Rampion 2 Wind Farm

Category 6: Environmental Statement

Volume 4, Appendix 9.4 Geophysical survey (Part 3 of 7)

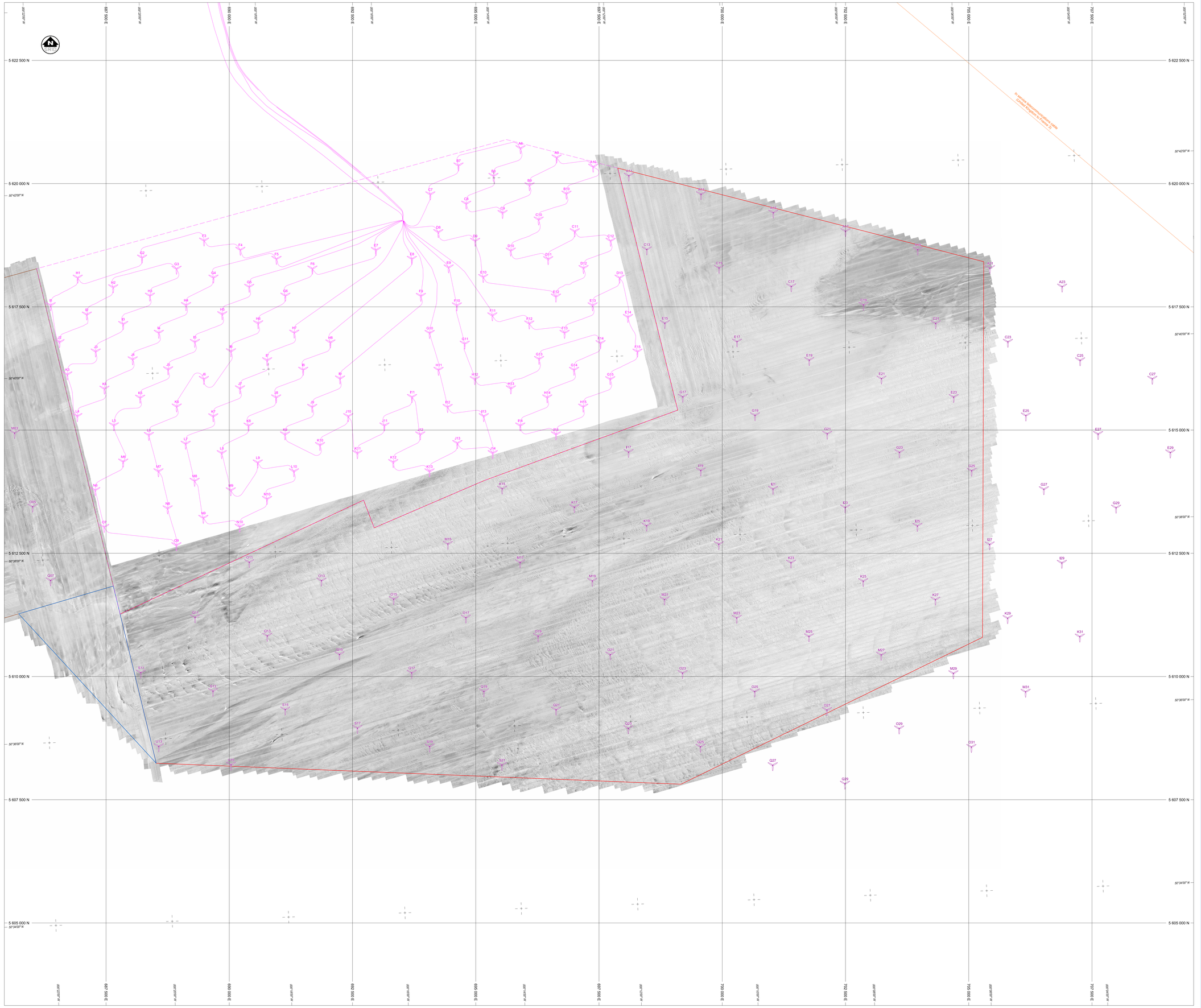
Date: August 2023

Revision A

Document Reference: 6.4.9.4
Pursuant to: APFP Regulation 5 (2) (a)
Ecodoc number: 004866474-01

Document revisions

Revision	Date	Status/reason for issue	Author	Checked by	Approved by
A	04/08/2023	Final for DCO Application	GoBe	RED	RED



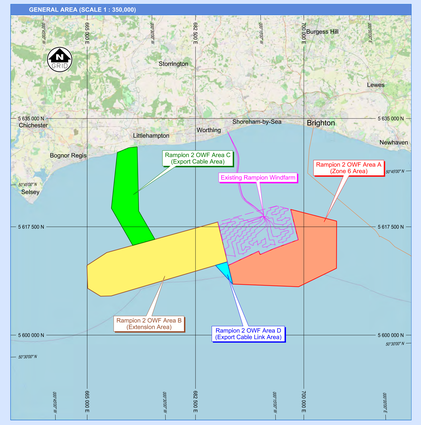
LEGEND

- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)
- CABLE (SOURCE: CLIENT PROVIDED)

NOTES

1. THE SIDE SCAN SONAR MOSAIC HAS BEEN GENERATED FROM M.V. TITAN DISCOVERY USING A FREQUENCY OF 122/550kHz AND M.V. VIGILANT USING A FREQUENCY 122/410kHz AND EXPORTED AT A RESOLUTION OF .2 METRES PER PIXEL.

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

SURVEY INFORMATION

SURVEY VESSEL:	M.V. VIGILANT	M.V. OCEAN OBSERVER
SURVEY DATE:	30-JUN-2020 TO 01-AUG-2020	16-SEP-2020 TO 13-OCT-2020
POSITIONING SYSTEM:	OCEANERRING C-NAV DGNSS SONARDYNE RANGER USBL	FUGRO STARFIX DGNSS SONARDYNE RANGER USBL
NAVIGATION SYSTEM:	VOYAGER 5	VOYAGER 5
ECHO SOUNDER (MULTIBEAM SYSTEM):	SIMRAD EM2040	SIMRAD EM2040
ECHO SOUNDER (SINGLE-BEAM SYSTEM):	SIMRAD EA400	SIMRAD EA400
SIDE SCAN SONAR:	EDGETECH 4200FS	EDGETECH 4200FS
MAGNETOMETER:	GEOMETRICS G882	GEOMETRICS G882
SUB-BOTTOM PROFILER:	GEOACOUSTICS PINGER	GEOACOUSTICS PINGER
ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I. SLEEVE GUN 75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

Gardline

GARDLINE LIMITED
ENDEAVOUR HOUSE, ADMIRALTY ROAD, GREAT YARMOUTH, NORFOLK NR30 3NG, ENGLAND
TELEPHONE +44 (0) 1493 845600 FAX +44 (0) 1493 852106 WEBSITE WWW.GARDLINE.COM

CLIENT

RWE
The energy to lead

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

SIDE SCAN SONAR MOSAIC

CHART 9

REVISION

REV:	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CT	JS	MK	DIG

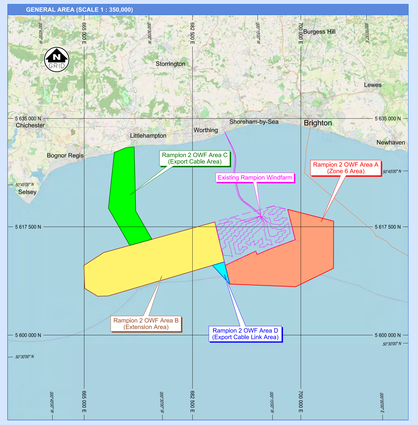
CLIENT REFERENCE		REPORT REFERENCE 11521.2	DRAWING NUMBER 11521.2.09

LEGEND

- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)
- CABLE (SOURCE: CLIENT PROVIDED)
- MAGNETOMETER ANOMALY WITH FIELD STRENGTH IN nT

NOTES

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

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ECHO SOUNDER (MULTI-BEAM SYSTEM):	SIMRAD EM2040D	SIMRAD EM2040
ECHO SOUNDER (SINGLE-BEAM SYSTEM):	SIMRAD EA400	SIMRAD EA400
SIDE SCAN SONAR:	EDGETECH 4200FS	EDGETECH 4200FS
MAGNETOMETER:	GEOMETRICS G882	GEOMETRICS G882
SUB-BOTTOM PROFILER:	GEOACOUSTICS PINGER	GEOACOUSTICS PINGER
ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I.I. SLEEVE GUN 75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

GARDLINE LIMITED
ENDEAVOUR HOUSE, ADMIRALTY ROAD, GREAT YARMOUTH, NORFOLK NR30 3NG, ENGLAND
TELEPHONE +44 (0) 1493 845600 FAX +44 (0) 1493 852106 WEBSITE WWW.GARDLINE.COM

CLIENT

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

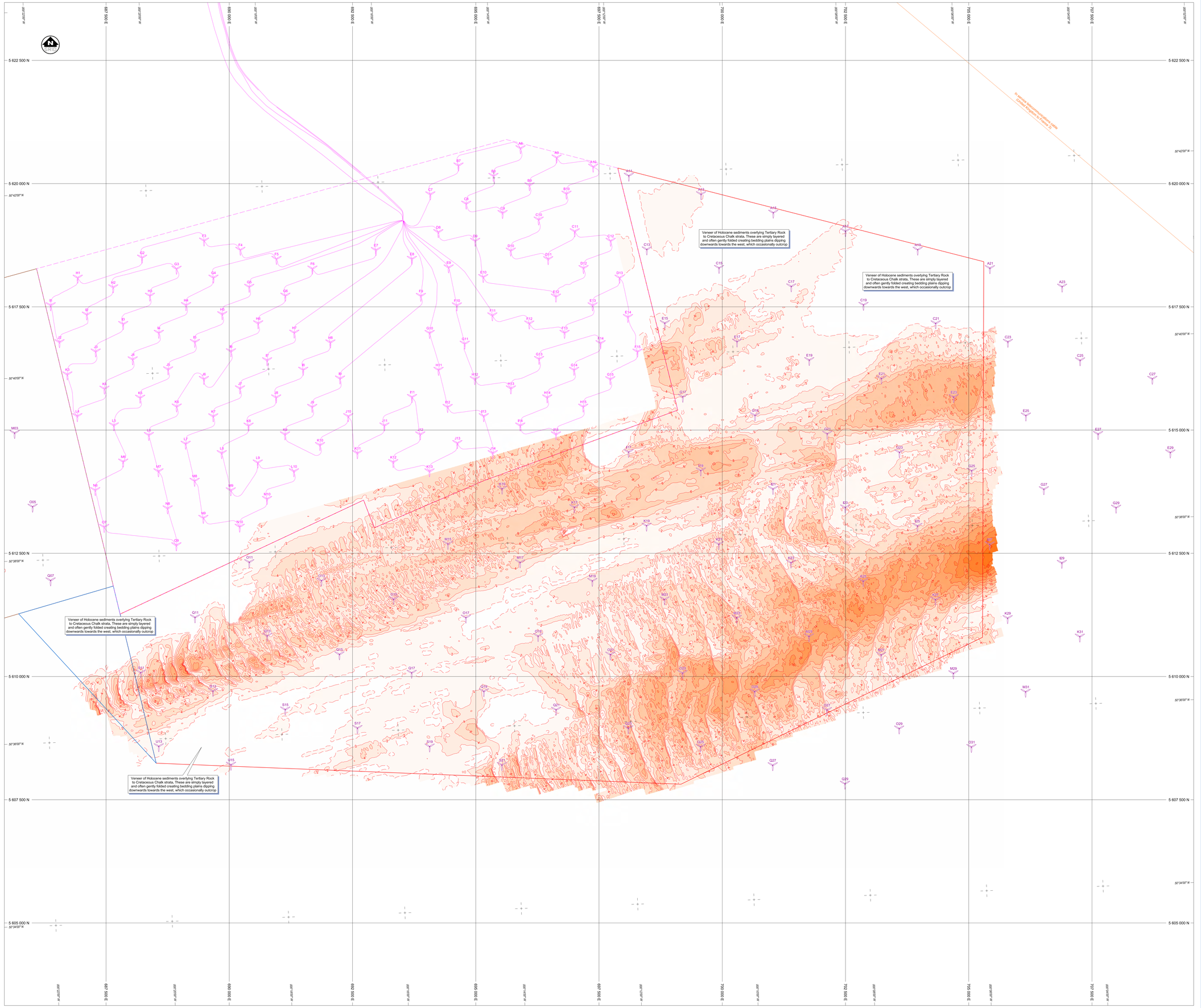
MAGNETOMETER RESIDUAL GRID

CHART 10

REVISION

REV.	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CT	JS	MK	DIG

CLIENT REFERENCE		REPORT REFERENCE	11521.2
DRAWING NUMBER			11521.2.10



LEGEND

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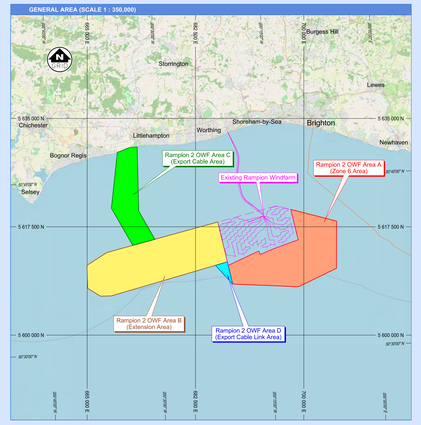
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)
- CABLE (SOURCE: CLIENT PROVIDED)
- 2 — DEPTH IN METRES BELOW SEABED TO BASE OF H05, CONTOURED AT 2 METRE INTERVALS
- LIMIT OF BASE OF H05

DEPTH IN METRES BELOW SEABED TO BASE OF H05: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

NOTES

1. ASSUMED SEISMIC VELOCITY = 1700m/s
2. H05 = YOUNGER HOLOCENE DEPOSITS COMPRISING UNCONSOLIDATED SEDIMENTS, LARGELY SAND AND GRAVEL. POTENTIALLY MOBILE IN PLACES

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

SURVEY INFORMATION

SURVEY VESSEL:	M.V. VIGILANT	M.V. OCEAN OBSERVER
SURVEY DATE:	30-JUN-2020 TO 01-AUG-2020	16-SEP-2020 TO 13-OCT-2020
POSITIONING SYSTEM:	OCEANERRING C-NAV DGNSS	FUGRO STARFIX DGNSS
	SONARDYNE RANGER USBL	SONARDYNE RANGER USBL
NAVIGATION SYSTEM:	VOYAGER 5	VOYAGER 5
ECHO SOUNDER (MULTI-BEAM SYSTEM):	SIMRAD EM2040D	SIMRAD EM2040
ECHO SOUNDER (SINGLE-BEAM SYSTEM):	SIMRAD EA400	SIMRAD EA400
SIDE SCAN SONAR:	EDGETECH 4200FS	EDGETECH 4200FS
MAGNETOMETER:	GEOMETRICS G882	GEOMETRICS G882
SUB-BOTTOM PROFILER:	GEOACOUSTICS PINGER	GEOACOUSTICS PINGER
ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I. SLEEVE GUN
		75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

Gardline

GARDLINE LIMITED
ENDEAVOUR HOUSE, ADMIRALTY ROAD, GREAT YARMOUTH, NORFOLK NR30 3NG, ENGLAND
TELEPHONE +44 (0) 1493 845600 FAX +44 (0) 1493 852106 WEBSITE WWW.GARDLINE.COM

CLIENT

RWE
The energy to lead

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT
GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

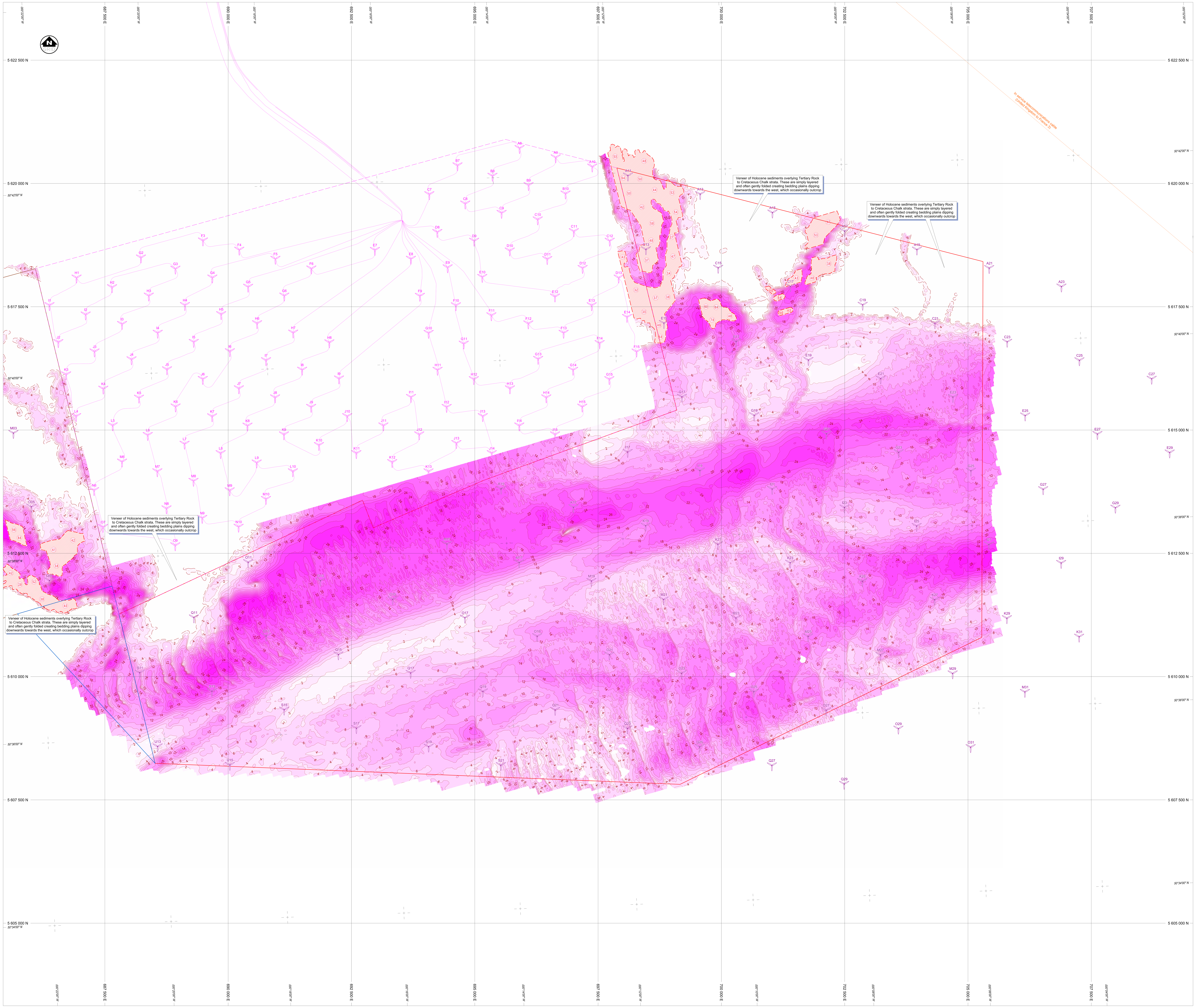
SHALLOW SOILS
(BASE OF H05)

CHART 11

REVISION

REV.	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CB	JS	MK	DIG

CLIENT REFERENCE		REPORT REFERENCE 11521.2	DRAWING NUMBER 11521.2.11



LEGEND

- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
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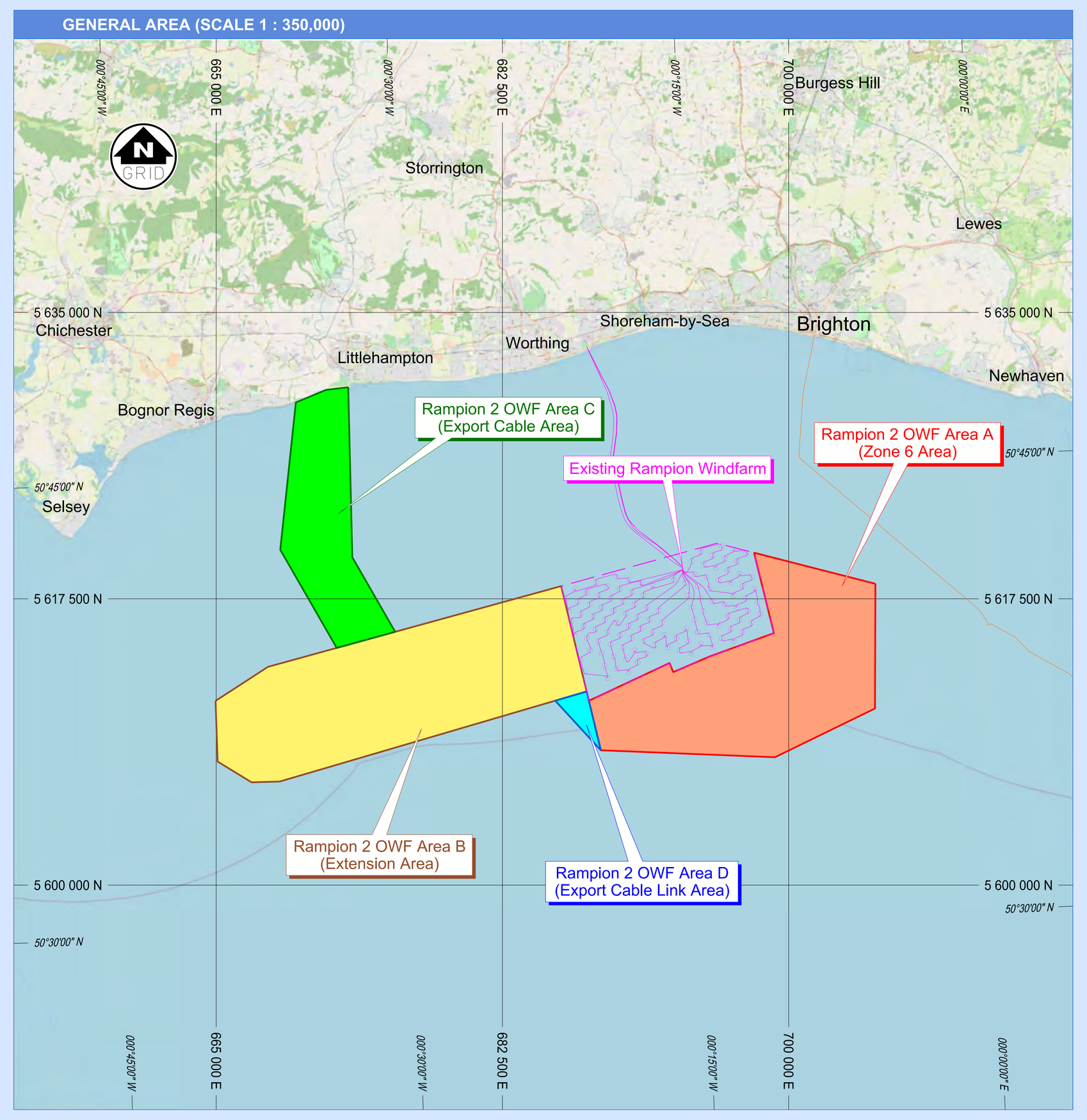
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)
- CABLE (SOURCE: CLIENT PROVIDED)
- 2 DEPTH IN METRES BELOW SEABED TO BASE OF H10 - PALAEOCHANNEL, CONTOURED AT 2 METRE INTERVALS
- LIMIT OF BASE OF H10
- 11.4 AREA OF BLANKING WITH SPOT DEPTHS IN METRES BELOW SEABED

DEPTH IN METRES BELOW SEABED TO BASE OF H10: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32

NOTES

1. ASSUMED SEISMIC VELOCITY = 1700m/s
2. H10 = PALAEOCHANNELS ARE SEEN CUTTING THROUGH THE BEDROCK. THESE CHANNELS ARE INTERPRETED TO COMPRISE INTERBEDDED CLAY, SANDS AND GRAVELS, WITH PEAT LAYERS AND BASAL GRAVELS AND ARE ASSOCIATED WITH GLACIAL ADVANCES AND THE ASSOCIATED FALLS IN SEA LEVEL

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

SURVEY INFORMATION

SURVEY VESSEL:	M.V. VIGILANT	M.V. OCEAN OBSERVER
SURVEY DATE:	30-JUN-2020 TO 01-AUG-2020	16-SEP-2020 TO 13-OCT-2020
POSITIONING SYSTEM:	OCEANERRING C-NAV DGNSS SONARDYNE RANGER USBL	FUGRO STARFIX DGNSS SONARDYNE RANGER USBL
NAVIGATION SYSTEM:	VOYAGER 5	VOYAGER 5
ECHO SOUNDER (MULTI-BEAM SYSTEM):	SIMRAD EM2040D	SIMRAD EM2040
ECHO SOUNDER (SINGLE-BEAM SYSTEM):	SIMRAD EA400	SIMRAD EA400
SIDE SCAN SONAR:	EDGETECH 4200FS	EDGETECH 4200FS
MAGNETOMETER:	GEOMETRICS G882	GEOMETRICS G882
SUB-BOTTOM PROFILER:	GEOACOUSTICS PINGER	GEOACOUSTICS PINGER
ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I. SLEEVE GUN 75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

Gardline

GARDLINE LIMITED
ENDEAVOUR HOUSE, ADMIRALTY ROAD, GREAT YARMOUTH, NORFOLK NR30 3NG. ENGLAND
TELEPHONE +44 (0) 1493 845600 FAX +44 (0) 1493 852106 WEBSITE WWW.GARDLINE.COM

CLIENT

RWE The energy to lead

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT
GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

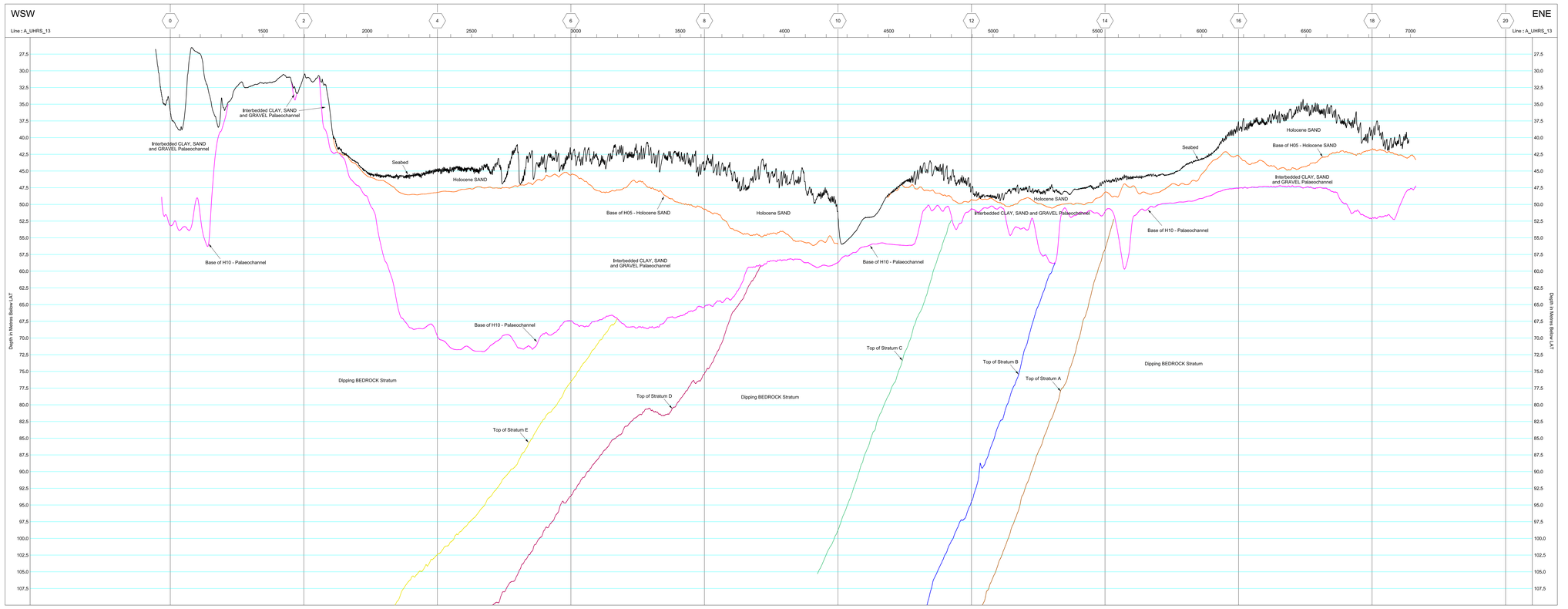
SHALLOW SOILS
(BASE OF H10)

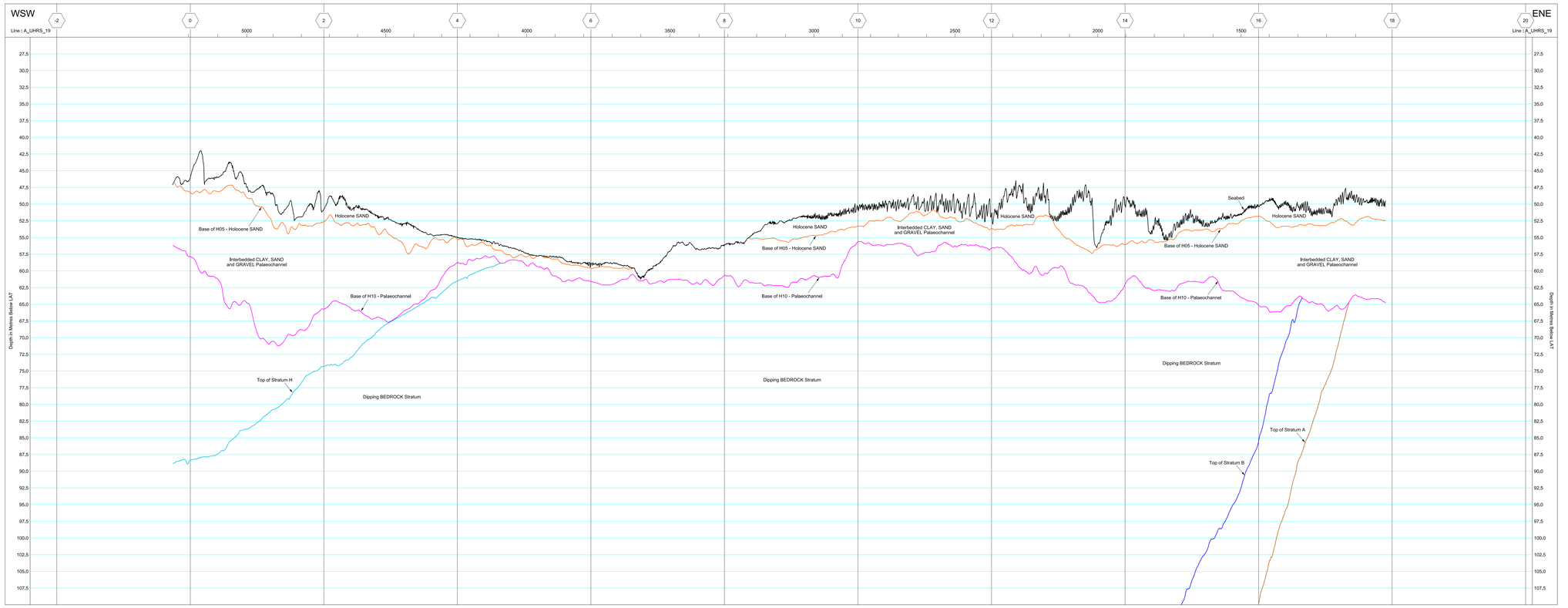
CHART 12

REVISION

REV.	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CB	JS	MK	DIG

CLIENT REFERENCE	REPORT REFERENCE 11521.2	DRAWING NUMBER 11521.2.12





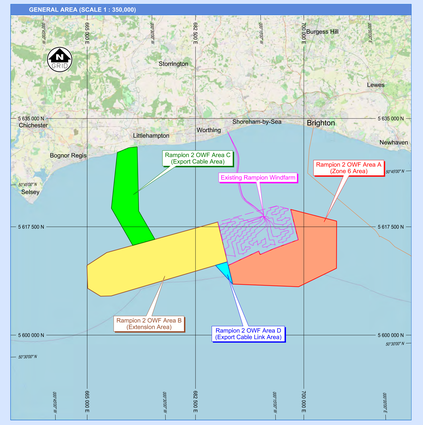
LEGEND

- SEABED
- BASE OF H05 - HOLOCENE SAND
- BASE OF H10 - PALAEOCHANNEL
- TOP OF STRATUM A
- TOP OF STRATUM B
- TOP OF STRATUM C
- TOP OF STRATUM D
- TOP OF STRATUM E
- TOP OF STRATUM H

NOTES

1. ASSUMED SEISMIC VELOCITY = 1700m/s
2. VERTICAL SCALE = 1 : 250
3. VERTICAL EXAGGERATION = 100 : 1

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

SURVEY INFORMATION

SURVEY VESSEL:	M.V. VIGILANT	M.V. OCEAN OBSERVER
SURVEY DATE:	30-JUN-2020 TO 01-AUG-2020	16-SEP-2020 TO 13-OCT-2020
POSITIONING SYSTEM:	OCEANEERING C-NAV DGNSS	FUGRO STARFIX DGNSS
	SONARDYNE RANGER USBL	SONARDYNE RANGER USBL
NAVIGATION SYSTEM:	VOYAGER S	VOYAGER S
ECHO SOUNDER (MULTI-BEAM SYSTEM):	SIMRAD EM2040D	SIMRAD EM2040
ECHO SOUNDER (SINGLE-BEAM SYSTEM):	SIMRAD EA400	SIMRAD EA400
SIDE SCAN SONAR:	EDGETECH 4200FS	EDGETECH 4200FS
MAGNETOMETER:	GEOMETRICS G882	GEOMETRICS G882
SUB-BOTTOM PROFILER:	GEOACOUSTICS PINGER	GEOACOUSTICS PINGER
ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I. SLEEVE GUN
		75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

GARDLINE LIMITED
ENDEAVOUR HOUSE, ADMIRALTY ROAD, GREAT YARMOUTH, NORFOLK NR30 3NG. ENGLAND
TELEPHONE +44 (0) 1493 845600 FAX +44 (0) 1493 852106 WEBSITE WWW.GARDLINE.COM

CLIENT

RWE The energy to lead

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT
GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

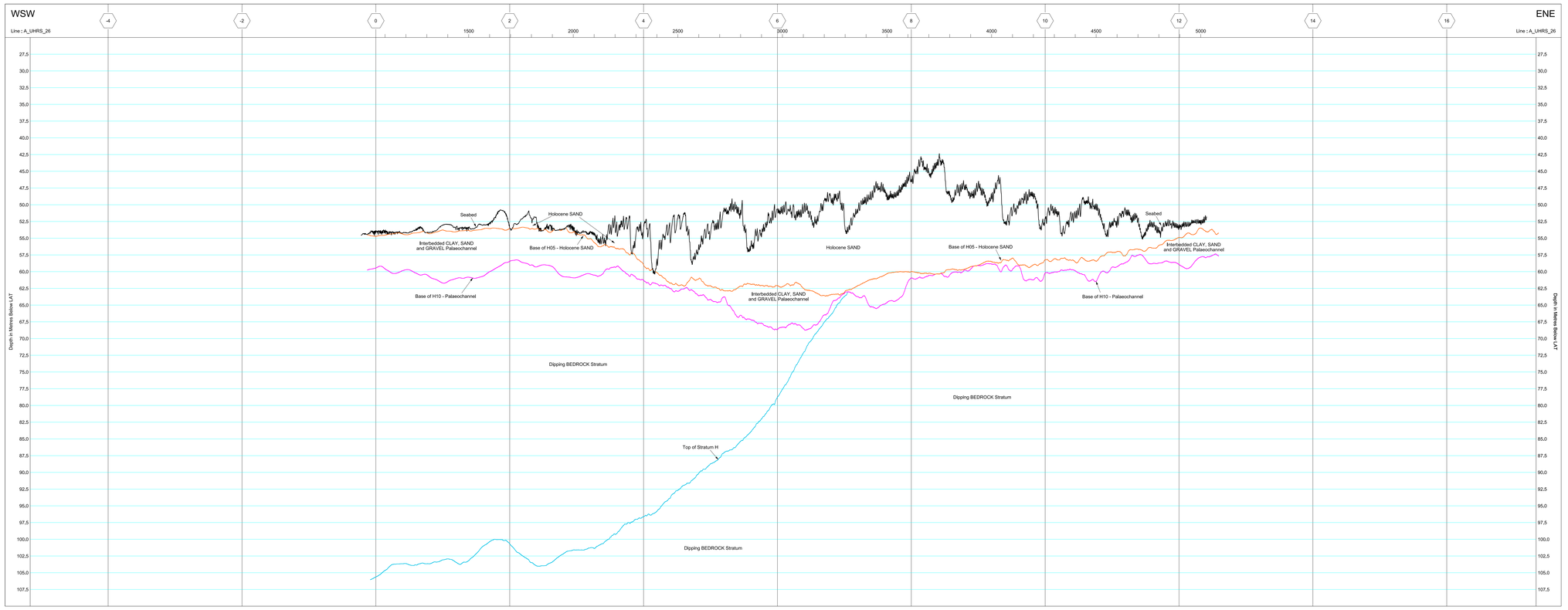
GEOLOGICAL PROFILES - 2D UHRS
(LINES A_UHRS_13 AND A_UHRS_19)

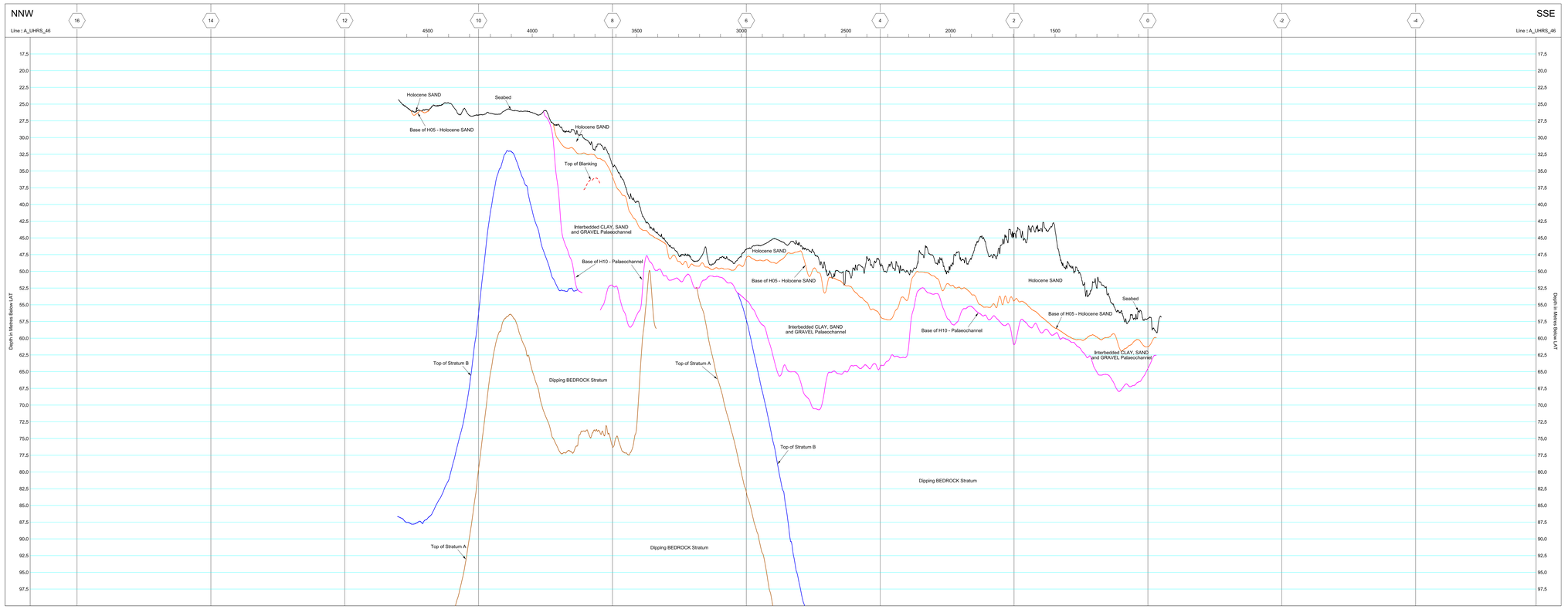
CHART 13

REVISION

REV.	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CB	JS	MK	DIG

CLIENT REFERENCE	REPORT REFERENCE 11521.2	DRAWING NUMBER 11521.2.13





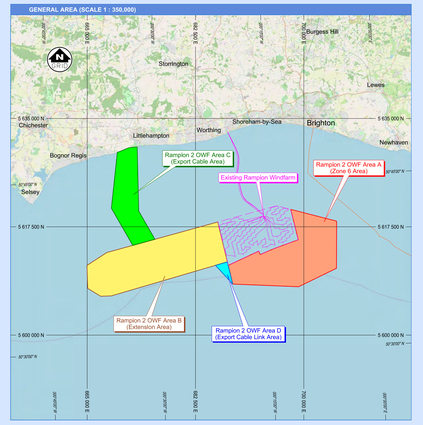
LEGEND

- SEABED
- BASE OF H05 - HOLOCENE SAND
- BASE OF H10 - PALAEOCHANNEL
- TOP OF BLANKING
- TOP OF STRATUM A
- TOP OF STRATUM B
- TOP OF STRATUM H

NOTES

1. ASSUMED SEISMIC VELOCITY = 1700m/s
2. VERTICAL SCALE = 1 : 250
3. VERTICAL EXAGGERATION = 100 : 1

GENERAL AREA (SCALE 1 : 350,000)



GEODETIC REFERENCE SYSTEM

GEODETIC DATUM:	WGS84
ELLIPSOID:	WGS84
PROJECTION:	UTM ZONE 30 N (CENTRAL MERIDIAN 3° W)

SURVEY INFORMATION

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ULTRA HIGH RESOLUTION SEISMIC (UHRS):		1 x 10 cu.in. T.I. SLEEVE GUN 75m TELEDYNE STREAMER

SCALE (A0 ORIGINAL)

1 : 25 000 (Horizontal)

250 0 1250 2500

METRES

TITLE

SURVEY CONTRACTOR

Gardline

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CLIENT

RWE
The energy to lead

PROJECT TITLE

RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT GEOPHYSICAL SITE SURVEY FOR AREA A

DRAWING TITLE

GEOLOGICAL PROFILES - 2D UHRS (LINES A_UHRS_26 AND A_UHRS_46)

CHART 14

REVISION

REV.	DATE	TITLE	DESCRIPTION	AUTHOR	DRAWN	CHECKED	APPROVED
0	16-DEC-2020	DRAFT	FIRST ISSUE FOR CLIENT REVIEW, PDF ONLY	CB	JS	MK	DIG

CLIENT REFERENCE		REPORT REFERENCE 11521.2	DRAWING NUMBER 11521.2.14

Survey Report for
RWE Renewables UK Ltd

Project:
Rampion 2 OWF Development

Description:
Area B Geophysical Survey

Survey Date:
March to Oct 2020

Project Number:
11521.3

Report Status:
Draft

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	C Buckmaster / C Thacker
	Surveying	T Stynes
Authorisation	Checked	M Kingston
	Approved	D I Gordon

Revision	Date	Title	Description
0	16-Dec-2020	Draft	Draft Report PDF only

Distribution

1 copy

RWE Renewables UK Ltd
Greenwood House
Westwood Way
Westwood Business Park
Coventry
CV4 8TT

For attention of
Naren Mistry

EXECUTIVE SUMMARY

Gardline Limited was contracted by RWE Renewables UK Ltd to acquire shallow geophysical and UHRS data across areas being considered for development at the Rampion 2 Offshore Windfarm and associated export cable route corridor.

The offshore portion of the survey was undertaken predominantly by M.V. Vigilant, mobilising in Hull on 30-Jun-2020 and demobilising in Hull on 19-Aug-2020 after completion of the shallow geophysical data acquisition. The M.V. Ocean Observer carried out the UHRS portion of the survey including acquiring SBP and magnetometer data infilling the planned gaps in the geophysical survey including all crosslines. It mobilised in Lowestoft on 21-Sept-2020 and demobilised in Great Yarmouth on 13-Oct-2020. The M.V. Titan Discovery and Titan owned Unmanned Aerial Vehicle carried out the nearshore acquisition, mobilising on 01-Jul-2020 and demobilising 12-Aug-2020.

Within the survey area, the water depth ranges from 13.5m LAT to 65.0m LAT. Seabed gradients across the survey area are generally <1°. Localised gradients reach up to 20° within a depression interpreted as a dredging extraction area. The seabed undulates across much of the survey area, influenced by the underlying geology.

Seabed sediments are expected to comprise predominately sandy gravel with patches of gravelly sand. Over 15,000 boulders have been identified along with 12 debris items and 360 fishing pots. Linear debris is observed sporadically across the site along with a significant amount of fishing gear. A total of 14 wrecks have been identified along with 132 magnetometer contacts and 6 clusters of spudcan depressions.

Quaternary deposits are interpreted as comprising predominantly gravel and sand. The Quaternary deposits overlie the palaeochannels. The. Bedrock is interpreted to comprise Tertiary Claystones to Cretaceous Chalk strata. These subcrop the majority of the survey area, occasionally outcropping. Within Rampion 2 Area B there are four main channels with smaller tributary channels.

Report volumes are as follows:

Report	Report No.
Operations Report	11521.1
Rampion 2 OWF Area A Survey Report	11521.2
Rampion 2 OWF Area B Survey Report	11521.3
Rampion 2 OWF Area C Survey Report	11521.4

This report is the Rampion 2 OWF Area B survey report.

USE OF THIS REPORT

This report has been prepared with due care and diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work carried out under the contract and as such the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and unless clearly stated is not a recommendation of any course of action.

Gardline Limited has prepared this report for the client(s) identified on the front cover in fulfilment of its contractual obligations under the contract and the only liabilities Gardline Limited accept are those contained therein.

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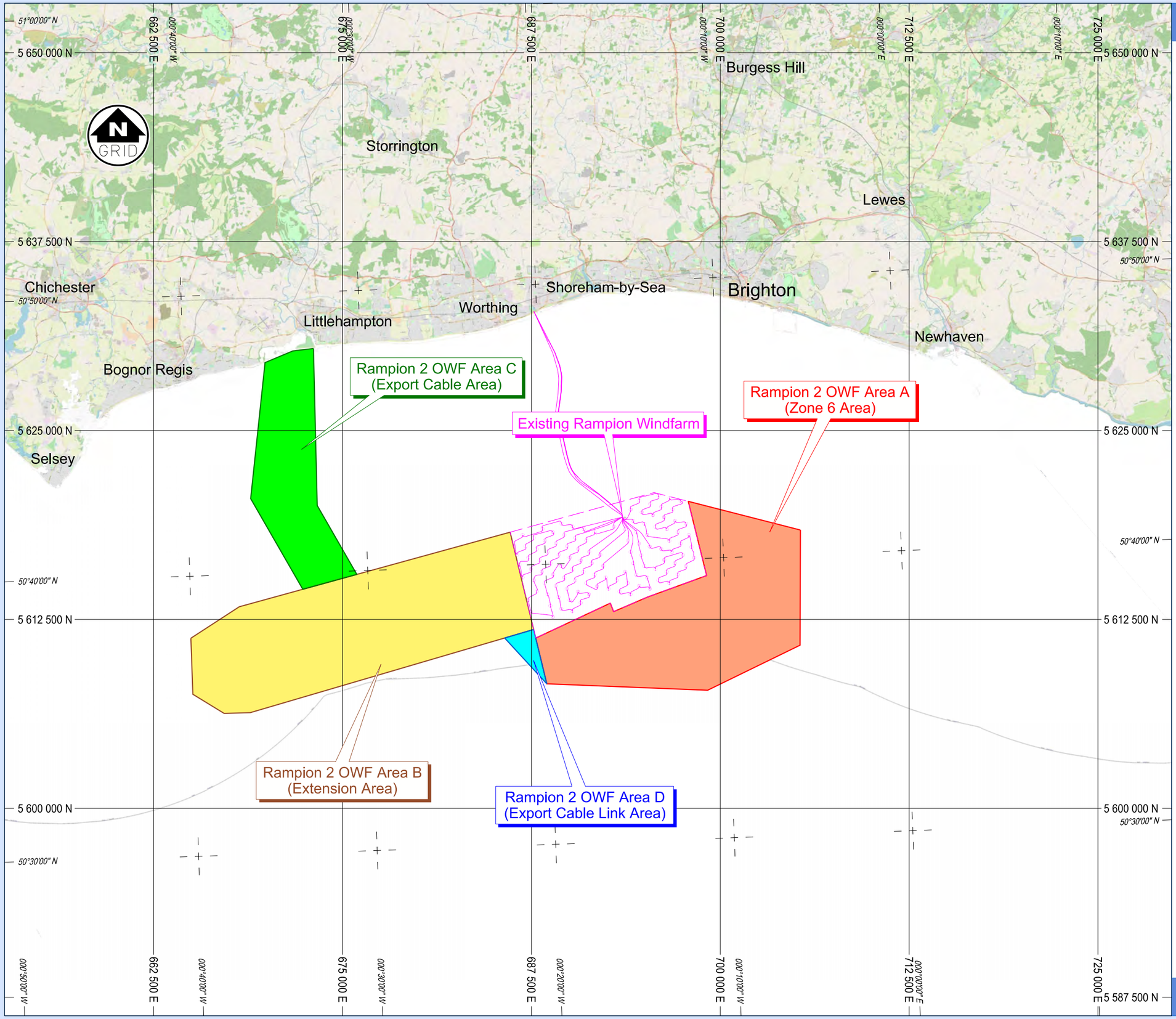

LOCATION MAP
RAMPION 2 OFFSHORE WINDFARM DEVELOPMENT

- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA C (EXPORT CABLE AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)

Scale 1 : 250 000
WGS84/UTM Zone 30N (3°W)

Job No. 11521.3

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LIST OF CHARTS

Charts are enclosed at a scale of 1:25,000:

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF ABBREVIATIONS

AVO	Amplitude Versus Offset
BASE	Bathymetry Associated with Statistical Error
BGS	British Geological Survey
BS	British Standards
BSB	Below Seabed
cm	Centimetre(s)
CMP	Common Mid Point
CoG	Centre of Gravity
CPT(U)	Cone Penetrometer Testing (Unit)
cu. in.	Cubic Inch(es)
d	Delta
dB	Decibel(s)
deg	Degree(s)
(D)GNSS	(Differential) Global Navigation Satellite System
EBS	Environmental Baseline Survey
EC	European Commission
EGNOS	European Geostationary Navigation Overlay Service
EPSG	European Petroleum Survey Group
f	Focal Length
ft	Foot/Feet
h	Hours (times expressed hh:mmh e.g. 12:45h)
H	Height
HDOP	Horizontal Dilution of Precision
ISO	International Organisation for Standardisation
J	Joule(s)
(k)Hz	(Kilo)Hertz
kg	Kilogram(s)
km	Kilometre(s)
kN	Kilonewton(s)
kPa	Kilopascal(s)
kW	Kilowatt(s)
L	Length
LAT	Lowest Astronomical Tide
m	Metre(s)
M	Megapixels
MBES	Multi-Beam Echo Sounder
MDAC	Methane Derived Authigenic Carbonates
MHWI	Mean High Water Interval
ml	Millilitre(s)
mm	Millimetre(s)
MPa	Megapascals
MRU	Motion Reference Unit
ms	Millisecond(s)
m/s	Metres per Second
MSL	Mean Sea Level
MSR	Mean Spring Range
M.V.	Motor Vessel
N,E,S,W	North, East, South, West
nT	NanoTesla
oct	Octave
OGP	International Association of Oil and Gas Producers
OSPAR	Oslo and Paris Commissions
PC	Piston Core
PDOP	Positional Dilution of Precision
ppm	Parts Per Million
QC	Quality Control
QPRO	Quality Procedure
r	Rotation
RMS	Root Mean Square
RPL	Route Positioning List
Rx	Receive
S	Second(s)
SBES	Single Beam Echo Sounder
sd	Standard Deviation
SEGY	Society of Exploration Geophysicists storage format
SNR	Signal to Noise Ratio
SP	Shot Point
SRME	Surface Related Multiple Elimination
SV	Sound Velocity
SWNA	Surface Wave Noise Attenuation
TWT	Two Way Time
Tx	Transmit
UHRS	Ultra High Resolution Seismic
UKCS	United Kingdom Continental Shelf
USBL	Ultra Short Base Line
(U)TM	(Universal) Transverse Mercator
VC	Vibrocore
(V)GPS	(Voyager) Global Positioning System
VORF	Vertical Offshore Reference Frames
WGS84	World Geodetic System 1984

1. PROJECT SUMMARY

1.1 Scope of Work

Gardline Limited carried out a shallow geophysical and UHRS survey for RWE Renewables UK Ltd off the coast of Brighton, Sussex. The objective was to investigate three areas being considered for development using multi-beam echo sounder, side scan sonar, magnetometer, sub-bottom profiler and UHRS equipment.

The three extension areas were designated:

- Area A: “Zone 6 Area” to the south-east of the existing Rampion offshore wind farm. Part of this area was previously surveyed during the original development and there was no requirement for re-surveying at this stage of the development.
- Area B: “Extension Area” to the west of the existing Rampion offshore windfarm.
- Area C: “Export Cable Area” to the north of Area B, with landfall between Littlehampton and Bognor Regis. No UHRS acquisition was required for Area C.

The purpose of the survey was to:

- To provide accurate bathymetry of the site regions and cable routes region
- To identity natural seabed features and any obstructions, man-made objects, debris, or wrecks
- To produce isopach charts to show sediment thickness of the upper, loose, and any mobile material, and of any other significant reflector levels which might impact on the engineering design to 50m below seabed for Areas A and B, and to 10m below seabed for Area C
- To locate any structural complexities or geohazards within the shallow geological succession such as faulting, accumulations of shallow gas, buried channels etc to 50m below seabed for Areas A and B, and to 10m below seabed for Area C
- Locate and identify sites of near surface soft material pertinent to jack-up operations
- To provide detailed geological interpretation to show strata variations and structural feature changes via appropriate maps and sections
- To provide interpretation to assist design of the offshore foundations / structures and cable routing and burial
- To identity items through correlation of magnetic anomalies and sonar contacts that may require further physical survey, for example UXO and wrecks

The offshore work scope was carried out by the Gardline vessels M.V. Vigilant, with additional work undertaken by M.V. Ocean Observer. The M.V. Vigilant acquired full coverage with MBES and SSS of Areas A, B and the offshore part of Area C. In addition, it acquired SBP and magnetometer data on all of the offshore part of Area C with a line spacing of 60m, and 4 out of every 5 main lines in Areas A and B, with a line spacing of 77m.

The M.V. Ocean Observer acquired UHRS, SBP and magnetometer data on Areas A and B at a line spacing of 385m, and on each of the cross lines in Areas A and B at a line spacing of 1336m. Both the main and cross lines are orientated and positioned so as to acquire UHRS data through the proposed locations of the turbines in Areas A and B.

The nearshore work scope was covered by the M.V. Titan Discovery and a Titan owned Unmanned Aerial Vehicle (UAV). Details of operational activities is included in the Operations Report, 11521.1.

All coordinates quoted in the report are with respect to **World Geodetic System 1984 (WGS84), UTM Grid Zone 30N (3° West)**. All water depths are reduced to **Lowest Astronomical Tide (LAT).** Full details of the geodetics used during the project are contained in Appendix A.

The grid of survey lines as acquired for Rampion 2 Area B is presented on Charts 1, Chart 2 and Chart 3.

This report is the Rampion 2 Area B Survey Report.

1.2 Equipment Summary

Table 1.1 Survey Equipment – M.V. Vigilant

System	Make/Model
Positioning system	Oceaneering C-Nav DGNSS
	Sonardyne Ranger USBL
Navigation System	Voyager5
Echo Sounder (MBES system)	Simrad EM2040D
Echo Sounder (SBES system)	Simrad EA400
Side Scan Sonar	EdgeTech 4200FS
Magnetometer	Geometrics G882
Sub-Bottom Profiler	GeoAcoustics Pinger

Table 1.2 Survey Equipment – M.V. Ocean Observer

System	Make/Model
Positioning Systems	Fugro Starfix XP2 DGNSS
	Sonardyne Ranger 2 USBL
Navigation System	Voyager5
Echo Sounder (MBES system)	Simrad EM710
Echo Sounder (SBES system)	Kongsberg EA400
Magnetometer	Geometrics G882
Sub-Bottom Profiler	GeoAcoustics Pinger
UHRS	Teledyne 24 Channel Streamer Applied Acoustics Dura Spark

2. ACCURACY AND TERMS FOR SEISMIC INTERPRETATION

2.1 Resolution and Limitations for Site Survey Data

2.1.1 Bathymetry

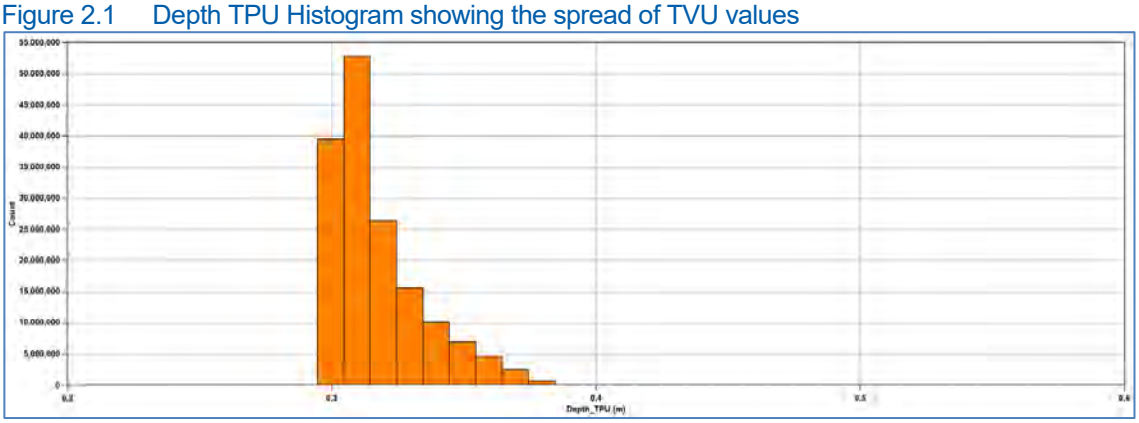
Several factors influence the accuracy of the bathymetric data:

- Variations in sound velocity
- Instrument accuracy (typically 0.2-0.5% of depth depending on beam angle)
- Weather effects/vessel movement
- Morphology of seabed

The uncertainty requirement of the survey is to achieve International Hydrographic Organisation's (IHO) Order 1. In the guidelines produced by the IHO, a formula is outlined to derive an accuracy level depending on the depth of water the survey is being carried out in. This Total Vertical Uncertainty (TVU) value is used to ensure the data collected meets the standard required to meet Order 1a. Using water depths of 13m and 65m as the rough range within which Gardline acquired data, the MBES TVU must be better than +/- 0.528m and +/- 0.982m, respectively.

The data were analysed using the Total Propagated Uncertainty (TPU) engine in CARIS. A depth TPU surface created within CARIS to identify the TVU range. The figure below shows that the TVU values meet the minimum level required to me the IHO Order1.

Figure 2.1 Depth TPU Histogram showing the spread of TVU values



In addition to the standard processing flow of the data, post processing was carried out on the raw GNSS records to produce a more accurate tidal profile to be applied to the data.

Multi-beam echo sounder data have been processed with a 1m bin size. As such, localised gradients of features with a smaller lateral extent will be underestimated.

2.1.2 Seabed Features

Side scan sonar data were collected for the purpose of mapping and imaging features and hazards on the seabed. Collected data from the Vigilant have frequencies of 122kHz and 410kHz and a range of 100m per channel.

From corrections made to the sonar mosaic, and comparing the sonar data with the bathymetry data, USBL positioning accuracy is expected to be in the order of ±2m, and horizontal resolution is expected to be approximately 0.5m. Vertical protrusions above the seabed over 0.1m should be detectable (and flat-lying objects above 0.1m diameter) measurable to the nearest 0.1m, depending on the range.

2.1.3 Magnetic Survey

Magnetometer data were inspected for potential anomalies with the results being presented on the enclosed Seabed Features Chart.

Records were of average quality with background noise apparent due to the relative close proximity of the magnetometer to the survey vessel due to the shallow water depths on site, as well as induced noise from the underlying geology.

Positioning of ferrous bodies from magnetic anomalies is problematical. Errors are introduced from uncertainties on raw navigation data and on offset errors, as well as from the inherent ambiguity of determining body shape from magnetic anomalies. Where possible magnetic anomalies are cross referenced against other datasets (e.g. bathymetry, side scan sonar, sub-bottom profiler, database records etc), in order to assign a likely centre of the magnetic deviation. Where this is not possible the positioning accuracy will be largely dependent on the acquired line spacing.

2.1.4 Sub-Seabed Data

Pinger and UHRS data were of good quality and exhibit an average penetration of 15m and 60m respectively. Dependant on the local geological conditions. An assumed seismic velocity of 1650m/s was used for time/depth conversion in the shallow sediments. Maximum vertical resolution may be determined theoretically by one quarter of the wavelength, which would give a maximum vertical resolution of the Pinger and UHRS data is approximately 0.1m and 0.6m respectively, assuming a dominant frequency of approximately 3500Hz and 750Hz. Theoretical minimum detectable layer, estimated at 1/30th the dominant wavelength, is calculated to be approximately 0.016m and 0.073m respectively at seabed.

2.2 Criteria for Horizon Picking

Interpretation of the sub-seabed data has been aided using BGS records and previous reports which are detailed in Section 4.

Horizons were picked where they separated distinct seismo-stratigraphic units. Generally, they were picked on the peak, but where the horizons represented a velocity inversion, they were picked on the trough.

3. GEOPHYSICAL SURVEY RESULTS

3.1 Bathymetry

Area B bathymetry is presented on Chart 4 as a colour shaded relief image with contours at 1m intervals. An overview of the bathymetry is illustrated on Figure 3.1.

A shaded relief image of the bathymetry is presented on Chart 5. An overview of the shaded relief is illustrated on Figure 3.2.

Seabed Gradient is presented on Chart 6. An overview is illustrated on Figure 3.3.

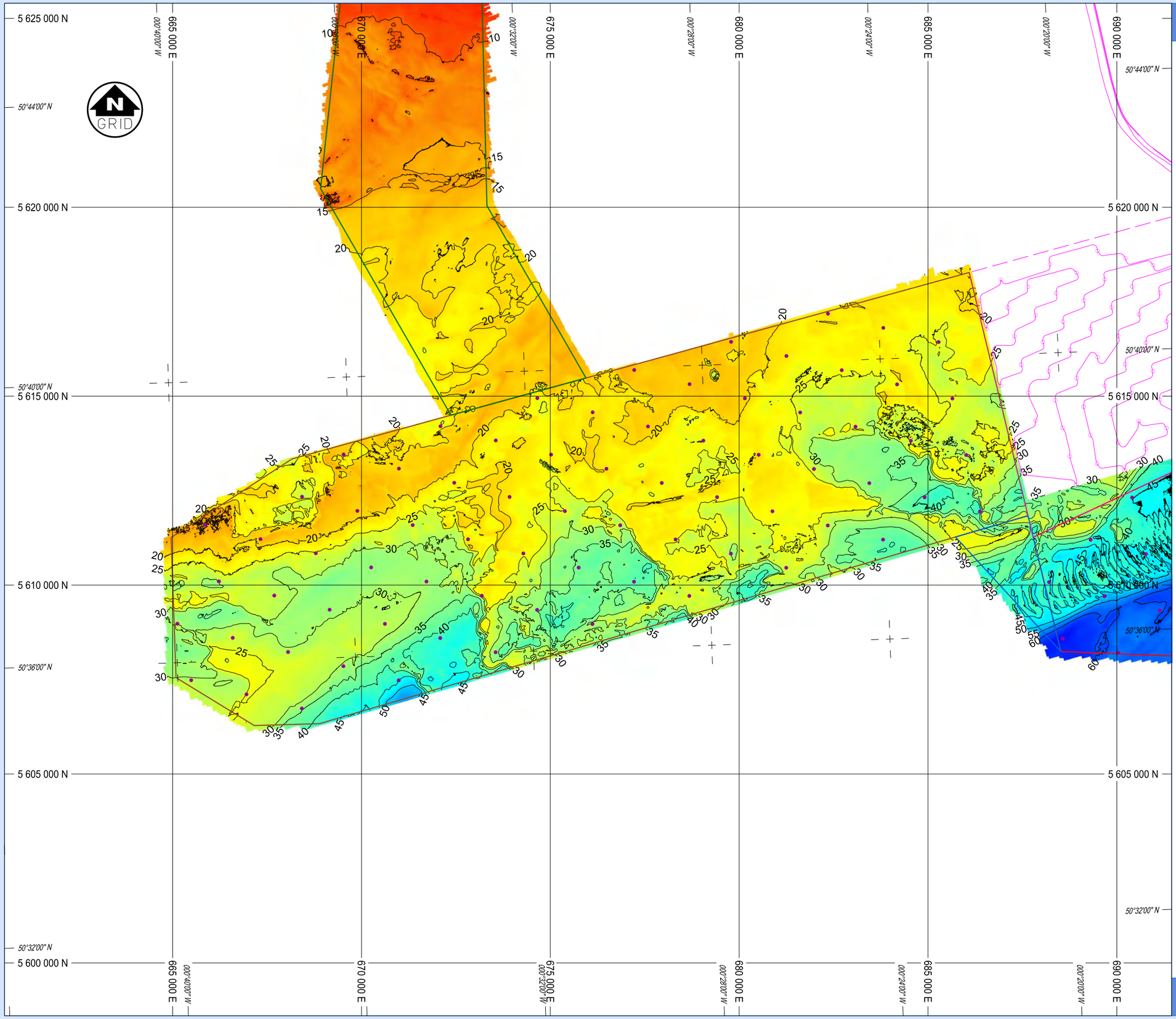
Within the survey area, the shallowest depth is 13.5m LAT on a rocky outcrop to the northwest of the survey area. Water depths reach 65.0m LAT within a broad depression to the southeast of the survey area. Seabed gradients across the survey area are generally <1°, dipping towards the south.

The seabed undulates across much of the survey area, influenced by the underlying geology. Occasional rocky outcrops are observed to the east of Area B, with seabed gradients reaching 5° locally.

Some significant seabed depressions are present in the north of Area B. with the largest measuring approximately 345m across and 12.5m deep, with gradients reaching 20° on its flanks. These depressions have been interpreted as possible dredging extraction areas.

The difference between LAT and MSL within the survey area is approximately 3.3m.

BATHYMETRY OVERVIEW FOR RAMPION 2 OWF AREAS B & D



PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)

PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)

PROPOSED RAMPION 2 OWF AREA C (EXPORT CABLE AREA)

PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)

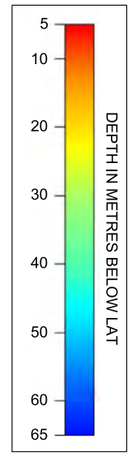
PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)

EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)

EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)

EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)

25 BATHYMETRIC CONTOURS SHOWN AT 5 METRE INTERVALS LAT

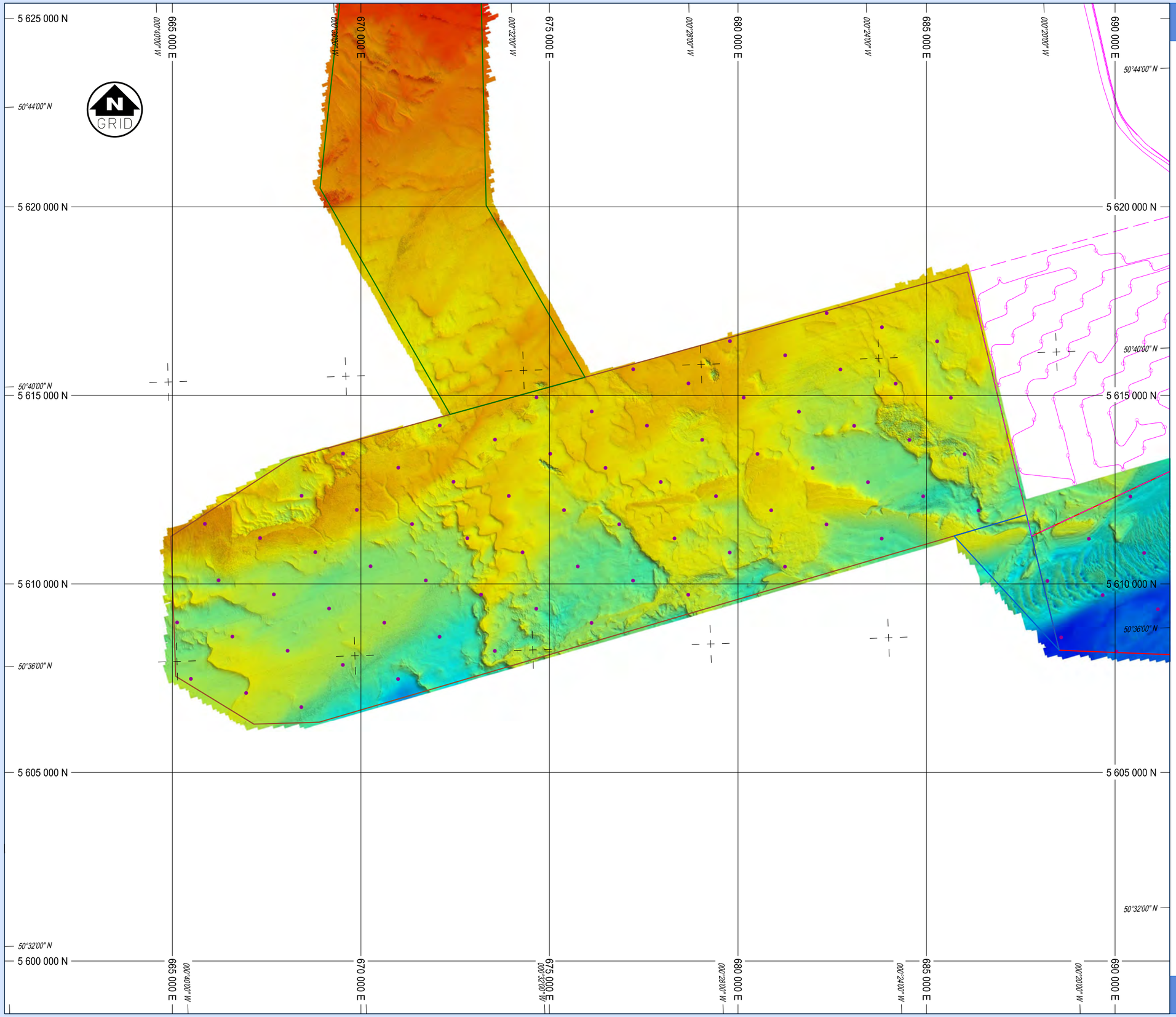


Scale 1 : 100 000
WGS84/UTM Zone 30N (3°W)

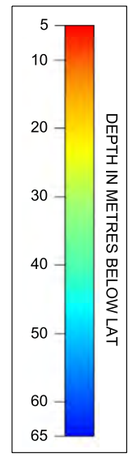
Figure 3.1

Job No. 11521.3

SEABED SHADED RELIEF OVERVIEW FOR RAMPION 2 OWF AREAS B & D



- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA C (EXPORT CABLE AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)

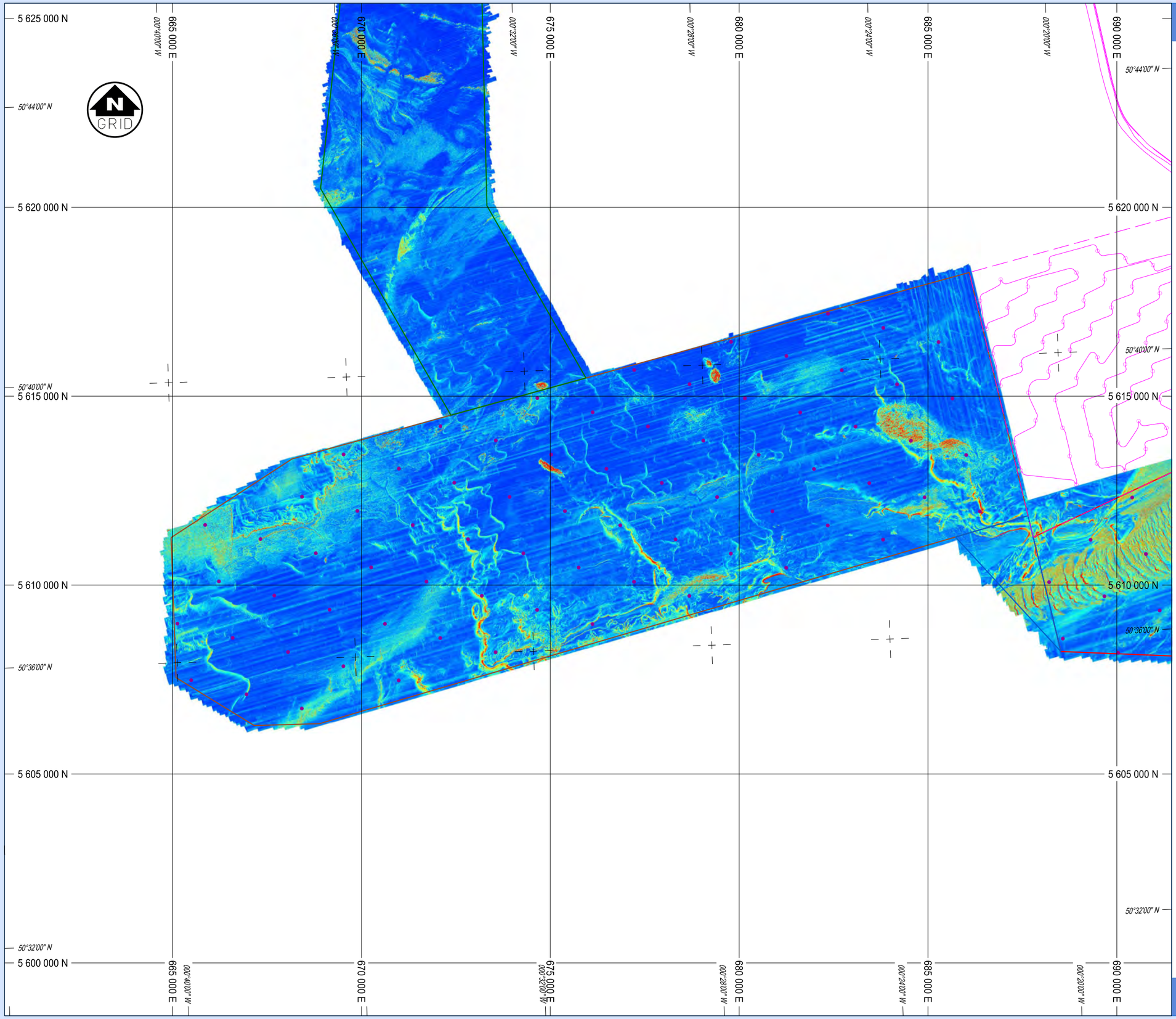


Scale 1 : 100 000
WGS84/UTM Zone 30N (3°W)

Figure 3.2

Job No. 11521.3

SEABED GRADIENT OVERVIEW FOR RAMPION 2 OWF AREAS B & D



- PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)
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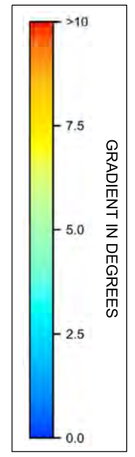
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)



Scale 1 : 100 000
WGS84/UTM Zone 30N (3°W)

Figure 3.3

Job No. 11521.3

3.2 Seabed Features

Seabed features are presented on Chart 7, with an overview illustrated as Figure 3.4. A side scan sonar mosaic is presented on Chart 8, with an overview illustrated as Figure 3.5.

Seabed sediments are expected to comprise predominately sandy gravel with patches of gravelly sand, and occasional outcrops of rock located in the southeast of the survey area.

The seabed undulates across much of the site, influenced by the underlying geology, where the dipping strata in the bedrock frequently approach seabed. A side scan sonar data example of the undulating seabed is illustrated on Figure 3.6.

Over 15,000 point contacts exceeding 0.5m in any dimension are interpreted across Area B, all of which are interpreted as boulders. The largest measures 2.5 in height, and is located in the centre of the survey area. 12 contacts are interpreted as debris with largest measuring 2.7m in height, located to the east of the survey area. 360 contacts are interpreted as fishing pots across the survey area.

Areas of numerous boulders cover much of the survey area with the majority being associated with rock outcrops or reworked sandy gravel. These are illustrated in Figure 3.7, and Figure 3.8. Boulders found within interpreted boulder fields have not been individually picked.

Linear debris is observed sporadically across the survey area. Nine items of linear debris are interpreted within the survey area limits. The longest item of linear debris is 194m in length, located in the north of the survey area, illustrated in Figure 3.9. 26 linear contacts are interpreted as fishing gear; an example of these can be seen in Figure 3.10, Figure 3.11 and Figure 3.12. The largest item of potential fishing gear is 641m in length, located in the west of the survey area.

No infrastructure is observed across the survey area.

A total of 14 wrecks occur across Area B, 12 of which are known wrecks on admiralty charts. The largest wreck, illustrated on Figure 3.13, has a length of 145m, width of 38m and a height of 5.9m. Figure 3.14 and Figure 3.15 illustrate 2 other wrecks seen within the survey area. A list of wrecks within Area B is included in Table 3.1.

A total of 132 magnetometer contacts have been interpreted across the survey area, and are presented on Chart 7. 26 of which have been associated with observed wrecks. 7 magnetometer contacts are associated with items of debris. The remaining magnetometer targets are interpreted to be buried or - due to the relative distance to underlying geology - associated with geological features. Illustrated on Figure 3.16.

Several areas of the seabed appear as large depressions and the seabed appears to be scarred. This is often indicative of a dredging extraction zone, illustrated on Figure 3.17 and Figure 3.18. there are two types of dredging areas observed, heavily scarred, and lightly scarred. The extents of these areas have been delineated on Chart 7 as possible dredging extraction areas. The largest extraction area measures 3400m in length and 1100m in width, located to the east of the survey area.

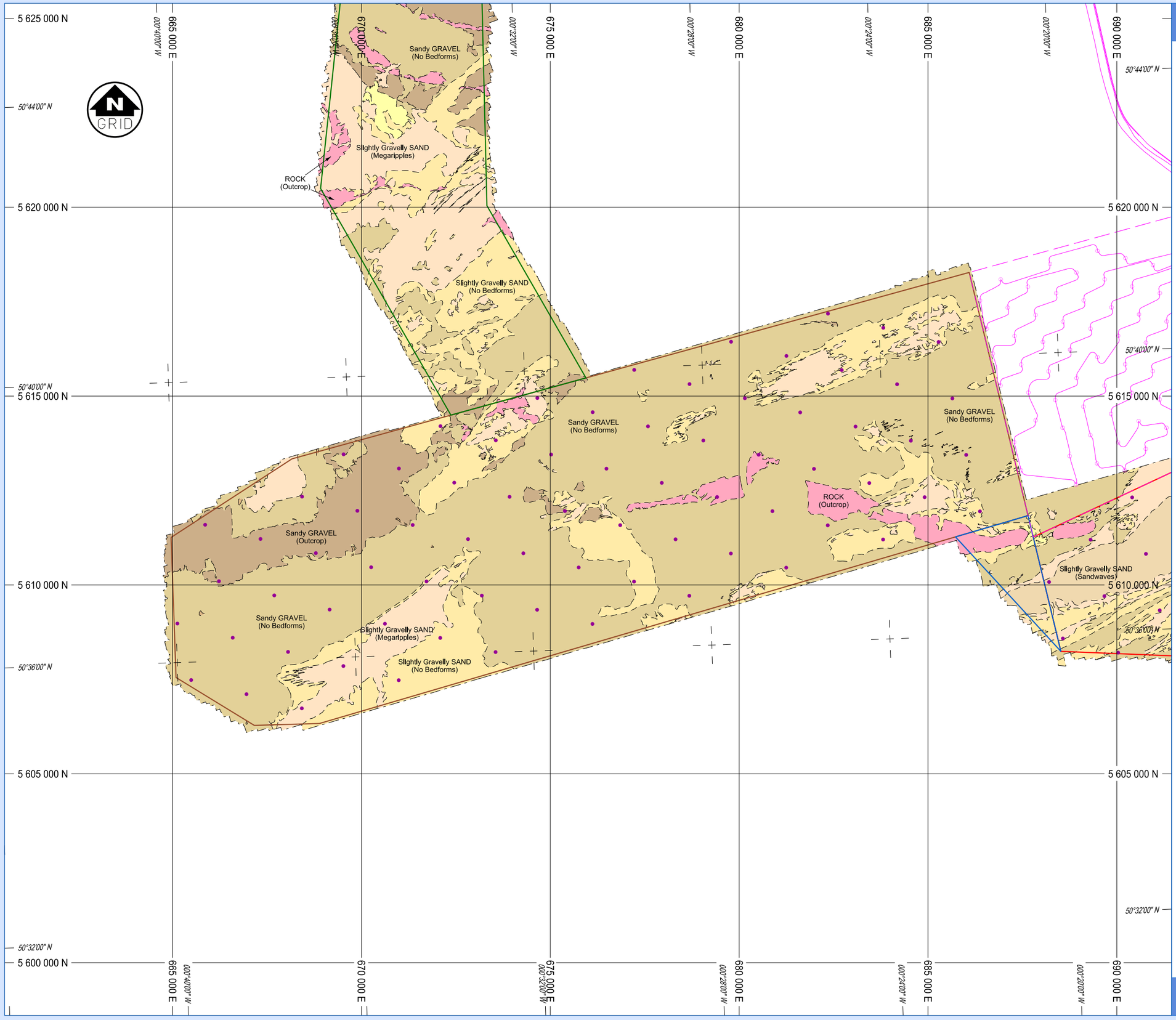
Spudcan depressions associated with the existing Rampion Windfarm are observed on the eastern edge of the survey area, in six distinctive clusters. With a maximum depths of 1.2m, and gradients up to 6° measured on the flanks all spudcan depressions are observed on bathymetry and side scan sonar data. Illustrated on Figure 3.19.

Table 3.1 Table of Wrecks Interpreted in Area B

Name	Easting	Northing	Length (m)	Width (m)	Height (m)
Wreck 1	674 009	5 613 969	11.8	4.2	1.2
Wreck 2	675 624	5 613 488	59.6	16.0	3.5
Wreck 3	669 041	5 610 661	144.5	38.1	5.9
Wreck 4	671 876	5 611 021	86.8	63.8	2.0
Wreck 5	680 144	5 613 201	83.4	27.4	4.4
Wreck 6	682 798	5 613 927	101.1	23.1	3.5
Wreck 7	683 277	5 614 681	12.1	5.1	3.1
Wreck 8	686 573	5 615 393	22.5	5.4	1.4
Wreck 9	665 778	5 608 506	98.2	33.8	3.7
Wreck 10A	680 908	5 611 556	13.1	7.3	1.9
Wreck 10B	680 938	5 611 543	35.3	17.5	2.9
Wreck 11	681 134	5 611 260	123.2	41.6	5.3
Wreck 12	669 194	5 607 240	88.1	23.2	2.6
Wreck 13	666 950	5 606 348	72.3	20.5	2.9
Wreck 14	684 144	5 616 072	78.5	35.2	3.1

MBES and side scan sonar montages of Wreck 5 and Wreck 14 are illustrated on Figure 3.20 and Figure 3.21, respectively.

SEABED SEDIMENTS OVERVIEW FOR RAMPION 2 OWF AREAS B & D



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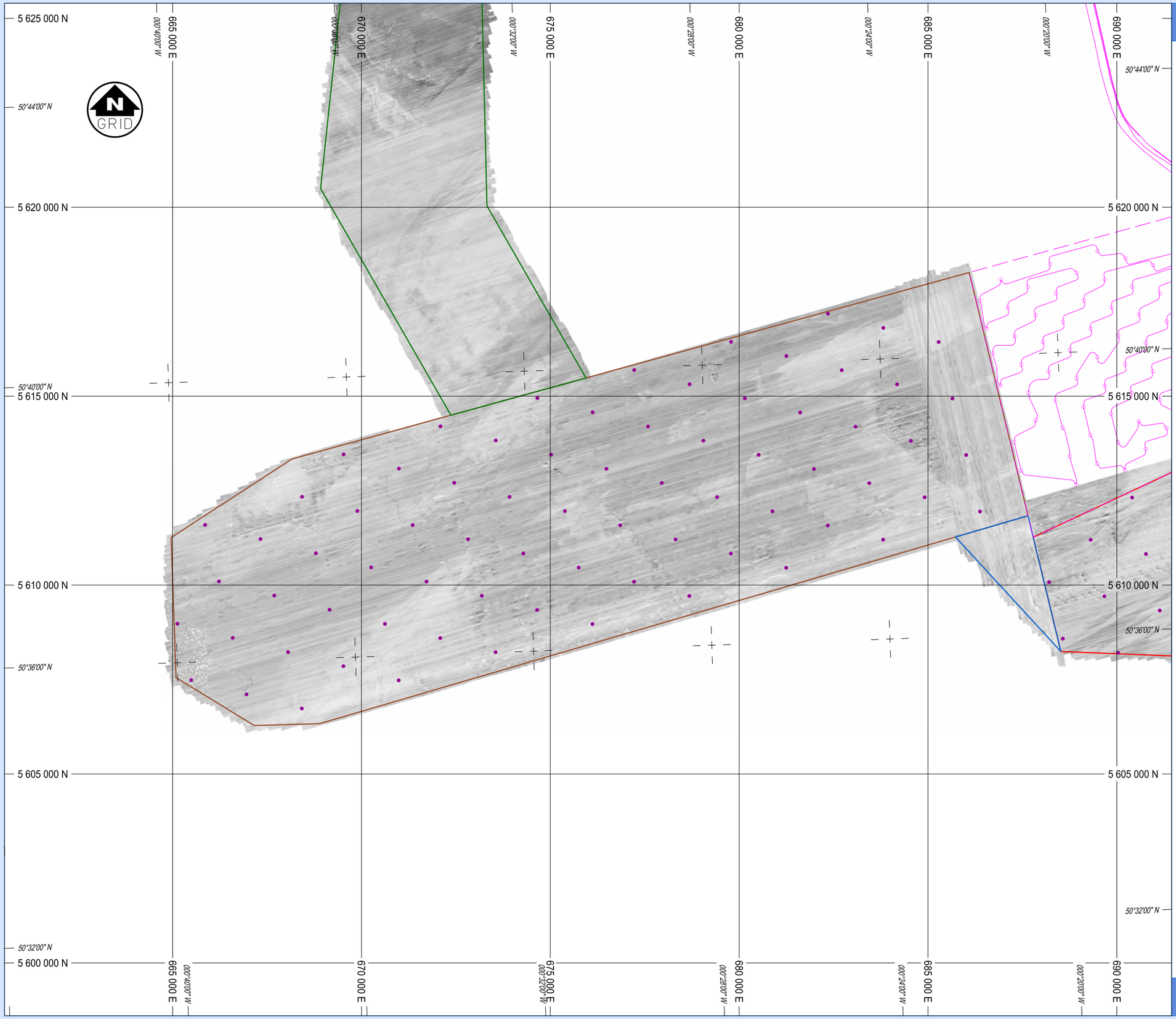
- PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)
- PROPOSED RAMPION 2 OWF AREA C (EXPORT CABLE AREA)
- PROPOSED RAMPION 2 OWF AREA D (EXPORT CABLE LINK AREA)
- PROPOSED RAMPION 2 WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND TURBINE GENERATOR LAYOUT (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)
- EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)
- SAND (NO BEDFORMS)
- SAND (MEGARIPPLED)
- SLIGHTLY GRAVELLY SAND (NO BEDFORMS)
- SLIGHTLY GRAVELLY SAND (MEGARIPPLED)
- SLIGHTLY GRAVELLY SAND (SANDWAVES)
- SANDY GRAVEL (NO BEDFORMS)
- SANDY GRAVEL (MEGARIPPLED)
- SANDY GRAVEL (OUTCROP)
- ROCK (OUTCROP)
- LIMIT OF SIDE SCAN SONAR COVERAGE

Scale 1 : 100 000
WGS84/UTM Zone 30N (3°W)

Figure 3.4

Job No. 11521.3

SIDE SCAN SONAR MOSAIC OVERVIEW FOR RAMPION 2 OWF AREAS B & D



PROPOSED RAMPION 2 OWF AREA A (ZONE 6 AREA)

PROPOSED RAMPION 2 OWF AREA B (EXTENSION AREA)

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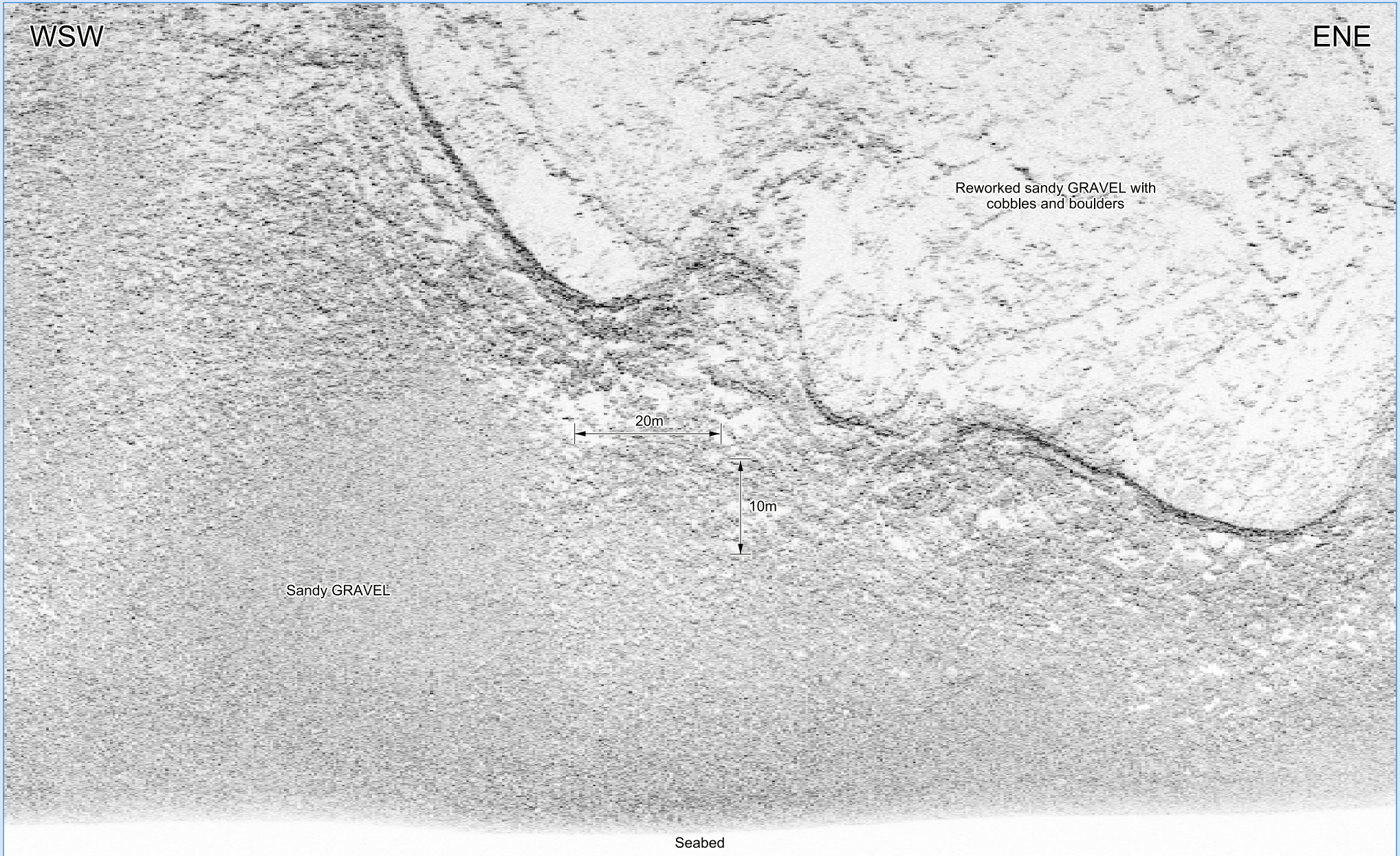
EXISTING RAMPION WIND FARM CABLE (SOURCE: CLIENT PROVIDED)

EXISTING RAMPION SURVEY AREA (SOURCE: CLIENT PROVIDED)

Scale 1 : 100 000
WGS84/UTM Zone 30N (3°W)

Figure 3.5

Job No. 11521.3

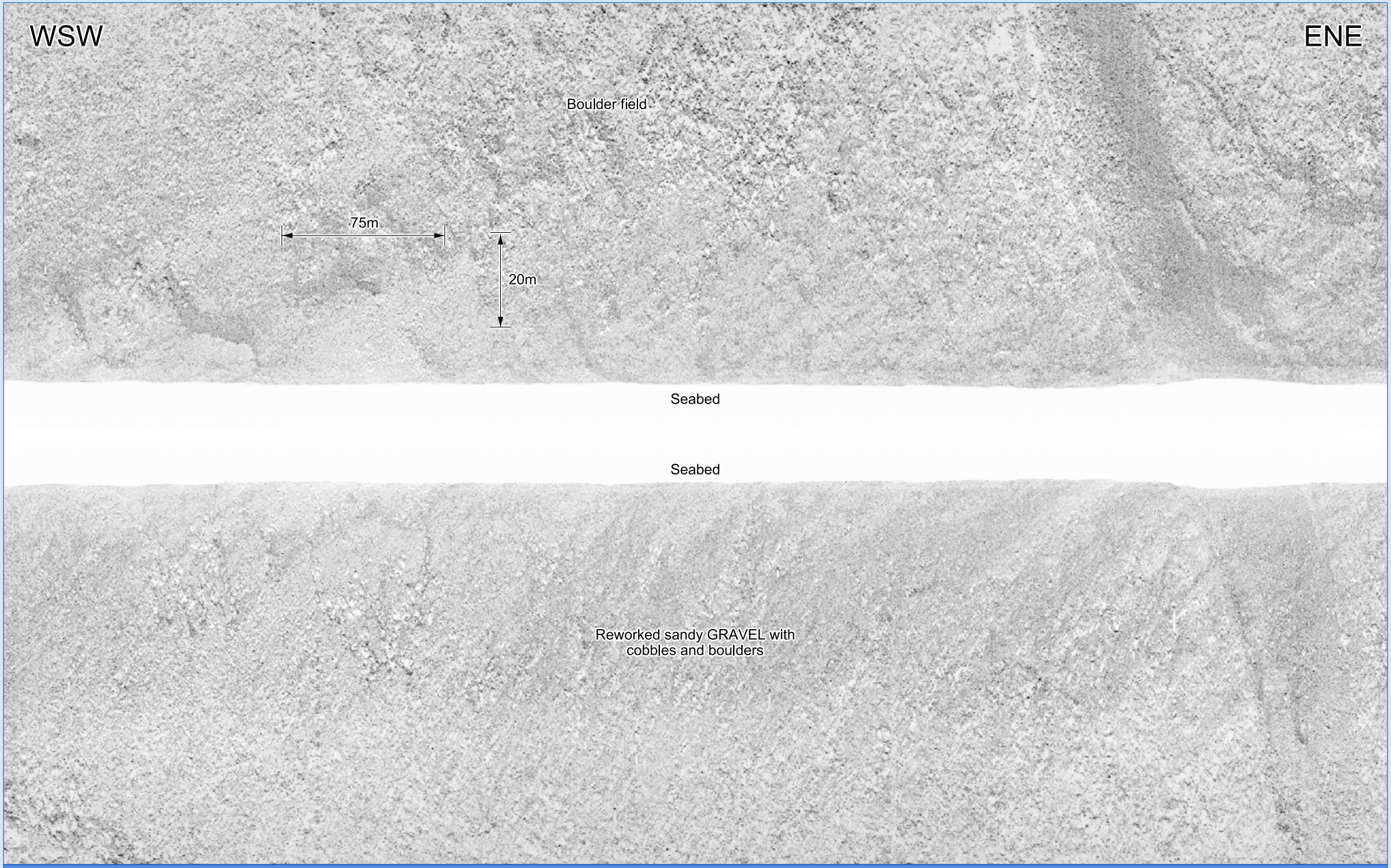


Line B_M-16

SIDE SCAN SONAR
Illustrating undulation

Figure 3.6

Job No. 11521.3

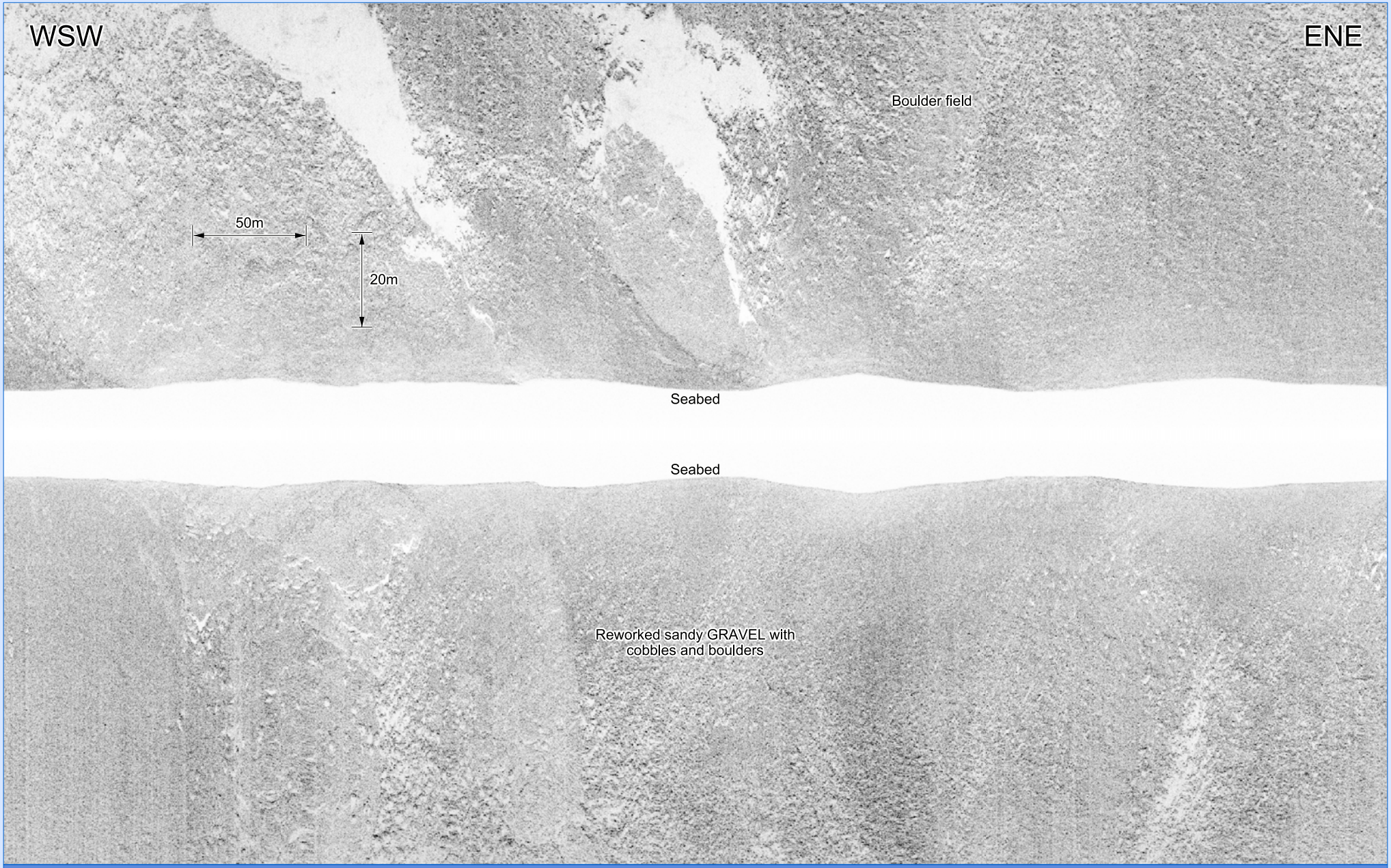


Line B_M-23

SIDE SCAN SONAR
Illustrating boulder field area

Figure 3.7

Job No. 11521.3



Line B_M-5

SIDE SCAN SONAR
Illustrating boulder field area

Figure 3.8

Job No. 11521.3

Line B_M-6A

SIDE SCAN SONAR
Illustrating linear debris

Figure 3.9

Job No. 11521.3