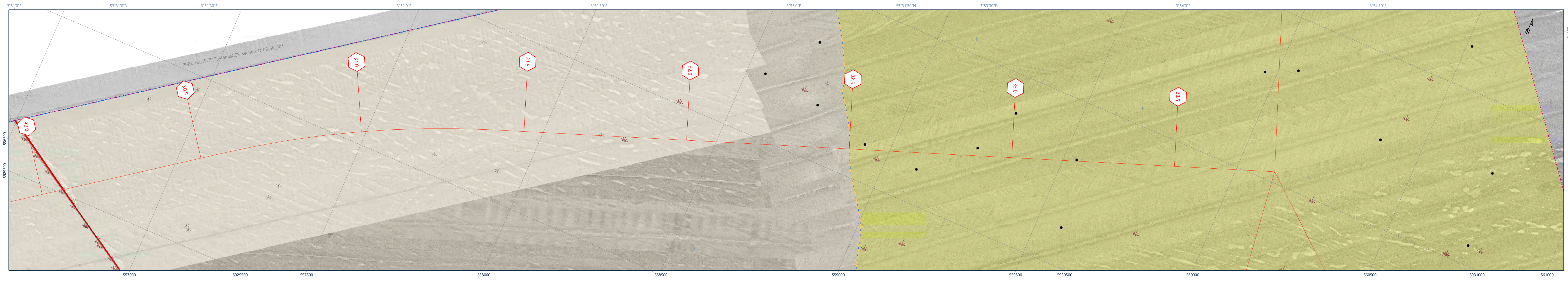
Chart Name: 2022\_FU\_197217\_AramisCCS\_Section\_D\_08\_5k\_R01 | Chart No. 08 of 09 | Enclosure 082 of 105



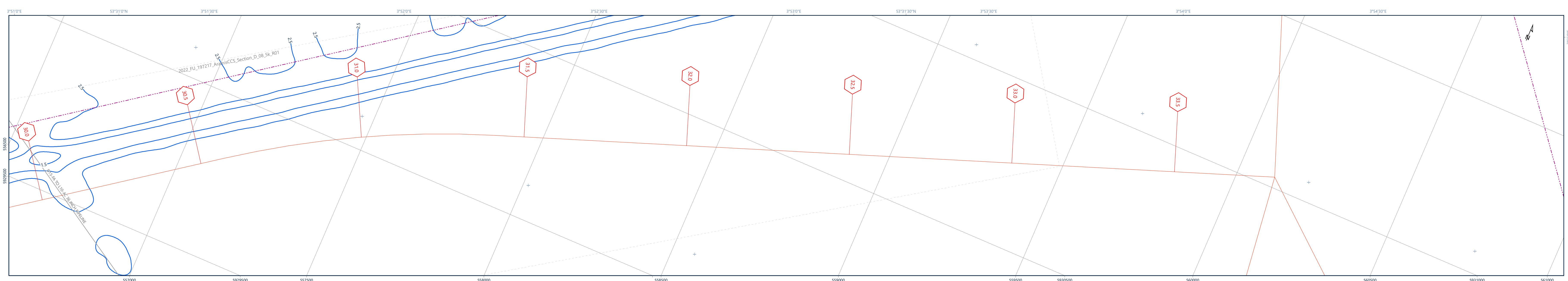
BATHYMETRY



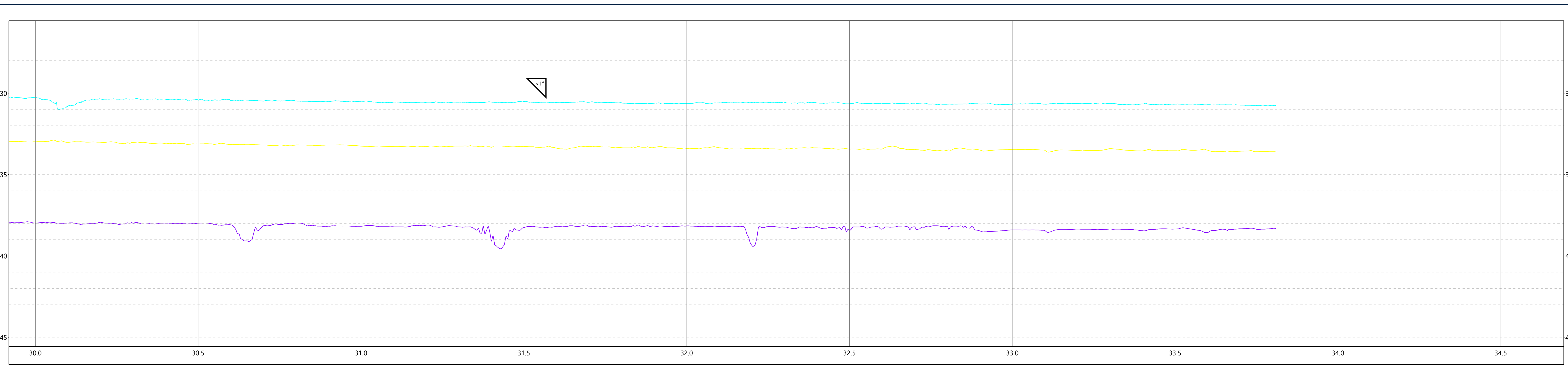
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

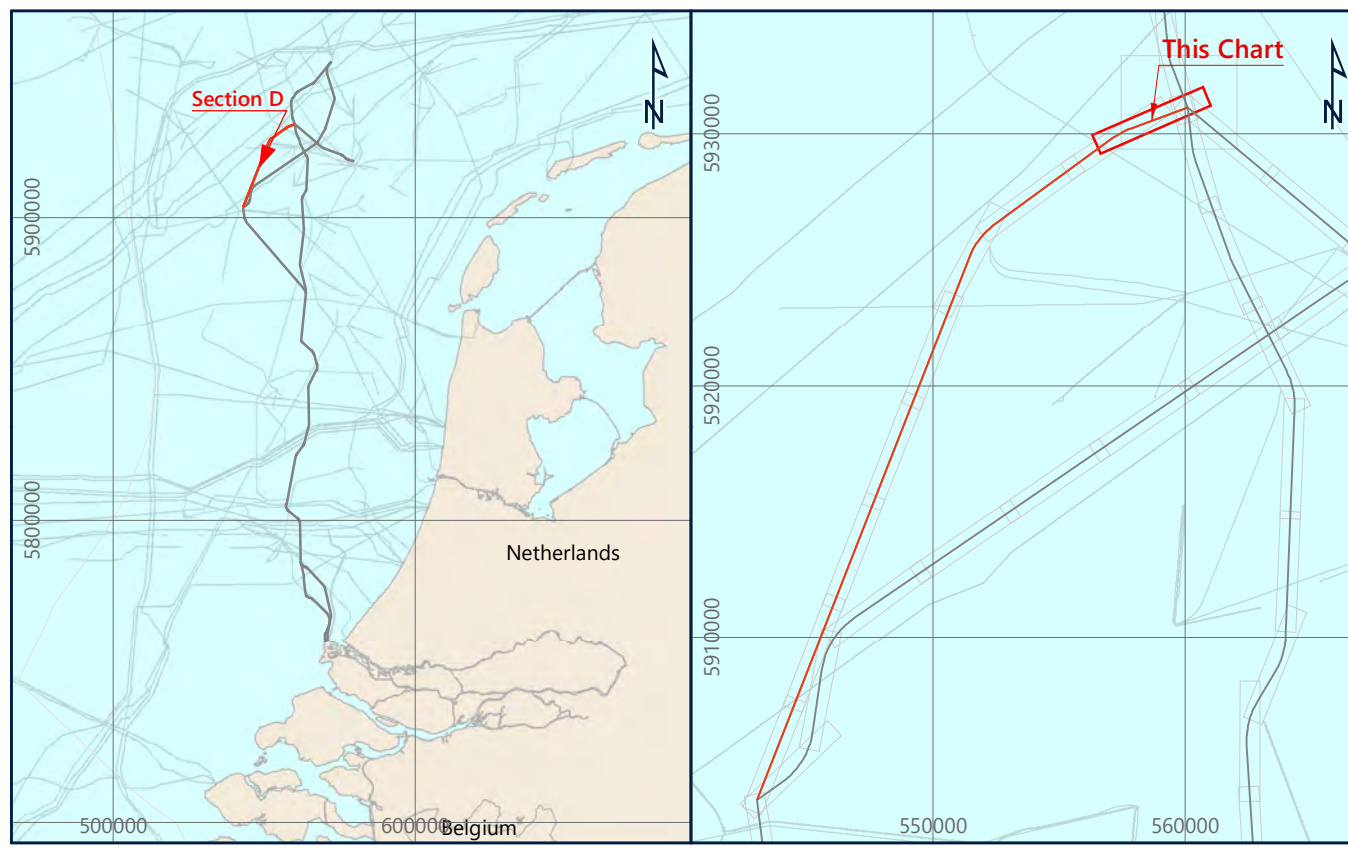
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- This document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for that commission. Unauthorised use of this document in any form whatsoever is prohibited.

**GEODETIC PARAMETERS**

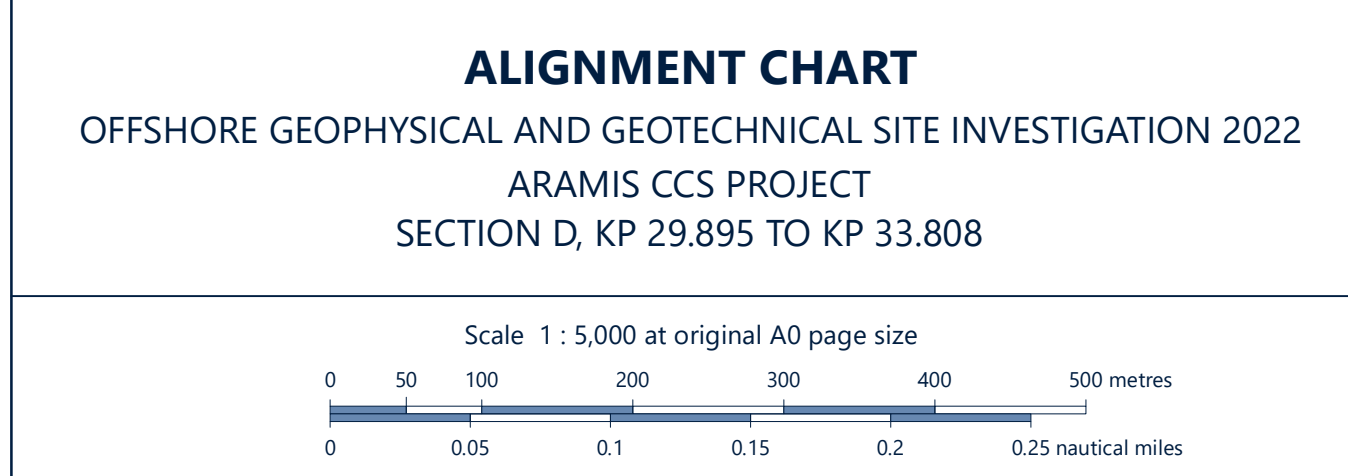
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ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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 Aramis Area 23, 2360 Coentlagen, Denmark  
<https://totalenergies.com/>

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 Prinsstraat 4, 2031 RF Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION D, KP 29.895 TO KP 33.808



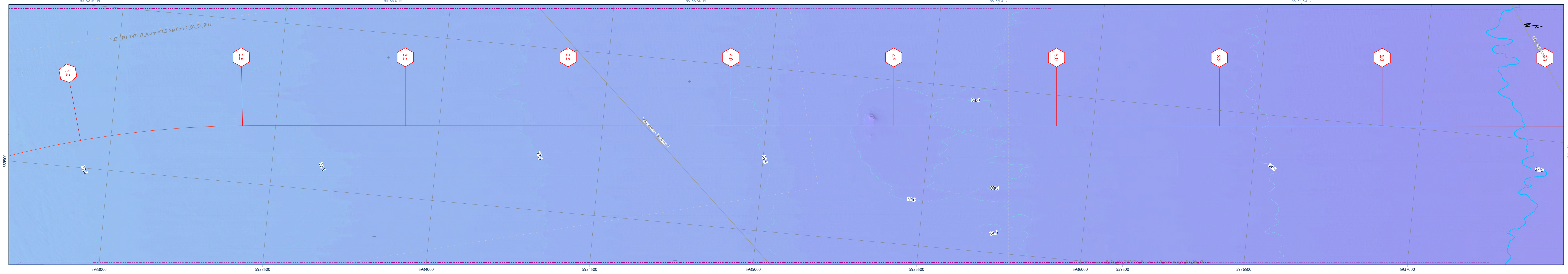
Fugro Document No.	F197217-REP-GEOP-001	Vessel(s)	Fugro Searcher, Fugro Seeker, Fugro Discovery	Survey Date	July - December 2022
Chart Name	2022_FU_197217_AramisCCS_Section_D_09_5k_R01	Chart No.	09 of 09	Enclosure	083 of 105



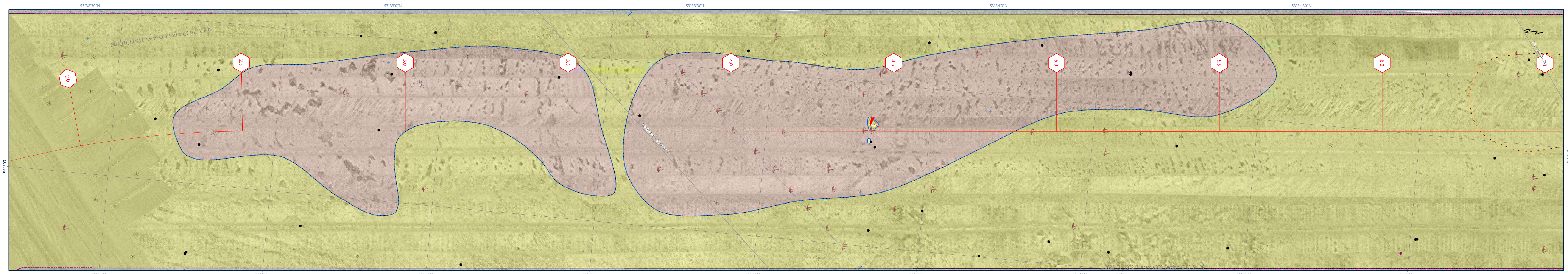
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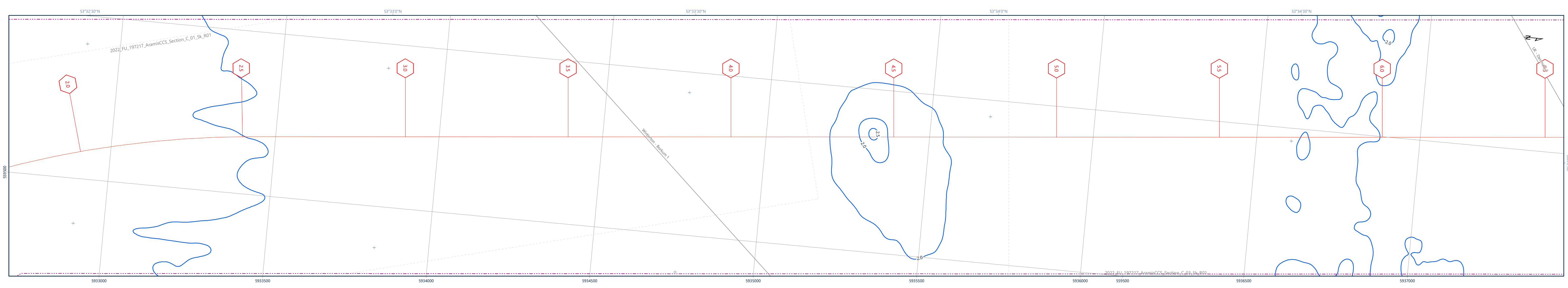
BATHYMETRY



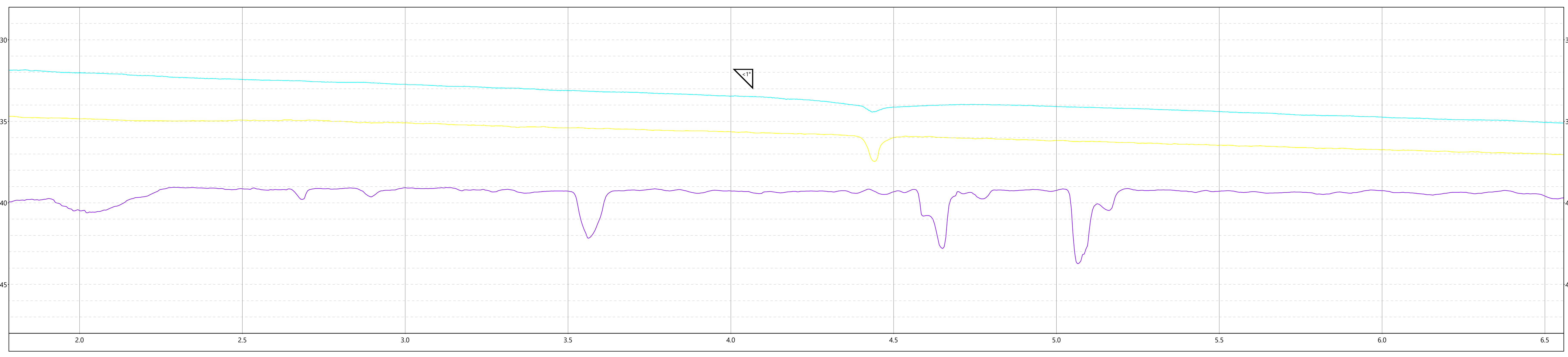
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

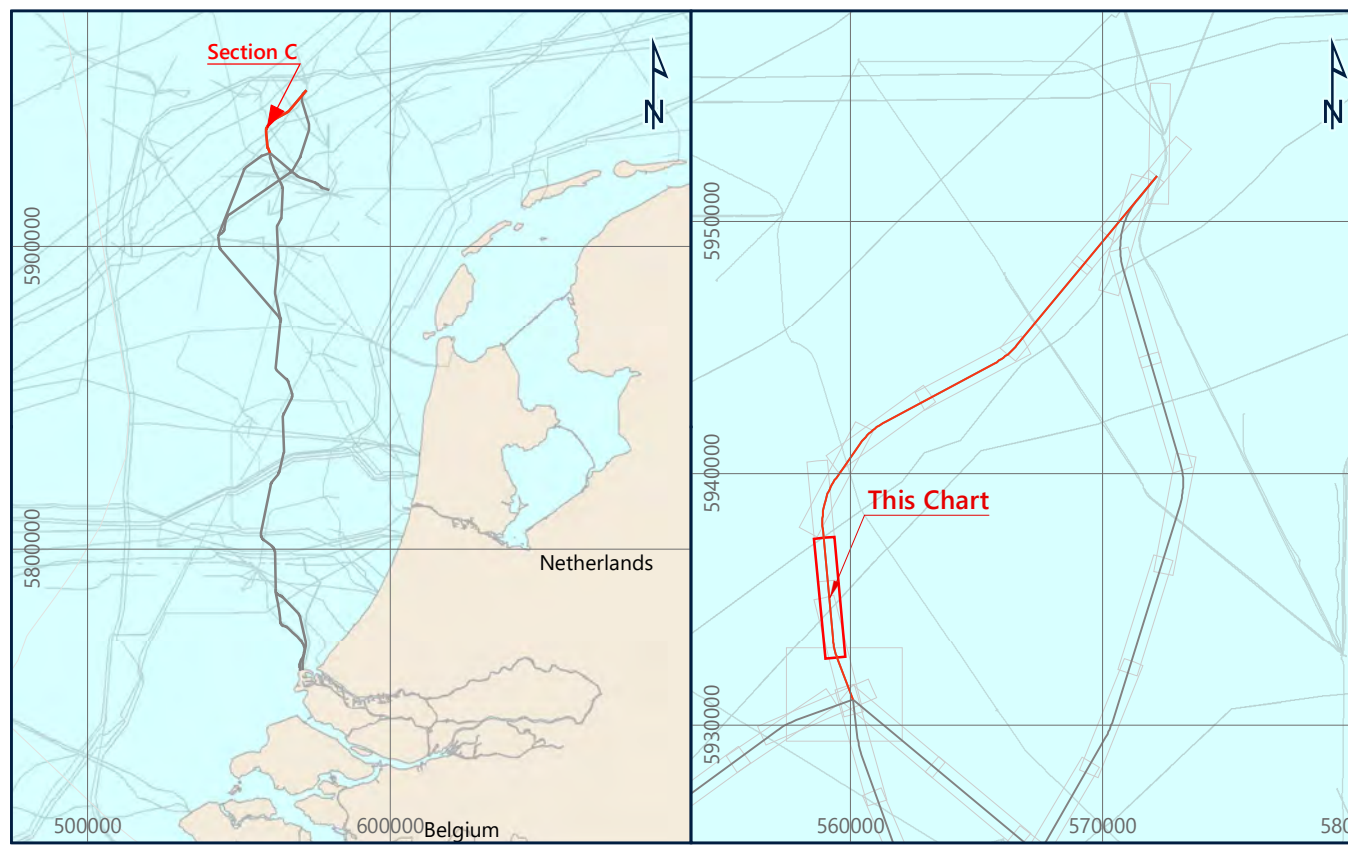
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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- This document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for that commission. Unauthorised use of this document in any form whatsoever is prohibited.

**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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 Avenue Flor 25, 2140 Coentzen, Denmark  
<https://totalenergies.com/>

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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 1.775 TO KP 6.558

Scale 1 : 5,000 at original A0 page size

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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

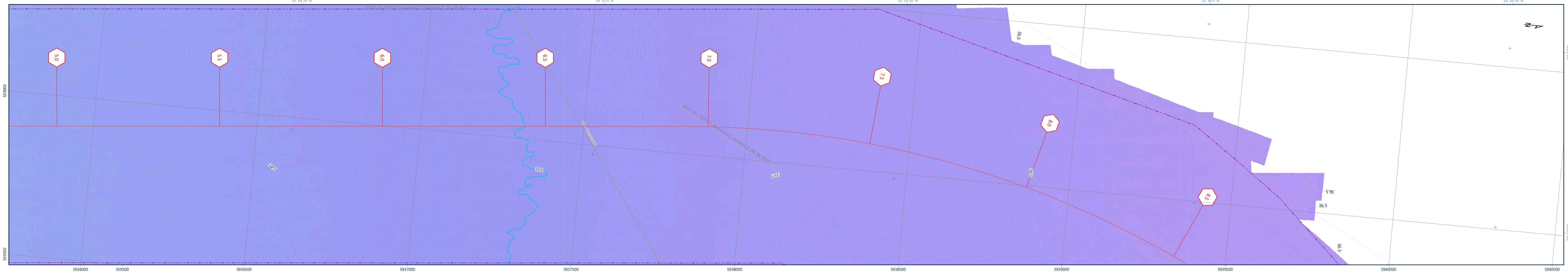
Issue	Date	Status	Interpr	Drawn	Chld	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

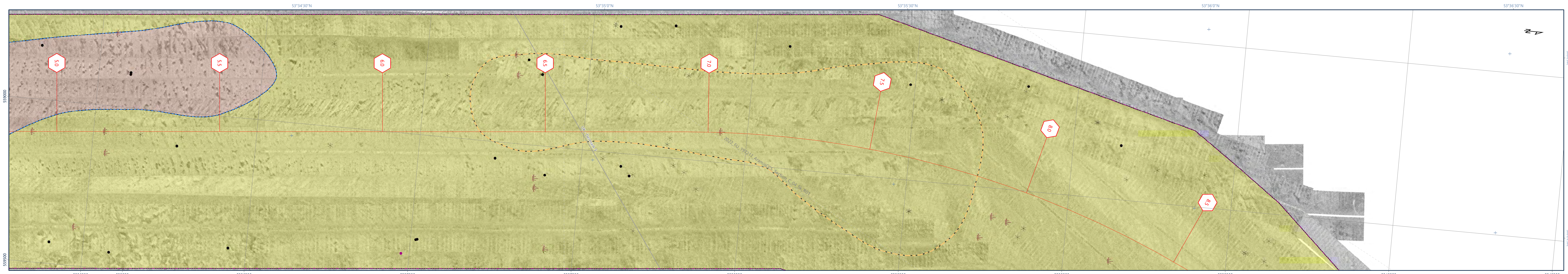
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 Chart No. 02 of 09  
 Enclosure 058 of 105



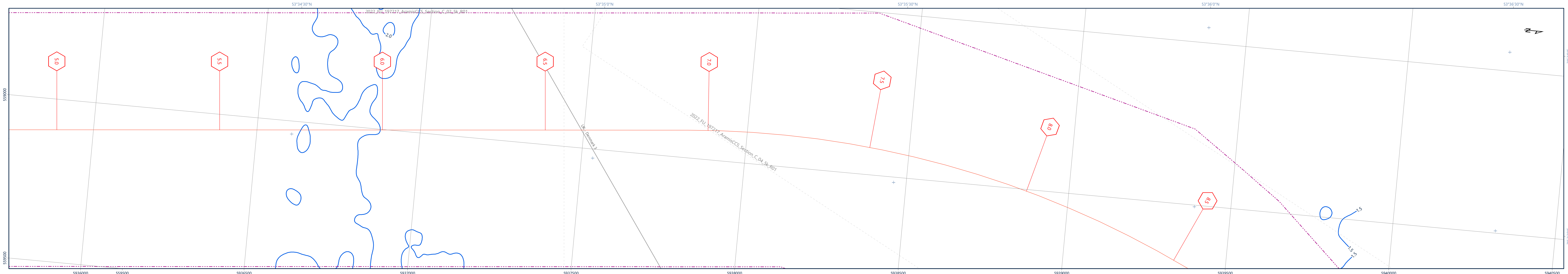
BATHYMETRY



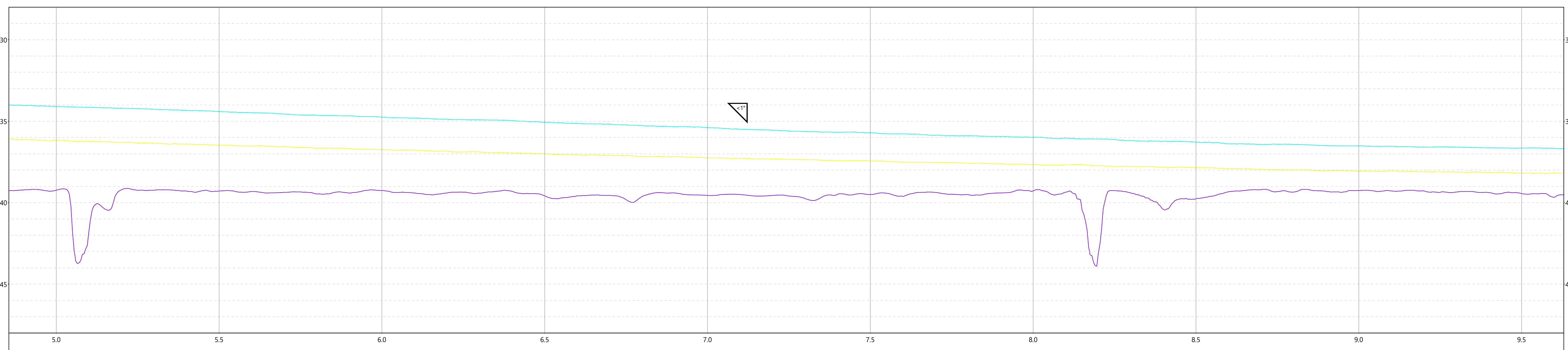
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

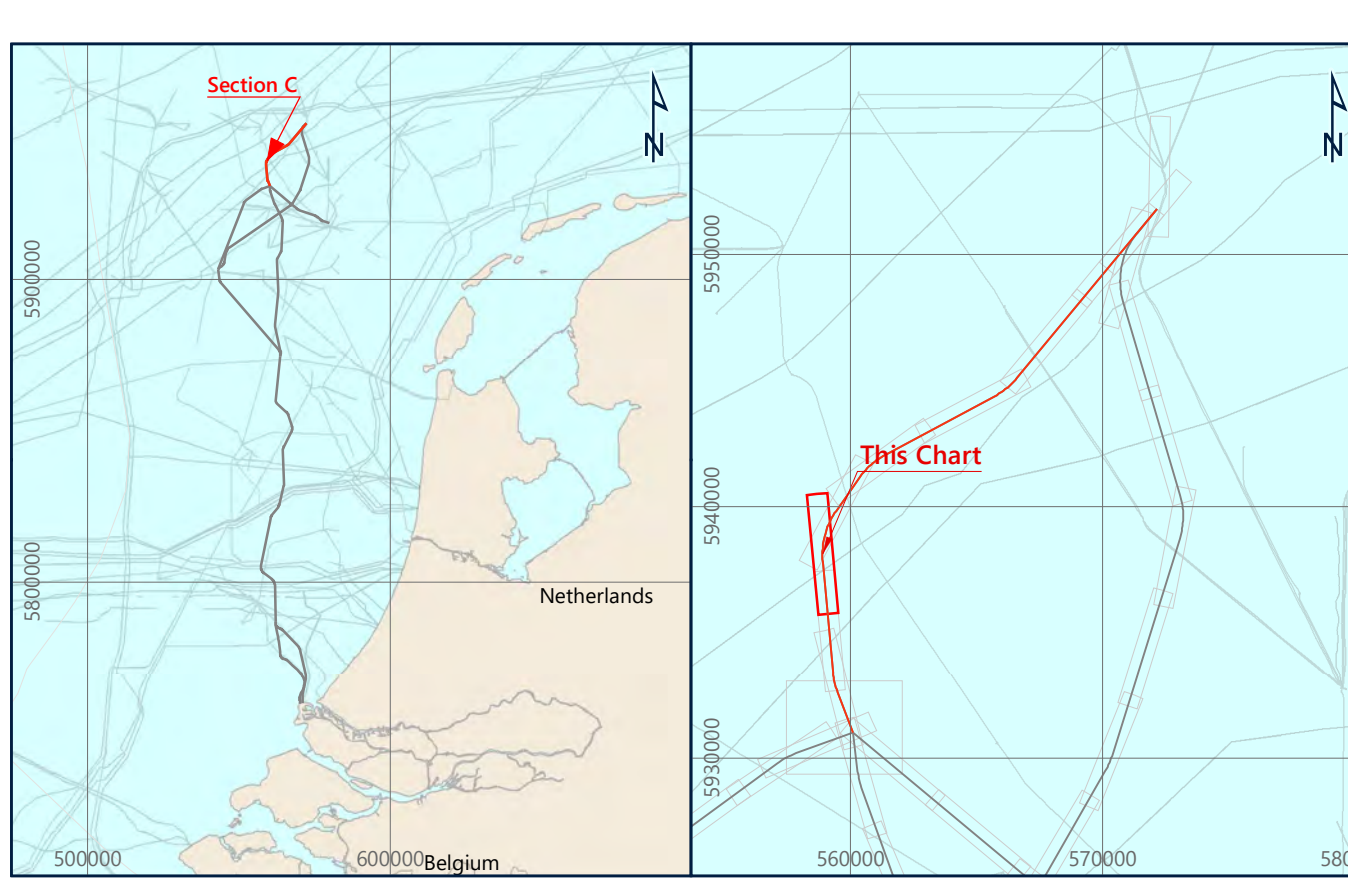
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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 Avenue Flor 25, 2140 Coenraadsloot, Denmark  
<http://totalenergies.com/>

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 Prinsstraat 4, 2031 RT Noordwijk, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 4.853 TO KP 8.551

Scale 1 : 5,000 at original A0 page size

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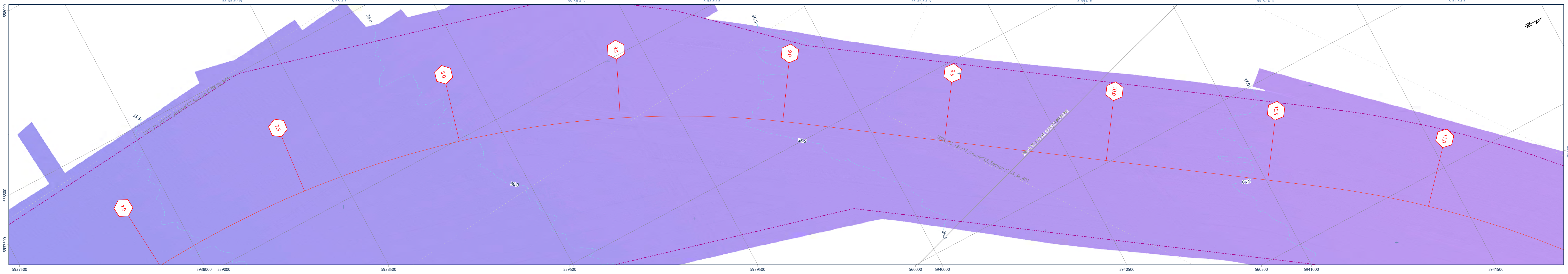
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

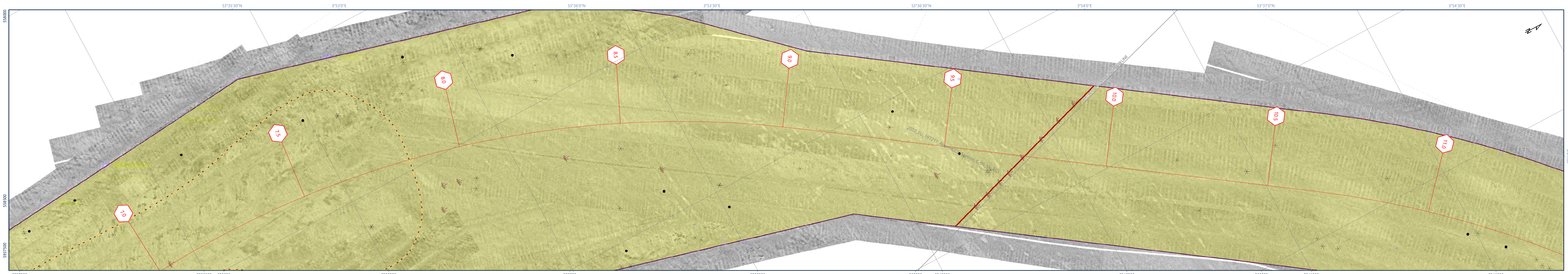
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 Chart No. 03 of 09  
 Enclosure 099 of 105



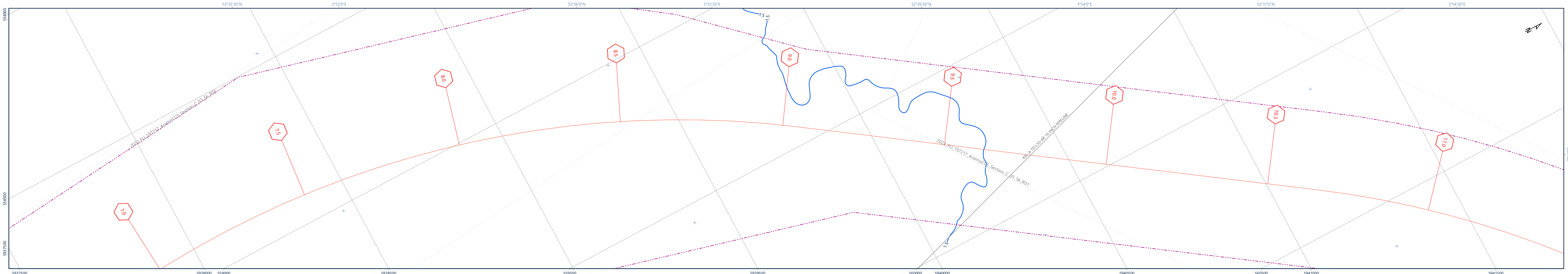
BATHYMETRY



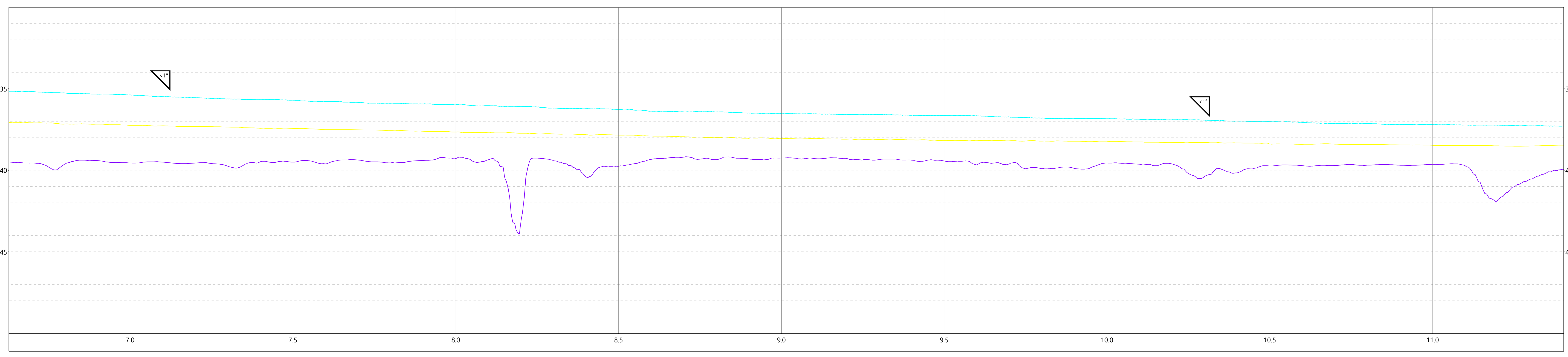
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
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- Area of Anchor/Wire scars
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- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

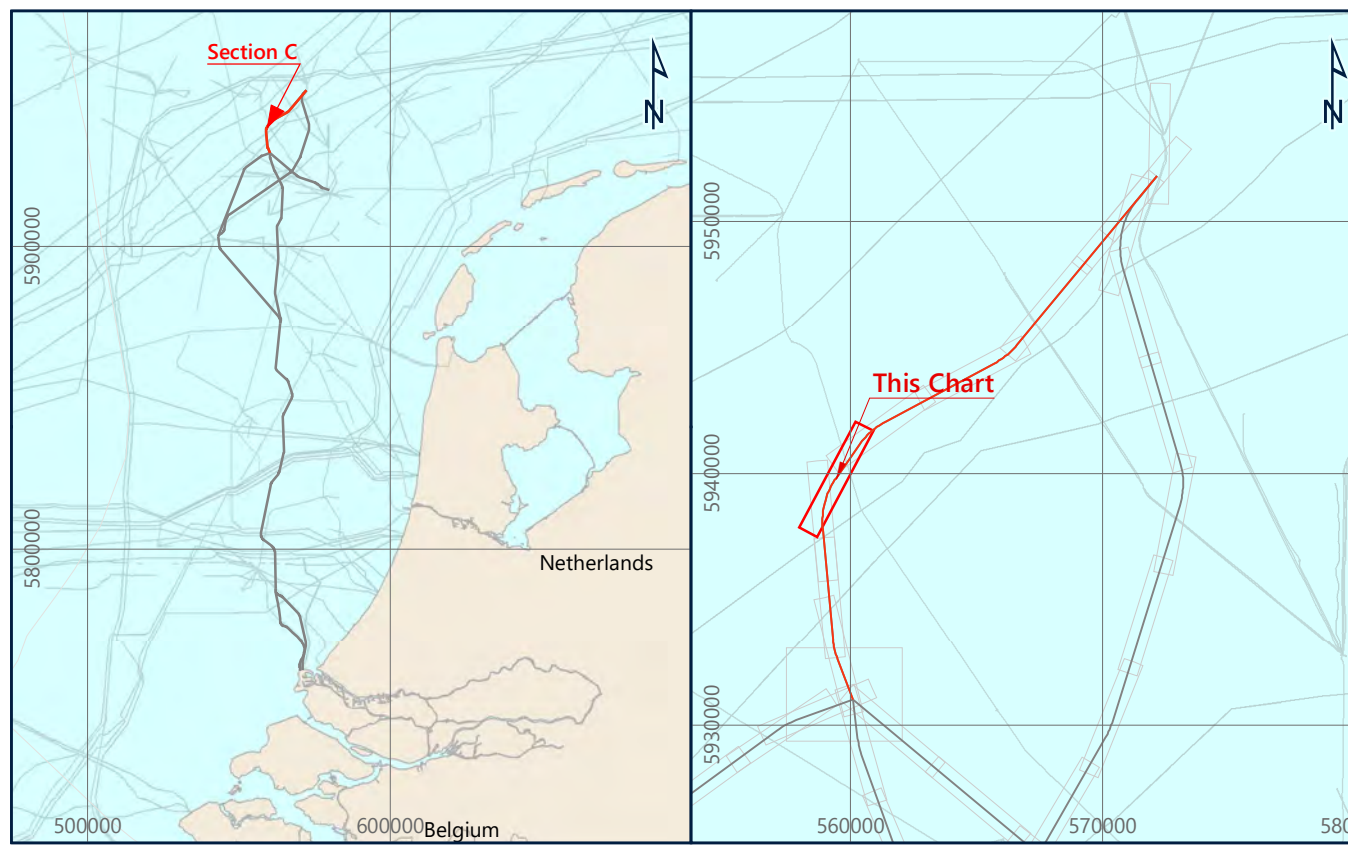
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
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  - Magnetic anomalies measuring at least 10.0 nT in peak to peak amplitude were picked using the Blakely Test.
  - The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.
- This document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for that commission. Unauthorised use of this document in any form whatsoever is prohibited.

**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 7.005 TO KP 11.437

Scale 1 : 5,000 at original A0 page size

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Issue	Date	Status	Interpr	Drawn	Chkd	Appr
01	13/04/2023	Complete	AB	MB	MS	AD

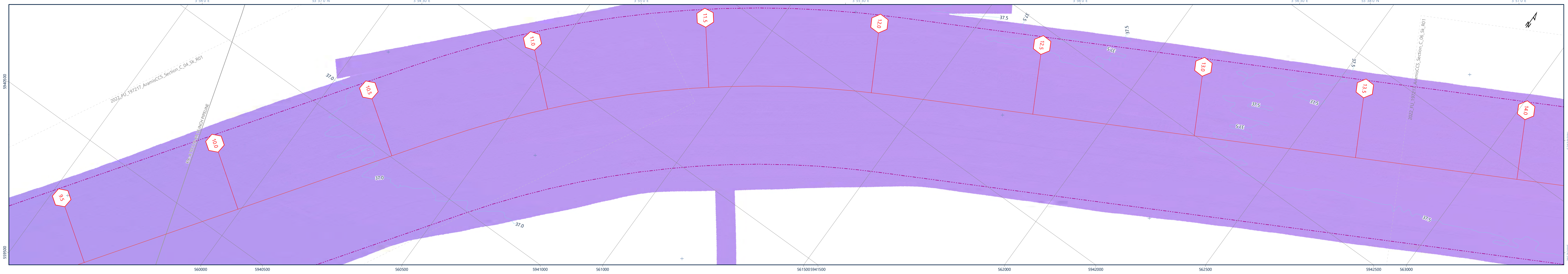
Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_C\_04\_Sk\_R01  
 Chart No. 04 of 09  
 Enclosure 060 of 105

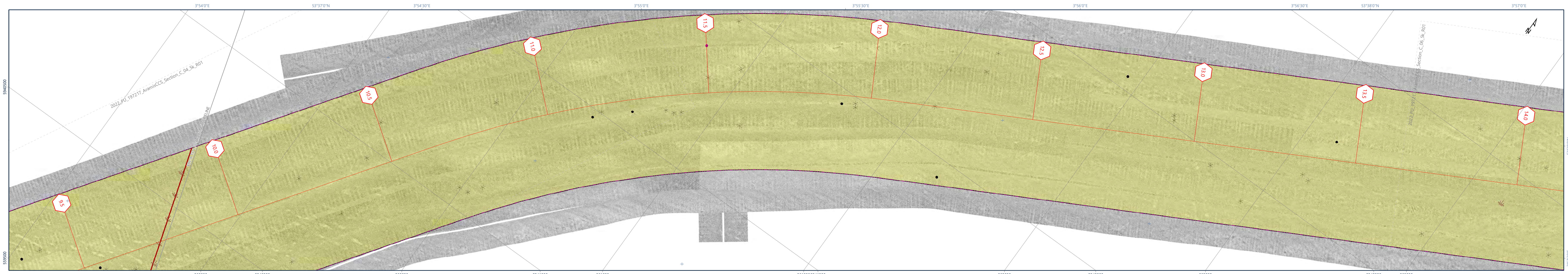
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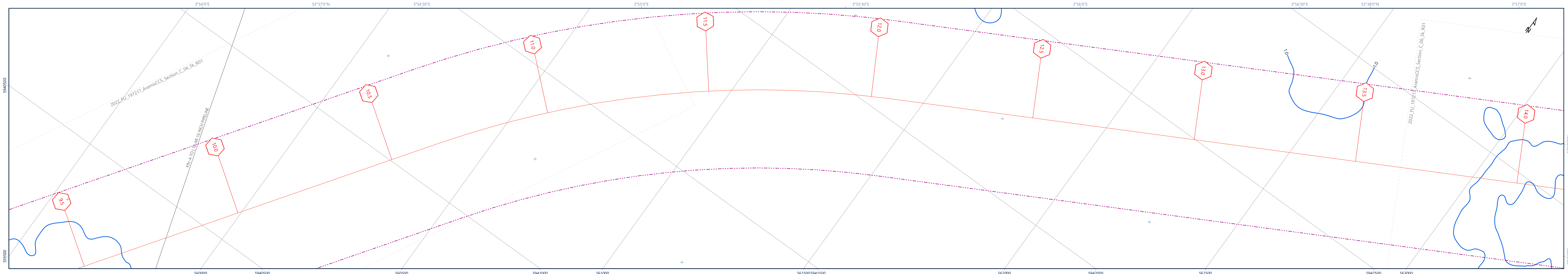
BATHYMETRY



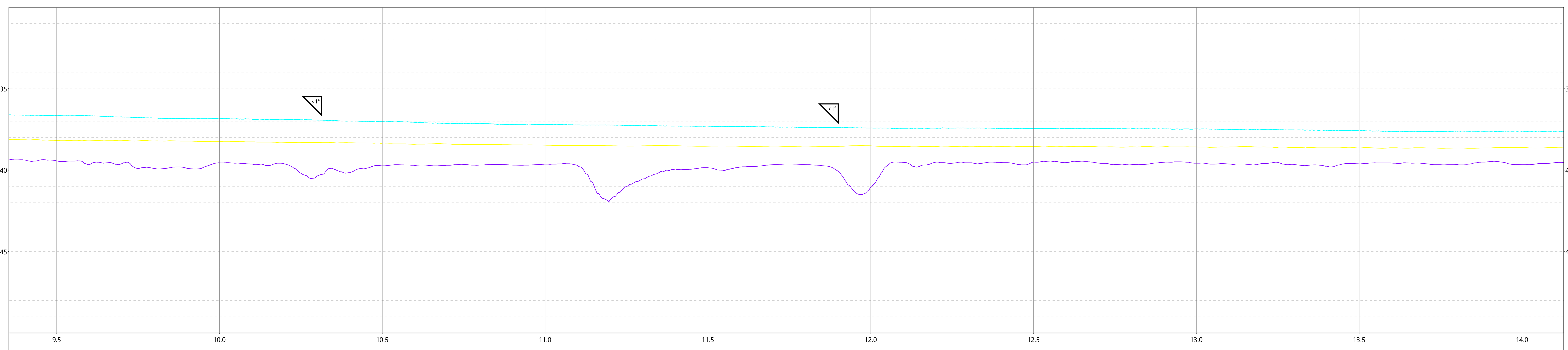
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isobath Contours of Unit A
- Buried Channels
- Acoustic Diffraction

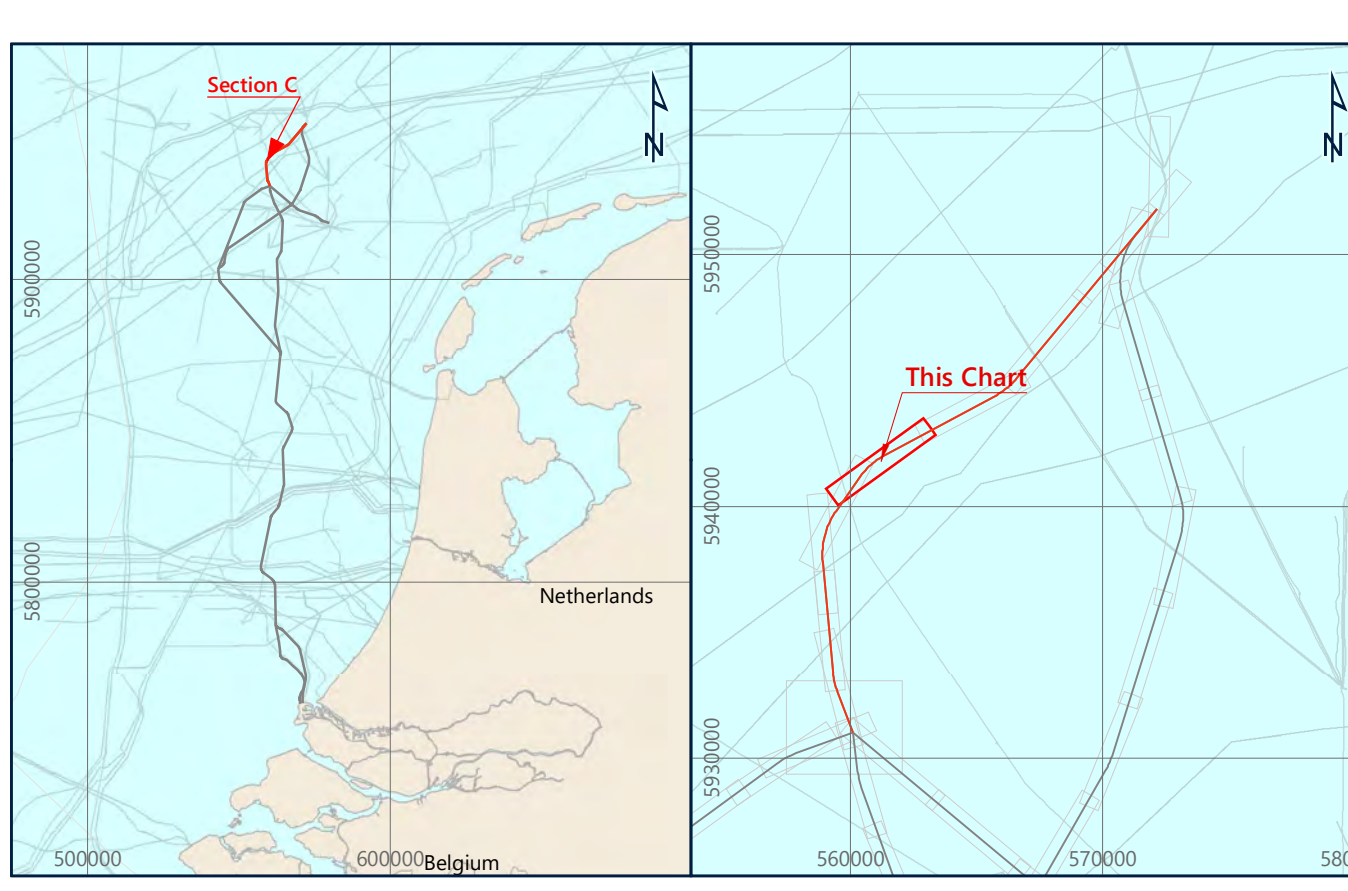
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 9.478 TO KP 14.145

Scale 1 : 5,000 at original A0 page size

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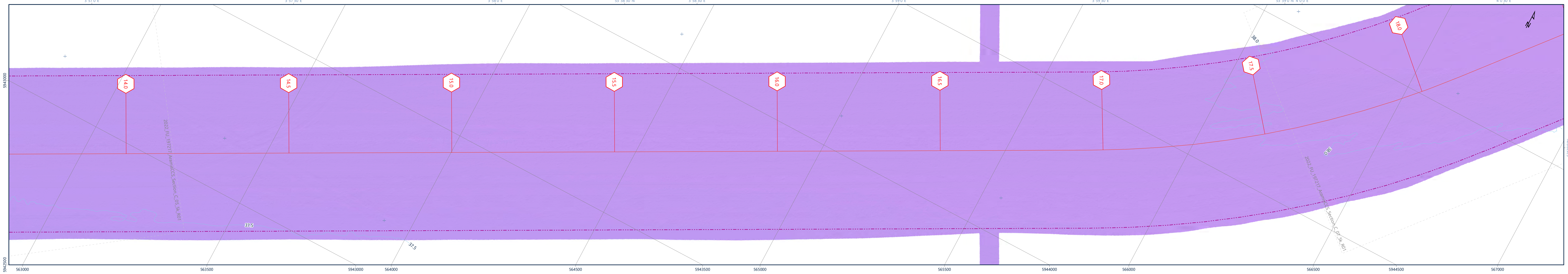
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

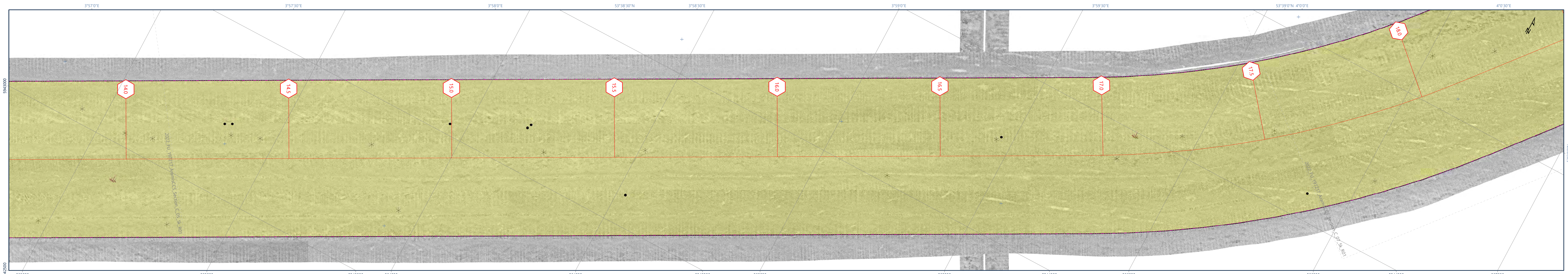
Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_C\_05\_Sk\_R01  
 Chart No. 05 of 09  
 Enclosure 061 of 105



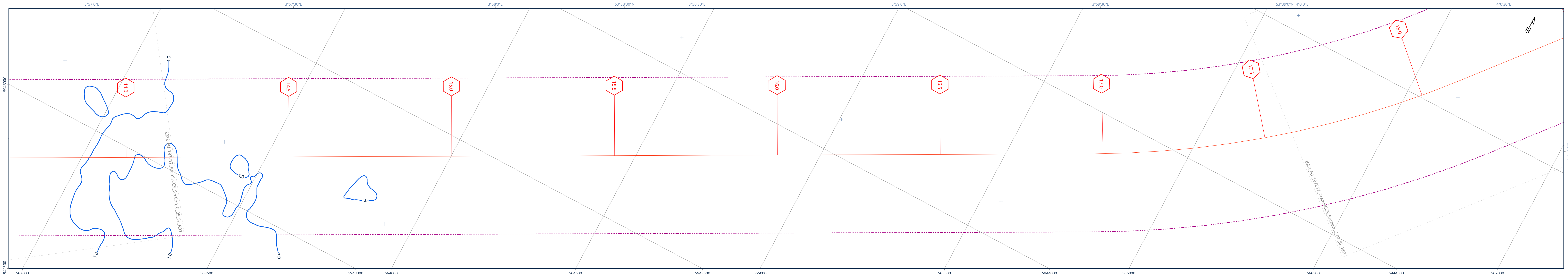
BATHYMETRY



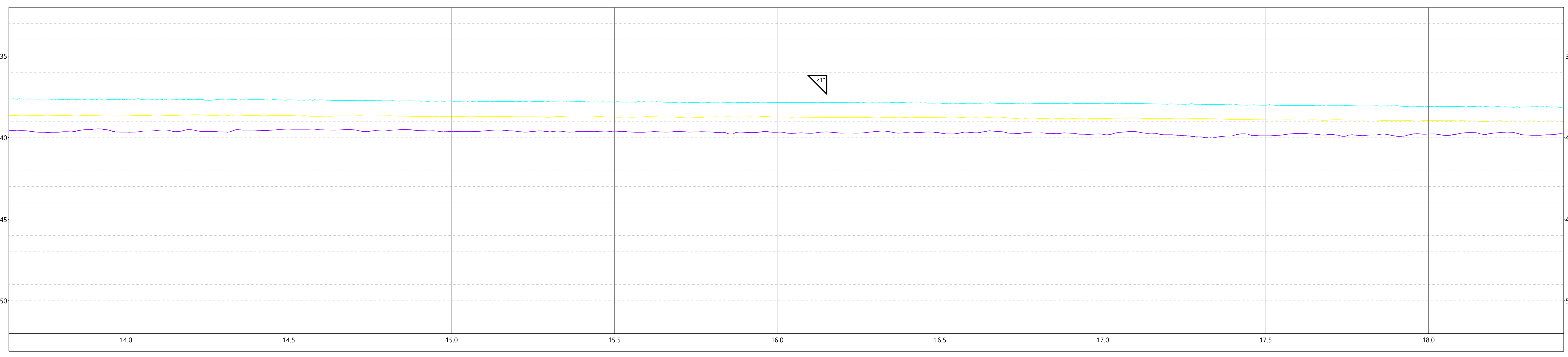
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

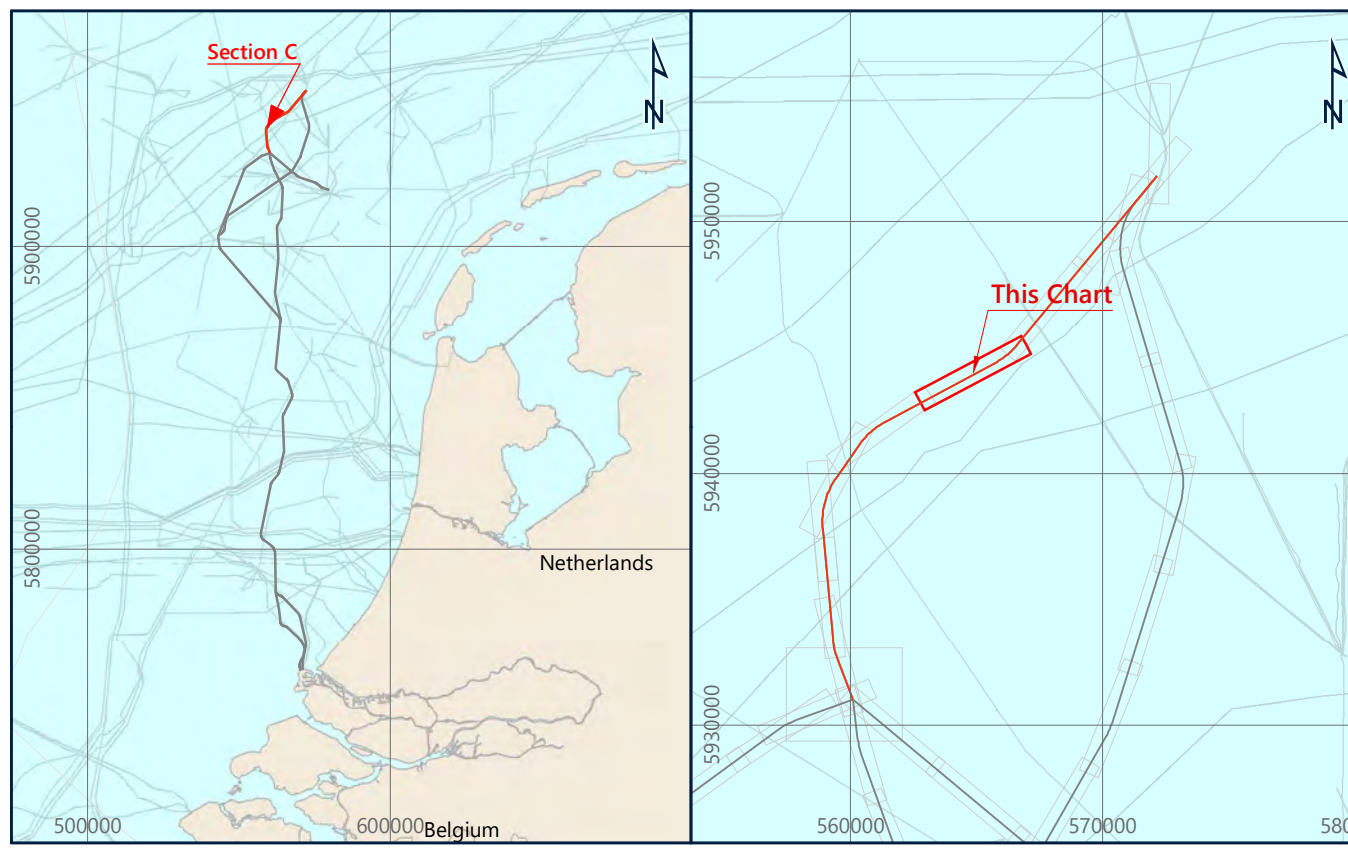
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**GEODETTIC PARAMETERS**

GEODETTIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 13.640 TO KP 18.470

Scale 1 : 5,000 at original A0 page size

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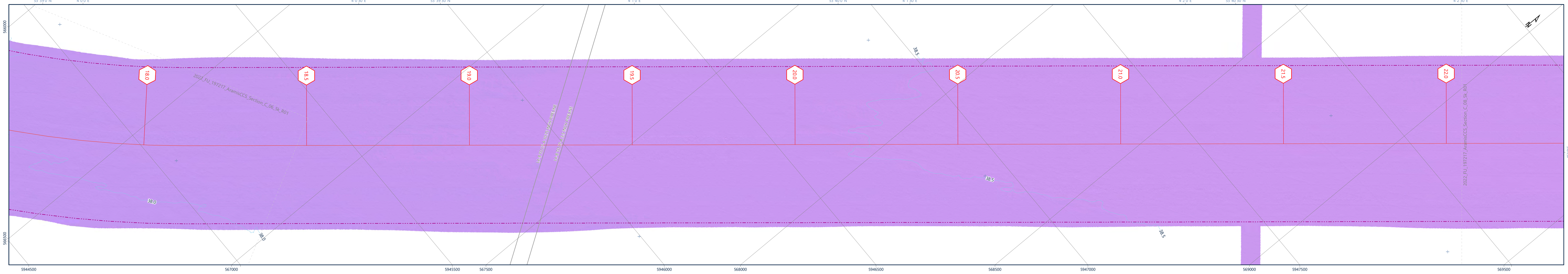
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

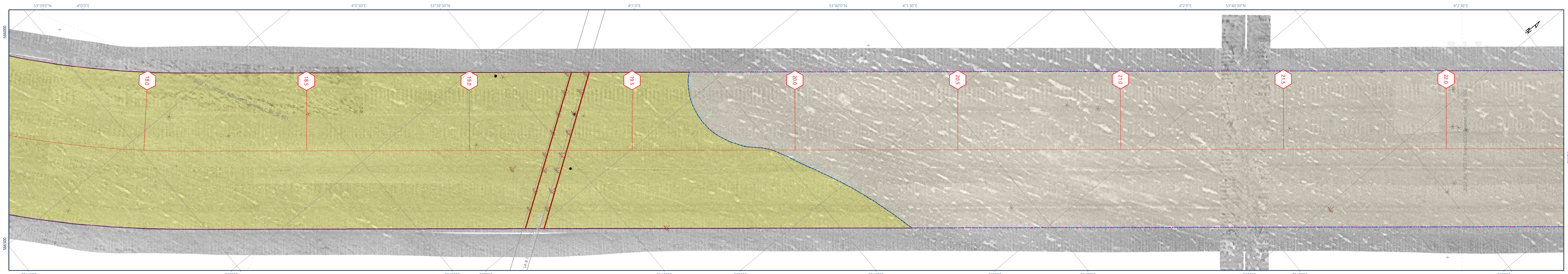
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 Chart No. 06 of 09  
 Enclosure 062 of 105



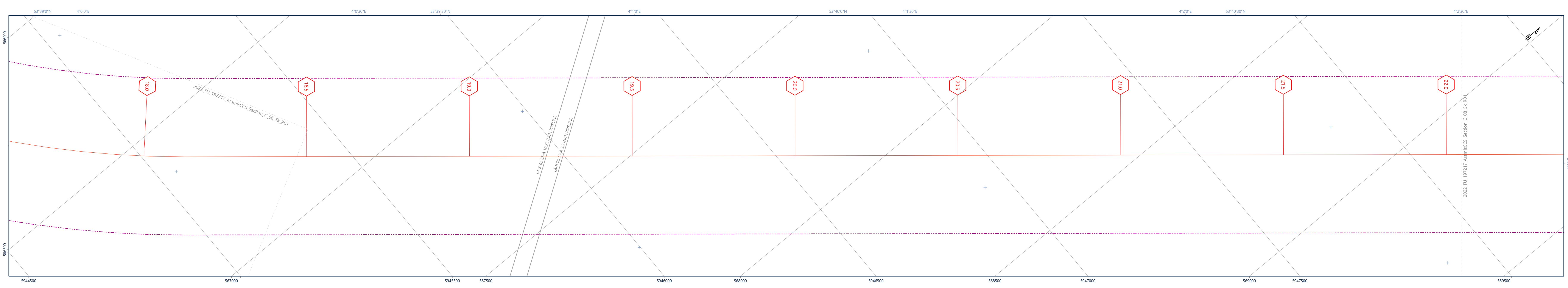
BATHYMETRY



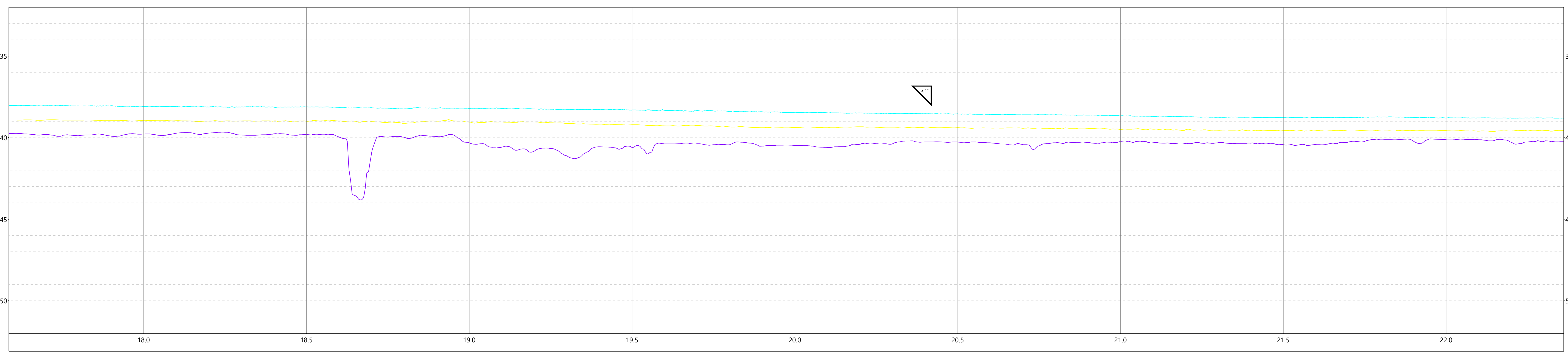
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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### LEGEND

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

### NOTES

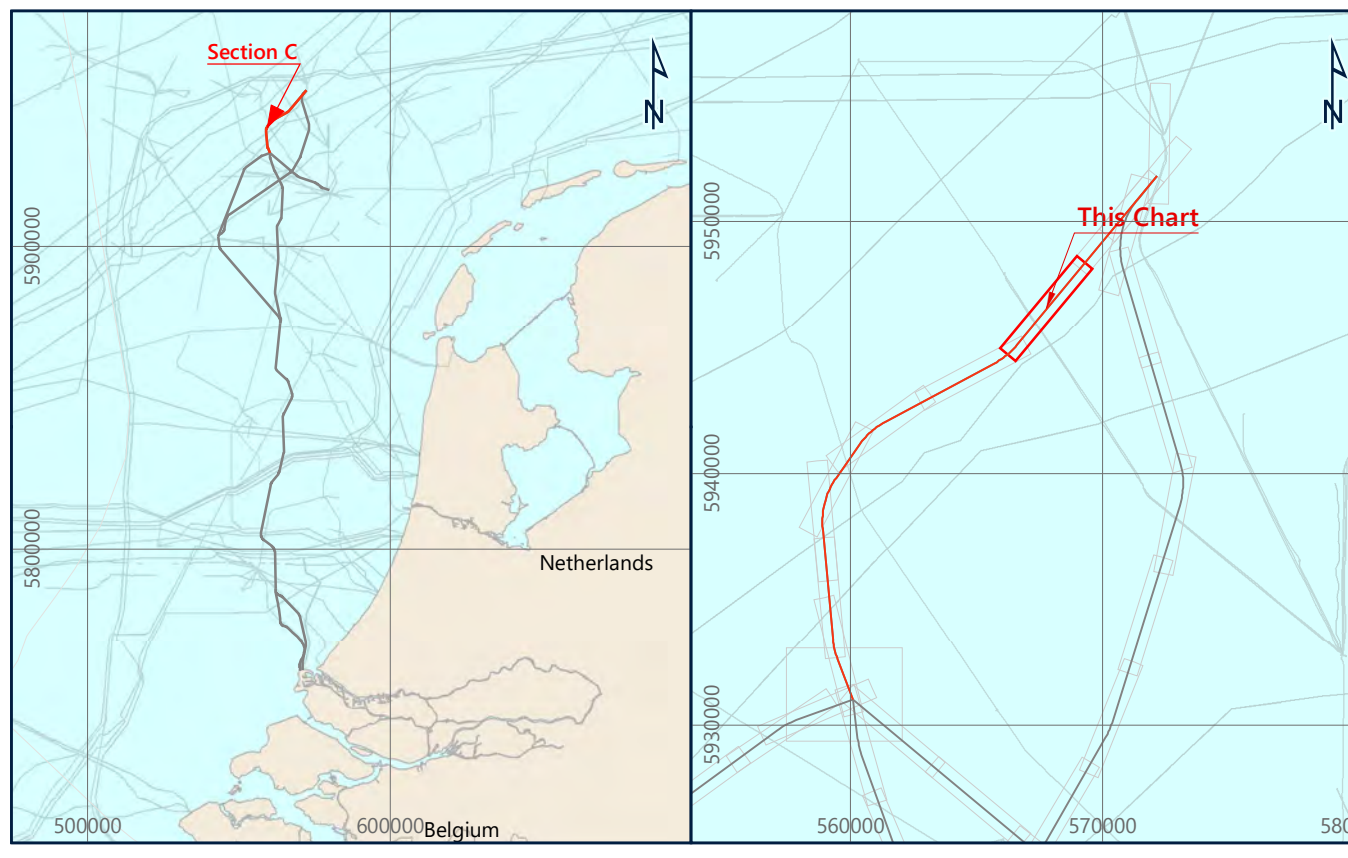
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### GEODETIC PARAMETERS

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 17.583 TO KP 22.361

Scale 1 : 5,000 at original A0 page size

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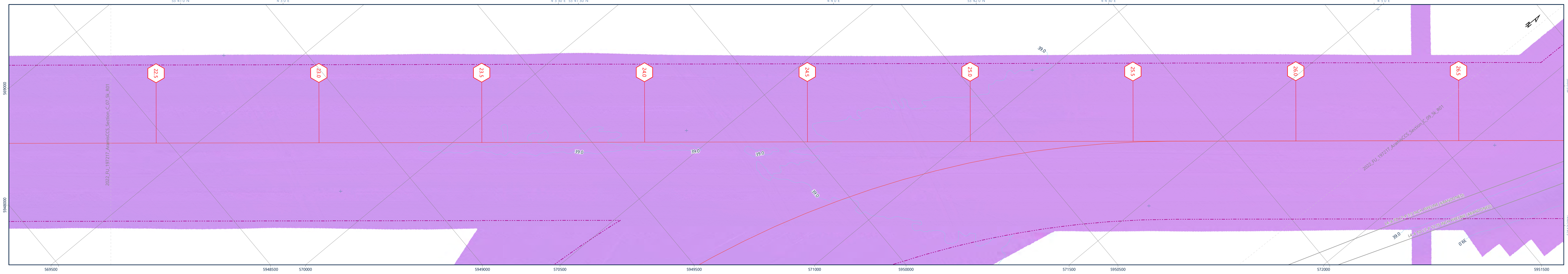
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MS	AD	

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

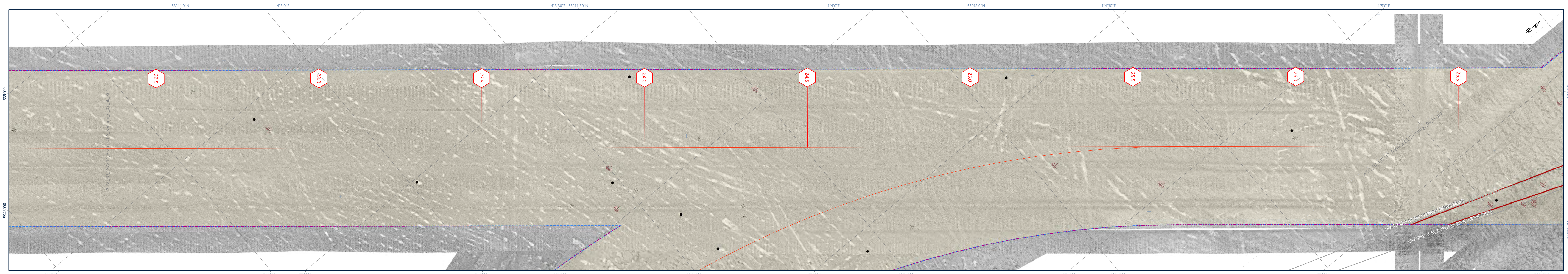
Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_C\_07\_Sk\_R01  
 Chart No. 07 of 09  
 Enclosure 063 of 105



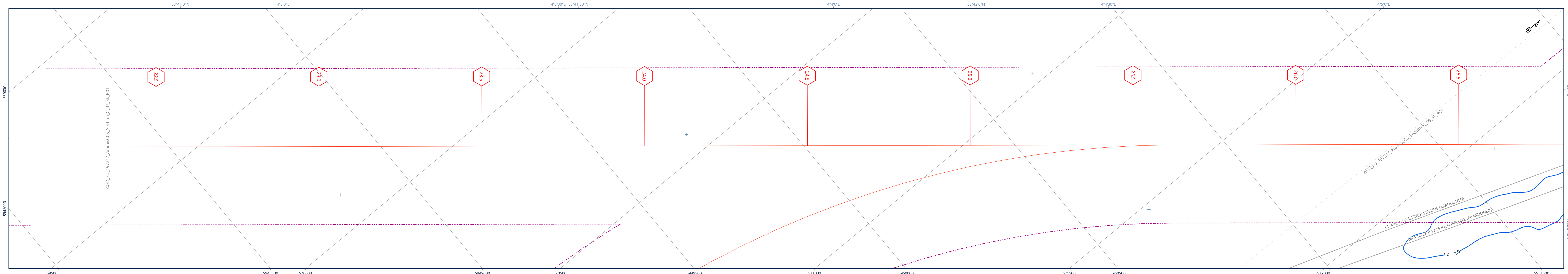
BATHYMETRY



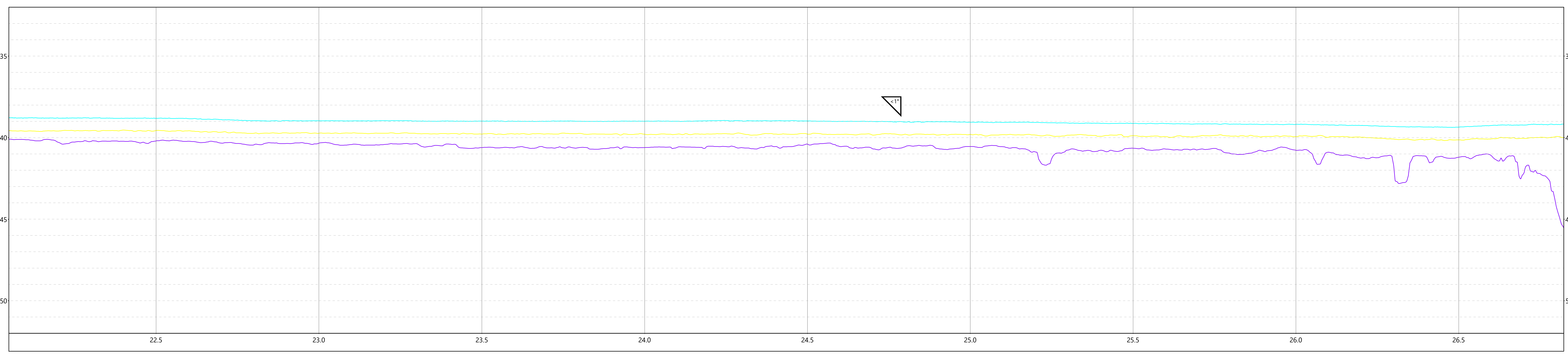
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

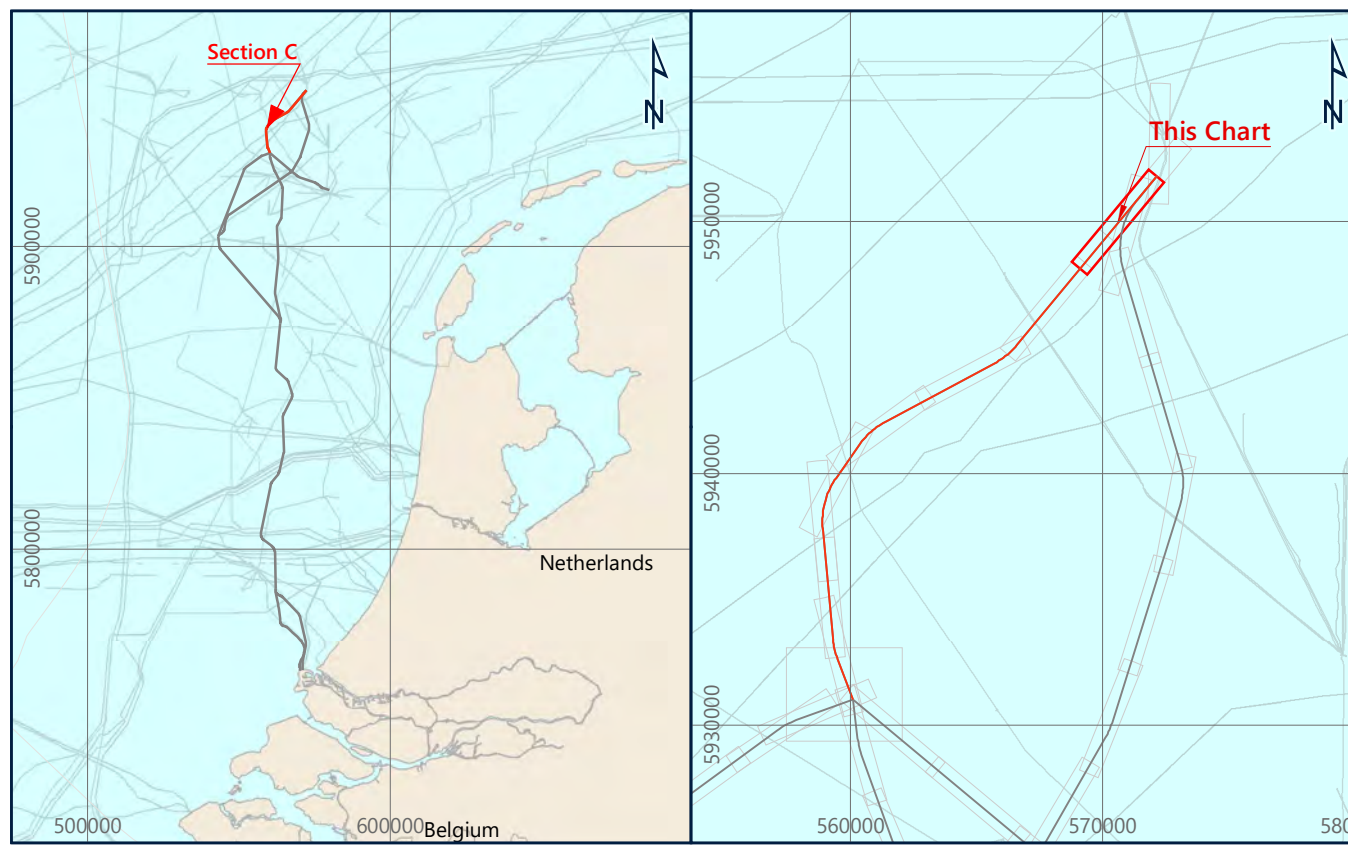
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 22.047 TO KP 26.822

Scale 1 : 5,000 at original A0 page size

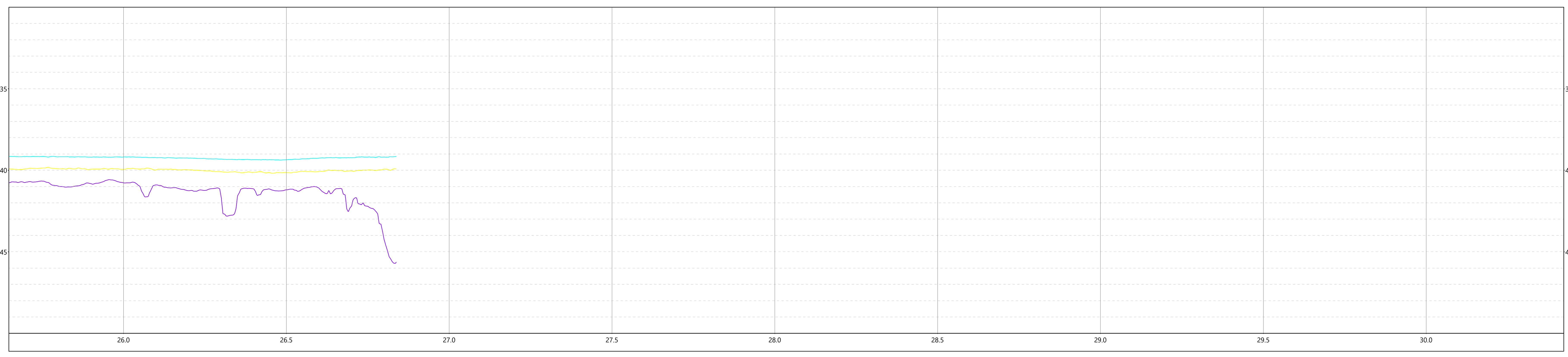
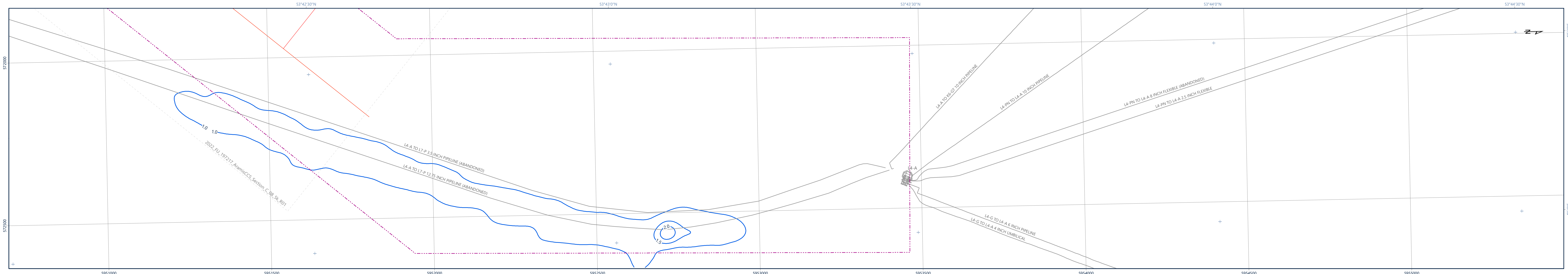
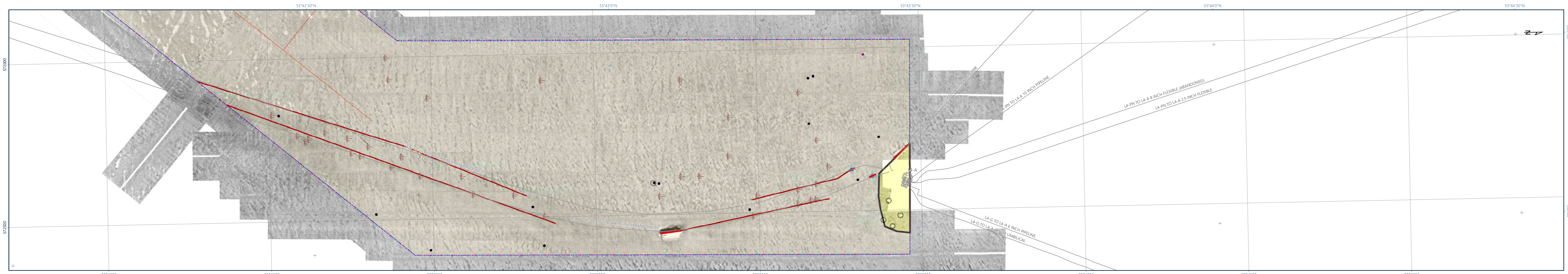
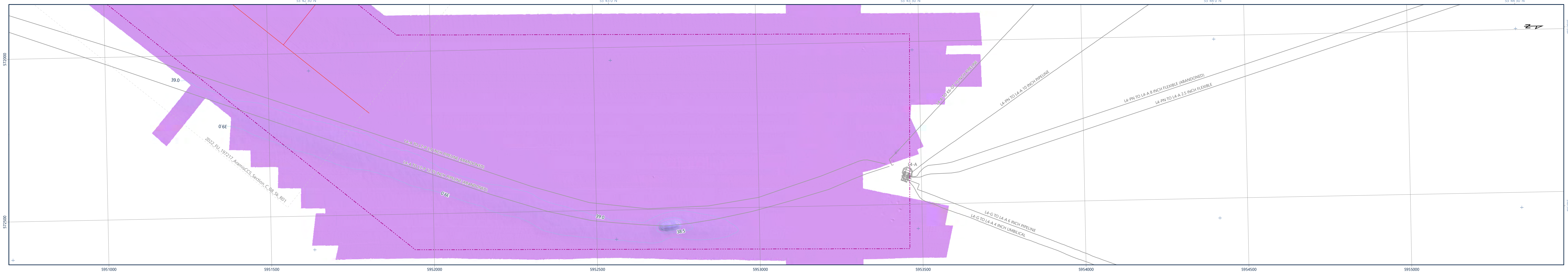
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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_C\_08\_Sk\_R01  
 Chart No. 08 of 09  
 Enclosure 064 of 105





**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
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- Areas with Numerous Boulders
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- Platform
- Debris
- Disturbed Sediment
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- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

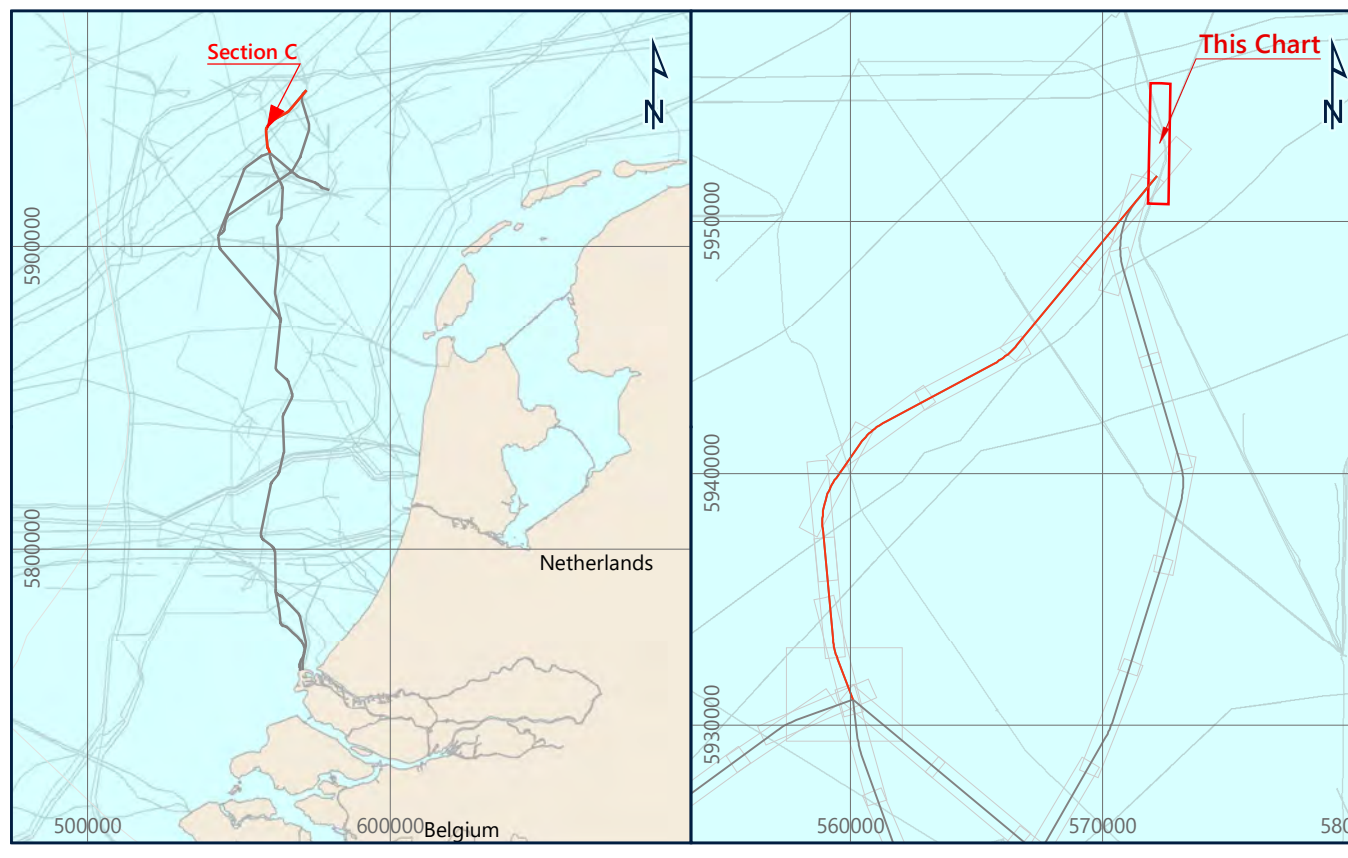
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
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- Seafloor Gradient

- NOTES**
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  - Magnetic anomalies measuring at least 10.0 nT in peak to peak amplitude were picked using the Blakely Test.
  - The shallow sub-seafloor isopach and shallow sub-seafloor profile panel show gridded horizons. The time to depth conversion was performed using fixed sub-seafloor velocity of 1600 m/s. For details refer to report main text.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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<https://totalenergies.com/>

**FUGRO**  
 Prinsstraat 4, 2031 RT Noordop, The Netherlands  
[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 26.301 TO KP 26.837

Scale 1 : 5,000 at original A0 page size

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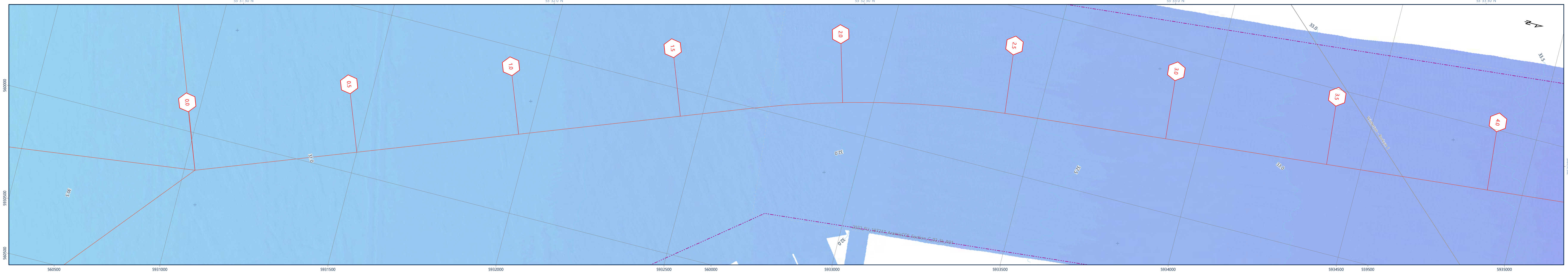
Issue	Date	Status	Interpr	Drawn	Chkd	Appr
01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F19217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

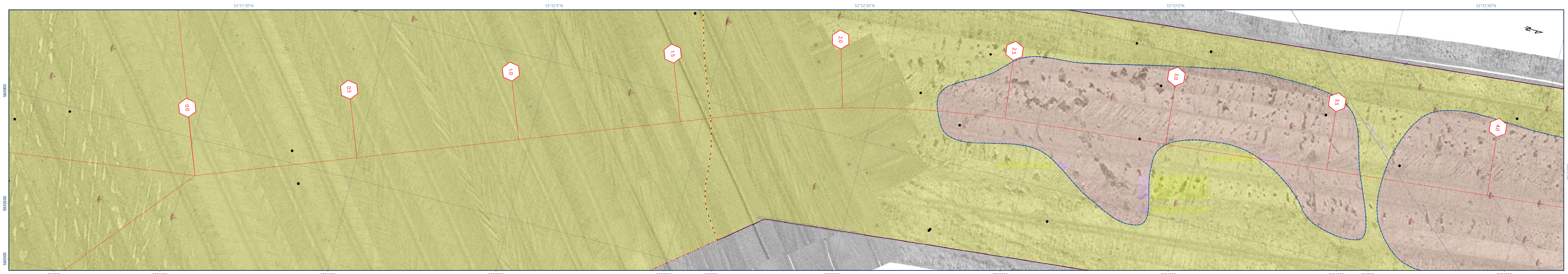
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 Chart No. 09 of 09  
 Enclosure 066 of 105



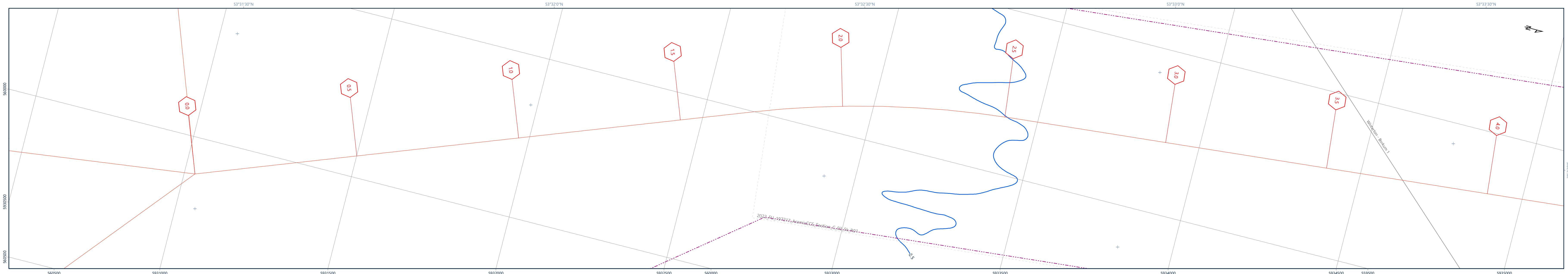
BATHYMETRY



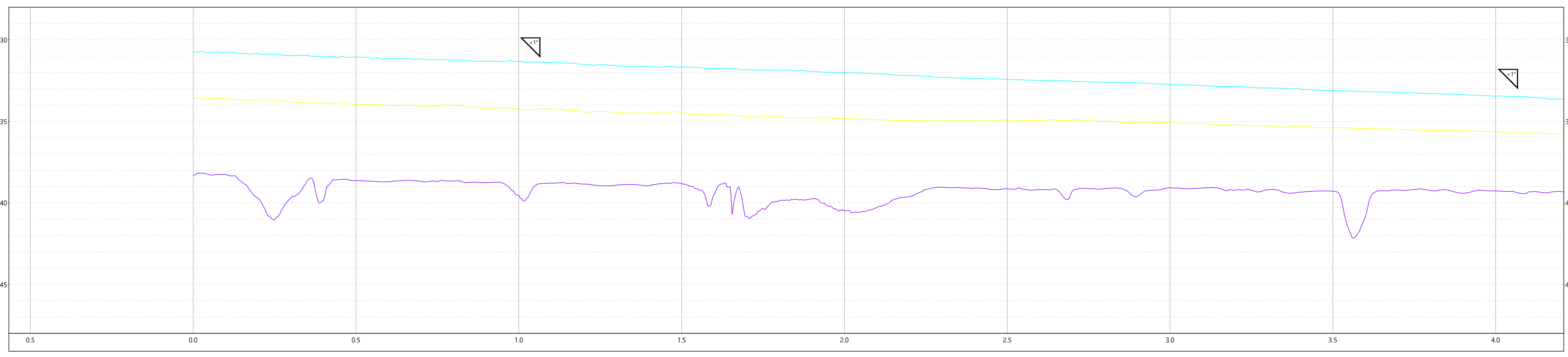
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

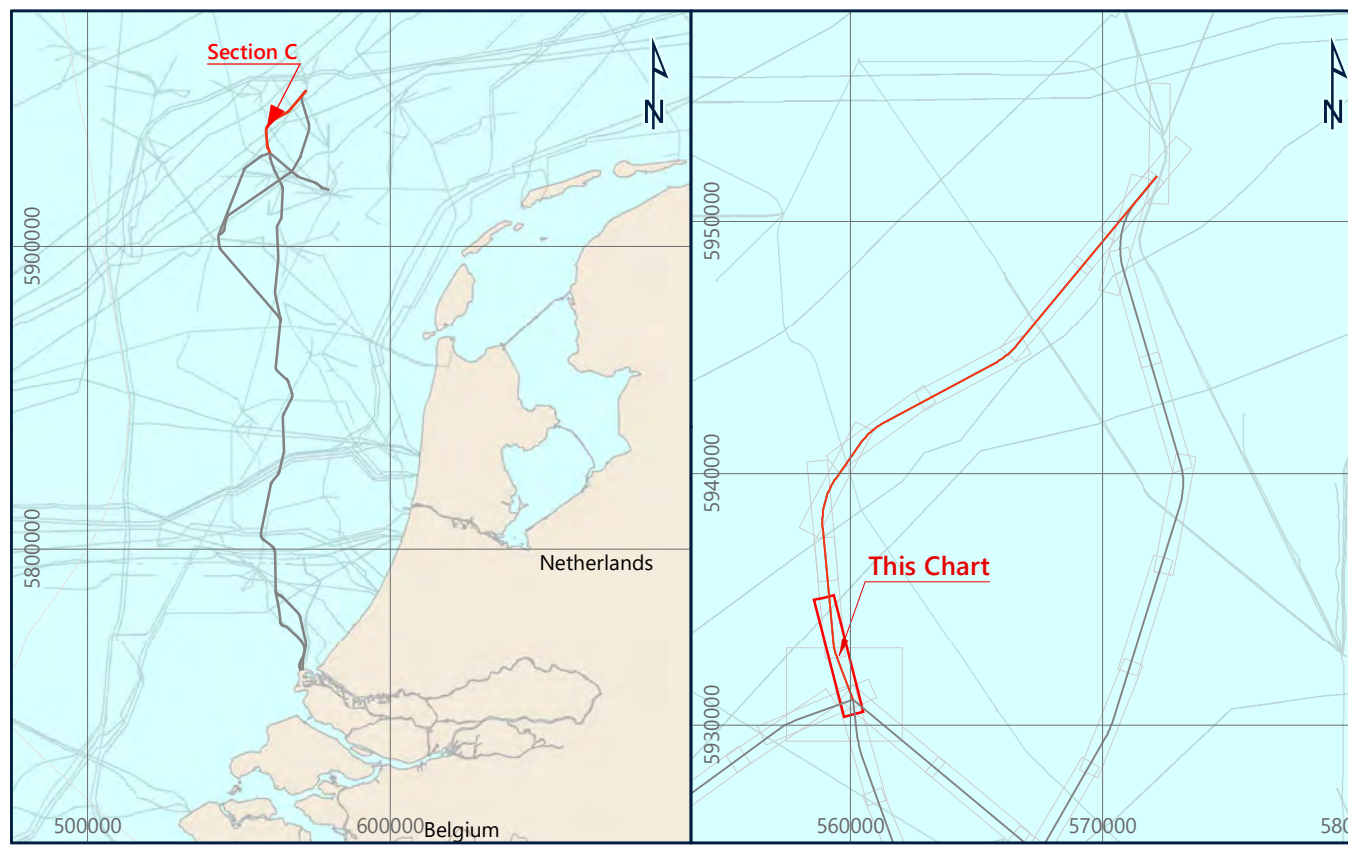
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson Seabat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION C, KP 0.000 TO KP 4.238

Scale 1 : 5,000 at original A0 page size

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 0 0.05 0.1 0.15 0.2 0.25 nautical miles

Issue	Date	Status	Interpr	Drawn	Chkd	Appr
01	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s): Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date: July - December 2022

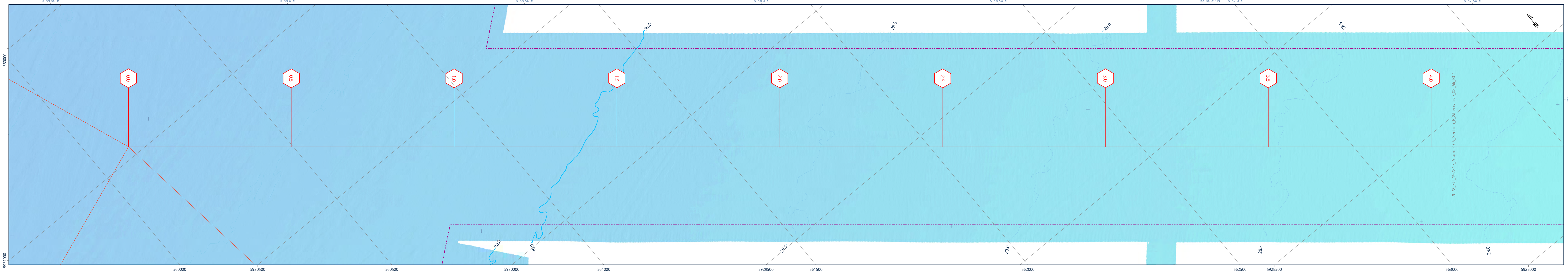
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 Chart No. 01 of 09  
 Enclosure 057 of 105



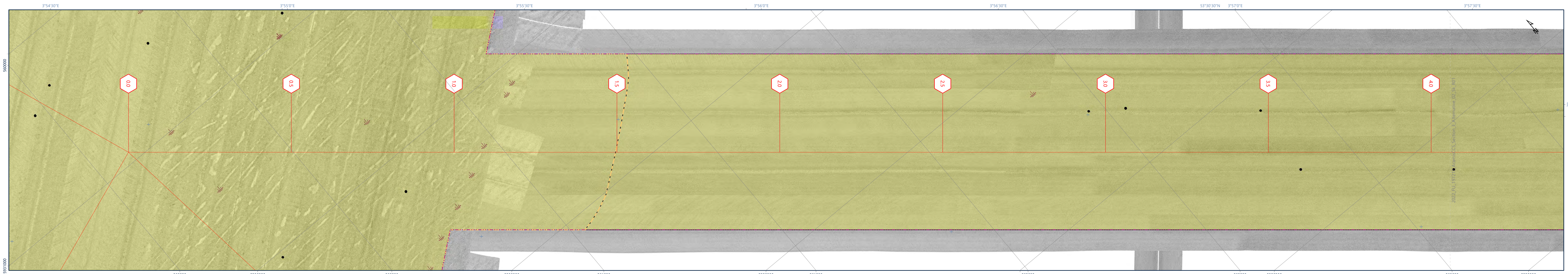
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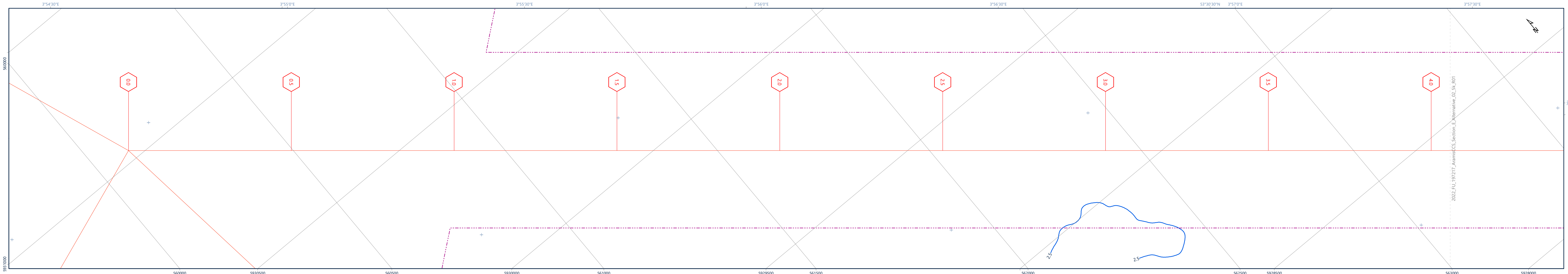
BATHYMETRY



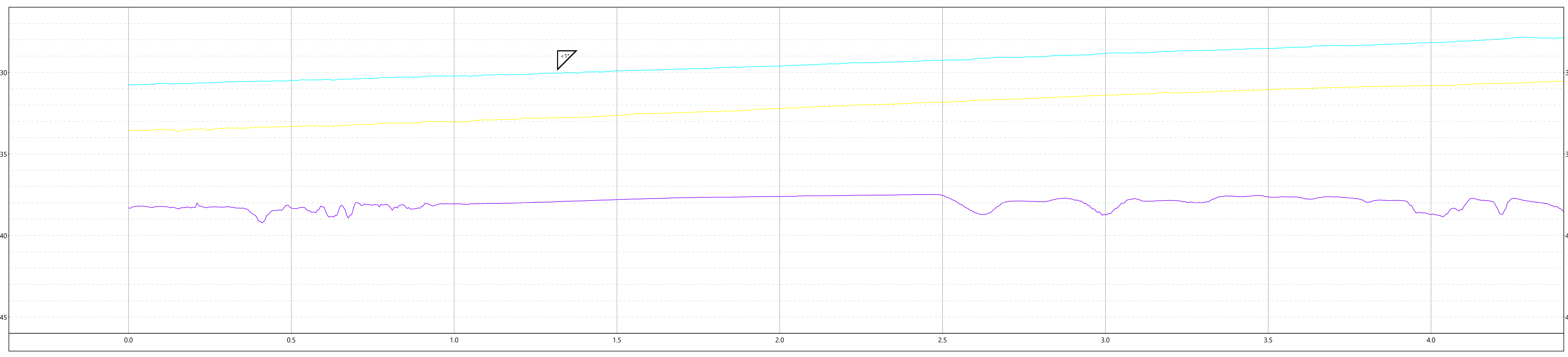
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

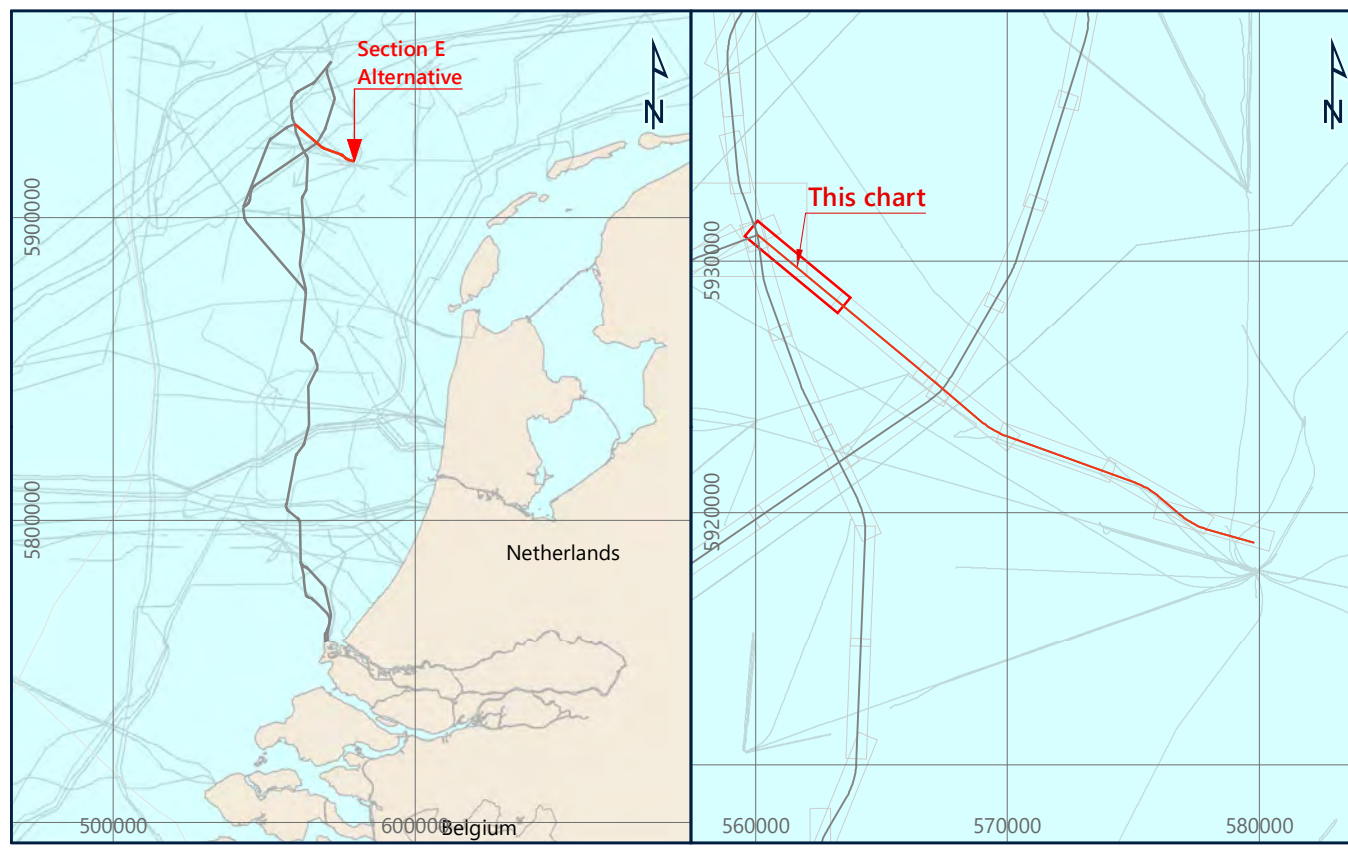
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
- Bathymetry data acquired with Kongsberg EM 2040 by Fugro Discovery and Fugro Searcher and with Reson SeaBat 7125 by Fugro Seeker. Data sampled to 1.0 m x 1.0 m grid.
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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[www.fugro.com](http://www.fugro.com)

**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION E ALTERNATIVE, KP 0.000 TO KP 4.407

Scale 1 : 5,000 at original A0 page size

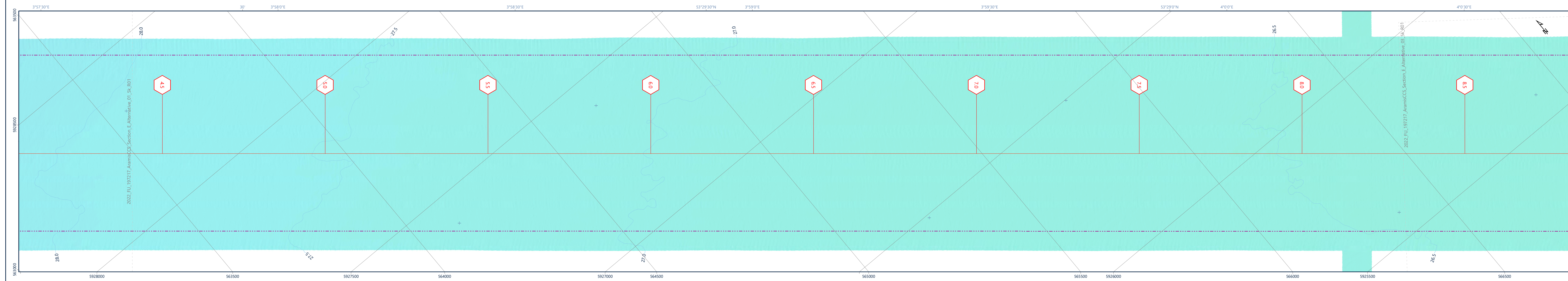
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01	13/04/2023	Complete	AB	MS	AD	

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

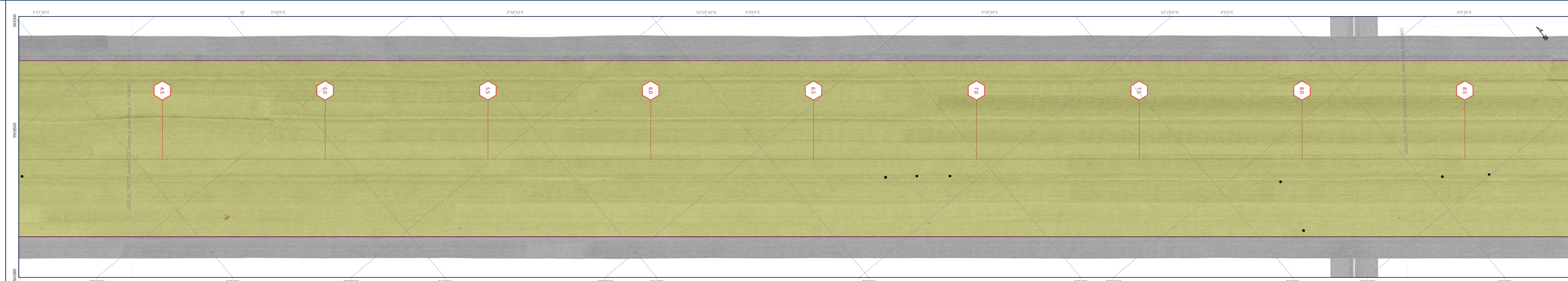
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 Chart No. 01 of 06  
 Enclosure 100 of 105



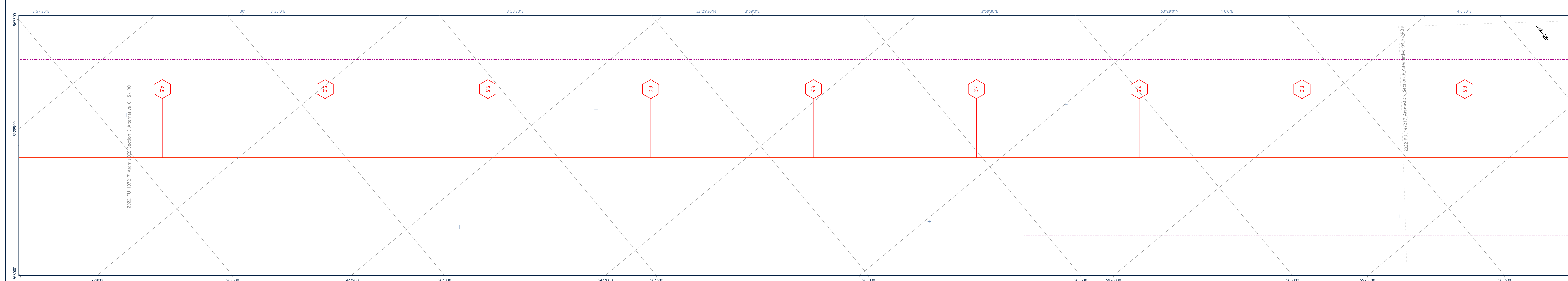
BATHYMETRY



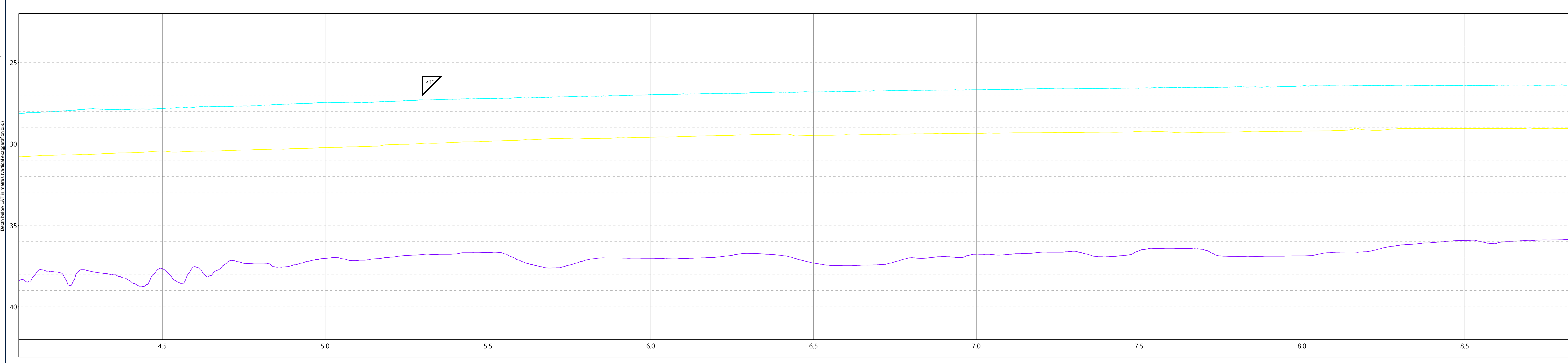
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Oredredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

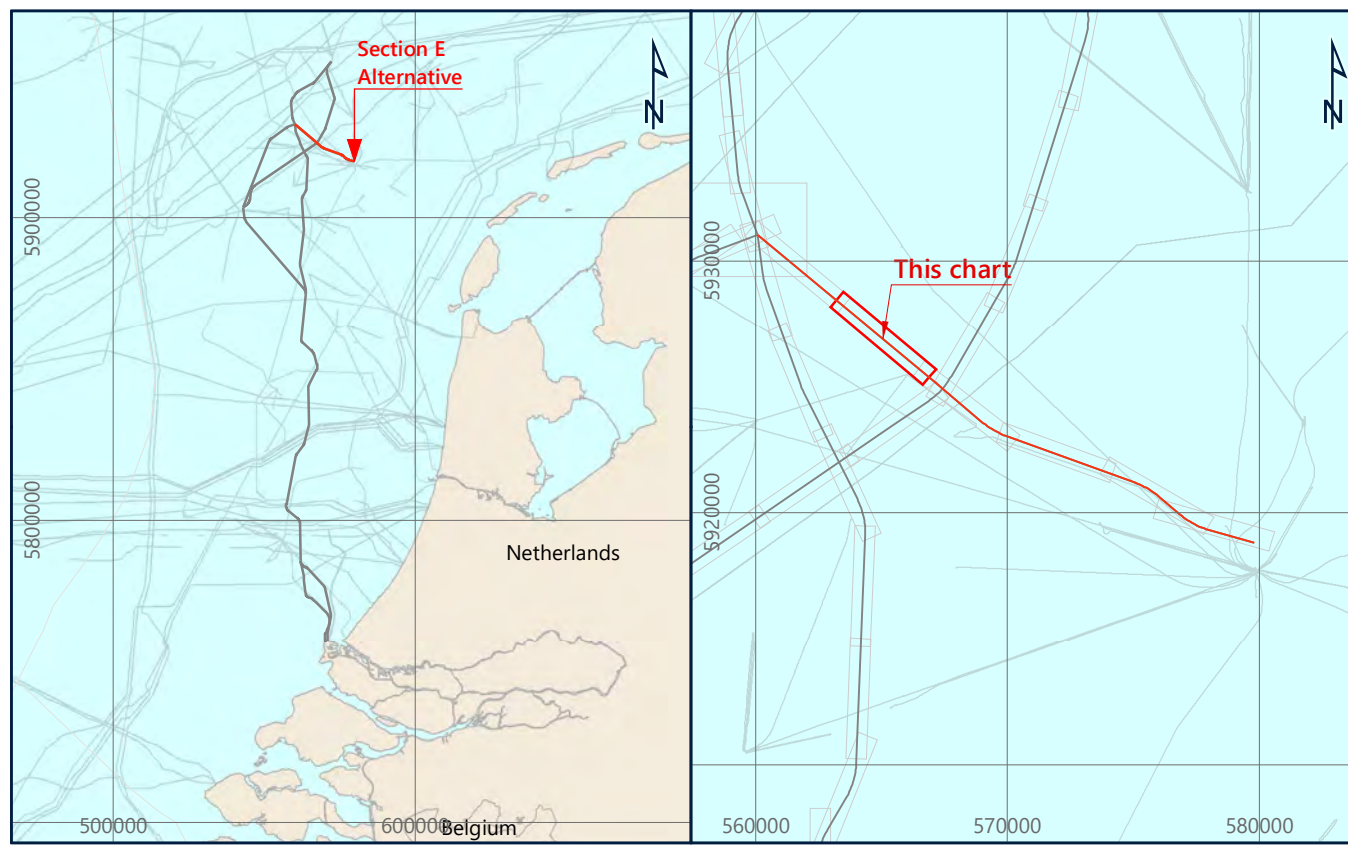
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

- NOTES**
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**GEODETTIC PARAMETERS**

GEODETTIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION E ALTERNATIVE, KP 4.059 TO KP 8.834

Scale 1 : 5,000 at original A0 page size

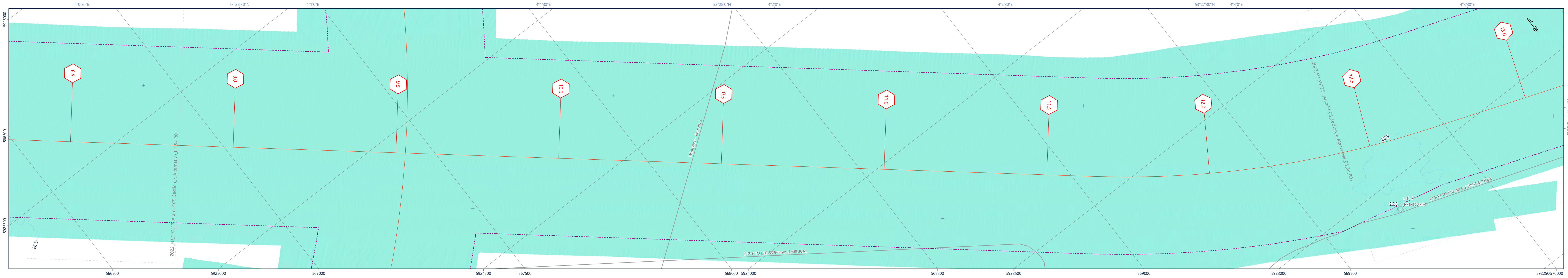
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No.	Vessel(s)	Survey Date
F197217-REP-GEOP-001	Fugro Searcher, Fugro Seeker, Fugro Discovery	July - December 2022

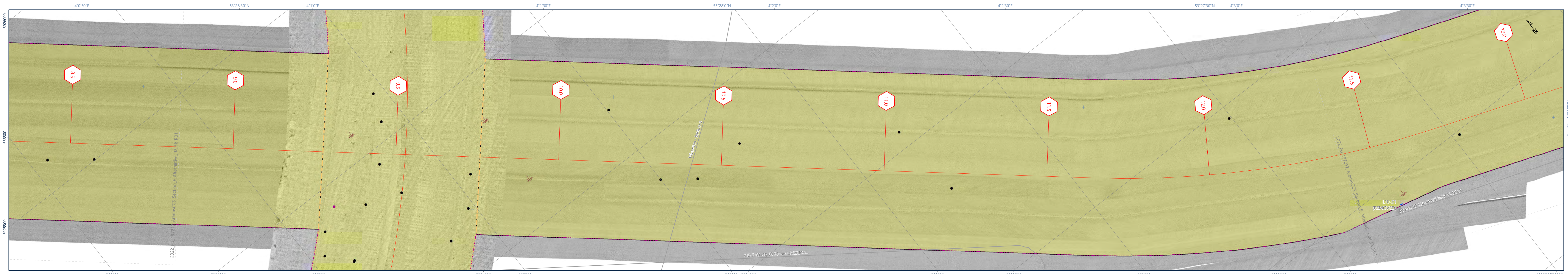
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2022_FU_197217_AramisCCS_Section_E_Alternative_02_Sk_R01	02 of 06	101 of 105



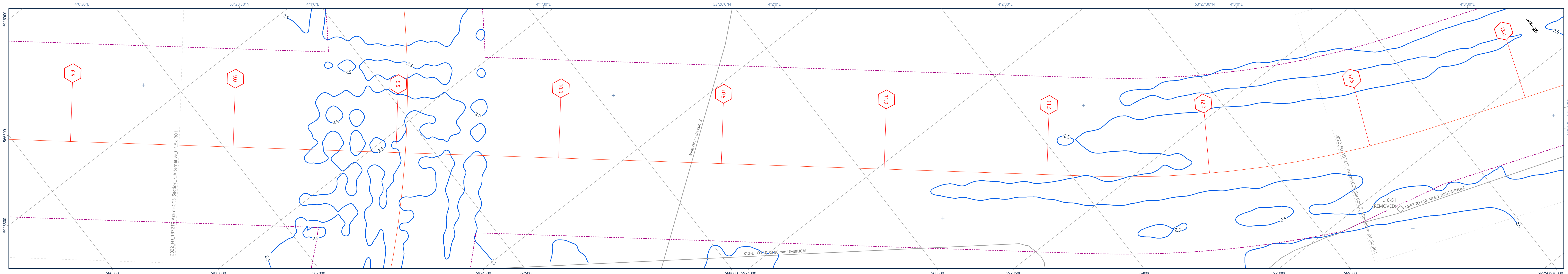
BATHYMETRY



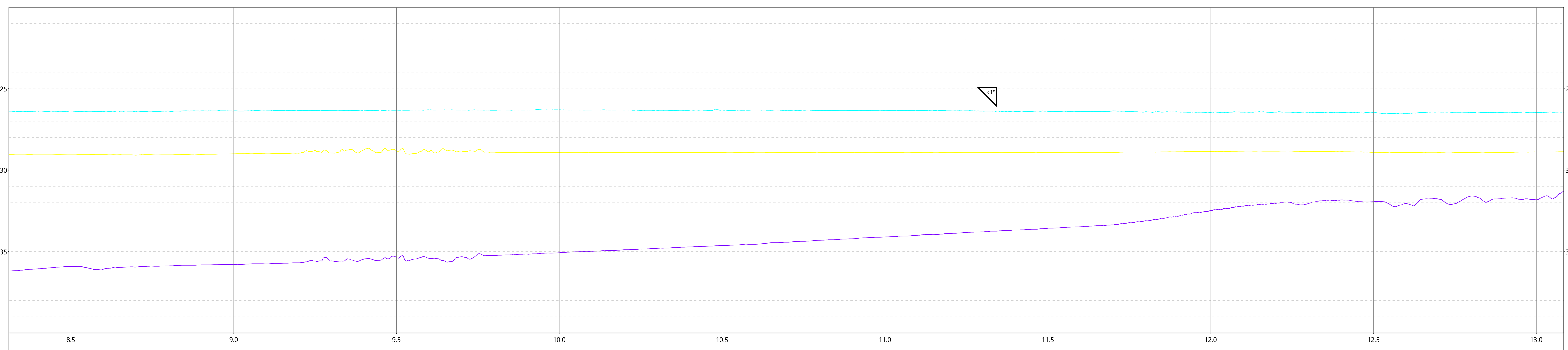
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



BLANK

**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Sand
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silty - Sand
- Rocky
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Sea floor Gradient

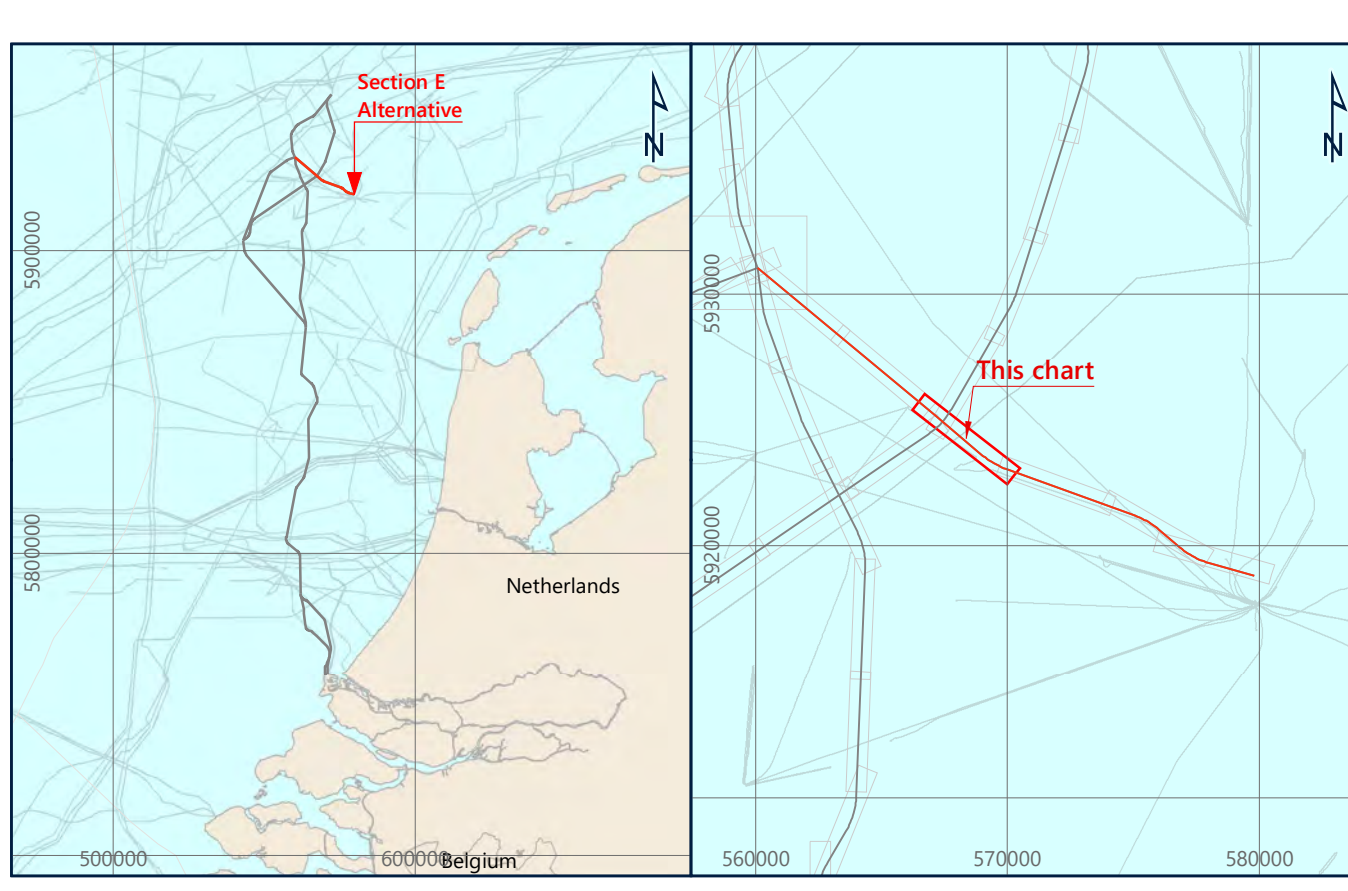
**Water Depth [m LAT]**

Color scale from 0 to 40 meters.

- NOTES**
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**GEODETIC PARAMETERS**

GEODETIC DATUM	ETRS 1989	GRID SYSTEM	ETRS 1989 UTM Zone 31N (EPSG: 25831)
ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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**ALIGNMENT CHART**  
 OFFSHORE GEOPHYSICAL AND GEOTECHNICAL SITE INVESTIGATION 2022  
 ARAMIS CCS PROJECT  
 SECTION E ALTERNATIVE, KP 8.311 TO KP 13.124

Scale 1 : 5,000 at original A0 page size

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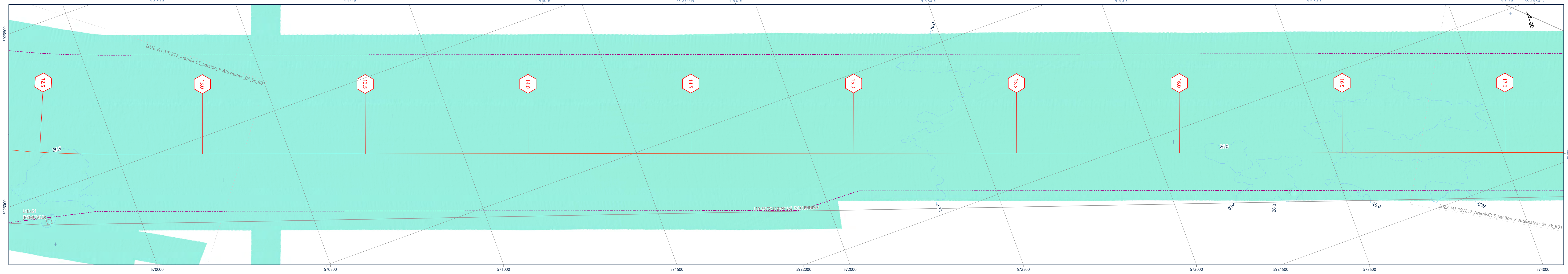
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D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

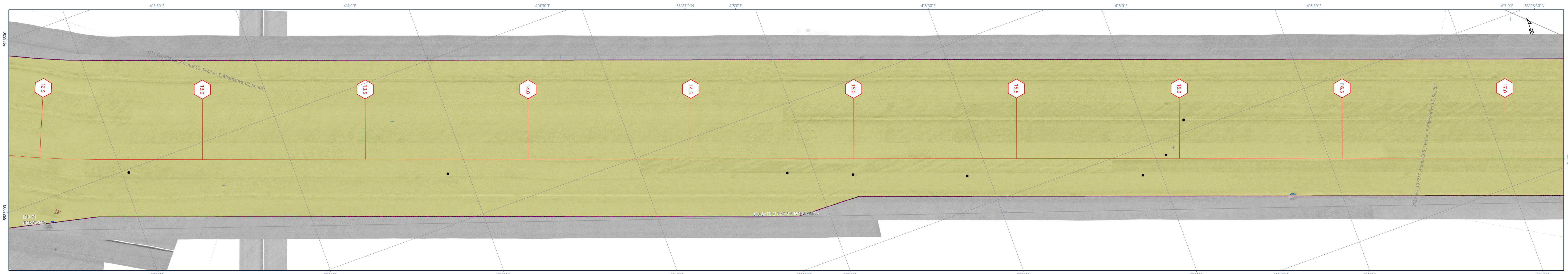
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 Chart No. 03 of 06  
 Enclosure 102 of 105



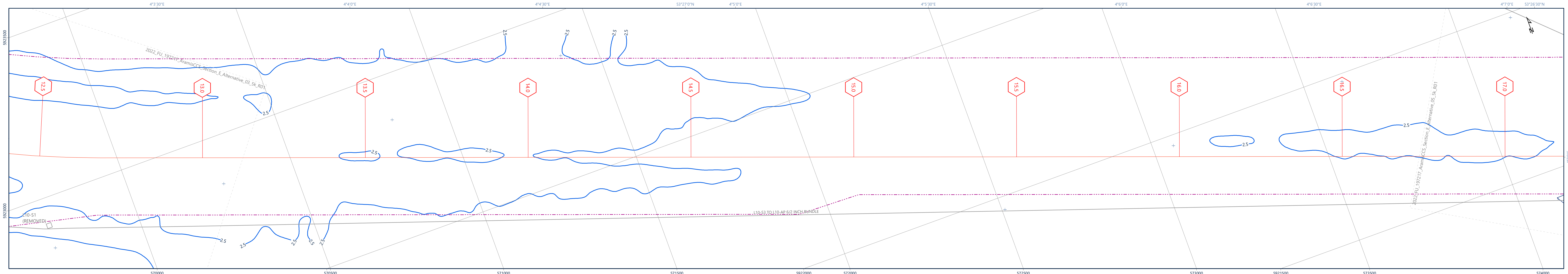
BATHYMETRY



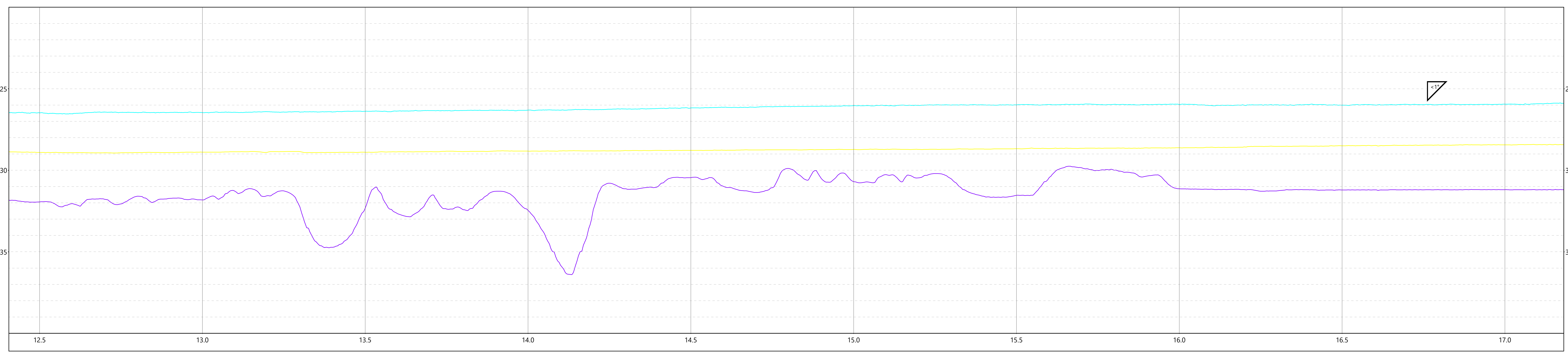
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Other
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
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- Ridge
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- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**NOTES**

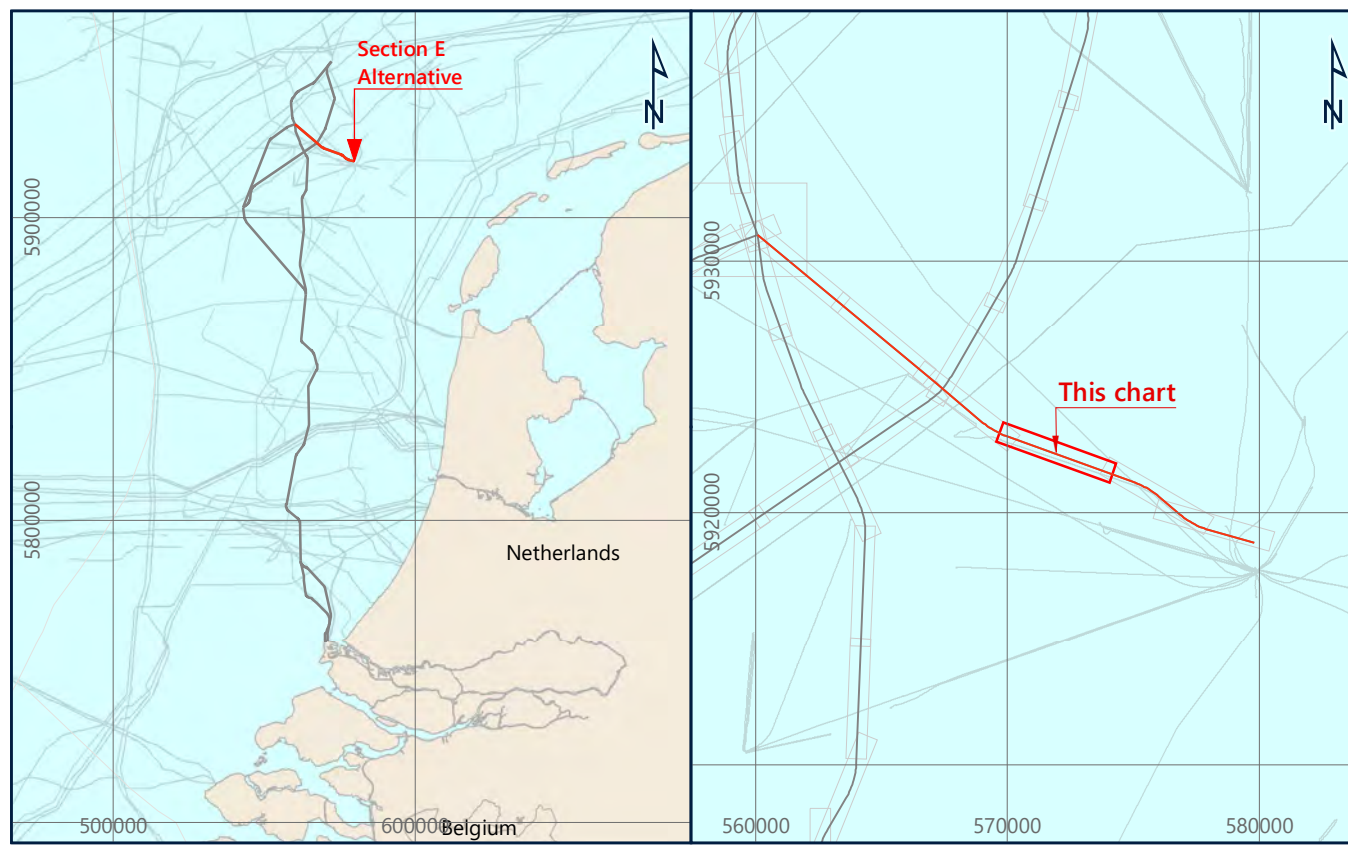
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**GEODETTIC PARAMETERS**

GEODETTIC DATUM: ETRS 1989  
 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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 ARAMIS CCS PROJECT  
 SECTION E ALTERNATIVE, KP 12.405 TO KP 17.180

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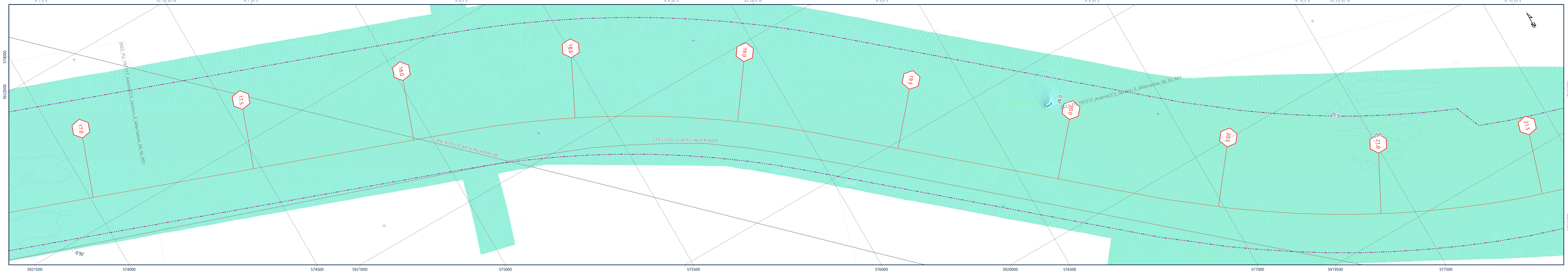
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Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_E\_Alternative\_04\_Sk\_R01  
 Chart No. 04 of 06  
 Enclosure 103 of 105



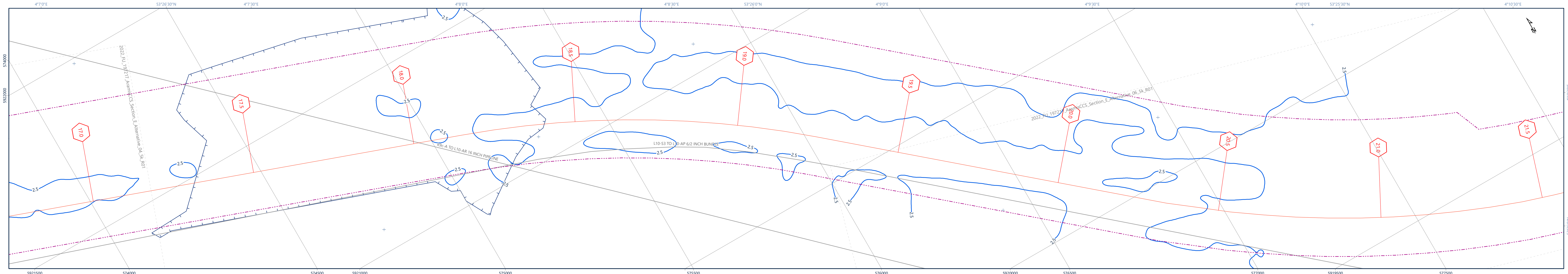
BATHYMETRY



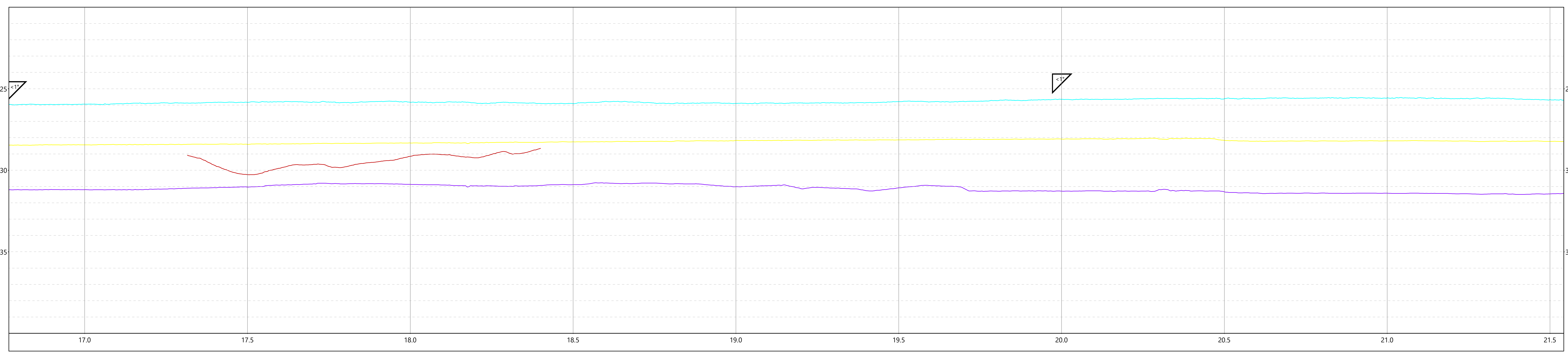
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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**LEGEND**

**General**

- Proposed Route with KP
- Existing Infrastructure
- Survey Extents

**Bathymetry**

- Major Contours at 1.0 m Interval
- Minor Contours at 0.50 m Interval

**Seafloor Features**

- Boulder
- Isolated Pockmark
- Pipe
- Fish Trap
- Wreck
- Identified Debris
- Debris/Suspected Debris
- Magnetometer Contact
- Buried Pipeline
- Exposed Pipeline
- Linear Debris
- Other
- Trawl Scar
- Ridge
- Areas with Numerous Boulders
- Boundary - Others
- Pipe/Cable Support
- Platform
- Debris
- Disturbed Sediment
- Area of Anchor/Wire scars
- Dredged Area - Trench
- Rock Dump
- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Sand
- Silty - Sand
- Other Type - Gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

**Water Depth [m LAT]**

**NOTES**

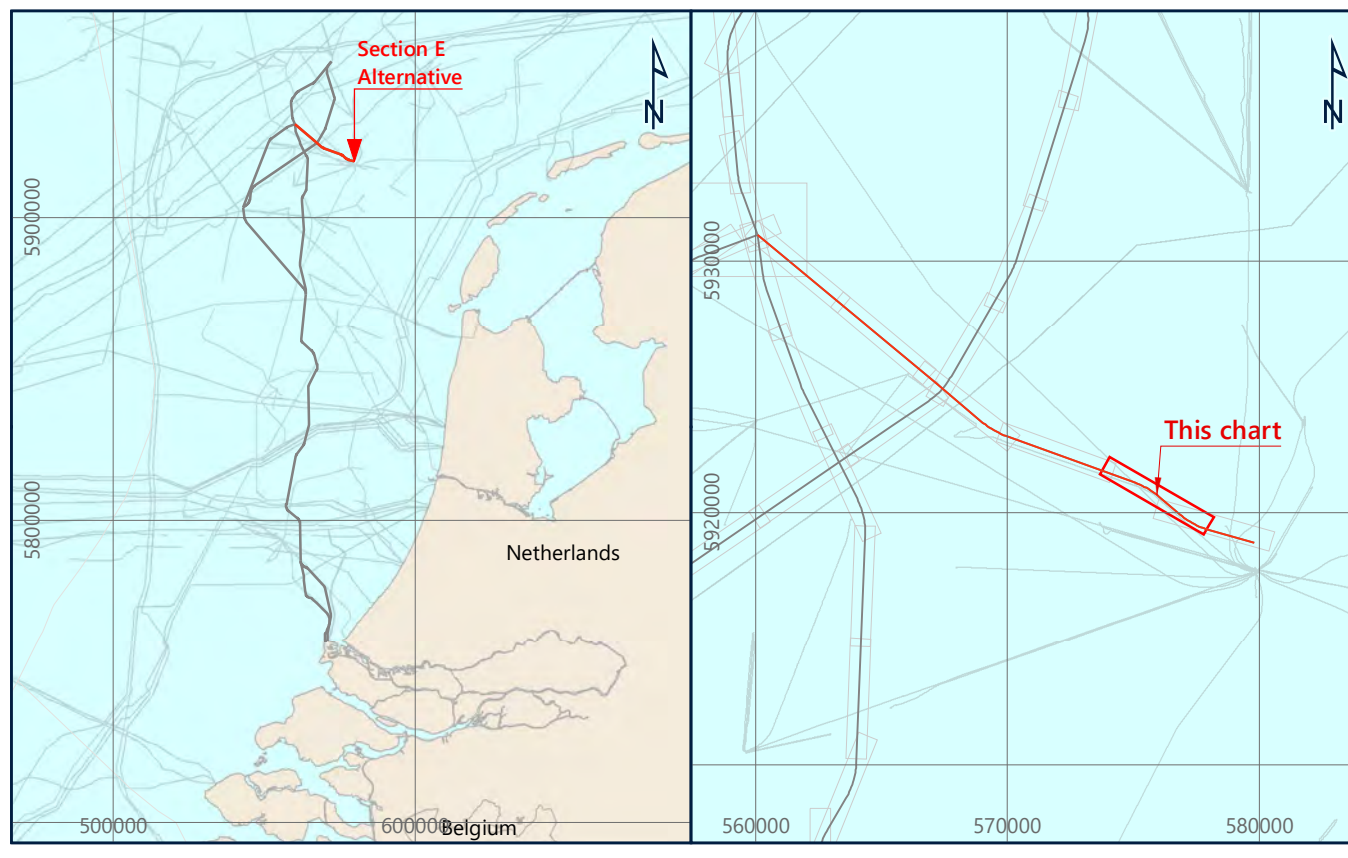
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**GEODETTIC PARAMETERS**

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 ELLIPSOID: GRS 1980  
 PROJECTION: Transverse-Mercator

GRID SYSTEM: ETRS 1989 UTM Zone 31N (EPSG: 25831)  
 VERTICAL DATUM: Lowest Astronomical Tide (LAT)



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 SECTION E ALTERNATIVE, KP 16.737 TO KP 21.568

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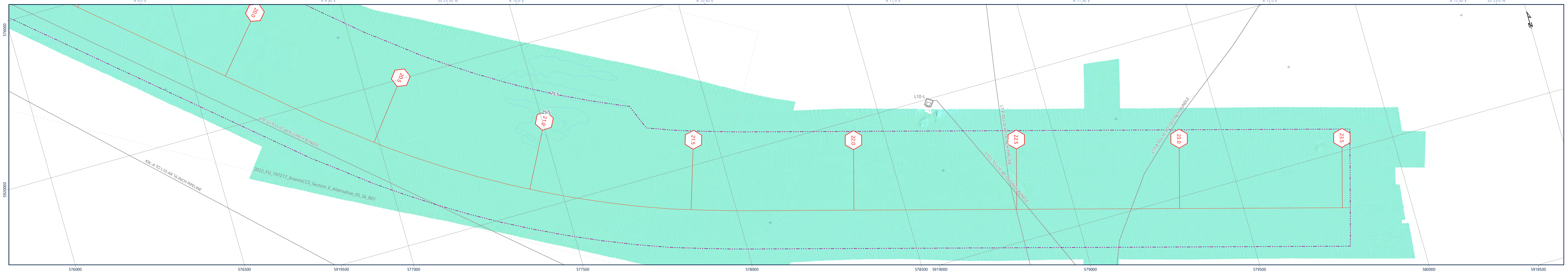
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Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

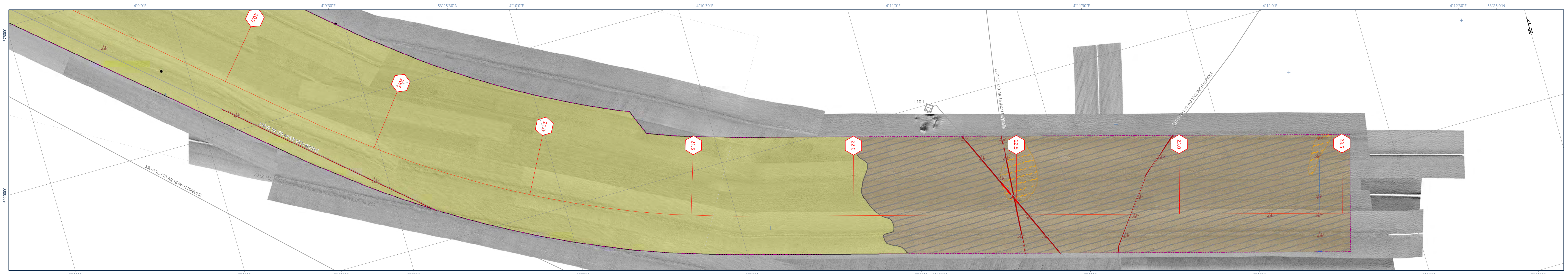
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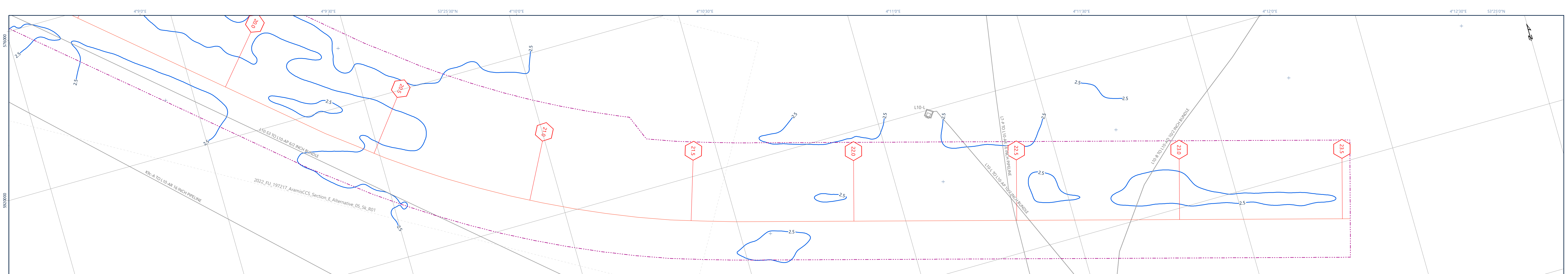
BATHYMETRY



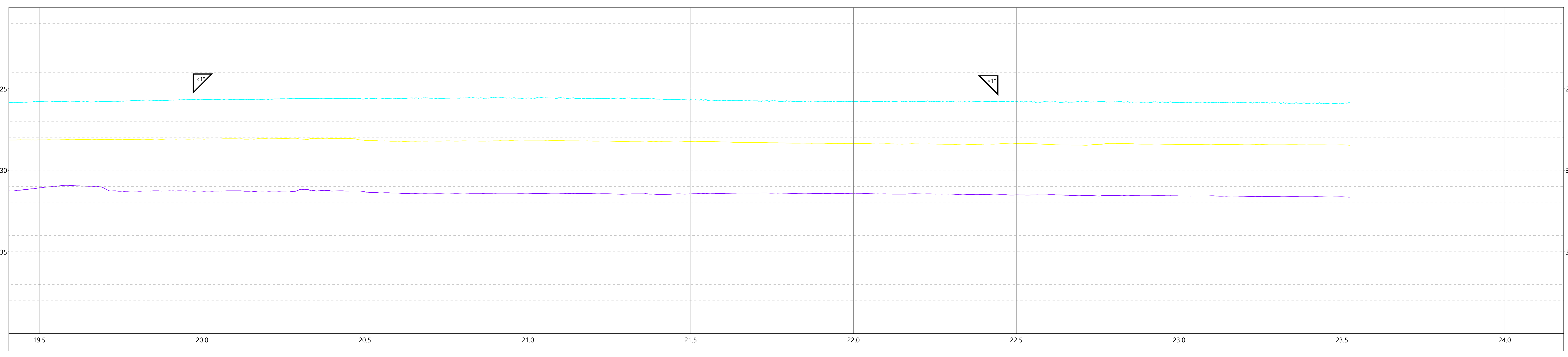
SEAFLOOR FEATURES



SHALLOW GEOLOGY



SHALLOW SUB-SEAFLOOR PROFILE (Vertical scale 1:100)



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- Existing Infrastructure
- Survey Extents

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- Channel Floor
- Sand Bar
- Sand Ripples
- Mega Ripples
- Silt - Sand
- Sand
- Other Type - Gravelly SAND
- Other Type - Slightly gravelly SAND

**Shallow Geology**

- Major Isopach Contours of Unit A
- Buried Channels
- Acoustic Diffraction

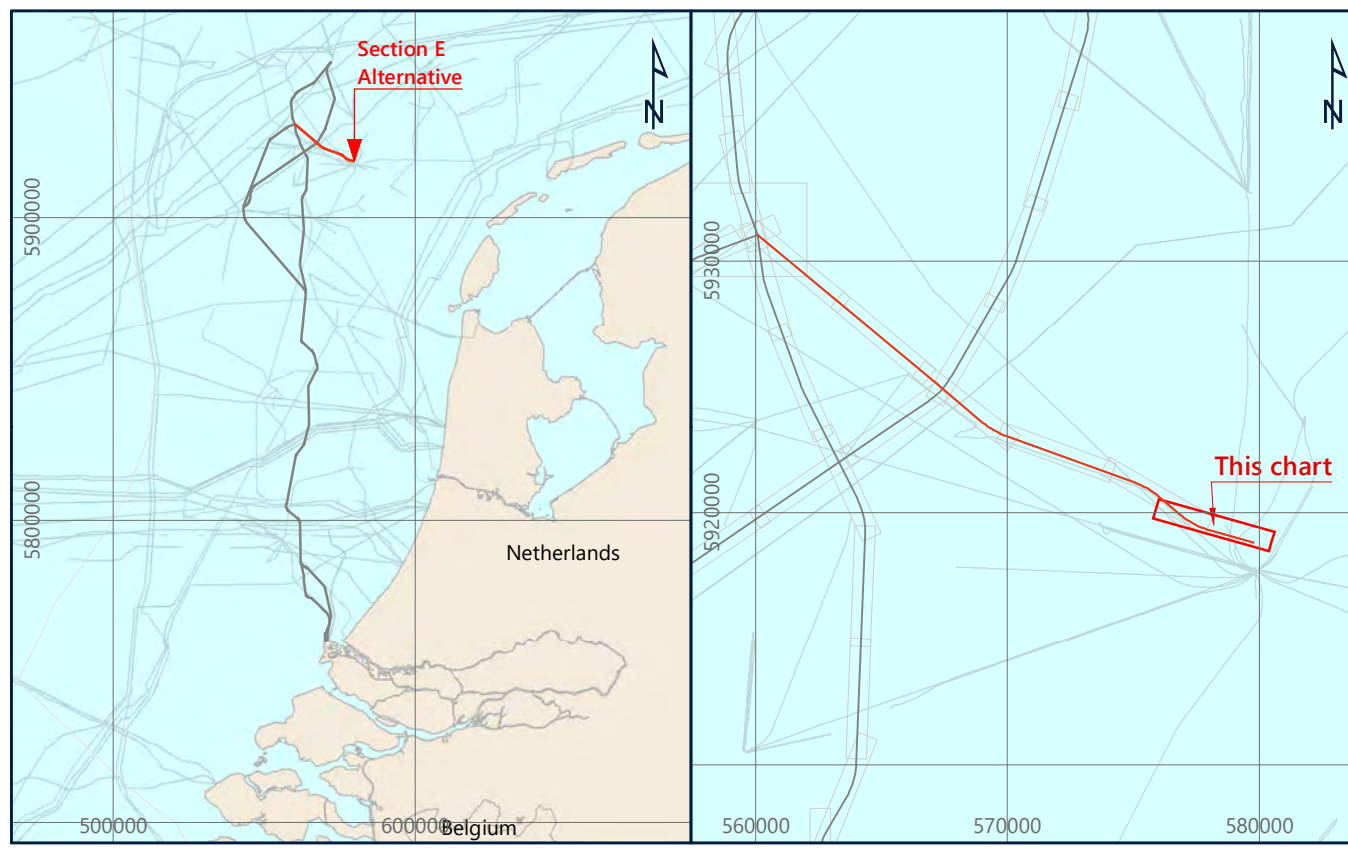
**Shallow Sub-Seafloor Profile**

- Seafloor
- Buried Channel
- Horizon H10, Base of Unit A
- Horizon H15, Base of Unit B
- Seafloor Gradient

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**GEODETIC PARAMETERS**

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ELLIPSOID	GRS 1980	VERTICAL DATUM	Lowest Astronomical Tide (LAT)
PROJECTION	Transverse Mercator		



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 SECTION E ALTERNATIVE, KP 19.480 TO KP 23.523

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Issue	Date	Status	Interpr	Drawn	Chkd	Appr
D1	13/04/2023	Complete	AB	MB	MS	AD

Fugro Document No. F197217-REP-GEOP-001  
 Vessel(s) Fugro Searcher, Fugro Seeker, Fugro Discovery  
 Survey Date July - December 2022

Chart Name 2022\_FU\_197217\_AramisCCS\_Section\_E\_Alternative\_06\_Sk\_R01  
 Chart No. 06 of 06  
 Enclosure 105 of 105



# ARAMIS TRANSPORT


## BASIS OF DESIGN

### V0



Rev n°	Date	Designation	Issued by	Verified by	Approved by
0	March 2023	Table of Contents	Nicolaas van Dijk		
1	Sep 2023	Issued for Comments	Nicolaas van Dijk	TL	
2	October 26	Comments addressed and issued for final comments	Nicolaas van Dijk	TL	
3	November 10	Final comments addressed and issued	Nicolaas van Dijk	TL	TCM
		Version	<b>SIGNED</b>		<b>DATE</b>
V0	TL Total Energies	V0: Start FEED			
V0	TL Shell	V0: Start FEED			
V0	TL EBN	V0: Start FEED			
V0	TL GasUnie	V0: Start FEED			
V0	JT	V0: Start FEED			




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	<b>Basis of Design V0</b>		
	Ref.: ARM-PFE-BB0-APP-BOD-0237	NOV 2023	Page 2 / 50

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**18. OPERATIONS .....50**



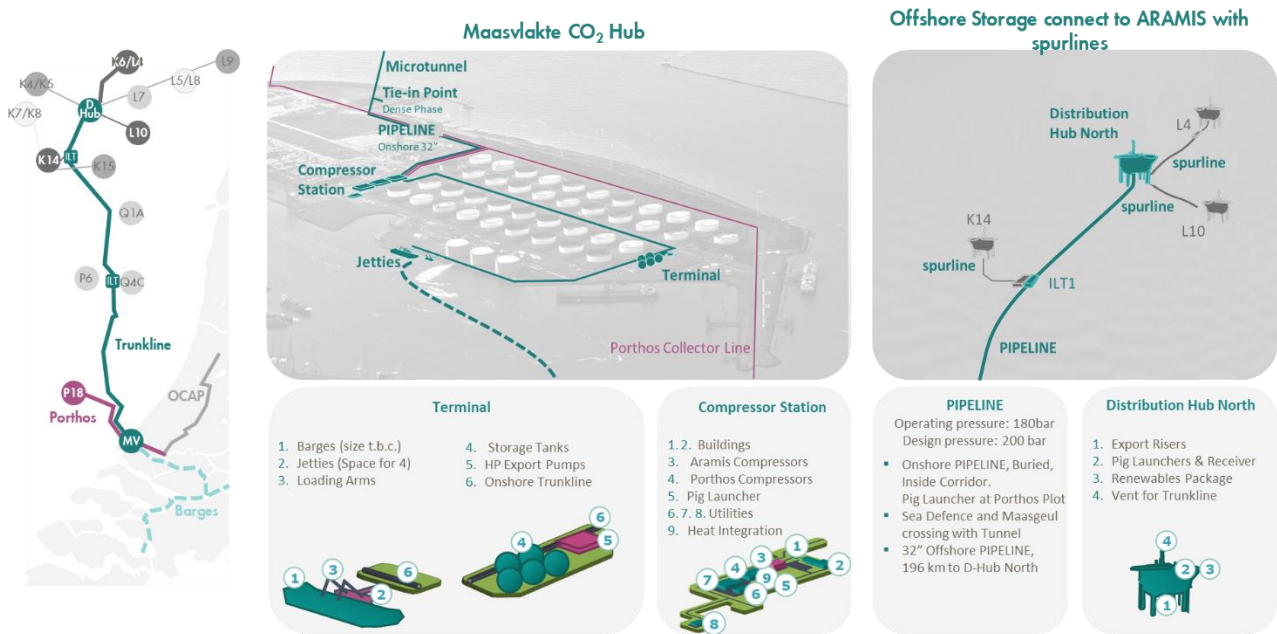
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# 1. ABSTRACT- EXECUTIVE SUMMARY

Aramis is the name for a cooperation agreement between TotalEnergies, Shell, Energie Beheer Nederland and Gasunie to realise a 22 million Ton Per Annum (MTPA) carbon transport and storage chain (CCS) with high availability (>95%). The transport chain comprises of various transport entities, each having different ownership, as shown in figure 1 below. Aramis develops the offshore pipeline and distribution hub, Co2nnext develops the shipping terminal and Porthos develops the compression station. Stores connect to the pipeline by means of spurlines to the distribution hub or directly to the pipeline. The infrastructure needs to provide open non-discriminatory access.


In addition to developing the offshore pipeline and distribution hub, Aramis, in line with its mission, has also taken upon itself to develop the operating system and an integrated control centre to manage the flow of CO2 over various assets from emitter to store.

This document is the basis of design for the pipeline, landfall, distribution hub as well as for an integrated control room that will coordinate the shipment of product from emitters to stores.



**Figure 1 CO2 transport infrastructure**



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## 2. HOLDS

HOLD	Page	Topic	Status	Value
HOLD 1	10	KP0 for PIPELINE	OPEN	
HOLD 2	21	Temperature cycles (magnitude and occurrence)	OPEN	
HOLD 3	27	Minimum design temperature PIPELINE - 25	CLOSED	-25 deg C
HOLD 4	30	OverPressure Protection Terminal to PIPELINE	OPEN	For design purposes a PSV is assumed
HOLD 5	30	Design rate for onshore tie in at beach valve station	CLOSED	14 MTPA
HOLD 6.	31	Inclusion of a composition analyser at beach valve station	CLOSED	Inclusion of composition analyser and housing at beach valve station
HOLD 7	31	Composition analyser design	OPEN	
HOLD 8	38	ILT1 size	CLOSED	Outcome of FEED work
HOLD 9	38	ILT1 location	OPEN	
HOLD 10	38	ILT2 spurline size and origin/destination	OPEN	
HOLD 11	38	ILT2 location	OPEN	
HOLD 12	39	Minimum Operating Pressure D-HUBN	OPEN	
HOLD 13	40	Size of export risers	CLOSED	3x 24" and 2x 20"
HOLD 14	40	Dimension and mass of spurline pigs	OPEN	
HOLD 15	41	Maximum elevation capacity of walk to work vessel	OPEN	
HOLD 16	42	Lifting capacity of walk to work vessel	OPEN	
HOLD 17	46	Acceptable CO2 concentration away from vent	OPEN	
HOLD 18	48	Design Basis Temporary Facilities at Maasvlakte	OPEN	
HOLD 19	49	Number of People in Onshore Control centre	OPEN	

## 3. REFERENCES

REF	Page	Title
REF 1	15	Aramis HSSE&SP POLICY
REF 2	15	Aramis HSSE&SP MANAGEMENT FRAMEWORK
REF 3	15	Aramis Project HSSE&SP plan



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REF 4	20	ARM-CPT-B08-PRO-MEM-0033 CO2 specification
REF 5	21	ARM-PFE-BB3-PRO-REP-0235: Process Report
REF 6	21	Meteorological and Meteocean design basis
REF 7	26	RWS A7H 9924 series: Maasvlakte Sea-Defense
REF 8	35	ARM-CPT-BB3-PR3-LAY-0045 – REV 5.0 Tunnel Alignment Drawing
REF 9	41	ARM-PFE-BB0-COR-REP-0199: Material Selection Report
REF 10	44	ARM-PFE-B11-TEL-PHI-0222 Telecom Philosophy
REF 11	47	ARM-PFE-B10-PJM-PLN-270_v02: Aramis Overarching Execution Plan
REF 12	47	ARM-CPT-BB8-OPE-PHI-0192: Commissioning and Startup Philosophy
REF 13	48	ARM-PFE-B11-ICS-BFD-0220: Instrumentation and Automation Philosophy
REF 14	50	ARM-PFE-BB8a-OPE-PHI-0180 Aramis Operating Philosophy




#### 4. ABBREVIATIONS

AIS	Automatic Identification System
BB3	PIPELINE or LANDFALL or HUB
CCR	ControlRoom
CCS	Carbon Capture and Storage
CCTV	Close Circuit TeleVision
CP	Cathodic Protection
CRA	Corrosion resistant Alloy
CS	Carbon Steel
CSU	Commissioning and Start Up
EBN	Energie Beheer Nederland
EC	European Committee
EEG	Europese Ecomische Gemeenschap
EPCC	Engineering Procurement Construction and Commissioning
ESD	Emergency Shut Down
EU	European Union
FEED	Front End Engineering Design
GU	GasUnie
HBOR	Handboek Beheer Ondergrond
HSE&SP	Health, Safety, Sustainability Environment and Social Performance
HTT	Hot Tap Tee
HVAC	Heating Ventilation and Air Conditioning
ICC	Integrated Control Centre
ICSS	Instrument Control and Safety Systems
ID	Inner Diameter
ILT	Inline Tee Assembly
ISP	Internet Service Provider
KP	Kilometer Point
kVAR	kilo volt ampere reactive
kW	kiloWatt
LAN	Local Area Network
LAT	Lowest Astronomic Tide
LTCS	Low Temperature Carbon Steel
MAN	Manifold
MTPA	Milltion Tons Per Annum
MVL	Maasvlakte
NAP	Normaal Amsterdams Peil

NEN	Nederlandse Norm
POB	People on Board
PSV	Pressure Safety Valve
RACON	Radar Responder
RFSU	Ready For Start Up
TCC	Transfer of Care and Custody
Te	Tonnes Equivalent
TTE	TotalEnergies
UXO	Unexploded Ordonance
VCR	Verification Certificate of Readiness
VHF	Very High Frequency
W2W	Walk to Work



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## 5. DEFINITIONS

### 5.1 Units

All dimensional data and results presented shall be expressed in SI (metric) units. In addition, other units may be used where they are universally accepted standards, such as for standard flow rates, temperature (°C), pressure (barg), or pipeline diameters (inch). For avoidance of doubt, all data and results shall be presented with units used.

Other than design pressures, where applicable, pressures will be stated together with elevation to reference depth

### 5.2 Coordinate System

The selected projection system for offshore for the project is ETRS 89/UTM zone 31N projection in line with NEN 3656

The selected coordinate system for onshore for the project is CRS Amersfoort / RD New [EPSG::28992]

The KP0 point for the PIPELINE will be at [HOLD 1]

### 5.3 Reference Depth

The water depths, tidal level and offshore levels shall be defined by reference to lowest astronomical tide (LAT). Near shore and onshore, levels will also be specified relative to Normaal Amsterdams Peil.(NAP) For avoidance of doubt, when depths are referenced to NAP and not to LAT this should be clearly indicated.

### 5.4 Defined Terms

PIPELINE in capital letters refers to the Aramis nominal 32” pipeline from Pig Launcher to Pig Receiver


D-HUBN in capital letters refers to the fixed platform at the end of the PIPELINE

LANDFALL in capital letters refers to the crossing of the sea-defence and the Maasgeul

ARAMIS refers to assets owned and operated by Aramis

DESIGN LIFE means the duration from start-up over with the ARAMIS shall be designed to operate normally




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## 6. PURPOSE AND STRUCTURE OF THE DOCUMENT

The principal purpose of this document is to provide the basis of design for the PIPELINE, LANDFALL and D-HUBN, collectively referred to as ARAMIS.

To fulfil its role as system integrator this document also includes the basis of design for an integrated Onshore Control Centre (OCC) that includes a control room for the ARAMIS asset. For avoidance of doubt, Aramis will not operate assets in the transport chain owned by others. For commissioning, start-up and pre-commercial phase a temporary OCC will be built in the Maasvlakte, also addressed in this basis of design.



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## 7. STANDARDS, CODES AND REGULATIONS

In addition to COMPANY General Specifications (GS), the Aramis PIPELINE, LANDFALL and D-HUBN design is subject to EU and Dutch Directives and design codes (NEN codes). The following are some of the key codes under these headers. Where there is misalignment between standards, codes, or regulation the most stringent should be adhered to. The misalignment and ultimate design choice shall be reported to CLIENT.


### 7.1 COMPANY Specifications

COMPANY General Specifications (GS), edition 2023, shall be adhered to entirely where applicable

### 7.2 Mandatory EU Directives

- 2006/42/EC On machinery, and amending Directive 95/16/EC.
- 2014/68/EU On the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment.
- 2014/34/EU On the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
- 92/58/EEC On the minimum requirements for the provision of safety and /or health signs at work.
- 2009/104/EC Concerning the minimum safety and health requirements for the use of work equipment by workers at work.
- 2014/35/EU On the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.
- 2014/30/EU On the harmonisation of the laws of the Member States relating to electromagnetic compatibility.
- 98/13/EC Relating to telecommunications terminal equipment and satellite earth station equipment, including the mutual recognition of their conformity.
- 1999/5/EC On radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
- 2014/90/EU On marine equipment and repealing Council Directive 96/98/EC.
- 89/391/EEC On the introduction of measures to encourage improvements in the safety and health of workers at work.
- 88/609/EEC On the limitation of emissions of certain pollutants into the air from large combustion plants.



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## 7.3 List of mandatory national rules, laws and regulations for the Netherlands


Mijnbouwwet	Staatsblad 554, 1 Januari 2017
Mijnbouwbesluit	Staatsblad 556, 01 Juli 2017
Nota van Toelichting Mijnbouwbesluit	Staatsblad 556, 01 Juli 2017
Inwerktreding Mijnbouwbesluit	Staatsblad 603, 6 December 2002
Wijziging Mijnbouwbesluit	Staatsblad 89, 6 Maart 2017
Mijnbouwregeling	01 Januari 2018
Nota van toelichting Mijnbouwregeling	Staatscourant 16804, 15 September 2011
Besluit algemene regels milieu mijnbouw	Staatsblad 114, 27 Maart 2017
Regeling algemene regels milieu mijnbouw	Staatsblad 91, 3 April 2008
Arbeidsomstandighedenwet	Staatsblad 22, 08 Februari 2017
Arbeidsomstandighedenbesluit	Staatsblad 225, 19 juni 2017
Arbeidsomstandighedenregeling	Staatscourant. Suppl. 7530, 16 Februari 2016
Wijziging Arbeidsomstandighedenregeling	Staatsblad 340, 29 september 2016
Warenwetbesluit drukapparatuur	Staatsblad 229, 22 Juni 2016
Besluit Drukapparatuur	Staatsblad 311, 5 juli 1999
Wijzigingsbesluit Besluit Drukapparatuur	Staatsblad 339, 5 juli 2001
Ministeriele regeling drukapparatuur	Staatsblad 224, 19 november 2001
Wijziging Warenwetbesluit drukapparatuur	Staatblad 387, 22 juli 2004
Ministeriele regeling inspectie scheepvaart	Staatsblad 1939 10october 2010

## 7.4 List of relevant design standards for offshore CO2 pipelines

Unless noted otherwise, the revision as valid and applicable at the EFFECTIVE DATE shall apply.

NEN 3650	Requirements for pipeline systems (Part 1 & 2)
NEN 3651	Additional requirements for pipelines in or nearby important public works
NEN 3654	Mutual influence of pipelines and high-voltage circuits
NEN 3656	Requirements for submarine pipeline systems in steel
NEN 3655	Safety management system for pipeline systems for the transport of hazardous substances - Functional requirements
DNV-ST-F101	Submarine pipeline systems.



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DN-RP- F104	Design and operation of carbon dioxide pipelines.
DNV-RP-F109	On-bottom stability design of submarine pipeline.
ISO 27914	Carbon dioxide capture, transportation, and geological storage - Geological storage.
ISO 27913	Carbon dioxide capture, transportation, and geological storage - Pipeline transportation systems.

Diving techniques and operations shall conform to:


IOGP 411            Recommended Practices for Diving Operations (2021)

## **7.5 List of relevant design standards of offshore structures and topsides**

Unless noted otherwise, the revision as valid and applicable at the EFFECTIVE DATE shall apply.

NEN 17349	Petroleum and natural gas industries - Offshore platforms handling streams with high content of CO <sub>2</sub> at high pressures (NEN-EN-ISO 17349:2016).
ISO 19900	Petroleum and natural gas industries - General requirements for offshore structures.
ISO 19901	Petroleum and natural gas industries - Specific requirements for Offshore structures (Part 1-6, 9)
ISO 19902	Petroleum and natural gas industries - Fixed steel offshore structures
DNV- RP-C203	Fatigue design of offshore steel structures
EEMUA 158	Construction Specification for fixed offshore structures.
EEMUA 197	Specification for the Fabrication of Non-Primary Structural Steelwork for Offshore Installations.
BS EN-10025	Hot rolled products of structural steels. General technical delivery conditions
ISO 14122	Safety of machinery - Permanent means of access to machinery (Parts 1 – 4).
NACE SP 0176	Corrosion Control of Submerged Areas of Permanently Installed Steel Offshore Structures Associated with Petroleum Production.
IMO SOLAS	International Convention for the Safety of Life at Sea Consolidated Edition
IMO LSA	International Life-Saving Appliance (LSA) Code
IOGP 411	Recommended Practices for Diving Operations



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## 7.6 Site Specific Guidelines (Onshore and Landfall)

HBOR 2022  
DELTA RES

Handboek Beheer Ondergrond Rotterdam 2022  
Voorschriften toetsen op Veiligheid, technisch deel 2017

## 8. HEALTH, SAFETY, SECURITY, ENVIRONMENT & SOCIAL

### PERFORMANCE (HSSE&SP)

Aramis Project is committed to No Harm, thereby minimising the risks to the safety and health at work for all employees and contractors, and the protection of the environment, asset(s) and communities.

The HSSE and SP aspects of the Aramis project will be controlled by the application of the Aramis HSSE&SP policy (REF 1) and Aramis HSSE&SP Management plan (REF 2)

For the FEED reference should be made to the Project HSSE&SP plan (REF 3)

### 8.1 Emissions and Discharges

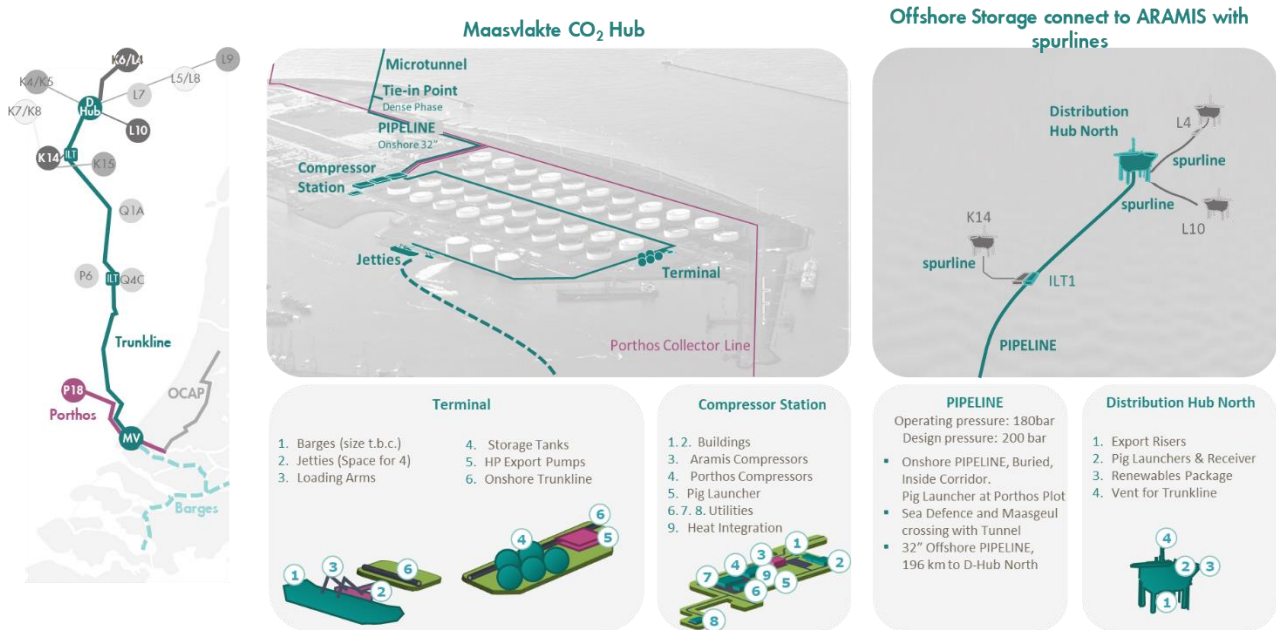
Aramis aims to minimise emissions. The emissions of NO<sub>x</sub> – predominantly related to construction activities - need to be kept as low as possible related to depositions limits in Natura 2000 areas.

There will be no operational venting of CO<sub>2</sub> in Aramis, except for equipment related small emissions such as the onshore analyser. Operational discharges to water will be minimised and limited to cooling water (discharged through Porthos).



## 9. BASE CASE OF THE TRANSPORT AND STORAGE LAY OUT

### 9.1 Layout



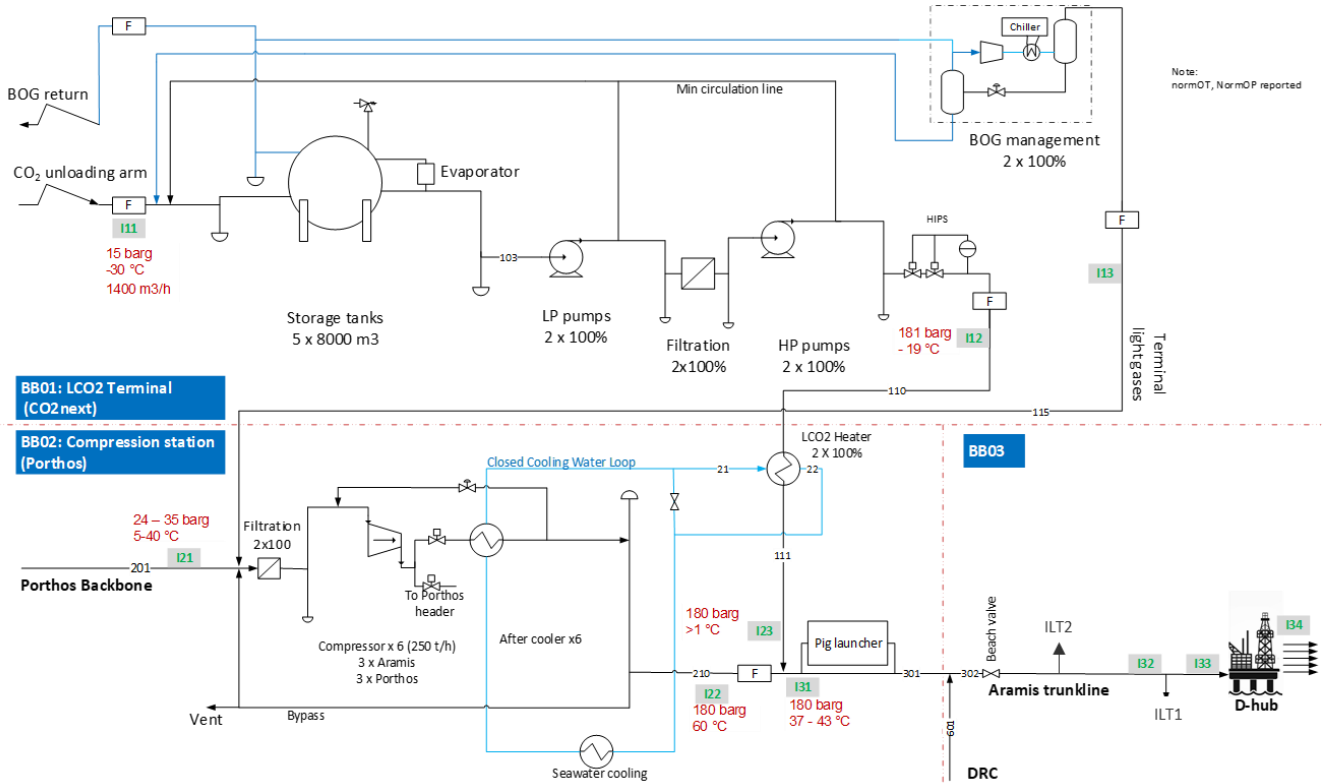
**Figure 2: Aramis Transport System Layout**

In figure 2 above the base case layout of the transport system is depicted. In the left panel the 32" PIPELINE route is shown ending at the D-HUBN. Launch stores K14 (Shell) and L4 (TTE) are part of the 'day 1 or launch' development with K14 tied into the PIPELINE via an ILT2 and L4a with a spurline to the D-HUBN. Other stores such as L10 (currently operated by Neptune) may also be connected to the system from day 1.

### 9.2 Process

In figure 3 below the basic flow diagram for terminal and compressor is depicted including expected normal operating temperatures and pressures. Please refer to 11.2 for a full overview of design and operating cases for FEED.





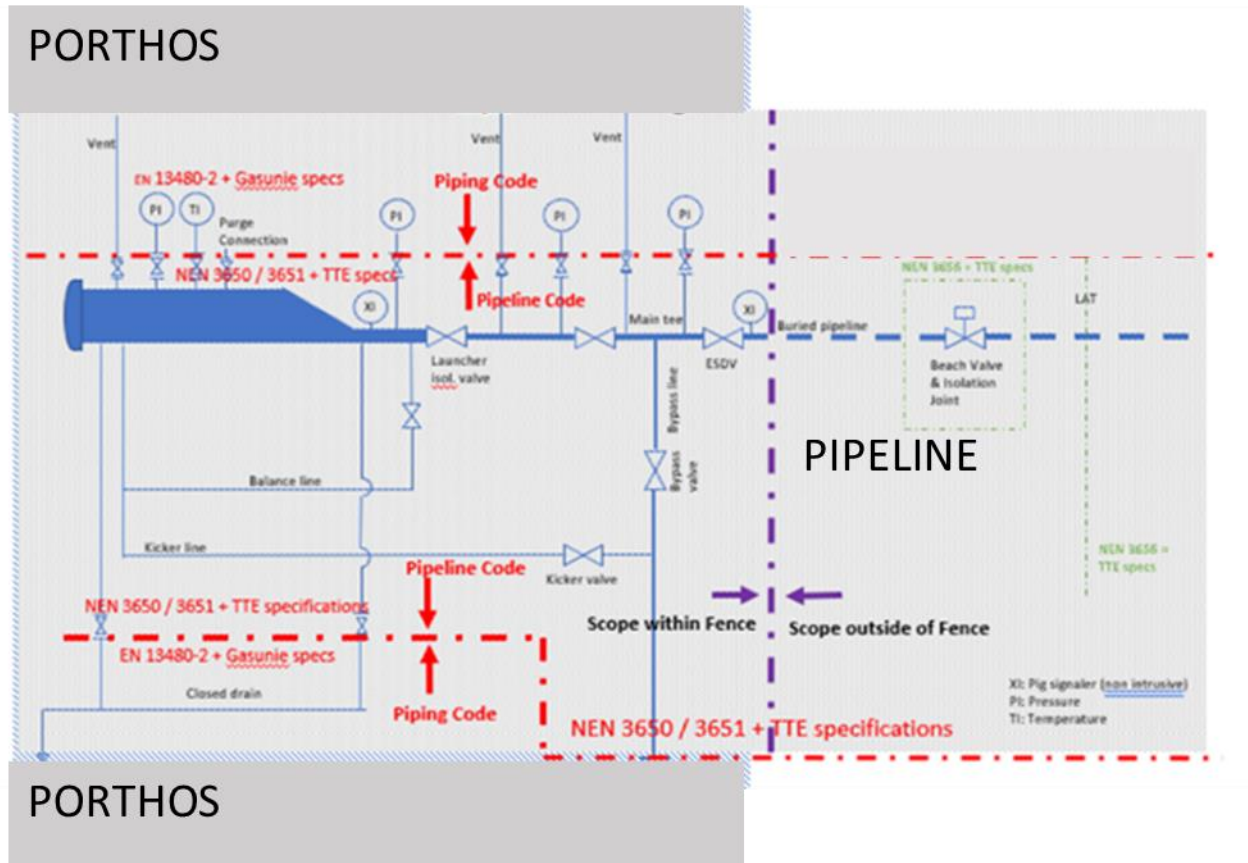
**Figure 3: Terminal and compressor station flow diagram**

## 10. FEED BATTERY LIMITS

The engineer's FEED battery limits for ARAMIS scope are as follows:

- Upstream boundary is the onshore pig launcher located at the Porthos plot. See Figure 4 below
- Downstream the scope ends at the flange of the ILT and at the bottom riser flange of the D-HUBN, see Figure 4
- A stand-alone temporary control centre and contractor offices
- A permanent integrated control centre



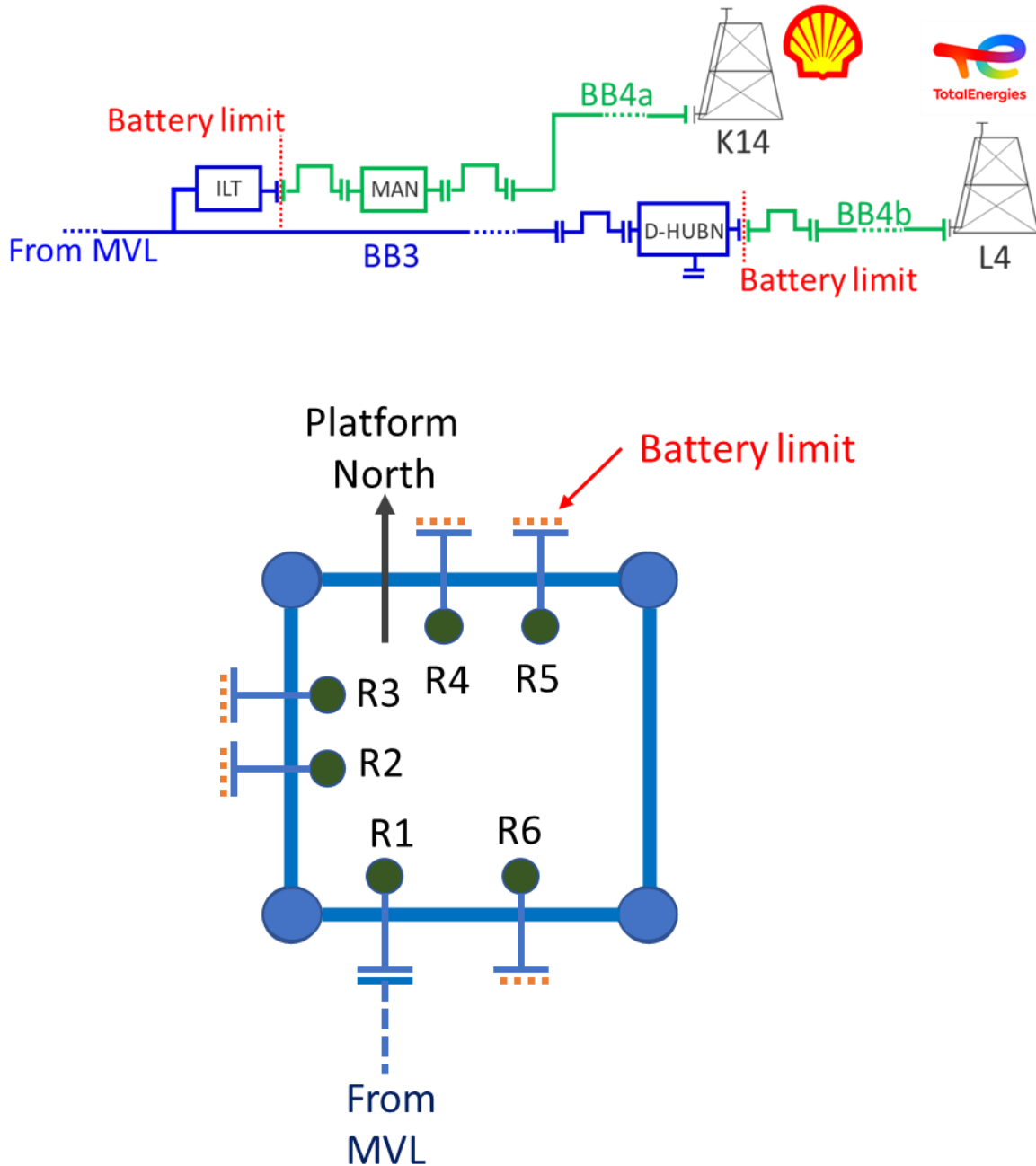


**Figure 4: Onshore battery limits**

The ARAMIS Pig Launcher is part of the PIPELINE but will be installed on Porthos plot (within Fence). Aramis will design the ARAMIS Pig Launcher, Valves and Lines that are to be located on the Porthos plot.

Porthos will install the pig launcher and pipeline within fence of the Porthos plot, Aramis will procure the materials that need to be installed on Porthos plot. Installation and pre-commissioning is by Porthos, commissioning shall be part of Aramis under Porthos permit to work system and free issue this material /equipment to Porthos for installation and commissioning.





**Figure 5 Offshore battery limits of FEED engineering – ILT flange and D-HUBN bottom riser flange**



## 11. FLOW ASSURANCE BASIS OF DESIGN

### 11.1 Fluid Specifications

The full specification of the product fluid is given in REF 4 For modelling purposes the below shall be observed:

- The composition in Table 1 below shall be used for development of the phase envelopes.
- Amine is represented by PZ. This molecule does not represent all possible types of amines. However, it is expected to be the most representative molecule to be used as basis for hydraulic calculations.
- NO<sub>x</sub> is kept in the composition based on hypothetical repartition as no information is available on its repartition. It should be noted that NO<sub>x</sub> has a value below 2.5 ppm and can be removed from the table regarding the fact that it has no effect on the hydraulic and phase envelope properties.
- N<sub>2</sub> concentration: 2% considered in case of ship for N<sub>2</sub> to respect overall limitation of sum of volatiles < 4%, and 290 ppm for ship composition.
- 

**Table 1 Composition of Cryo CO<sub>2</sub> (LCO<sub>2</sub>) and Vapour CO<sub>2</sub> (gCO<sub>2</sub>)**

	Composition	
	LCO <sub>2</sub> (mol%)	gCO <sub>2</sub> (mol%)
CO <sub>2</sub>	99,7834%	95,7793%
H <sub>2</sub> O	0,0030%	0,0070%
N <sub>2</sub>	0,0290%	2,0000%
O <sub>2</sub>	0,0010%	0,0040%
H <sub>2</sub>	0,0500%	0,7500%
Ar	0,0000%	0,2000%
CH <sub>4</sub>	0,0000%	1,0000%
CO	0,1200%	0,0750%
NO	0,00005%	0,00005%
NO <sub>2</sub>	0,00010%	0,00020%
SO <sub>2</sub>	0,0010%	0,0000%
H <sub>2</sub> S	0,0005%	0,0005%
PZ	0,0010%	0,0000%
formaldehyde	0,0020%	0,0000%
acetaldehyde	0,0020%	0,0000%
NH <sub>3</sub>	0,0010%	0,0000%
Methanol	0,0040%	0,0620%
ethanol	0,0020%	0,0020%
Ethane	0,0000%	0,1200%
Solids diameter (micron)	<1	<1



Table 1 above can be used for flow assurance simulation purposes. However, heavy metals will need to be considered for material compatibility

## 11.2 Design and Operating Cases

Table 2 below states the operating cases at inlet of PIPELINE for

**Table 2 Design and Operating Cases**

		PIPELINE Inlet Conditions				
		Q (CO <sub>2</sub> )		T <sub>in</sub> (Sim)	P <sub>in</sub>	C_CO <sub>2</sub>
Case	Description	MTpa	Tph	°C	Barg	%
1	NormOp_phase 1 min	4.9	560	43	155	97.0%
2	NormOp_phase 1 max	12.0	1 365	43	180	97.0%
3	NormOp_ultimate (22 Mtpa)	22	2 500	36	180	97.0%
4	Term_maxQ,normOT/NoComp	11.0	1 250	5	180	99.8%
5	TermNoQ/CompMaxQ, normOT	11.0	1 250	60	180	95.0%
7	Ter_turndown/NoComp	1.0	115	34	155	99.8%
8	TermNoQ/Comp_turndown	1.0	115	50	155	95.0%
9	TermNoQ/CompMaxQTSHH	11.0	1 250	65	180	95.0%
10	Term_maxQ,TSL/NoComp	11.0	1250	-5	180	99.8%


The breakdown of the flowrates vis-à-vis Porthos and CO2next that make up the overall flowrate can be found in REF 5 ARM-PFE-BB3-PRO-REP-0235

Further the design and operating cases shall be evaluated over WINTER and SUMMER conditions as stated in the Meteorological and Metocean report [REF 6]

## 11.3 Thermal Cycles

The PIPELINE and D-HUBN shall be designed for the following thermal cycles at inlet of PIPELINE: [ HOLD 2 ] over its design life.



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## 12. DESIGN CRITERIA

### 12.1 Design Life

The DESIGN LIFE is 30 years.

### 12.2 Availability

The combined availability of PIPELINE and D-HUBN must be 99.5% or higher

### 12.3 Application of New Technology

The design shall be developed using proven technologies to the maximum extent possible. Proven technologies are defined as technologies that have been used in equivalent operational service and environments for a period of 10 years or more. For design components where this cannot be achieved, CONTRACTOR shall inform COMPANY and where considered necessary, develop and propose a technology qualification plan.

### 12.4 Key Functional Specifications

- The PIPELINE shall be (inspection) piggable for internal inspection.
- The PIPELINE shall have a constant internal diameter over its full length.
- Connection, commissioning, and start-up of new spurlines to the PIPELINE or D-HUBN shall be feasible with PIPELINE and D-HUBN remaining in continuous normal operation, ensuring that at the same time no water is able to enter into the operating system.
- PIPELINE and D-HUBN shall be designed to allow for full (planned) depressurisation whilst avoiding formation of an aqueous phase during this activity.


## 13. SITE AND ENVIRONMENTAL DATA

### 13.1 METEOROLOGICAL AND METEOCEAN DATA

Meteorological and metocean design basis shall be extracted from the Meteorological and Metocean design basis REF 6

The waterdepth along the route varies from 0 to -39,5m with -30,8 m at the location of D-HUBN. Seawater temperature varies from 4 deg C in winter to 16 deg C in summer for most of the route,



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with warmer waters in the shallower sections where the water temperature in summer is average 16,8 deg C.

## 13.2 Environmental Sensitive Areas

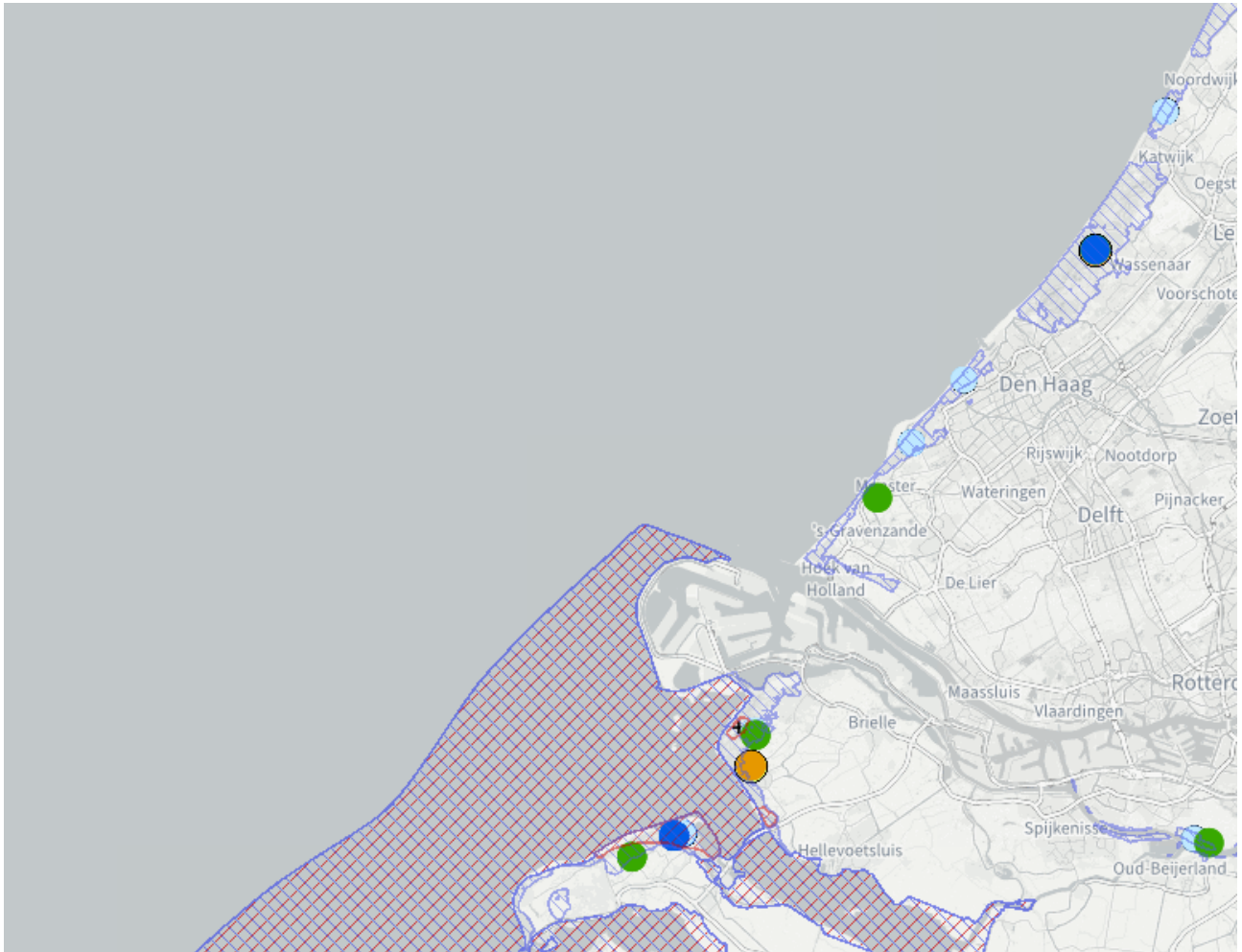
The Dutch sector of the North Sea is heavily used. Reference is made to [Home - Noordzeeloket UK](#) for location of specific areas that should be avoided including but not limited to:

- Shipping lanes
- Areas allocated to existing and future windfarms
- Sand win areas
- Anchoring places

Further the Dutch Sector of the North Sea is the habitat of protected species and as such for any activities in the North Sea a nature permit is required to execute these activities.

Of particular note is the Natura 2000 area Voordelta that embraces the Maasvlakte and falls under EU habitat directive [EUR-Lex - 01992L0043-20130701 - EN - EUR-Lex \(europa.eu\)](#),





**Figure 6 Natura 2000 indicated by shaded area**

## 13.3 Survey Data

### 13.3.1 Conducted Surveys

In table below the geophysical and geotechnical surveys that have been conducted are listed, with final reports available September 2023. For the offshore section multiple routes were surveyed. For the landfall both direct pipe and tunnel alignments have been surveyed.

Area	Type of survey	Acquisition
OFFSHORE PIPELINE	Geotechnical soils investigations	166×Vibro-Cores + 161×CPTUs (6 m below seabed) + 3×Deep CPTUs (>20m bsb)



	Geophysical site investigation	High resolution seabed imaging (MBES, Side Scan Sonar), shallow-soils conditions (Sub-bottom Profiler and UHRS) and UXO boxes to de-risk geotechnical soils investigations
DHUBN	Geotechnical soils investigations	1 Continuous Piezocone Test (CPTU) and 1 Continuous Sampled BoreHole down to 80m below Seabed
	Geophysical site investigation	High resolution seabed imaging (MBES, Side Scan Sonar), shallow-soils conditions (Sub-bottom Profiler and UHRS) and UXO boxes to de-risk geotechnical soils investigations
LANDFALL	Geotechnical soils investigations within Maasgeul Channel	6×DeepPush CPTUs (>30m bsb)
	Geotechnical soils investigations outside Maasgeul Channel and on Maasvlakte	Land and Nearshore BoreHoles and CPTs at various depths (95m below ground level)
	Geophysical site investigation	High resolution seabed imaging (MBES, Side Scan Sonar), shallow-soils conditions (Sub-bottom Profiler and UHRS) and UXO boxes to de-risk geotechnical soils investigations

### 13.3.2 Field report key findings

Field reports indicate:


- UXO: acquired to de-risk geotechnical operations along the trunkline routing. The nearshore area is highly impacted by potential UXO
- Considering seabed sediments mobility, new UXO survey is requested prior to pipe laying operations.

Geophysical:

- The overall water depth varies between 0 m and 39.5 m within the Aramis pipeline route.
- The following morphological characteristics were identified: bedforms (ripples, megaripples and sand waves), irregular seafloor, area with numerous boulders, area with occasional boulders.

Four ship-wreck areas have been identified and interpreted



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## 13.4 Other Data

### 13.4.1 Onshore pipeline corridor

Current information on the onshore pipeline corridor, installed pipes and cables has to be obtained through KLIC melding (<https://www.kadaster.nl/zakelijk/producten/graafwerk/klic-melding>).

### 13.4.2 Maasvlakte Sea Defence

Maasvlakte sea defence is a manmade structure, originally constructed by the Port of Rotterdam and now maintained by Rijkswaterstaat. Layout, as-built cross-section, and properties of sea defence have been provided by Rijkswaterstaat [REF 7]

## 14. PIPELINE, LANDFALL AND DISTRIBUTION HUB NORTH

### 14.1 Isolation Philosophy


The following are considered minimum isolation requirements for safety reasons

- To provide safe work conditions downstream during expansion and where found necessary for maintenance of the system this will be realised through installing double block and bleed isolation valves at the PIPELINE start (Compressor station) and end (D-HUBN) locations of the PIPELINE, as well as all (subsea and above water) tie-in locations along the pipeline. These can be actuated or non-actuated valves.
- To mitigate the consequences of a large onshore release, preventing backflow of the offshore PIPELINE, an actuated beach valve shall be installed in accordance with NEN 3656 requirements. No further sectionalization of the PIPELINE is foreseen onshore or offshore.
- No SSIV is required for (personal) safety reasons at the D HUBN, because this is a not permanently manned facility with minimum facilities, hence very limited personnel presence. The benefits of an SSIV do not weigh up to the additional cost and (HSE) risk of subsea installation and maintenance

In addition, there are the proposed isolation requirements driven by the asset integrity and economic analysis

- To prevent a large uncontrolled release from a spurline or store platform impacting the entire PIPELINE, resulting in rapid depressurization, very low temperatures, and potential damage requiring an extended shutdown for repair a remote actuated [fail close] isolation valve is to be installed at each spurline tie-in location. Specifically:



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- For the each spurline connecting at the DHUB-N, at the top of each riser and under the control of the Aramis OCC there will be a remote actuated riser isolation valve.
- For the each spurline connecting subsea at one of the Aramis ILT locations, the tie-in manifold (to be designed, constructed, and installed by the store Operator) will be required to contain a remote actuated subsea isolation valve. Control of this valve will be by the store Operator

## 14.2 Standards

Design of the PIPELINE shall comply with specifications, standards and regulations as laid out in section 9

Design of the PIPELINE shall further comply with all permit requirements as stipulated in Article 93 of the mijnbouwbesluit ([https://wetten.overheid.nl/BWBR0014394/2017-07-01#Hoofdstuk6\\_Paragraaf6.1\\_Artikel93](https://wetten.overheid.nl/BWBR0014394/2017-07-01#Hoofdstuk6_Paragraaf6.1_Artikel93))

## 14.3 Design Data

The design requirements for the pipeline are as per Table 3


**Table 3 Design requirements PIPELINE**

Design pressure	200 barg
Design temperature at inlet	70 °C
Min Design temperature	-25 °C HOLD 3]
Constant ID	Constant 755.6 mm (minimum)
Corrosion allowance	3mm
Material Pipeline	carbon steel grade X65. Sour service region 0 As per NEN standards
Crack Arrest Distance	

Pipeline shall be piggable from Pig Launcher to D-HUBN

Line pipe shall be specified in accordance with IOGP S-616 – Line pipe V2



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Line pipe shall have a 3-layer polyethylene external corrosion coating (specific sections like the landfall and riser may require more robust coating)

Field joint coating shall be applied to the field welds

## 14.4 Onshore Section

### 14.4.1 Battery limit

Onshore section is defined as the Aramis PIPELINE departing from the Porthos Compressor station (incl. pig launcher) up to the start of the landfall crossing, including the beach valve station as well as the potential expansion loop and connection to the landfall, see Figure 7

The interface at the Porthos compressors station is shown in Figure 4

### 14.4.2 Pipeline Corridor

The onshore PIPELINE shall be buried and placed in the pipeline corridor where possible. Constructability study for The PIPELINE shall be based on a 40cm spacing (wall to wall) to adjacent pipelines in the corridor. If during FEED studies construction risks to PIPELINE or adjacent pipeline or cost to avoid those are high, an alternate route parallel to the pipeline corridor can be considered





**Figure 7 - Aramis onshore route overview. Various crossing locations have been analysed with 1A selected and 1B (alternate tunnel departure) and 2 (Direct Pipe) deselected.**

#### 14.4.3 PIG Launcher

The pig launcher will be installed within Porthos Fence. Pig launcher shall allow for launch of a pig with 6.0 meters length and mass 2.5 Te. Bypass line and pig trap shall be executed in LTCS.

Safeguards shall be included against re-pressurisation of low temperatures to avoid low temperature embrittlement of LTCS


#### 14.4.4 Expansion Spool

On the upstream side of the landfall (between the beach valve and the start of the landfall), the PIPELINE design shall cater for potential expansion from the downstream section (i.e., the landfall section as well as non-fully restrained section offshore).

#### 14.4.5 Corrosion Protection

Cathodic protection: The pipeline shall be protected for external corrosion. An impressed current system shall be used for the onshore pipeline with an isolation joint above ground at the pig trap



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station. The offshore pipeline, including tees, spools and subsea structures shall be protected by cathodic protections (anodes).

#### **14.4.6 Insulation Onshore Pipeline**

The requirement for insulation in the onshore section shall be determined during FEED, based on evaluation of thermal influence between adjacent pipelines and cables. In case required, insulation shall be provided by a PUR-PE insulation system including the possibility to monitor for water ingress.

#### **14.4.7 Pressure protection PIPELINE**

The PIPELINE is protected for overpressure through a pressure safety valve (PSV) at the Compressor station and a PSV at Co2nnext [HOLD 4].

### **14.5 BEACH VALVE STATION**

A beach valve station shall be included in the design, just upstream the landfall and expansion loop. The beach valve station shall comprise the following main elements

#### **14.5.1 : Beach Valve**

To prevent backflow from a leak onshore, the beach (isolation) valve shall be a full-bore trunnion 32" mounted ball valve, installed underground and fully welded in the PIPELINE. The valve shall be remotely operable from the Aramis Transport control room and shall have an ESD function and close within 120 seconds following an onshore full-bore rupture event as per the pipeline QRA.

#### **14.5.2 Temperature Safety Valve**

A temperature safety valve (TSV) with vent in a safe area is to be included, to prevent over pressurisation of a closed-in onshore PIPELINE section due to closed in cold CO2 warming up to ambient

#### **14.5.3 Onshore Tie in Point.**

A tie-in point (barred tee with double block and bleed isolation valves) upstream of the beach valve, shall be included to enable connection of a future dense phase CO2 supply line with sizing for 14 MTPA inflow HOLD 5



#### 14.5.4 Composition Analyser

Composition analysers to monitor and control the CO<sub>2</sub> stream and prevent a corrosive environment in the PIPELINE shall be included HOLD 6.

The composition analyser shall monitor for the components as outlined in Table 4. The composition analyser shall pass on its data to the Aramis control room. The composition analyser shall be in a housing. The housing shall be sufficiently ventilated to avoid build-up of toxic CO<sub>2</sub> levels. CO<sub>2</sub> detectors shall be installed in the housing.

Design of the analysers shall include the following: [HOLD 7].

**Table 4 - Components for monitoring and safeguarding**

Component	Details in line with the system analysis outlined in this document	
	On-line monitoring	Safeguarding
H <sub>2</sub> O	Yes	Yes
H <sub>2</sub>	Yes	Yes
N <sub>2</sub> , Ar, CH <sub>4</sub> , CO	Yes	No
O <sub>2</sub>	Yes	Yes
Dew point	Yes	Yes
Alcohols, glycols	Yes	No
Ammonia	Yes	No
H <sub>2</sub> S	Yes	Yes
SO <sub>x</sub>	Yes	Yes
Total Sulphur		
NO <sub>x</sub>	Yes	Yes


#### 14.5.5 Beach valve Plot dimensions and layout

A plot space (see 14.6.1) provision for arrival of a future supply pipeline, including: pigtrap, metering, remotely operated isolation valve, composition analysers housing and associated utilities and controls is available. CONTRACTOR shall determine the actual space required as part of layout studies. IF applicable, the beach valve station shall encompass the surfacing outline of any permanent landfall tunnel shaft/entry structure. In addition, if applicable, the beach valve station shall encompass any permanent structure to accommodate the expansion loop between the landfall and beach valve.

The beach valve station layout shall be such that it can accommodate a future tie into the onshore tie in point.

The beach valve station shall be accessible from the main road through a driveway have adequate paving and be secured by a fence gate.



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## 14.5.6 Communication and Power

Communication at the beach valve station shall be through connection with the local telecoms/ISP provider. Electrical power for the beach valve station is foreseen through a permanent grid connection (for the operate phase). Timely request with grid operator Stedin is necessary to realise a connection in time.

## 14.6 LANDFALL

### 14.6.1 Site Overview

The PIPELINE will make landfall by means of a tunnel. The entry of the tunnel will be at the sharkfin area of the Maasvlakte and from there crosses both the man-made sea defense and the shipping lane (Maasgeul) before surfacing at the seafloor.



**Figure 8 Maasvlakte overview**

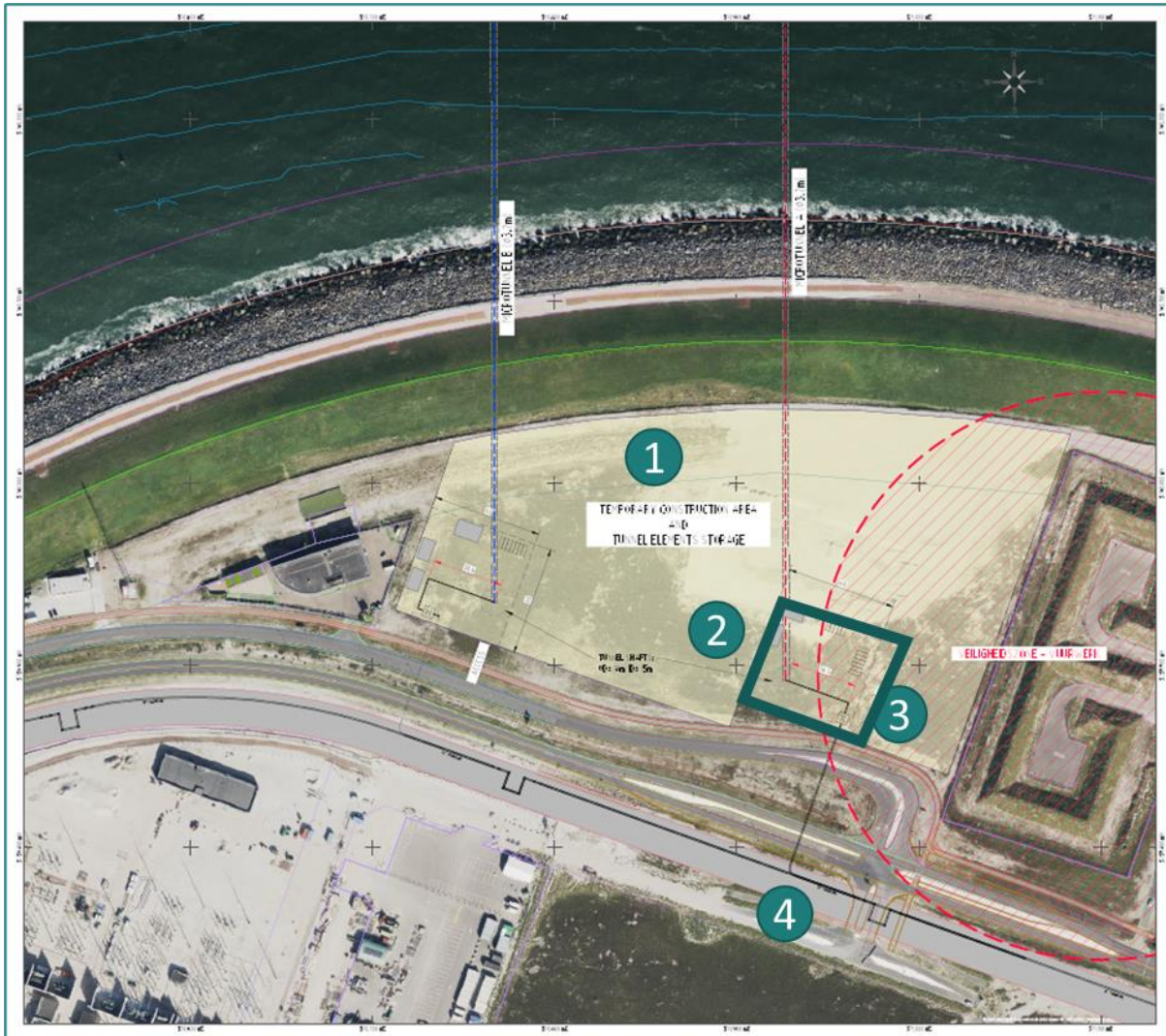




**Figure 9 Landfall area sharkfin**

See Figure 10 below. A short-term lease of highlighted land area (51000 m<sup>3</sup>) is under option with Port of Rotterdam to support onshore pipeline and tunnel construction, including materials storage, waste handling and project offices. This is indicated by the highlighted area in the figure. Further a long-term lease for permanent facilities with a plot size of 60x60 meters for the shaft and beach valve station. (2). Further an access road will be required for maintenance access (3)





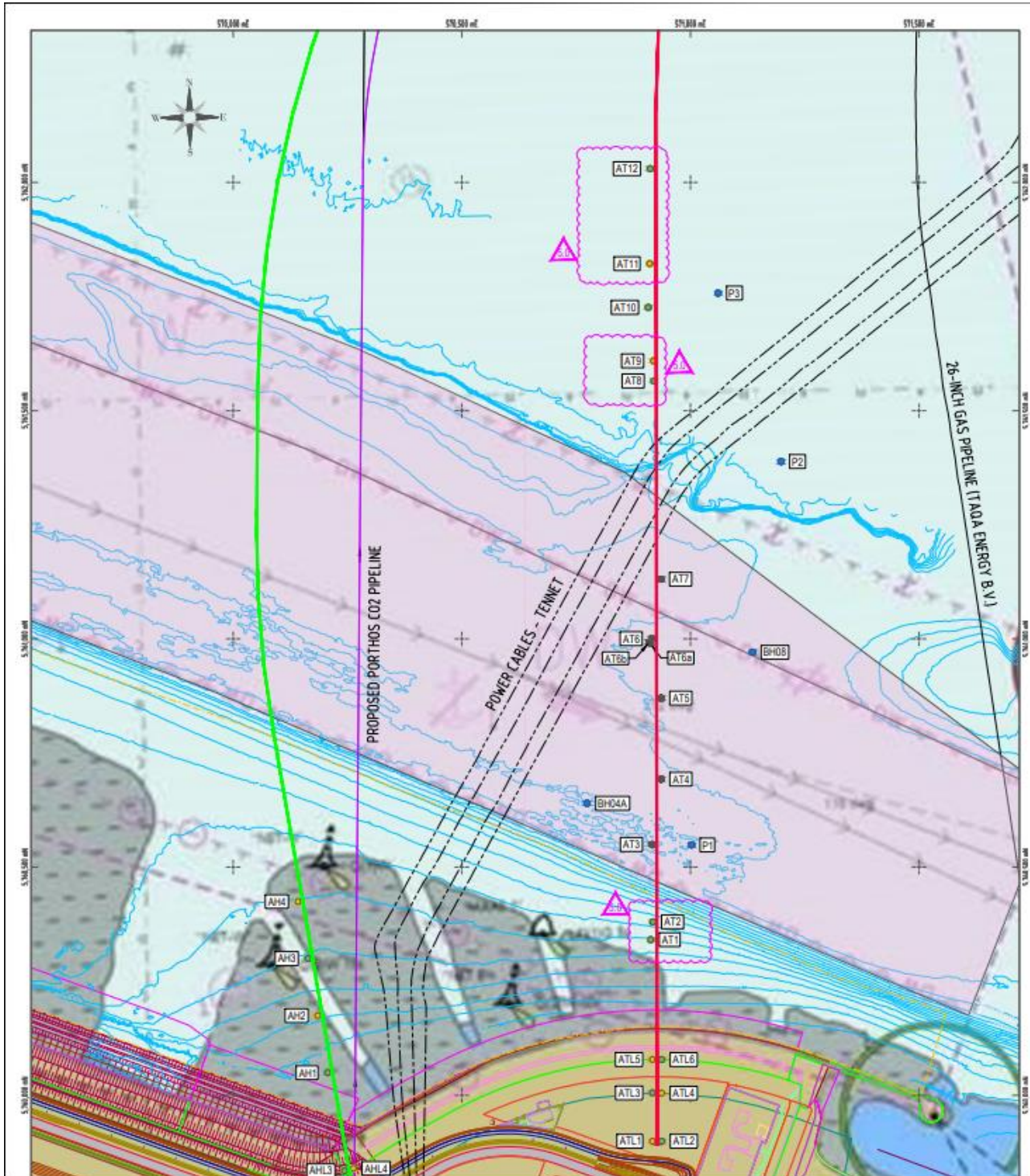
**Figure 10 'Shark fin' land Area for construction of Tunnel Shaft and construction of beach valve stations. The red line is the selected tunnel alignment. 1= general area that can be used for construction equipment and materials, 2 is a notional plot space for construction of beach valve station and 3 is access road that needs to be build 4= Onshore PIPELINE**

## 14.6.2 Tunnel Alignment

In Figure 11 below the tunnel alignment is shown together with location geotechnical boreholes. The tunnel starts at the sharkfin, crosses the man-made sea defense and Maasgeul before ending at the seafloor after some 2km. As the Maasvlakte shark fin is one of the designated landfall areas for the Maasvlakte, the tunnel design and construction needs to take note of the presence of existing and future (power) cables and pipelines.

For the Maasgeul crossing the nautical guaranteed depth ('Nautische Gegarandeerde Diepte' – NGD) shall be considered, whereby this NGD is to be considered 25m beyond the Maasgeul to accommodate potential widening of the Maasgeul in the future.





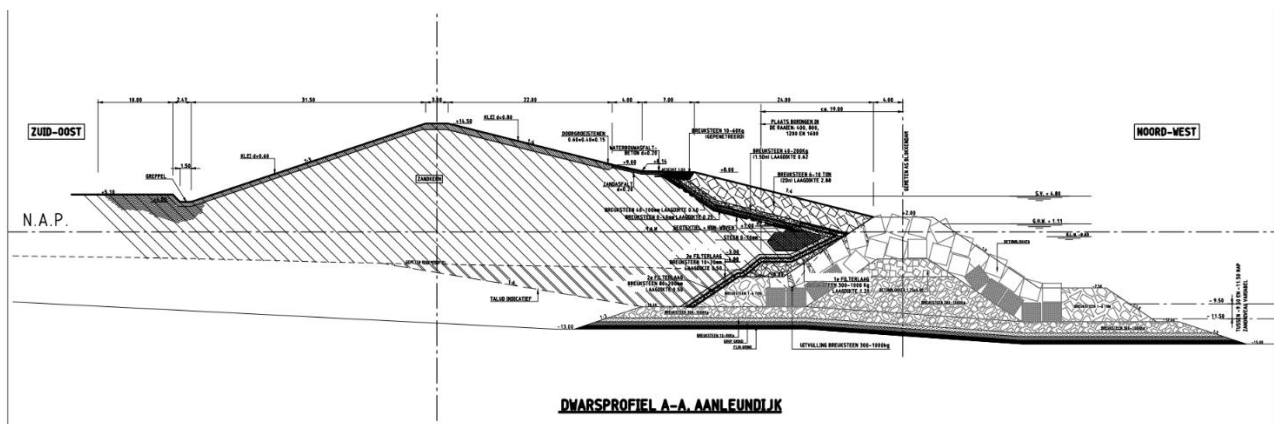
**Figure 11 Tunnel Alignment.** The red line is the selected alignment, starting at the sharkfin, crossing the sea-defense and maasgeul. The locations noted AT indicate locations where geotechnical data is available. (The green line is an alignment for a de-selected landfall crossing (Direct Pipe). (REF 8 ARM-CPT-BB3-PR3-LAY-0045 – REV 5.0)



### 14.6.3 Sea Defense

In Figure 12 below a typical cross section of the Maasvlakte Sea-Defence is depicted comprising of layers of stone, sand and concrete blocks.

The design of the tunnel needs to comply with NEN3651. The design needs to show that there will be no detrimental effect (damage, subsidence etc) in short and long term to the sea defence and that there is a plan for calamities during construction. A more detailed description can be found in the sections provided by Rijkswaterstaat REF 7



**Figure 12 Sea Defence Schematic**

### 14.6.4 Corrosion protection

Landfall pipeline section shall be fitted with cathodic protection, whereby the type (impressed current or sacrificial anodes) is to be determined by the FEED contractor, and isolation joints to be located accordingly.

### 14.6.5 Construction Power

Electrical power for tunnel construction needs to be supplied. As the Maasvlakte is close to max electrical transport capacity an early assessment of required electrical power is necessary. Due to the long lead time to secure a dedicated Aramis connection it is anticipated to use spare capacity from 'Porthos' or 'Euromax' connection. In all cases a cable needs to be designed and installed prior to tunnelling works.

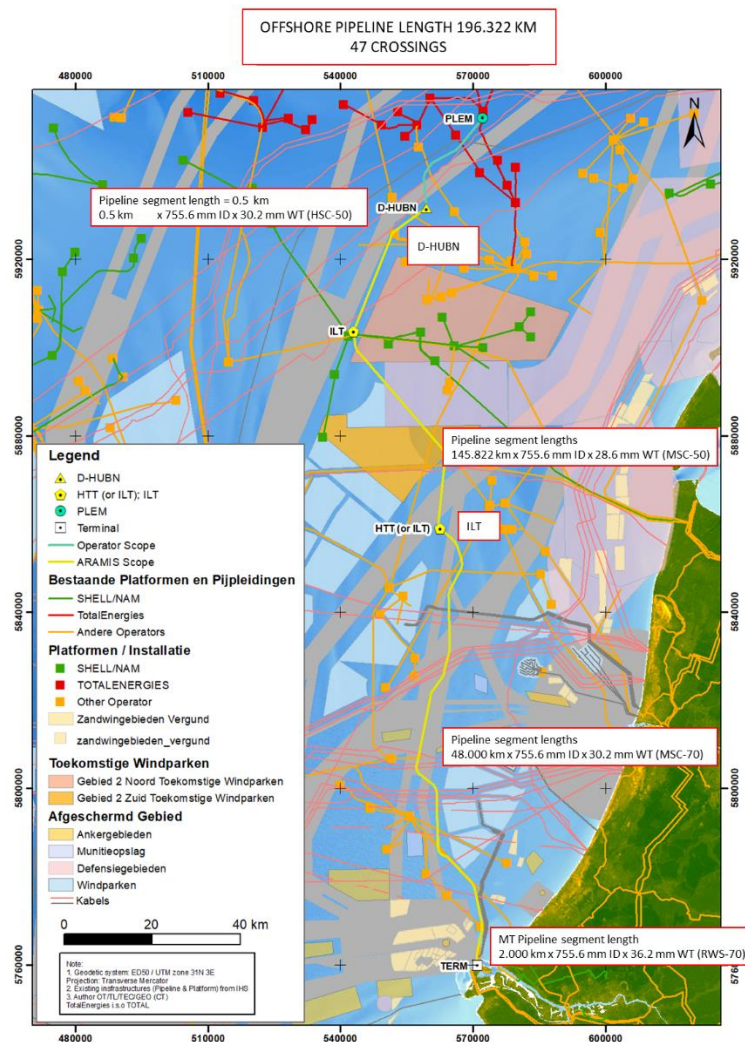
## 14.7 Offshore Section



### 14.7.1 Route


Figure 13 below shows the selected Offshore PIPELINE routing from Maasvlakte to D-HUBN. For the Offshore PIPELINE, including all the tie-out provisions, the 'Markeerdiepte', as specified by Rijkswaterstaat shall be maintained - :

<https://maps.rijkswaterstaat.nl/dataregister/srv/dut/catalog.search#/metadata/7508ca9c-8653-455b-86a1-b53bea06ab0b>



**Figure 13 Offshore PIPELINE route with notional wall thickness, both route and wt for illustration purposes**



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## 14.7.2 Tie Out Provisions

The PIPELINE shall include tie out structures for stores or other facilities to connect to PIPELINE via spurlines. The tie out structures design shall be such that spurlines can be connected and commissioned whilst PIPELINE can be maintained in dense operation. Spurlines requirements are outside the scope of this basis of design, however the requirement of the spurline are to be aligned with this basis of design

### 14.7.2.1 ILT's

The PIPELINE shall include 2 ILT structures:

ILT1 shall be a double branch ILT with size [HOLD 8]– with notional location [HOLD 9] and designed for 8MTPA export to [HOLD 10]

ILT2 shall be a single ILT with notional location [HOLD 11] and designed for 9 MTPA export to K14

The ILT shall be executed in Carbon Steel with Alloy 825 cladding.

The functionalities of the structures shall be confirmed during FEED when pre-commissioning, commissioning and future connections scenario will be defined and analyzed

### 14.7.2.2 HTT's

The addition of one or more in-line blind Hot Tap Tee's (HTT) structures in the PIPELINE is under consideration to provide future subsea expansion capabilities with a low level of capital pre-investment. The type, number, and location of any additional in-line structures providing subsea expansion flexibility is dependent upon future prospects and will be confirmed during the FEED.

### 14.7.2.3 Corrosion protection

Offshore pipeline section and ILT's shall be fitted with cathodic protection by sacrificial anodes. Consider CRA for crossing sections.

## 14.8 D-HUBN


A distribution hub platform (named D-HUBN) will be installed offshore to distribute CO<sub>2</sub> to connected stores. The D-HUBN is a not- permanently manned 4-legged platform. It has one import riser for PIPELINE and 5 export risers for connection of spurlines to stores. Two spurlines to stores will be connected from day 1 with a possible third

Further the D-HUBN will be the main pigging facility for trunkline (receive) and spurlines (send) to connected stores. Also, D-HUBN will include a vent to depressurize the TRUNKLINE and a telecoms tower to provide an access point for data transmission to shore

### 14.8.1 Design Requirements

Type	Not permanently manned
Design Pressure	200barg
Nameplate Capacity	22 MTPA
Number import risers	1



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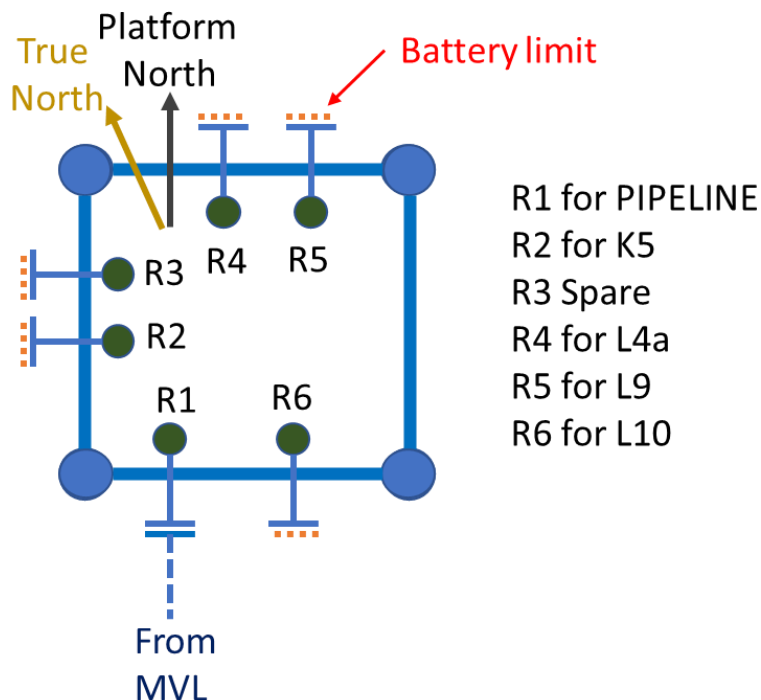
ID import riser	Same as PIPELINE
Number export risers	5 (2x20" and 3x24")
Normal Operating pressure	140 barg @ riser bottom flange
Minimum operating pressure (PSLL)	110 barg @ xxxx [HOLD 12]
Max POB	12 (For operations phase)

### 14.8.2 Location

The platform centre shall be located as close as possible to the following coordinates: E: 560 130.0m. N: 5 931 040.0m

### 14.8.3 Orientation

The platform shall be oriented 22.5 degrees clockwise from true north. The riser numbering shall be as per figure below



**Figure 14 D-HUBN layout and riser assignment. The riser locations in figure above are at the export flange.**

### 14.8.4 Operating Conditions

Normal operating pressure is such that a minimum pressure of 140barg at export riser bottom flange is delivered. To avoid the risk of excessive cooling due to inducing a phase transition in piping, the pressure at DHUB shall be always maintained above 90barg at top-deck level.



### 14.8.5 Import Riser

The import riser shall have an ID equal to PIPELINE of 755,6mm. A corrosion allowance of 3mm shall be included. Cathodic protection of the riser to be included in the jacket CP design. The riser shall be executed in CS, X65, Sour service region 0.

The minimum design temperature of the riser is -25 deg C HOLD 3. The maximum design temperature is 50 deg C. The design pressure of the riser is 200barg.

### 14.8.6 Export Risers

The size of the 5 export risers is given in Table 5 below [HOLD 13] and each to be designed for 8MTPA export rate. A corrosion allowance of 3mm shall be included. Cathodic protection of the riser to be included in the jacket CP design. The riser shall be executed in CS, X65, Sour service region 0. The minimum design temperature of the riser is -25 deg C HOLD 3. The maximum design temperature is 50 deg C. The design pressure of the riser is 200barg.

**Table 5 Export risers sizes**

Export Riser	Size
R2	24"
R3	24"
R4	20"
R5	24"
R6	20"

### 14.8.7 PIPELINE Pig Receiver


The D-HUBN will be fitted from the start with one permanent horizontal pig receiver for PIPELINE. Pig receiver shall allow for reception and recovery of a pig with 6.0 meters length and mass 2.5 Te. The pig will be retrieved by external lifting means

### 14.8.8 Export Riser Pig Launcher

One permanent pig launcher for 20" export risers to spurlines will be installed with provision for later instalment of a 24" pig launcher. The permanent pig launchers shall allow for loading and launching of a pig with following length and mass [HOLD 14]

Launcher	Pig Length (m)	Pig weight (Te)
----------	----------------	-----------------



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20" export riser	HOLD 14	HOLD 14
24" export riser	HOLD 14	HOLD 14

### 14.8.9 Material Selection and Corrosion Protection

Material selection and corrosion protection shall be selected in order to minimise maintenance and lifecycle costs in accordance with Pre-Feed studies [REF 9]

### 14.8.10 Hub Connector Requirements

For piping classes rating 1500 and above, hub connectors instead of flanges shall be considered for the pipe size 12" and above.

### 14.8.11 Main Access

The primary laydown platform for transfer of equipment and materials to and from the D-HUBN by vessel mounted cranes is located on the east face of the platform, where no risers are present.

Personnel access for maintenance purposes will be provided by specialised Walk-To-Work (W2W) vessels of which the DP-2 Bibby Wavemaster 1 is considered typical. It should be noted that W2W gangway landings are to be installed on the platform north and east faces Error! Reference source not found. enabling the W2W vessel to approach and set-up in a drift-off configuration in most circumstances, reducing the probability of a drift-on collision in the event of DP failure. [HOLD 15]

Stair connection between decks shall be provided. The number and layout of stairs shall be in accordance with COMPANY General Specifications.

### 14.8.12 Utilities

Diesel will be available at the D-HUBN for the diesel generator. A tote tank for diesel storage shall be provided.

Space for Nitrogen bottle rack shall also be provided. The rack will not be permanently on site

Air bottle rack shall also be provided for operators breathing in case of major CO<sub>2</sub> leak.


### 14.8.13 Sampling Requirement

One permanent manual sampling facility for high pressure CO<sub>2</sub> (dense phase) shall be provided on the main header.

### 14.8.14 Muster Area

D-HUBN platform is not permanently manned. For operation phase, a muster area considering a max POB of 12 persons shall be provided. The muster point shall be at elevated deck on upper deck.



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Platform CO2 monitoring information shall be available at muster area, to allow for "all clear" decision to be taken from inside.

#### **14.8.15 Temporary Refuge**

The inclusion of an enclosed muster room as temporary refuge is to be considered based on risk studies that are carried in out in FEED.

#### **14.8.16 Storage room**

A storage room of 4m<sup>2</sup> shall be considered for PPE and tools storage. Under normal operating conditions, this room may shall be arranged in a dedicated container installed either onto :

- Upper Deck in pig receiver handling area
- Or Mezzanine Deck in the pig launch handling area

#### **14.8.17 Material Handling**

The D-HUNB is not fitted with permanent crane.

The D-HUBN is not fitted with permanent crane.

A maintenance and materials mechanical handling study is to be performed in FEED to define an equipment and materials handling solution on the D-HUBN, transferring loads safely between decks and down to the laydown down on the Lower Deck from where they will be offloaded, and to define the requirements for vessel-based cranes and subsequent vessel selection by COMPANY

The transfer of medium or light loads (typically less than 5 tons like pig, diesel tote tank, valve actuators, etc) shall be performed with the walk-to-work vessel crane-[HOLD 16]. The lay down area shall be designed such that it can be safely reached by the crane from a walk to work vessel.

For the loads heavier than 5t, this will be considered as a special operation and will require external lifting other than W2W vessels.


##### **14.8.17.1 32" Pig Receiver**

The 32" pig receiver will be permanently installed, but during the life of the platform may have to be removed/replaced. The transfer of the 32" Pig Receiver is a very infrequently operation. It will be performed with external lifting means. Its location shall be selected to ease its removal considering lifting from above. The layout arrangement shall also consider and avoid the risk for dropped object damage during this operation.

##### **14.8.17.2 Pig Launcher**

The transfer of a Pig Launcher is a very infrequently operation. It will be performed with external lifting means. Its location shall be selected to ease its installation considering lifting from the side. The layout arrangement shall also consider and avoid the risk for dropped object damage during this operation.



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#### 14.8.17.3 *Large Bore Valves*

The handling of 32" large bore heavy valves shall be performed with external lifting means (i.e. heavy lift vessel or jack up rig). Other valves will be handled with monorails and then transferred to laydown area.

However, the handling of large bore heavy valves is impacting the design. In case of valve dysfunction, only the replacement of internals shall be privileged. Consequently, heavy valves shall preferably be of Top Entry design.

Large bore valves may be equipped with cavity bleed valves. Bleeds will be vented to a safe location.

#### 14.8.17.4 *Laydown areas*

A main laydown area shall be provided on at platform upper deck. In addition, each deck shall be fitted with at least one laydown area to allow transferring loads to the main laydown area. The laydown area shall be able to receive the following equipment for a painting campaign. The sizing is based on the following table:

### 14.8.18 **Flow Meters**

No CO2 meters (spec or massflow) will be installed on D-HUBN platform.

### 14.8.19 **Thermal Relief Valve**

A thermal relief valve (TRV) shall be included in the design to avoid over pressure from blocked (shut in) lines due to heating of cold CO2 to ambient temperatures.

### 14.8.20 **Availability**

The overall D-HUBN target availability concerning ability to receive and distribute CO2 is minimum 99.5% on an annual basis, accounting for planned maintenance.


### 14.8.21 **Safety and Monitoring Systems**

An overall safety system shall be installed according to good industry standards and practices. No active control system is provided for the D-Hub, but computerized measured values for CO2 (pressure and temperature with local and remote indication in the control room, located onshore) shall be integrated to the extent practical in the safety system. Note that local pressure and temperature gauge will also be provided.

Safeguards shall be included against re-pressurisation of low temperature piping/pipe to avoid low temperature embrittlement of LTCS, notably for pig traps.

CCTV cameras shall be installed in areas critical to the CO2 operation. CCTV monitor shall be installed in the remote-control room.



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## 14.8.22 Telecoms Systems

The following telecom systems shall be provided (REF 10)

1. CCTV System
2. Radio Operations (Radio communication between the Hub and Control Room and/or other platform)
3. VHF Marine
4. AIS Transmitter
5. RACON (Radio Beacon)
6. Corporate LAN/ Telephone System
7. Telecom Industrial LAN (segregated from Corporate LAN due to cybersecurity)
8. General Alarm
9. Existing TAMPNET network (LoS+4G) for Internet and remote communication (WAN Link)

The D-Hub shall also be equipped with a ship detection system.

## 14.8.23 Telecom Mast

The D-Hub platform shall be outfitted with a Telecom mast. The mast shall be able to host the quantity of Antennas at their suitable height, result of a radio coverage study, to provide redundant communication links according to the company communication solution requirements and in compliance with the GS EP TEL 413. The main requirements for the communication solutions are the followings

- Minimum Bandwidth guaranteed per site: 25 Mbps
- Minimum Availability: 99.7%
- Maximum Latency: 120 ms
- Network/ Link Redundancy: 100%

The links shall provide Layer 2 and Layer 3 services, meaning that the information originated in one place could be transported/ routed to different destinations according to its classification (i.e., ICSS Data to Aramis ICC and Telecom data to TTE CCR as well as to ARAMIS ICC)


## 14.8.24 Power and Electrical

Platform shall be powered by renewable energy and one emergency diesel generator. The power generation shall be designed such that diesel generator do not exceed 500 running hours/year.

The following renewable power sources shall be provided:

- Wind Turbines
- Solar Panels



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- Batteries shall be installed within a dedicated container in the electrical room or in dedicated racks in the battery room. Batteries, shall have preference over diesel generator to handle intermittence of the available renewable power

#### 14.8.24.1 *Design Temperature*

Electrical Cabin, electrical package; electrical equipment and electrical installation shall be designed and installed in accordance with the environmental conditions to which it will be subjected.

Outdoor electrical equipment shall be designed to operate continuously in an ambient temperature corresponding to the extreme outside temperatures as defined in the project specific environmental data.

#### 14.8.24.2 *Site standardisation of equipment*

The power distribution system load and fault levels shall be established such that standard rated, certified and well-proven equipment can be used to simplify procurement and ultimately installation certification.

Instruction plates, equipment nameplates, asset specification plates, switches, push buttons, indicating lamps, earth terminal labels etc. shall be in English language and internationally accepted symbols / colours.

#### 14.8.24.3 *Design Basis*

The design of the electrical power distribution system shall be such as to afford the level of reliability and flexibility in operation consistent with operational requirements. The system shall remain stable under all operating conditions.

All systems shall be designed for ease of operation and maintenance with fail-safe features and simplicity consistent with maximum performance.


The power system shall be designed and sized so that the largest motor, per voltage level, can be successfully started at all levels of load utilisation without detriment to other connected loads.

The generation and distribution systems shall be designed such that electrical faults and loss of generator prime movers are correctly and safely isolated with the minimum of disturbance to the healthy system and ensure transient and steady state stability.

In order to determine the distribution of load throughout the installation and to establish the sizing of major items of electrical equipment, e.g. wind turbines, solar panel, batteries and distribution switchboards, a power balance document shall be prepared. The power balance document shall list all instruments and other electrical load consumers and shall include as a minimum for each load the following information:

- Equipment tag number
- Equipment description
- Load demand (Absorbed shaft power)
- Nameplate rating
- Efficiency



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- Power factor
- Operating mode (continuous, intermittent or standby)
- Diversity factor for intermittent loads
- Absorbed electrical load in kW and kVAR

Special note shall be taken of any large individual loads designated standby since the standby and duty loads may have to be operated concurrently for a short period during changeover.

All the loads shall be listed under the switchboard to which they are connected so that the load and size of each switchboard can be determined.

The power balance document shall also identify the individual wind turbines and solar panels ratings and study.

#### **14.8.25 HVAC**

There will only be HVAC in the ICSS/Telecom room.

#### **14.8.26 PIPELINE Depressurisation**

There will be no operational venting of the PIPELINE. If PIPELINE needs to be depressurised it will be a controlled depressurisation with no constraint on duration through the vent at the D-HUBN. The design and procedures to depressurise the PIPELINE will be such that:

- a) There will be no aqueous phase drop out at any point in time AND
- b) That the minimum temperature in the PIPELINE will not drop below minus 15 degC (10 deg C above minimum design temperature of -25 degrees HOLD 3]

The D-HUBN will not facilitate depressurisation of spurlines through the D-HUBN vent system.

#### **14.8.27 Vent Tip**


The vent tip should be located in a safe location such that the CO<sub>2</sub> is sufficiently dispersed such that the risk of human exposure to toxic CO<sub>2</sub> concentrations levels (HOLD 17) is established ALARP.

Moreover, the venting system design shall be such that there is no risk (the risk is established to be ALARP) of blockage due to dry ice formation in the vent line. The vent system shall be designed for controlled depressurisation

### **15. COMMISSIONING**

The pre-commissioning, commissioning and start-up scope for the Aramis project is split into two major elements. The first element consists of the Aramis owned and operated scope being the onshore beach station, the offshore PIPELINE, and the D-HUBN. This scope will be constructed,



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pre-commissioned and commissioned under the Aramis project. The second element consist of the start-up & ramp-up of the integrated system.

A project specific CSU philosophy has been developed for the Aramis project. Reference is made to the philosophy for more details. All CSU relevant information described in this Project Execution Strategy REF 11 (PES) is covered in the CSU philosophy REF 12 (ARM-CPT-BB8-OPE-PHI-0192)..

The design of all facilities shall support the commissioning and start-up & ramp-up activities (e.g. connection points for draining, venting, utilities). Focus shall be given to complete as much as possible commissioning activities onshore. Facilities should be designed to accommodate isolation and testing (sub)systems such that it simplifies commissioning and troubleshooting and aligns with the systemization approach. The design shall be verified during the FEED and Execute phase in model reviews to ensure it supports all CSU activities.

Requirements for temporary equipment, lay-down area for consumables, spare-parts, tools, etc. are to be included in the design.

### 15.1.1 Pre-Commissioning

Pre-commissioning is considered part of the construction activities. It is executed by the EPCC contractor. At the end of the pre-commissioning activities certificates are produced that document the completion and enable for the commissioning activities to start.

### 15.1.2 Commissioning

The commissioning activities are split into commissioning without CO<sub>2</sub> and commissioning with CO<sub>2</sub>. EPCC will execute the activities without CO<sub>2</sub> with support from COMPANY. COMPANY will execute activities with CO<sub>2</sub> with support from EPCC. The end of the commissioning activities without CO<sub>2</sub> is marked by the Transfer of Care and Custody (TCC) / Ready for Start-Up (RFSU) milestone. It is expected that not all commissioning activities can be executed prior to the introduction of CO<sub>2</sub> in the system, these shall be completed post the TCC / RFSU milestone.


### 15.1.3 Start-up and Ramp-up

The integrated start-up & ramp-up of the value chain is executed by the Aramis operations team in close corporation with all contributing parties including support from the EPCC. The Aramis operations team will have the accountability for the integrated start-up & ramp-up.

The starting point for the integrated start-up & ramp-up is that each operator in the value chain has achieved its independent Transfer of Care and Custody (TCC) / Ready for Start-Up (RFSU). This will be verified using a verification certificate of readiness (VCR) signed by the individual operator and the Aramis operations team. This applies also to the Aramis owned and operated assets; beach station, PIPELINE, and distribution-hub and integrated control environment.

Multiple start-up & ramp scenarios have been developed and will be further detailed during the FEED. Two main scenarios are described; both are based on a combination of both vapor and cryogenic CO<sub>2</sub> supply. One scenario focusses on majority of supply from the vapor suppliers, the other scenario is based on the main supply coming from cryogenic emitters.



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During the initial start-up & ramp-up the start-up team will be located at the Maasvlakte in a temporary facility. This facility is integrated with the construction site at the shark-fin area at the Maasvlakte. During the start-up, the temporary facilities will be manned 24x7 by at least the system integrator and the pipeline operator. Expectation is that the other operators (e.g. compressor station representation, stores representation) are physically present during the initial phase during day-time and available during night-hours in case of upsets. The temporary facility will include a temporary control room as a remote satellite station from the main offsite integrated control centre located in the Rotterdam area. The diagram below shows the proposed set up over time. For further details on the offsite integrated control centre, please see Section **Error! Reference source not found.** Functional specifications for temporary facilities are still to be developed [HOLD 18].



**Figure 15 A temporary ICC will be at the Maasvlakte**

## 16. INSTRUMENT, CONTROL AND SAFETY SYSTEMS (ICSS)

Each entity in the CCS chain will have their own control and safety system.

The control system for PIPELINE and D-HUBN shall be such as to allow the safe operation at or above required availability. The Aramis control room to operate the PIPELINE and D-HUBN will be in the integrated control centre.

Further, the integrated control centre will receive the necessary data from each entity in the CCS chain to enable the chain to perform safely at and above the 95% availability.

The Instrument and Automation philosophy is documented in REF 13


## 17. ONSHORE CONTROL CENTRE

### 17.1 Purpose

To manage the flow of CO<sub>2</sub> from emitters to stores (the system) an Onshore Control Centre will be realised. The objective of this centre is to provide (real time) data to an integrator and where necessary from one system party to the other. Data requirements and structure have not been defined yet.

For avoidance of doubt – each asset owner in the overall system will operate its own asset. The system integrator does not operate – but coordinates.



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The centre will provide an integrated space for the right people and data from all sources to work together to ensure that the Aramis system balances and safe transportation of CO2 to the stores can be achieved.

## 17.2 Users


The onshore control centre will have multiple users [HOLD 19] operating in a variety of capacities as outlined in the table below. Aramis will provide the Integrated Control Centre, but each company is expected to provide their own I.T. facilities. Aramis will provide equipment for the remote-control room to operate the PIPELINE and D-HUBN, plus the equipment for system integration.

<b>Party</b>	<b>Details</b>
Emitters	A data interface room receiving data from each of the emitters
CO2next	A satellite station for the onshore terminal, with option to take over full control
Porthos	A data interface room to view data from the Porthos facilities (operated from a local control room on site at Maasvlakte)
Aramis	A remote-control room to operate the PIPELINE and D-Hub facilities
Shell	A remote-control room for operation of the offshore store operated by Shell (including unattended platform facilities)
Total Energies	A data interface room to view data for the Total Energies operated store (operated from an existing control room in Den Helder)
Neptune	A data interface room to view data for the Neptune operated store (operated from an existing control room in Den Helder)
System Integrator	Space for an independent system integrator
Expansion Options	Space available for future external party growth stores (2 rooms).

## 17.3 FACILITIES

In addition to space for each of these users, the integrated control centre will have the following additional facilities.



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Facilities	Details
Collaboration Area	A dedicated collaboration area for activities such as integrated problem solving
Emergency Response	An emergency response room with access available to all parties. This can be combined with the collaboration area.
Data Handling Facilities	Space for data servers/cabinets. One per company, with segregated access for cybersecurity control.
Basic Facilities	Facilities such as toilets and break areas in line with local regulations
Visitors Centre	Facilities to allow industrial tourism

## 17.4 Location

The integrated control centre will be located offsite (away from Maasvlakte) in the Rotterdam area. This facility shall be available at mechanical completion. This will ensure maximum availability whilst reducing HSSE risks associated with personnel on site and transportation to site. Additionally, a temporary control centre will be located on site at Maasvlakte for (pre-)commissioning, start-up and ramp-up. This will be managed as part of the CSU scope as described in section 16.

Once steady operations have been achieved (~2+ years), the value of having the integrated control centre can be reviewed and a fully remote set-up considered for future operations.

Existing rental facilities shall be used to accommodate the offsite Integrated Control Centre. .

## 18. OPERATIONS

Full details are provided in the Aramis Operating Philosophy [ REF 14 ]