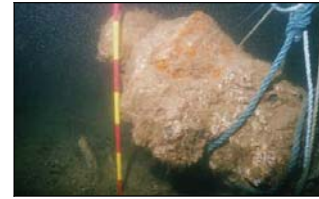
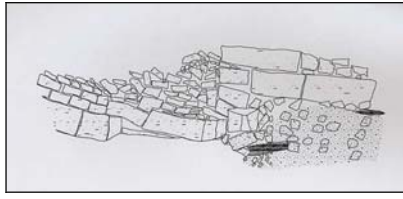


APPENDIX B

ADCO GEOPHYSICAL SURVEY REPORT



ARCHAEOLOGICAL ASSESSMENT OF BRINE OUTFALL AND SEA INTAKE LOCATIONS, LARNE LOUGH GAS STORAGE PROJECT, CO. ANTRIM

MARINE GEOPHYSICAL DATA REVIEW

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

**ARCHAEOLOGICAL ASSESSMENT OF BRINE
OUTFALL AND SEA INTAKE LOCATIONS, LARNE
LOUGH GAS STORAGE PROJECT, CO. ANTRIM**

MARINE GEOPHYSICAL DATA REVIEW

16 November 2011

Project Director

Dr. Niall Brady

Brehon House, Kilkenny Road, Castlecomer, Co. Kilkenny

info@adco-ie.com

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

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LIST OF ABBREVIATIONS

ADCO	The Archaeological Diving Company Ltd
NIEA	Northern Ireland Environment Agency

EXECUTIVE SUMMARY

The location for the Brine Outfall and Sea Intake components of the Larne Lough Gas Storage Project off the NE coastline of Island Magee, Co. Antrim, is an area of archaeological potential, which has been highlighted in desk-based studies of the terrestrial and the subsea areas for the larger project study.

The present report concerns an archaeological review of the marine geophysical data acquired for the project.

A comprehensive marine geophysical survey was carried out, deploying a suite of equipment to provide bathymetric, side-scan sonar, magnetometer, and sub-bottom profiling data. A number of small-scale anomalies were detected but none are considered to represent indicators of high archaeological potential, and no anomalies are located on the proposed pipeline route.

It is recommended that the sea intake location and the brine outfall terminus points are archaeologically inspected in advance of construction.

Additional archaeological mitigation may arise following onsite inspection.

LIST OF FIGURES

Figure 1: Site location showing terrain model of the seabed in the development area.

Figure 2: Marine survey area showing tracklines from the side-scan sonar survey.

Figure 3: Selection of seabed images as revealed in the side-scan sonar data.

Figure 4: Distribution of marine geophysical survey anomalies and features.

Figure 5: Selection of sub-bottom profile images.

1.0 INTRODUCTION

1.1 General

The Archaeological Diving Company Ltd (ADCO) was commissioned by RPS Consulting Engineers on behalf of Islandmagee Storage Ltd to undertake an archaeological assessment of the Brine Outfall and Sea Intake components for the Larne Lough Gas Storage project on Islandmagee, Co. Antrim. The report will inform an Environmental Impact Assessment for the larger scheme.

An assessment based on desktop information and a set of foreshore and underwater photographs from the project area was completed in advance of the marine geophysical survey data being acquired for the present report.¹ The present report is to present an archaeological review of the marine geophysical survey data acquired in April 2010, and to address the need for further archaeological mitigation along the foreshore and sub-tidal sections of the project area. The present report does not extend to archaeological diver-truthing of the seabed or an archaeological site inspection of the shoreline.

1.2 Location

The marine impact areas associated with the present project are located within and south of Castle Robin Bay, off the northeast shore of Islandmagee peninsula, east of Skernaghan Hill (Figure 1).

2.0 THE PROPOSED DEVELOPMENT

The Larne Lough Gas Storage Project seeks to establish an underground gas storage facility in a salt layer approximately 1600m beneath Larne Lough. As part of the project, it is proposed to construct a new sea-water intake point in Castle Robin Bay, close inshore and below the Low Water Mark, 50m south of an existing gas pipeline. It is also proposed to construct a brine outfall pipeline 230 south of the intake point that will extend 430m offshore. The construction design favours directional drilling, which will result in minimal impact on the seabed surface. Disturbance is only

¹ Niall Brady, 'Archaeological assessment of brine outfall location, Larne Lough Gas Storage Project, Co. Antrim', unpublished report by the Archaeological Diving Company Ltd, March 2010.

expected at the point where the drill breaks through the surface at ING 345079.51E 403469.64N.

3.0 THE RECEIVING ENVIRONMENT

The wider terrestrial and maritime archaeology has been presented in the previous report for this project.² The known archaeological sites help to frame the archaeological potential of the project area. The proximity of ancient burial monuments to the sea indicates the importance of the maritime environment to the early settlers, while the presence of landing places, jetties, and small harbours surrounding Islandmagee demonstrates a more direct maritime perspective during the nineteenth- and twentieth-centuries. The number of shipwreck events recorded for the coastal waters surrounding Islandmagee indicate an area of relatively high archaeological potential, but this is tempered by the rugged, active nature of the rocky coastline within the development area, coupled with the compact nature of the seabed. The existing desktop information indicated the conclusion that the archaeological risk associated with the marine survey area is low.

4.0 GEOPHYSICAL DATA

4.1 Scope

The archaeological objective of marine geophysical survey is to collect information that will reveal the nature of the seabed and anomalies that may be of cultural heritage interest, either lying exposed on the surface of the seabed or buried within the surface sediments. The information can include natural features, such as buried/former shorelines, as well as manmade features, such as landing places, ship- and boat wrecks, and random debris that can be associated with the former or lie in isolation.

The Centre for Maritime Archaeology set out its requirements for the survey:³

- 1) Sidescan sonar – range of 50m, line spacing of 30-50m. Dual frequency – 100Khz and 500Khz.
- 2) Magnetometer – ideally caesium vapour, line spacing of 30-50m.
- 3) Sub bottom profiles – Chirp or Boomer, line spacing of 30-50m.

² As set out in further detail in the previous report, Brady, 'Archaeological assessment of brine outfall location', pp 5-9.

³ Correspondence from CMA to RPS 15 July 2009.

4.2 Operational

The marine geophysical survey was conducted by IMAR Survey Ltd. in April 2010.

The following equipment was used:

- Side-scan sonar, using a Geoacoustics system, operating at a 75m range at 410 kHz;
- Geometrics G861 marine magnetometer;
- Applied Acoustics surface tow boomer for sub-bottom profiling.

The following information was made available to ADCO for review:

- Side-scan Sonar Data digital record
- Magnetometer Logs
- Project Drawings, including route corridors and waypoints, and magnetometer profiles.

The present report complements the primary geophysical report prepared by IMAR Survey Ltd. Readers are referred to the IMAR report for the complete project drawings and other technical data.

4.3 Results

Survey Grid

The survey area measured 600m long from shore to sea and 650m wide, centered on the proposed route for the pipeline (Figure 2). The survey lines were run at 40m intervals along the alignment of the pipeline, and at right angles to it where sufficient water depth was occurring on the seaward side. The result created a detailed grid. Each device (bathymetry, side-scan sonar, magnetometer and boomer) has a slightly different trackplot within this grid, based on the actual routes traveled by each towed sensor, with variations in the order of +/- 3m. The result is a comprehensive and detailed survey that conforms to the standards required by the Centre for Maritime Archaeology.

Bathymetry Survey

The bathymetry surveys reveal a shelf inshore that c. 100m from the shoreline drops relatively quickly by c. 1m to a flat and/or gently sloping seabed that ranges in depth from 2m below Chart datum to c. 3m below Chart Datum at the outer edge of the survey area.

Side-scan Sonar Survey

The side-scan sonar survey reveals a rocky ledge inshore that compares favourably with the shelf indicated in the bathymetric data, and a sandy seabed off shore (Figure 3). The seabed retains some areas of limited boulder scatters and sediment rippling, and there is the possibility of some draglines.

There is a series of seventeen anomalies identified on the seabed surface (Figure 4, Appendix A). The anomalies are distributed widely across the survey area, and only one anomaly lies in proximity to the proposed pipeline, anomaly ss10 lies c. 10m from the pipe route and appears to be a cluster of boulder features.

The side-scan sonar targets observed are regarded as retaining a low archaeological potential because they are most likely natural in origin, or represent unassociated debris.

Magnetometer Survey and correlation with Side-scan Sonar data

The magnetometer offers a further opportunity to acquire data. Side-scan sonar gathers information by sweeping across the seabed surface which permits the generation of a surface terrain image, but it cannot penetrate the seabed to see below the surface deposits. In contrast, a magnetometer is able to observe buried ferrous metallic material, but cannot acquire data other than from directly below the survey device. Where there are large spaces between survey lines, the magnetometer is often ineffective when searching for small objects. In the present instance, the spacing of survey lines allowed for the acquisition of information along narrow corridors separated by 40m. While this is far better than larger line-spacing, it is still only gaining a sample of the potential information.

Four magnetic anomalies were identified (Figure 4, Appendix B). The anomalies indicate small-scale localized variations in the magnetic field distributed across the survey area. In two instances, the magnetic anomalies correspond with side-scan sonar anomalies (ss1 and mg1, ss2 and mg 2). In such instances it may be presumed that the overlap indicates a metallic content to the side-scan sonar target. Anomaly 221/mg1 lies c. 240m from the pipeline, anomaly ss2/mg2 lies 165m distant. It is unlikely that either will be impacted by the development.

Sub-bottom profiling

The sub-bottom profile data reveals the naturally shelving shoreline close inshore and a flat seabed offshore (Figure 5). The data does not indicate the presence of features associated with archaeological material, such as a former shoreline, or a

buried object such as a vessel. In one instance however (Figure 4, sbp3; Appendix C), there is a small variation in the surface deposit that may related to buried material. It is defined as a line that plunges seaward in a manner that is contrary to the surrounding strata. It is located c. 170 north of the pipeline discharge point.

Conclusion: Geophysical Surveys

The marine geophysical survey conducted has been thorough and the data sets are robust. The information generated informs the archaeological narrative of the wider survey area. Targets have been identified as side-scan sonar, magnetometer, and one sub-bottom profile anomaly. There is no clear indication of archaeologically significant features in the anomalies observed, and there are no anomalies located directly on the proposed pipeline route. The closest anomalies to the pipe line lie at distances of 10m (ss10) and 40m (ss11) respectively.

5.0 IMPACT OF DEVELOPMENT

The foreshore within the south east corner of Castle Robin Bay will be directly impacted by the proposed Sea Water Intake pipe. A direct impact to the foreshore 230m south of Castle Robin Bay will also be impacted by the launch-pit (direction drilling) associated with the insertion of the Brine Outfall pipe. Only one subsea area is to be impacted by the proposed development, at the outfall discharge (HDD break-through-point), located 430m offshore at ING 345079.51E 403469.64N.

6.0 CONCLUSIONS

The number of shipwreck events recorded for the coastal waters surrounding Islandmagee indicates an area of relatively high archaeological potential, but this is tempered by the rugged, active nature of the rocky coastline within the development area, coupled with the compact nature of the seabed. The archaeological risk is consequently limited at both the sea-water intake and the outfall pipe launch-pit locations, where the foreshore is composed of shelving bedrock and overlying shingle deposits. Marine geophysical survey conducted for the project has identified a series of anomalies but none are located at the proposed impact locations, and none of the anomalies appear to represent archaeologically significant material.

7.0 RECOMMENDATIONS

7.1 Pre-construction Measures

It is recommended that the sea intake location and the brine outfall terminus points are archaeologically inspected in advance of construction.

Additional archaeological mitigation may arise following the sequence of geophysical data interpretation and onsite inspection.

7.2 Construction Phase Measures

It is premature to describe a detailed construction phase mitigation strategy since these details are still under design. Nevertheless it can be expected that a programme of ARCHAEOLOGICAL MONITORING may be required during seabed disturbances associated with the scheme, with the proviso for full excavation of any archaeologically significant material uncovered at this time.

7.3 Project Management Measures

RETAINING AN ARCHAEOLOGIST/S. An archaeologist experienced in maritime archaeology and dredging should be retained for the duration of the relevant works.

THE TIME SCALE for the pre-construction and construction phases should be made available to the archaeologist, with information on where and when the various elements and ground disturbances and dredging will take place.

SUFFICIENT NOTICE. It is essential for the developer to give sufficient notice to the archaeologist/s in advance of the pre-construction and construction works commencing. This will allow for prompt arrival on site to undertake additional surveys and to monitor ground disturbances. As often happens, intervals may occur during the construction phase. In this case, it is also necessary to inform the archaeologist/s as to when ground disturbance works will recommence.

DISCOVERY OF ARCHAEOLOGICAL MATERIAL. In the event of archaeological features or material being uncovered during the construction phase, it is crucial that

any machine work cease in the immediate area to allow the archaeologist/s to inspect any such material.

ARCHAEOLOGICAL MATERIAL. Once the presence of archaeologically significant material is established, full archaeological recording of such material is recommended. If it is not possible for the construction works to avoid the material, full excavation would be recommended. The extent and duration of excavation would be a matter for discussion between the client and the licensing authorities.

ARCHAEOLOGICAL TEAM. It is recommended that the core of a suitable archaeological team, including an archaeological dive team, be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.

SECURE SITE OFFICES and facilities should be provided on or near those sites where excavation is required.

BUOYING of any such areas would be necessary once discovered and during excavation.

ADEQUATE FUNDS to cover excavation, post-excavation analysis, and any testing or conservation work required should be made available.

MACHINERY TRAFFIC during construction must be restricted as to avoid any of the selected sites and their environs.

SPOIL should not be dumped on any of the selected sites or their environs.

PLEASE NOTE: All of the above observations and conclusions are based on the archaeological desktop information and maps supplied. Should any alteration occur, further assessment would be required.

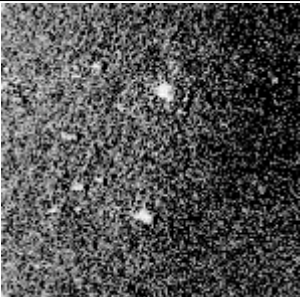

PLEASE NOTE: Recommendations are subject to approval by the regulatory authorities of the Northern Ireland Environment Agency.

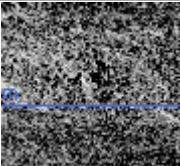

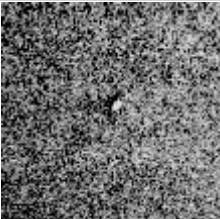
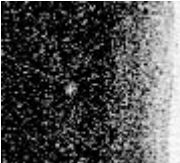
8.0 APPENDIX A: OBSERVATION OF SIDE-SCAN SONAR SURVEY ANOMALIES

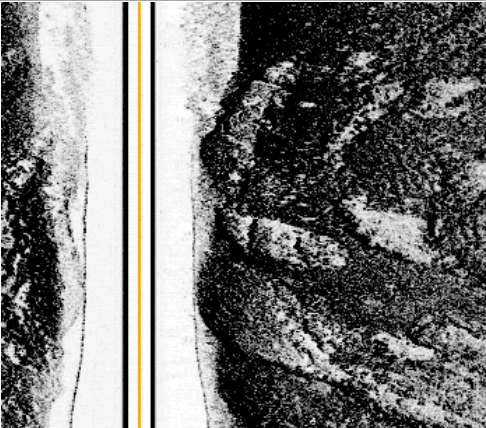
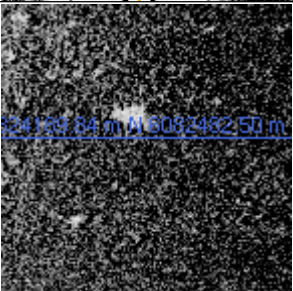

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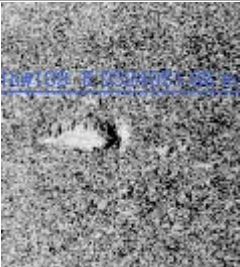
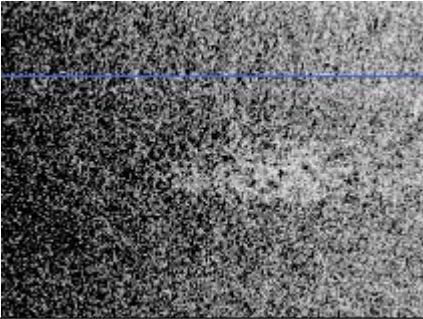
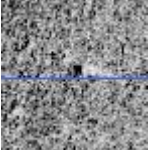

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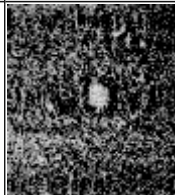


Refer to Figure 4 for distribution of each anomaly.

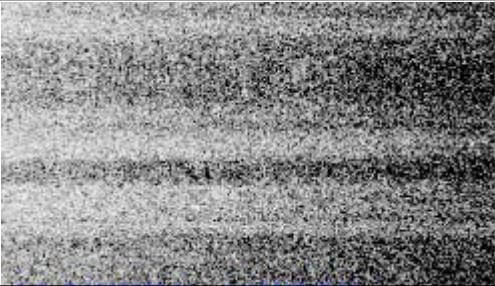
Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss1	Medium	323797	6082539	250m	Sonar target measuring 1m x 0.3m in size, associated with magnetic anomaly of 6nT. One of several small boulder-like anomalies, 0.58m in size.	
ss2	Medium	323861	6082484	160m	Sonar target measuring 1.6m x 0.5m in size, associated with magnetic anomaly of 2nT. Irregular shaped anomaly with acoustic shadow.	

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss3	Low	324500	6082566	500m	Anomaly, 0.88m in size, boulder.	
ss4	Low	324457	6082527	450m	Anomaly, 1.31m in size, rock.	
ss5	Low	324241	6082086	380m	Isolated boulder feature, 0.6m in size.	
ss6	Low	324294	6082314	290m	Anomaly, 0.5m in size, boulder.	

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss7	Low	324162	6082007	360m	Target in area of dynamic sand, perhaps an object causing obstruction; 6.65m long, 1m wide, in area of scour measuring c. 10m by 10m.	
ss8	Low	324134	6082480	115m	A more prominent looking boulder feature, measuring 2.41m in size, in wider area of rock.	
ss9	Low	324159	6082415	125m	Cluster of boulder features, measuring 2.41 in size.	

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss10	Low	323990	6082359	10m	Boulder feature, 2.41m in size, with acoustic shadow.	
ss11	Low	323959	6082404	40m	Ovoid-shaped area of soft sediment, perhaps a cluster of shell material, measuring 12.9m long, 4m wide.	
ss12	Low	323971	6082487	80m	Well defined small target, square in shape, 0.35m in size.	
ss13	Low	323683	6082616	385m	Well defined target, 1.13m long, close to rock outcropping.	

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss14	Low	324193	6082609	250m	Anomaly perhaps boulder, 1.14m in size, square shape.	
ss15	Low	324215	6082396	190m	Acoustic shadow in area of outcropping.	
ss16	Low	324030	6082291	90m	Boulder-like anomaly, 4.79m long, with acoustic shadow.	

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
ss17	Low	323921	6082742	340m	Very slight indicator comprising two short linear features in sandy/silty area. 1.46m and less than 1m in size. Close to mg2. However the correlation between fixes is not clear.	

9.0 APPENDIX B: OBSERVATION OF MAGNETOMETER SURVEY ANOMALIES

Source: Vessel Track Plots, Data Record

Coordinates presented on data record in Latitude/Longitude, and converted to Irish National Grid using Grid InQuest™

Refer to Figure 4 for distribution of each anomaly.

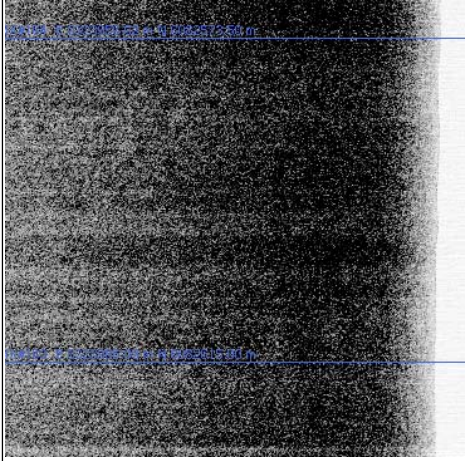
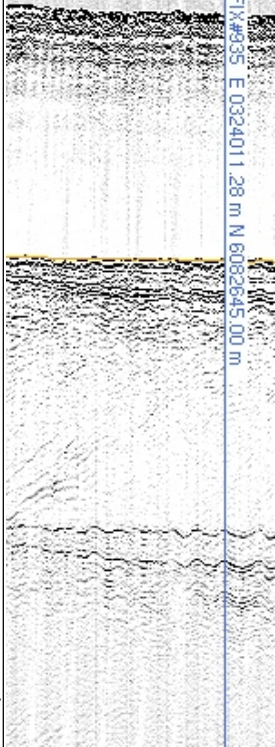
Reference Name	Archaeological Potential	Easting	Northing	250m	Distance to development	Description	Image
mg1	Medium	323797	6082539	160m	250m	Sonar target measuring 1m x 0.3m in size, associated with magnetic anomaly of 6nT. One of several small boulder-like anomalies, 0.58m in size.	
mg2	Medium	323861	6082484	195m	160m	Sonar target measuring 1.6m x 0.5m in size, associated with magnetic anomaly of 2nT. Irregular shaped anomaly with acoustic shadow.	
mg3	Medium	324192	6082318	316m	195m	2nT, mag anomaly 11m and 17m east of sonar contacts	
mg4	Medium	323997	6082743		316m	2nT, isolated mag anomaly	

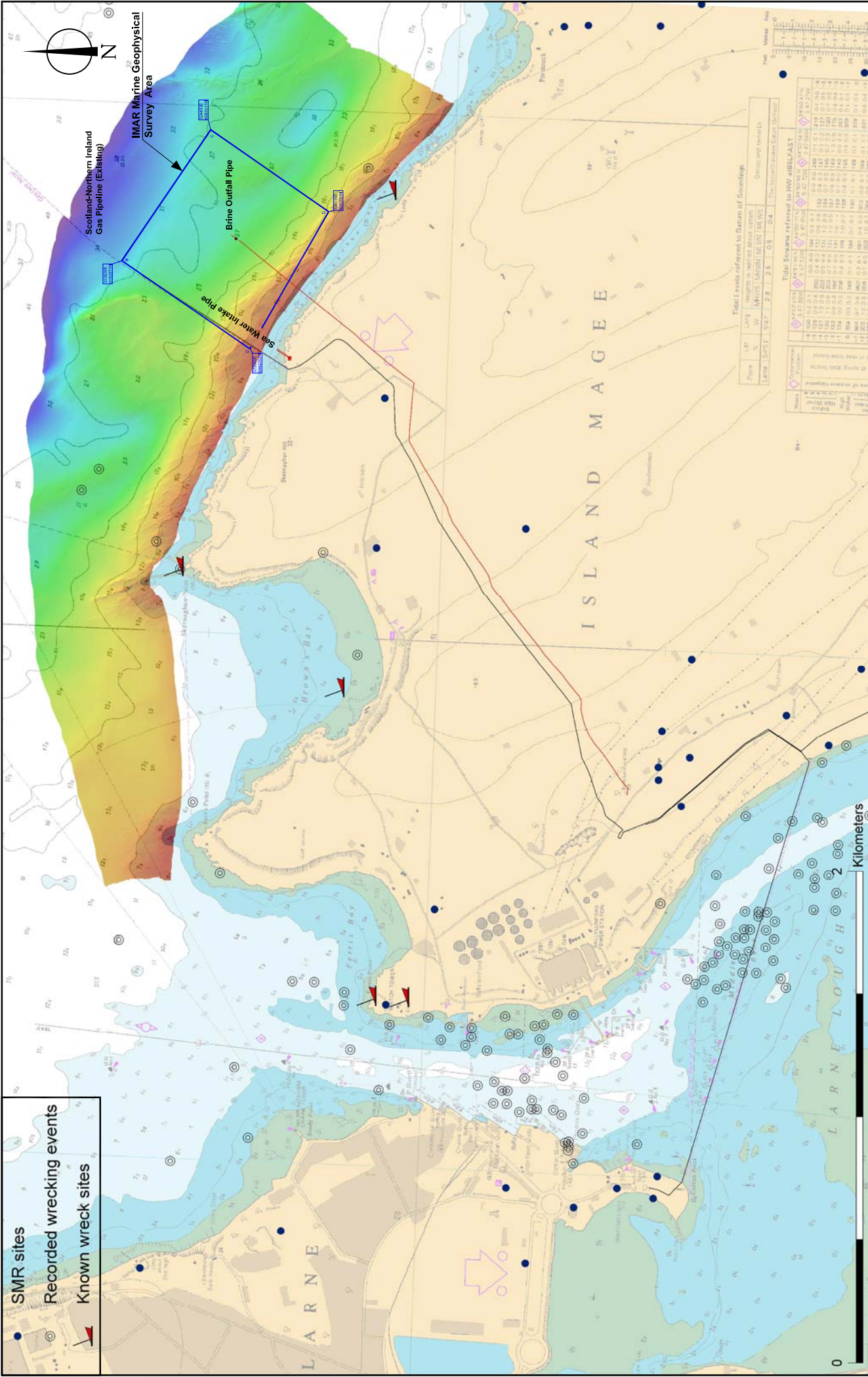
10.0 APPENDIX C: OBSERVATION OF SUB-BOTTOM PROFILE ANOMALY

Source: Vessel Track Plots, Data Record

Coordinates presented on data record in Latitude/Longitude, and converted to Irish National Grid using Grid InQuest™

Refer to Figure 4 for distribution of the anomaly.

Reference Name	Archaeological Potential	Easting	Northing	Distance to development	Description	Image
Sbp3	Medium	323983	6082600	180m	<p>Inverted reflector at surface strata level, inclining into the seabed. Clearly defined for 21m in length, with c. 2.3m right-angled section at surface level, extending 5.3m into seabed (see also Figure 5).</p>  <p>Sonar trace from seabed surface at the location of sbp3, showing no indication of an anomaly.</p>	



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Tel. 056 4440236 email: info@adco-ir.com

Notes
Shipwreck locations provided by the CMA, University of Coltraine.
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and the UK Hydrographic Office.

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Date
10.03.10

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R.Bangerter

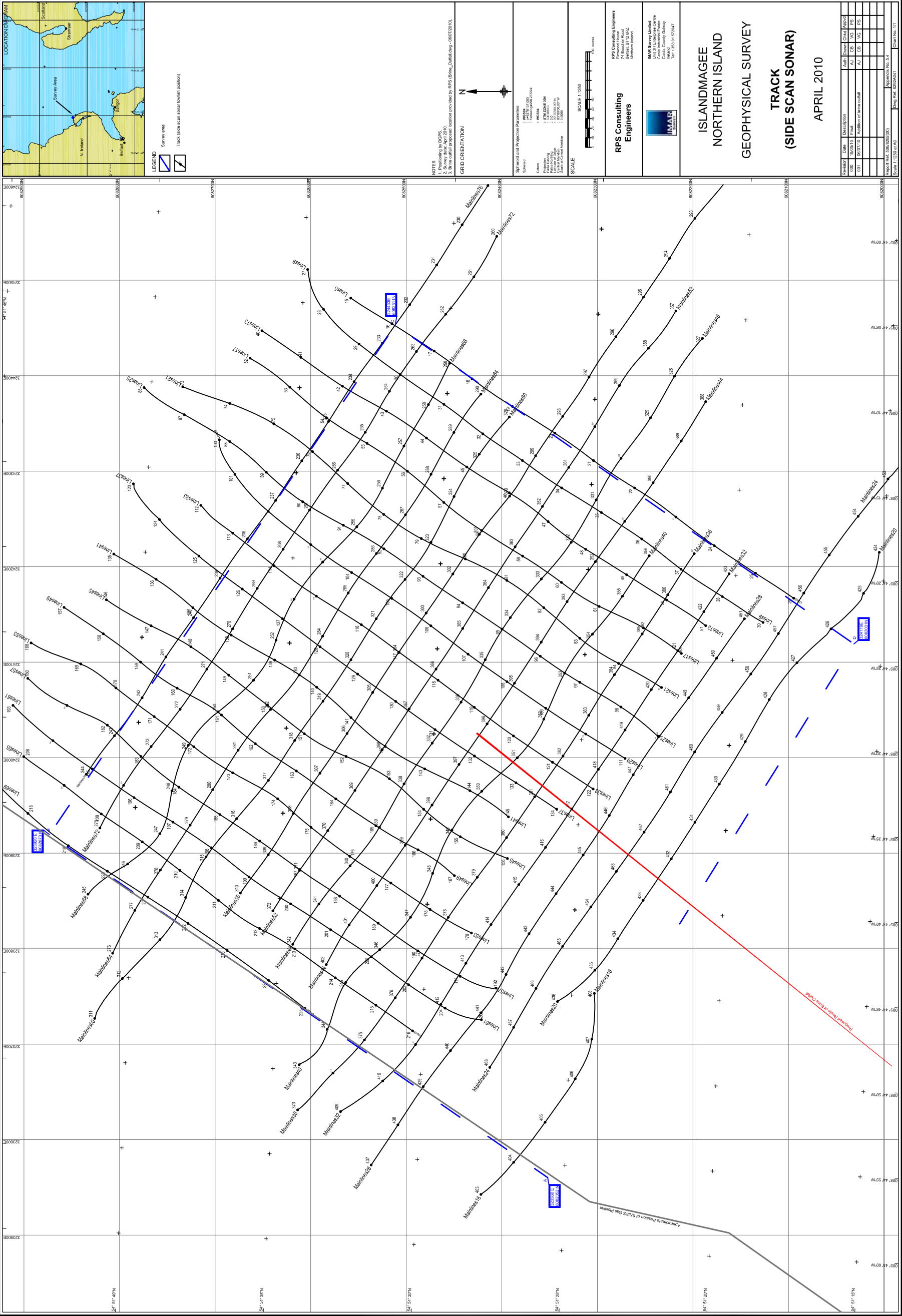
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Drawing No.
Figure xx

Client
RPS Group

Project
Island Magee Storage Project

Title
Figure 1- Site location showing terrain model of seabed in the development area.



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Notes
IMAR LTD.

Job/Exc No.

Date
10.12.10

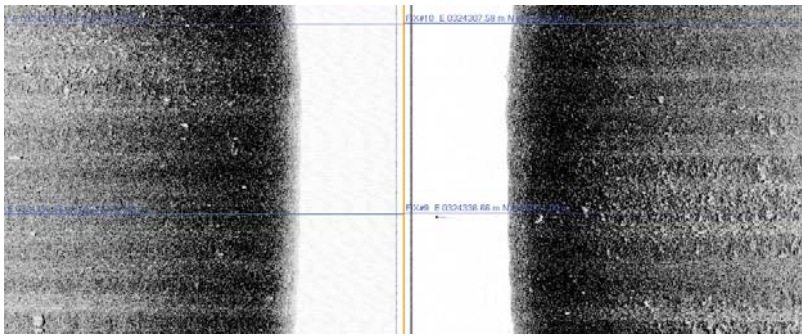
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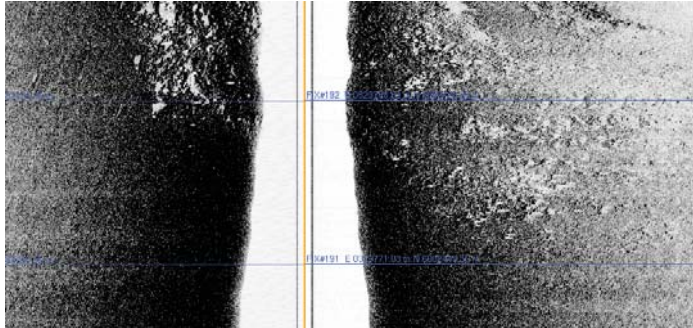
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RPS Group
Project
Island Magee Storage Project

Title
Figure 2- Marine survey area showing
tracklines from the the side-scan sonar
survey.

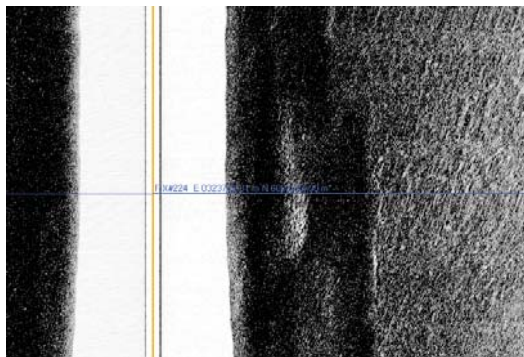
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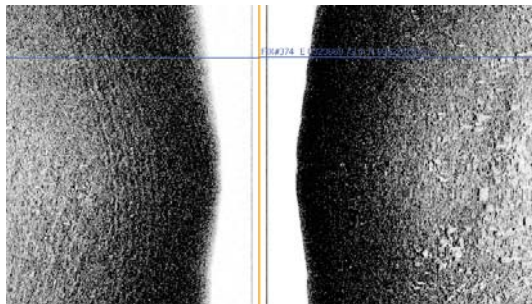
Seabed 1, showing boulder scatter



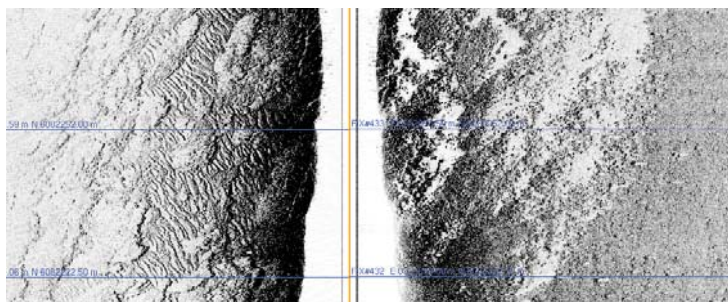
Seabed 2, showing rocky shelf along shoreline



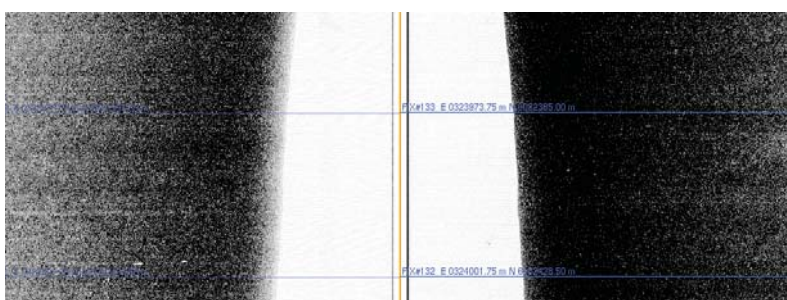
Seabed 3, showing existing trench feature



Seabed 4, showing possible draglines

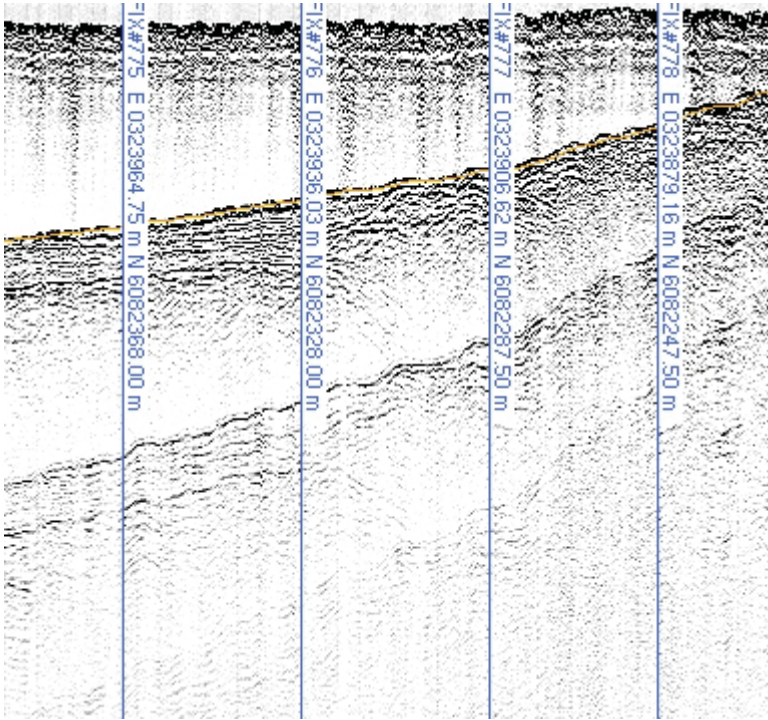


Seabed 5, showing rocky shelf along shore, with localised sand ripple features, close to location of proposed pipe route

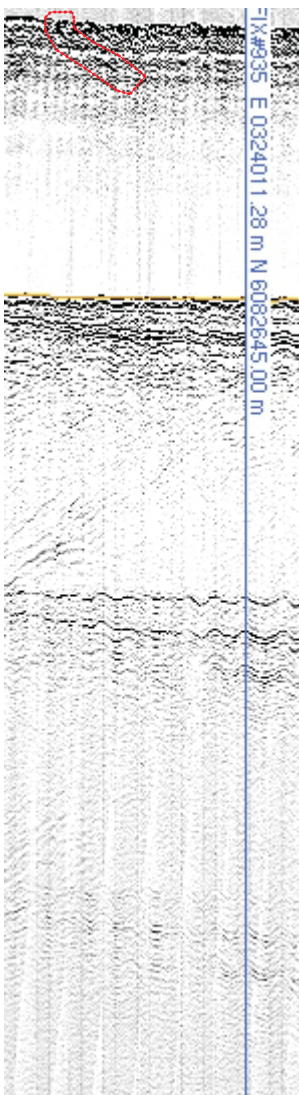


Seabed 6, showing soft sediment surface at proposed discharge point

Figure 3: Selection of seabed images as revealed in side-scan sonar data.
Note: see Figure 4 for image locations.



Sub-bottom profile image 2, showing shelving nature of seabed strata from shore. Shore to right of image



Sub-bottom profile image 3, highlighting in red anomaly in upper strata that may indicate a manmade feature

Figure 5: Selection of sub-bottom profile images.
Note: see Figure 4 for image locations.

A D C O

THE ARCHAEOLOGICAL DIVING COMPANY LTD

- Environmental Impact Assessment
- Riverine, Intertidal, Underwater Assessment
- Underwater Investigation and Excavation
- Monitoring of Dredging and Marine Construction projects
- Maritime Heritage Consultancy
- Accords to HSAHSE Diving at Work Regulations

Brehon House
Kilkenny Road
Castlecomer
Co. Kilkenny

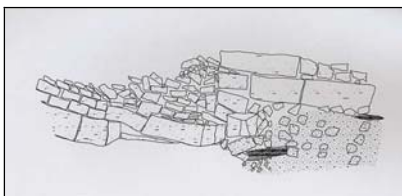
Phone +353 (0)56 444 0236
Fax +353 (0)56 444 0237
Internet www.adco-ie.com
E-mail info@adco-ie.com

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Archaeological Consultancy

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GAS 2025 Irish Sea
Interconnector



Underwater elevation of bridge pier collapsed in
1763. River Nore Flood Alleviation Scheme



Iron cannon on site of 17th-century
timber wreck discovered during
dredging programme
Waterford Harbour

