



Greater Dublin Drainage Scheme:

Sub- Bottom Analysis

Fingal County Council

TW/13/PRJ-012

14th June 2013

TechWorks Marine Limited

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Co. Dublin, Ireland

Private and Confidential

AGL13110

**REPORT ON THE
GEOPHYSICAL INVESTIGATION
FOR THE
GREATER DUBLIN DRAINAGE SCHEME
FOR
TECHWORKS MARINE**



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THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

PROJECT REFERENCE	AGL13110 GREATER DUBLIN DRAINAGE SCHEME		
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1. EXECUTIVE SUMMARY

- APEX Geoservices Limited was requested by Techworks Marine to carry out a geophysical investigation over two sites as part of the off shore investigations for the Greater Dublin Drainage Scheme.
- The objectives of the geophysical investigation were to conduct seismic data processing and interpretation of existing datasets and provide information on sub-bottom layers and sediment / overburden thickness.
- The seismic data allowed for the interpretation of a number of horizons, the seabed, sedimentary layers and base of sediments / overburden.
- In both survey areas the thickness of the sediments / overburden varies from < 2m to c. 30m. With the largest values recorded in the east.
- In the southern survey area (Area 1), offshore Portmarnock, these layers are generally < 16m thick and are mainly < 12m thick in the northern area (Area 2), offshore Skerries.
- Across both survey areas a channel feature, where the sediments are thickest, is well defined and oriented southeast – northwest in the southern area and south – north in the northern area.
- The seabed elevation varies between c. -3mOD to -22mOD from west to east in Area 1, offshore Portmarnock, and c. -3mOD to -18mOD in Area 2, offshore Skerries.
- The bedrock elevation varies from -2 to -52mOD in Area 1 and -8m to -44mOD in Area 2. Over both sites the bedrock elevation below mOD is greatest further out to sea and within the channel areas.
- It is recommended the interpretation of the data be reviewed when intrusive investigation data becomes available.

2. INTRODUCTION

APEX Geoservices Limited was requested by Techworks Marine to carry out a geophysical investigation, based on existing client supplied datasets, at two offshore sites near Portmarnock and Skerries, County Dublin. The purpose of the investigation is to provide information on the sub bottom strata, including depth to bedrock across the site.

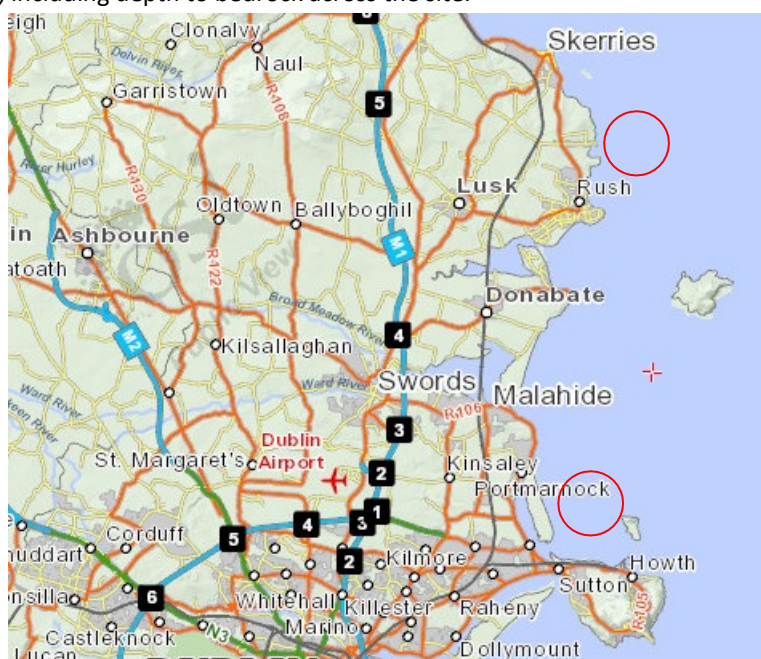


Figure 2.1: Survey areas off Portmarnock and Skerries (survey areas outlined in red).

2.1 Survey Objectives

The objectives of the geophysical investigation were to:

- Carry out seismic processing on Sparker and CHIRP data to provide information on the sub-bottom layers.
- Produce contour maps of sediment thickness.
- Identify and comment on any features of interest in the sediment and bedrock structure.

2.2 Site Background

As part of a seismic survey 12 CHIRP profiles and 8 Sparker profiles were acquired by the client over the two sites. Area 1 lies in the south, off Portmarnock, and measures approximately 4.7km x 0.8km and lies in water depths of approximately < 6m – 25m. The northern area, Area 2, is off Skerries and measures c. 2.7 Km x 1.5 Km. The water depth in this survey area varies between c. 5m and 23m.

2.3 Geology

The Geological Survey of Ireland (GSI) map does not show rock type for this sector of the Irish Sea but the rocks around Portmarnock are marine shelf and ramp facies consisting of argillaceous dark grey bioclastic limestones and shales.

The lithologies around Skerries consist of marine shelf facies, limestone and shales and dark grey argillaceous and cherty limestones.

The GSI seabed survey maps show the expected water depth to the east of the survey areas is > 20m.

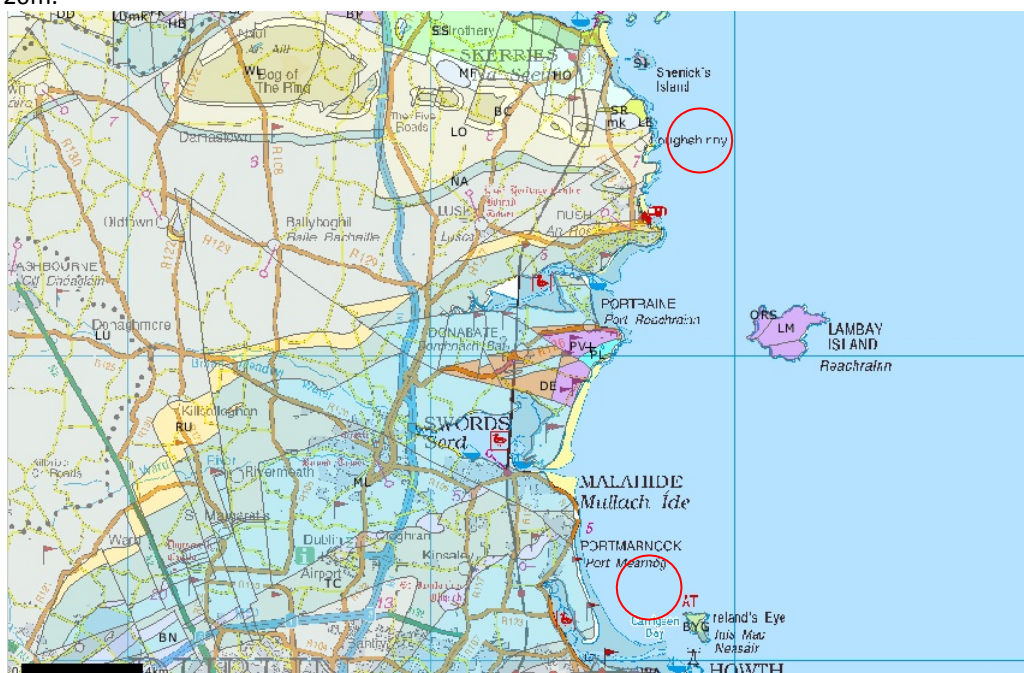


Fig. 2.2: GSI Geology Map showing survey areas in red.

2.4 Survey Rationale

Single channel seismic surveys including Sparker and CHIRP datasets are used to image sediments and bedrock below the seabed. The raw seismic data can contain unwanted noise and signal which can impede interpretation of the data. The application of a seismic data processing test sequence can improve the visual display of the data and the imaging of geological boundaries and structure.

Further information on the detailed processing methodology employed in this investigation is given in **APPENDIX B: DETAILED GEOPHYSICAL METHODOLOGY**.

3. FINDINGS

The findings from the investigation have been presented on Drawings 13110_01 – 13110_04.

3.1 Sparker and CHIRP Seismic Data

During the interpretation process the following horizons were picked in the time domain;

- Seabed
- Sedimentary horizons
- Base of sediments / overburden

The conversion of the time picks to depth values was performed based on a number of assumptions;

- The deepest reflector imaged by the survey represents the base of the sediments / overburden layer thickness.
- The data was converted using a sedimentary velocity of 1750m/s.

Based on the above conversion velocity of 1750m/s the horizon depth accuracy is +/- 10%.

While the overall data quality was good the Sparker data showed more detailed imaging of the base of the sediments / overburden than the CHIRP data.

One CHIRP profile, 109, was of generally low data quality and was not used in the interpretation.

Where sedimentary layers were present as dipping strong reflections on the CHIRP data the underlying base of sediments / overburden was not always well imaged. In such cases the energy from the Sparker data did penetrate the sediments and image the deeper events.

3.2 Area 1 Offshore Portmarnock

The seabed elevation is displayed in Drawing 13110_01 Figure 2 and shows the seabed dips eastwards between c. -3mOD in the west and -22mOD in the east.

For Area 1, offshore Portmarnock, the thickness of sedimentary layers / overburden is shown on Drawing 13110_02 Figure 2 and the data is in the range < 2 – c. 30m. The thickness values are generally 6 – 16m over most of the site with an increase to > 22m in the east of the area. This area is interpreted as a southeast - northwest channel (see Drawing 13110_02).

The bedrock elevation contour data is displayed on Drawing 13110_02 Figure 1 and is in the range - 2 to c. -52mOD. In the west of the site the elevation is generally -8 to -24 mOD. The bedrock is deepest in the east in the area of the channel.

3.3 Area 2 Offshore Skerries

The offshore Skerries data shows the seabed elevation varies from c. -3mOD in the west to -18mOD in the east. In the far northeast the seabed rises again from -18mOD to -8mOD.

The interpreted sedimentary layers are less than 12m thick over most of the western part of this survey area (see drawing 13110_04 Figure 2). Over the course of approximately 150m there is an increase in thickness to >20m. This change represents a south – north oriented channel in the top of the bedrock which has been filled with sediments.

In the northern part of this channel there is a localised decrease in sediment thickness to c. 12m. This represents a small area where the bedrock thickness decreases. This change in sediment thickness was interpreted across four of the seismic profiles.

Drawing 13110_04 Figure 1 represents the elevation of the bedrock in mOD. The elevation ranges c. -8m to -44mOD and shows the depth to bedrock is greatest in the east in the area of the channel.

The bedrock elevation contour map also shows a northeast – southwest oriented increase in elevation, which cuts the channel area. This indicates the bedrock shallows in the far northeast of the site.

3.4 Recommendations

It is recommended that the interpretation of the data be reviewed when any invasive investigation data is available.

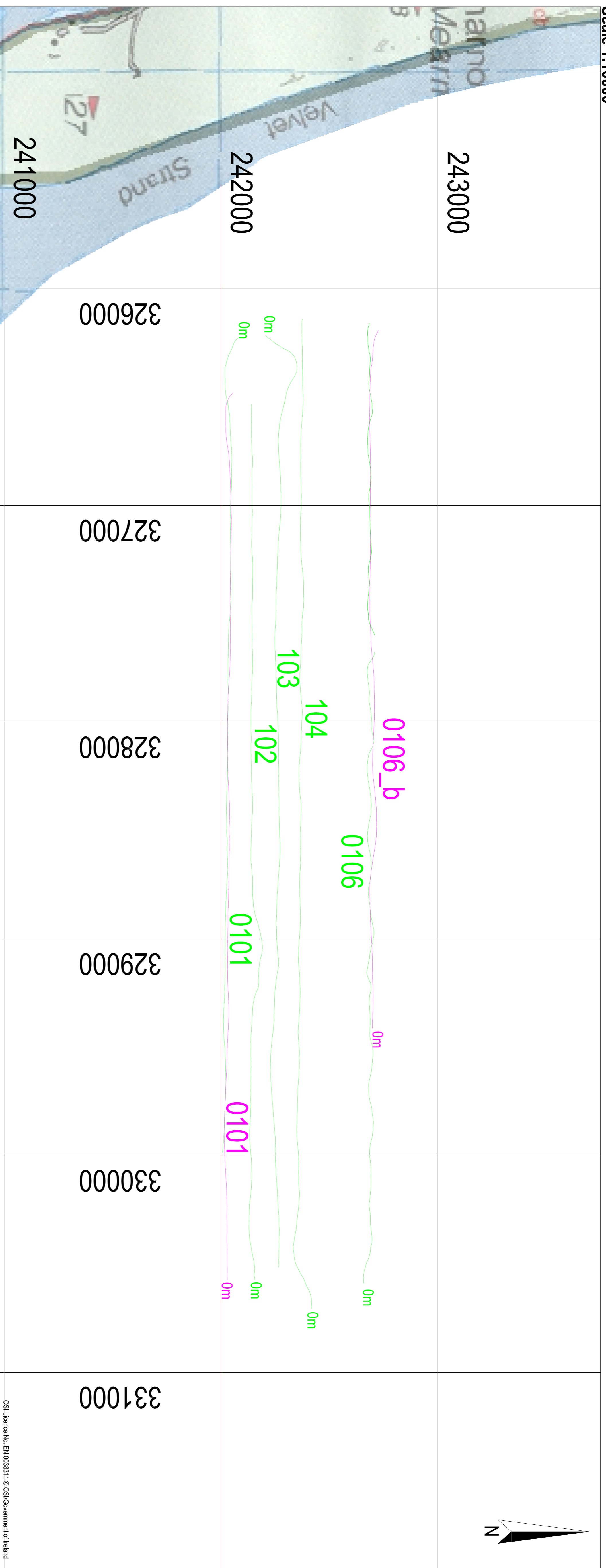
Generally the Sparker data has given better resolution of the base of the sediments / overburden, particularly where a dipping event is overlain by a strong reflection. If more single channel data is to be acquired priority should be given to Sparker acquisition.

4. APPENDIX A: DRAWINGS

13110_01	Figure 1: Area 1,Portmarnock, Seismic Survey Location Map	1:10000 @ A1
	Figure 2: Area 1, Portmarnock, Seabed Elevation (mOD)	1:10000 @ A1
13110_02	Figure 1: Area 1,Portmarnock, Bedrock Elevation Contour Map	1:10000 @ A1
	Figure 2: Area 1, Sediment / Overburden Thickness Map	1:10000 @ A1
13110_03	Figure 1: Area 2, Skerries, Seismic Survey Location Map	1:10000 @ A1
	Figure 2: Area 2, Skerries, Seabed Elevation (mOD)	1:10000 @ A1
13110_04	Figure 1: Area 2, Skerries, Bedrock Elevation Contour Map	1:10000 @ A1
	Figure 2: Area 2, Skerries / Overburden Thickness Map	1:10000 @ A1

FIGURE 1: Area 1, Portmarnock, Seismic Survey Location Map

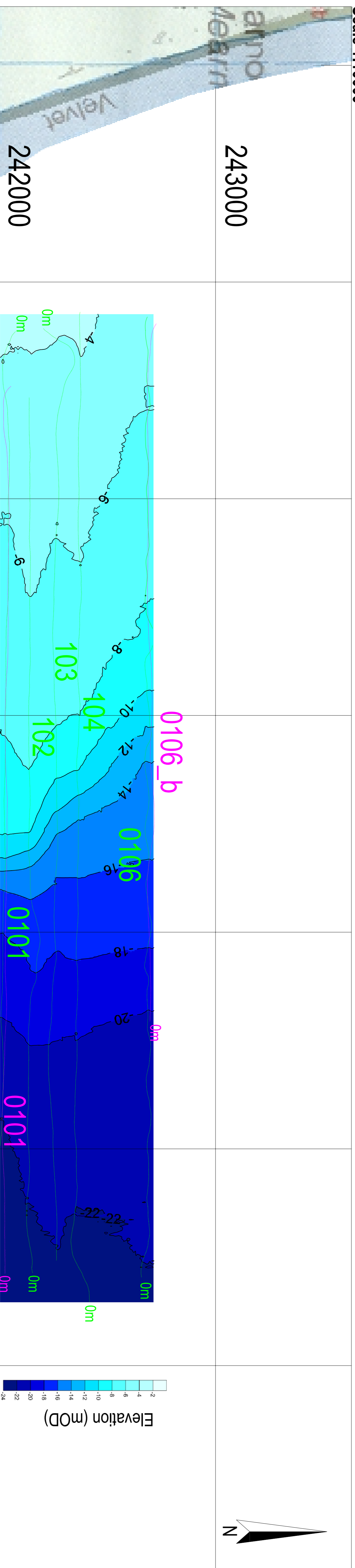
Scale 1:10000



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FIGURE 2: Area 1, Portmarnock, Seabed Elevation (mOD)

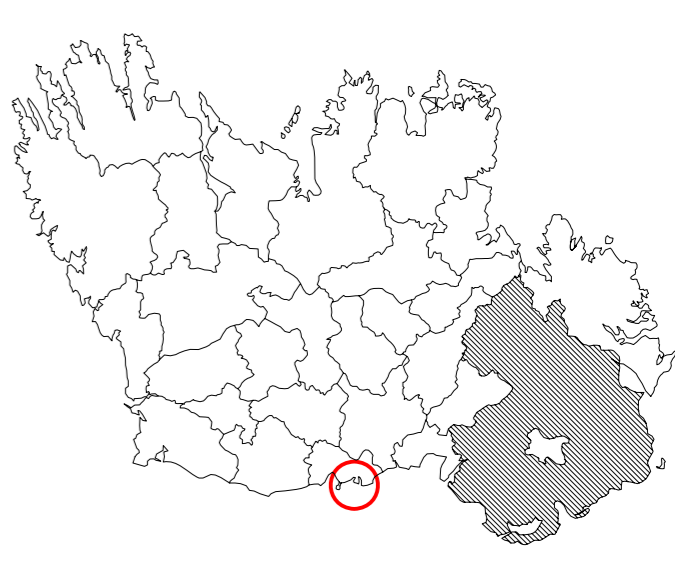
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INDEX MAP



LEGEND:

- 101 Sparker Profile
- 101 Chirp Profile

NOTES:

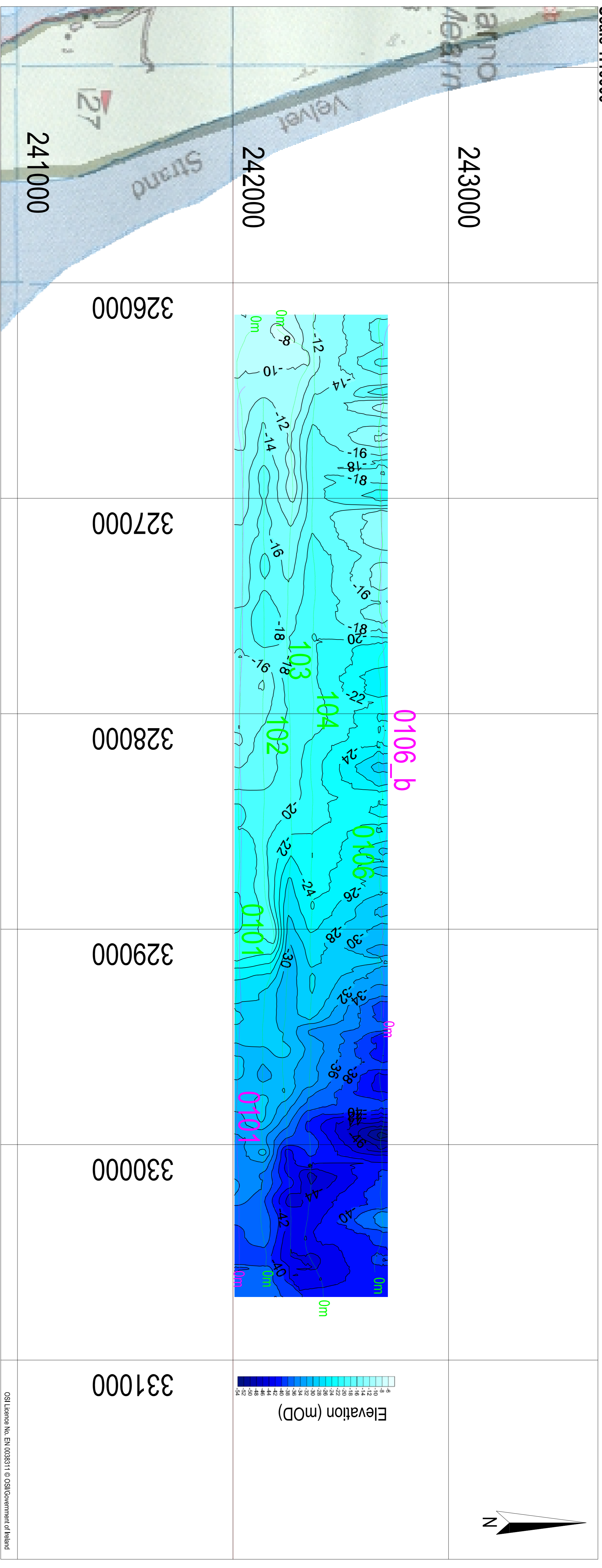
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SCALE: 1:10000 @ A1	
DATE: 14th JUNE 2013	
DRAWN: TL	DRAWN: CHECKED:
REVISION: DATE:	

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FIGURE 1: Area 1, Portmarnock, Bedrock Elevation Contour Map

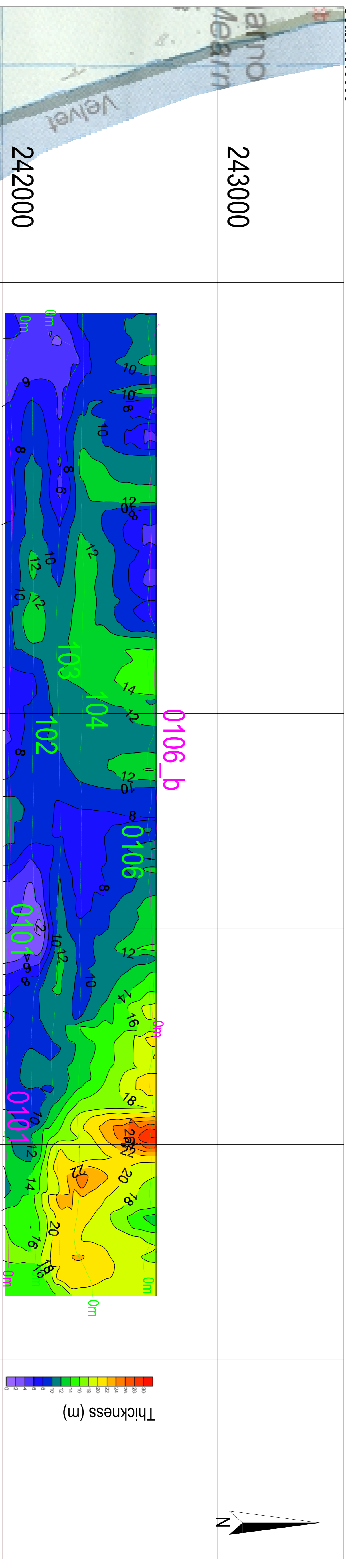
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FIGURE 2: Area 1, Portmarnock, Sediment / Overburden Thickness Map (m)

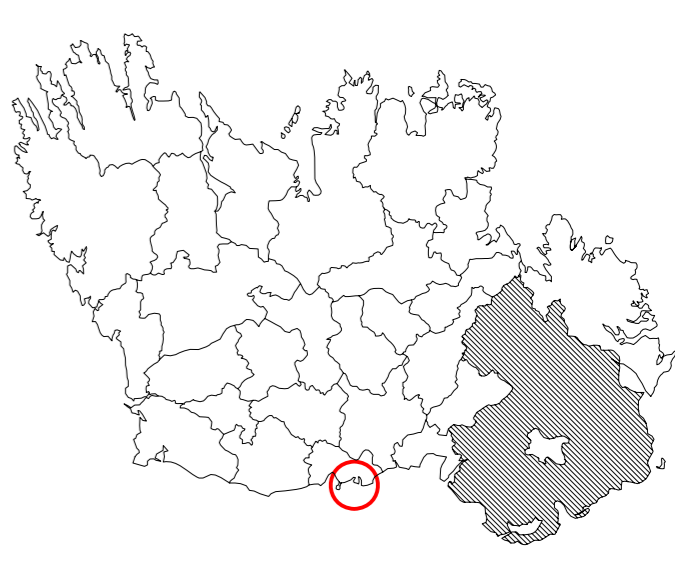
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INDEX MAP



LEGEND:
 101 Sparker Profile
 101 Chirp Profile

NOTES:

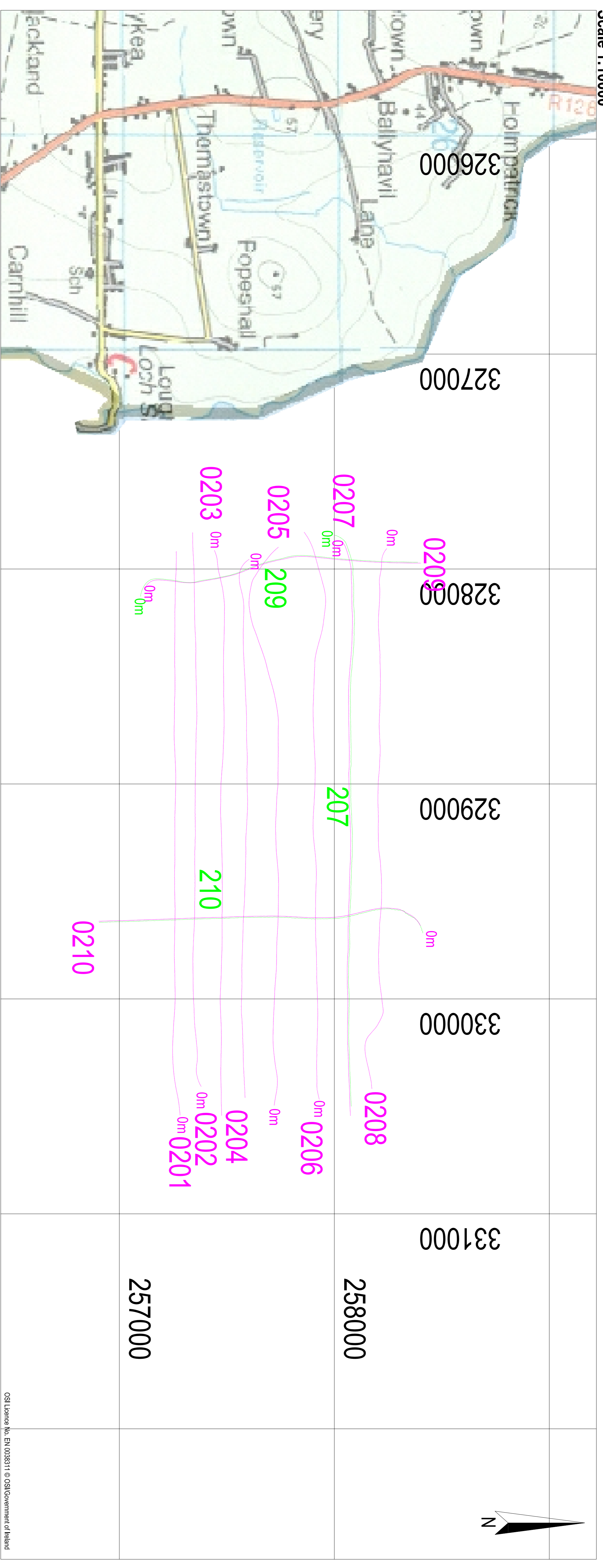
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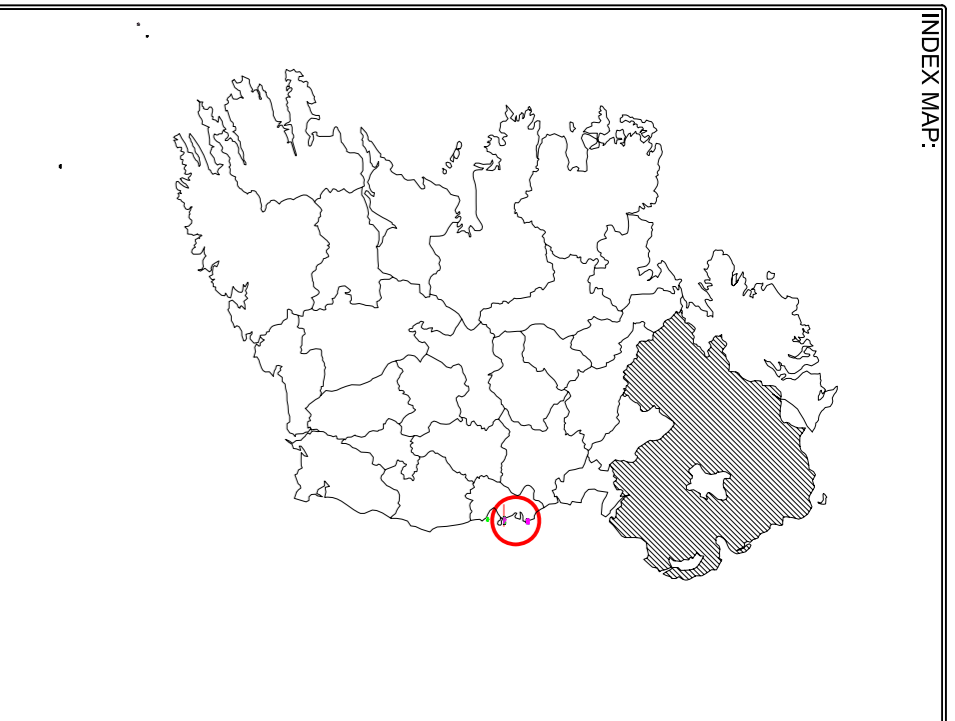
FIGURE 1: Area 2, Skerries, Seismic Survey Location Map

Scale 1:10000



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NOTES:

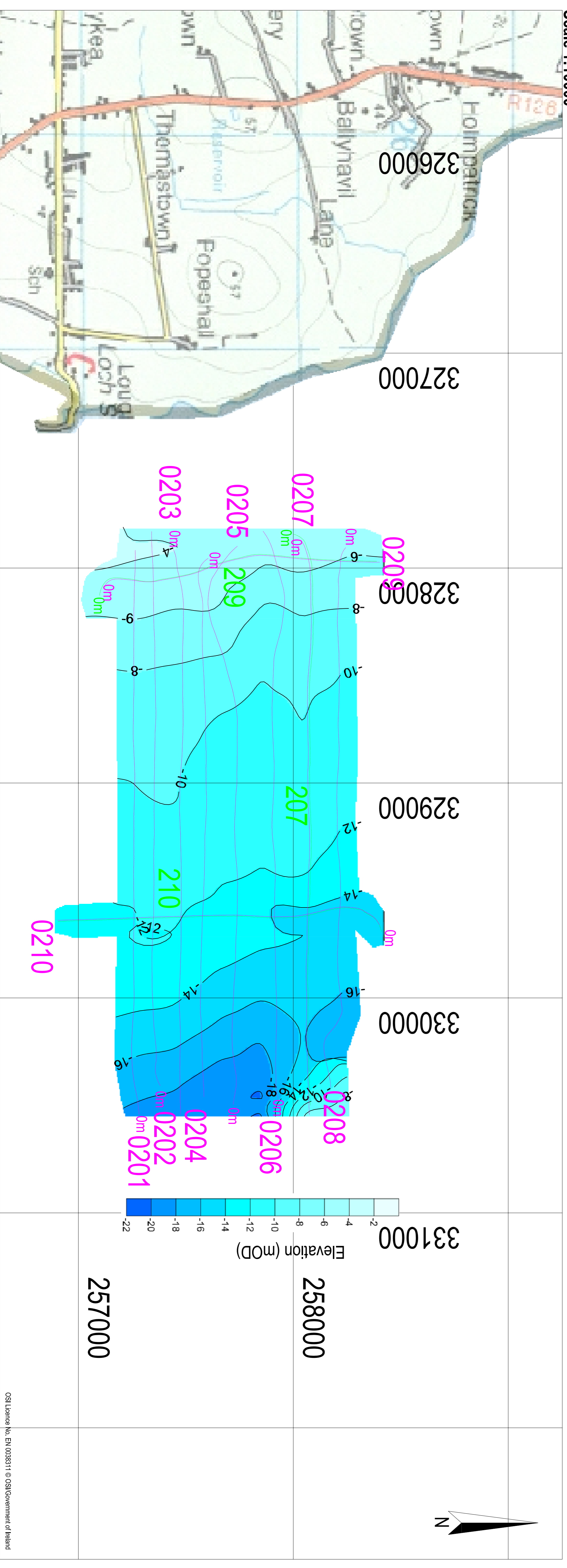


LEGEND:

- 101 Sparker Profile
- 101 Chirp Profile

FIGURE 2: Area 2, Skerries, Seabed Elevation (mOD)

Scale 1:10000



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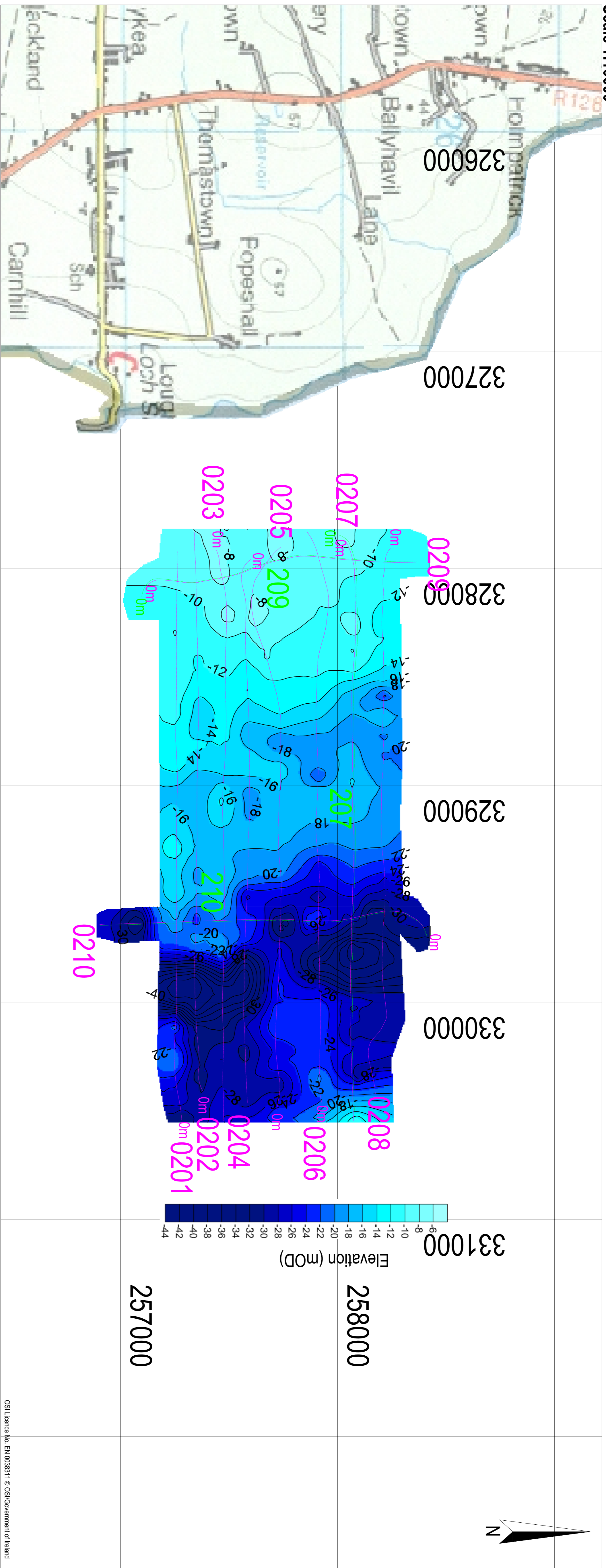


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FIGURE 1: Area 2, Skerries, Bedrock Elevation Contour Map

Scale 1:10000

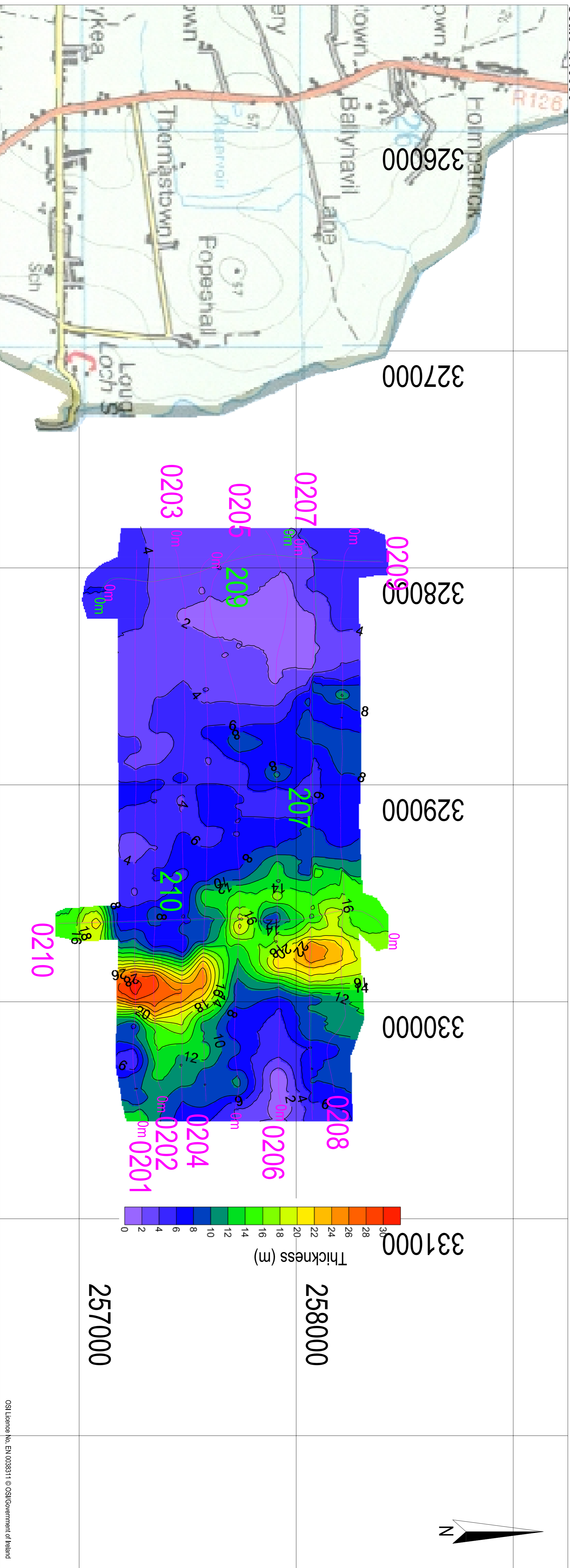


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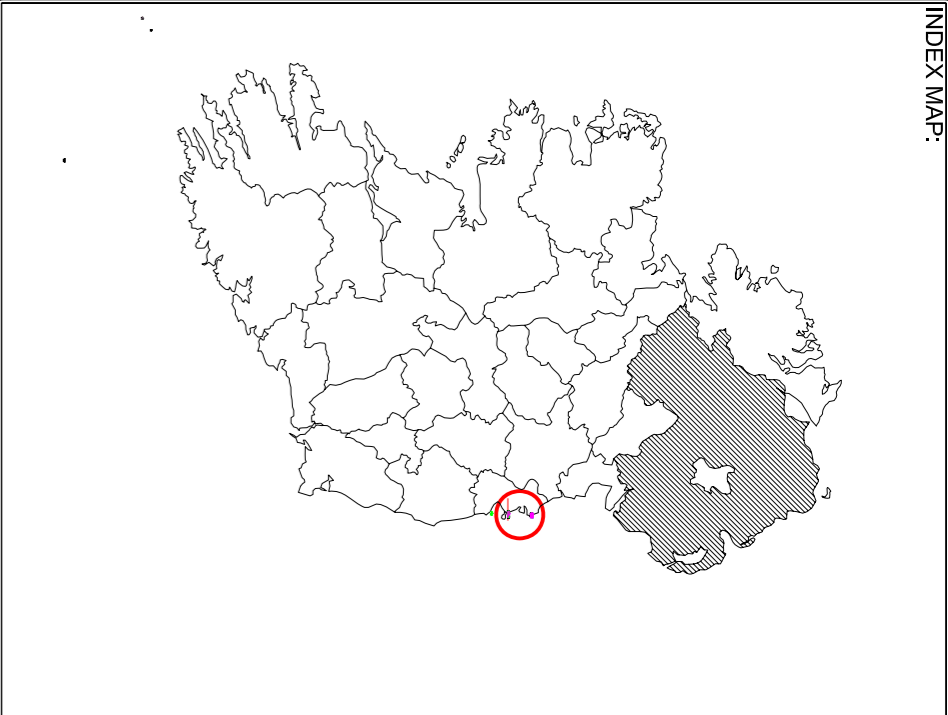
NOTES:

FIGURE 2: Area 2, Skerries, Sediment / Overburden Thickness Map (m)

Scale 1:10000



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LEGEND:

- 101 Sparker Profile
- 101 Chirp Profile

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5. APPENDIX B: DETAILED METHODOLOGY

The investigation consisted of a robust seismic processing testing sequence which resulted in the application of a number of processing steps to the Sparker and CHIRP data.

5.1 Data Processing Sequence

5.1.1 Finalised Processing

The finalised data processing sequence included;

Sequence	Process	Parameterisation
1	Data Conversion	Convert client supplied SegY files to internal format for Processing.
2	Geometry	Apply navigation data in Irish National Grid coordinates. Remove duplicate traces
3	Filter	Bandpass Butterworth filter
4	Running Average	A running average filter over 3 traces was applied to suppress trace dependent noise and emphasise horizontal coherent energy (applied to Sparker data only)
5	Gain	A time variant gain was chosen to improve overall visual clarity of the data.
6	Interpretation	A number of geological boundaries including the seabed, internal sedimentary layers and the base of sediments / over burden were picked in the time domain.
7	Depth conversion	The picked horizons were converted to depth using a sedimentary velocity of 1750m/s.
8	Tidal Correction	A tidal correction, appropriate to each survey profile, was applied to give finalised depth values for the picked horizons.

5.1.1 Additional Processing Testing

During the data processing other sequences were also tested. These included;

- Various filtering options
- Gain functions
- Deconvolution for multiple suppression
- Water bottom multiple suppression via subtracting average filters
- Sedimentary multiple suppression techniques

A number of the above techniques were not used in the final processing as they did not result in enhanced imaging of the target horizons and on some profiles had a negative impact on primary reflection events.

6. APPENDIX C: DATA EXAMPLES

The following Figures show data examples from the Sparker and CHIRP data over the two survey areas. The locations of the profiles are shown in Drawing 13110_01 and 13110_03. More detailed imaging of the horizons is seen on the Sparker data. The vertical axis shows time in ms and the horizontal shows trace no. (not true distance).

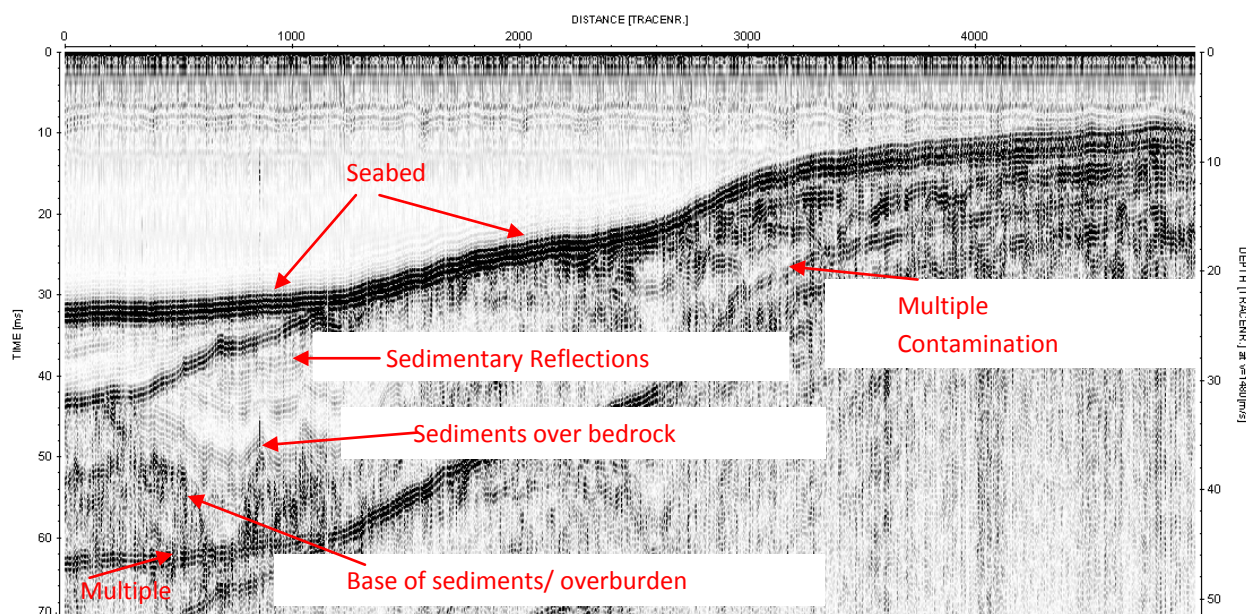


Figure 6.1: Sparker Profile 106 from the southern survey area, Portmarnock (plotted east - west).

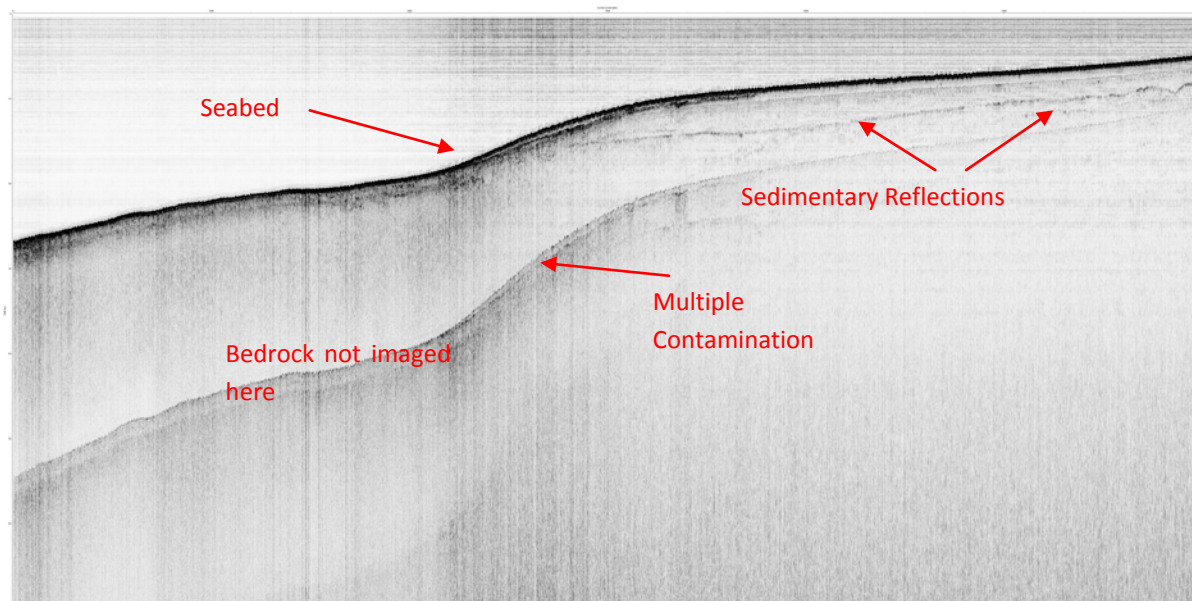


Figure 6.2: CHIRP Profile 106 from the southern survey area, Portmarnock (plotted east - west).

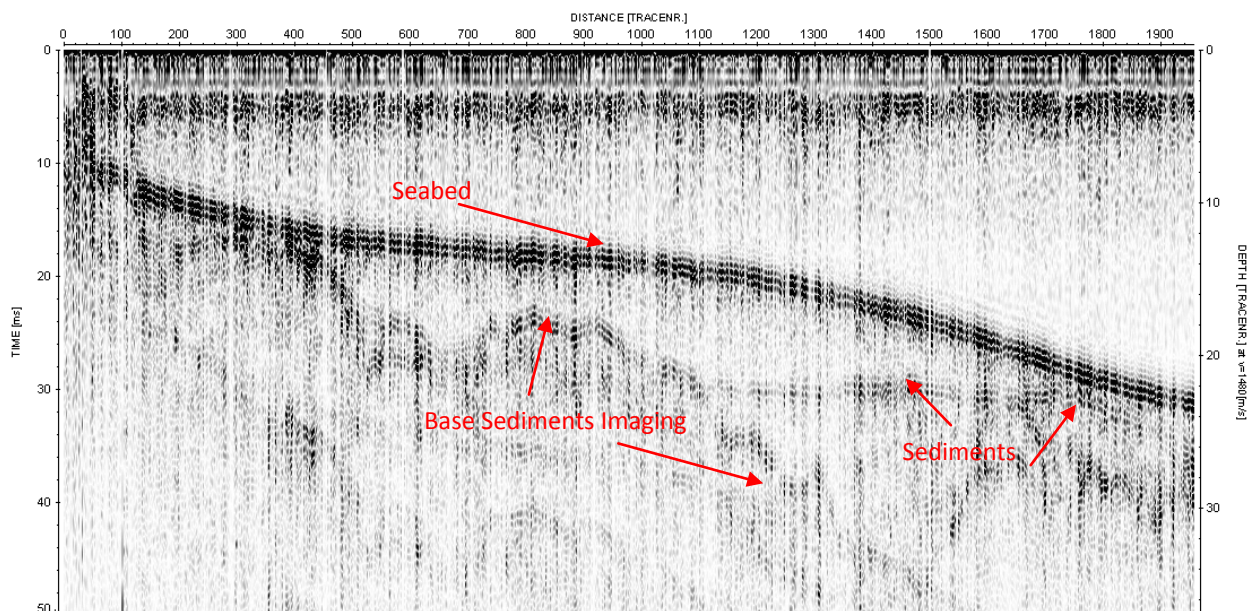


Figure 6.3: Sparker Profile 207 from the northern survey area, Skerries (plotted west – east).

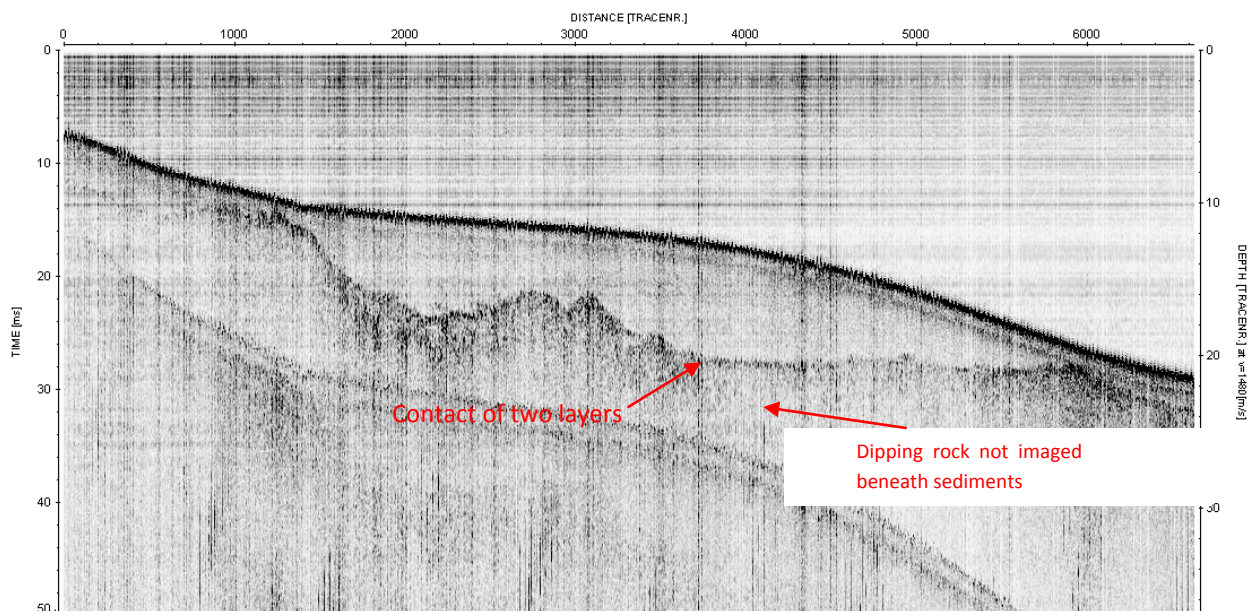


Figure 6.4: CHIRP Profile 207 from the northern survey area, Skerries (plotted west – east).