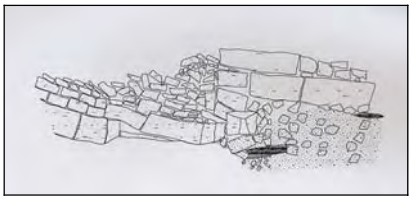
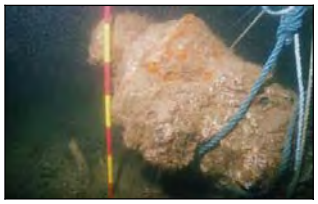
Appendix O

Underwater Archaeological Assessment Report

Corrib On-shore Gas Pipeline

Marine Geophysical & Geotechnical Data Interpretation, Underwater Archaeological Assessment and Inter-tidal Inspection

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

Corrib On-shore Gas Pipeline

Marine Geophysical & Geotechnical Data Interpretation, Underwater Archaeological Assessment and Inter-tidal Inspection,

February 2009

Project Director **Dr. Niall Brady**

Site Director **Rex Bangerter**

Brehon House, Kilkenny Road, Castlecomer, Co. Kilkenny info@adco-ie.com

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

CONTENTS

EXECUTIVE SUMMARY

The Archaeological Diving Company Ltd. (ADCO) was appointed by RPS on behalf of Shell E & P Ireland Ltd., to undertake geophysical data interpretation, inter-tidal survey, and underwater archaeological assessment of the proposed route of the Corrib Onshore Gas pipeline.

The archaeological assessment was carried out across Sruwaddacon Bay, reviewing the geophysical data acquired, conducting an inter-tidal foreshore inspection of the Bay, and a dive inspection of the sub-tidal zone. The work was carried out under licence from the Department of the Environment, Heritage and Local Government (DoEHLG). This study focuses on the two bay crossings (upper and lower) and an inlet crossing that are proposed for the present scheme: a crossing between Dooncarton (also known as Glengad) townland and Rosdoagh townland (lower crossing of the bay), a crossing between Rosdoagh townland and Aghoos townland (upper crossing of the bay), and an estuarine crossing of an inlet that forms the boundary between Aghoos townland and Bellagelly South townland, located in the southeast corner of Sruwaddacon Bay.

A desktop survey did not identify material of archaeological significance within the Bay area. However, cartographic sources indicate the presence of an active river channel running along the south side of the bay in the nineteenth century, which has subsequently become inactive.

The marine geophysical survey was comprehensive. A series of geophysical anomalies was identified and those within the Bay were diver-truthed as part of the underwater/ inter-tidal assessment. Only two anomalies, SS7 (tree debris) and SS29 (drainage pipe), were located

within the impact zone identified for the proposed pipeline crossings. None of the anomalies are deemed to retain archaeological significance.

Systematic visual inspection of the foreshore/inter-tidal and sub-tidal seabed areas did not reveal any material or features of archaeological significance.

Consideration was given to the geotechnical site investigations conducted across Sruwaddacon Bay for the pipeline crossing.

The conclusion of the present survey is that the known archaeological potential within Sruwaddacon Bay is low. The possibility remains that the subsurface deposits retain archaeological material, and the palaeo-channel on the south side of the bay would be an ideal holding area for such material. This is especially the case for all-wooden constructions, such as log boats and other pre-modern sailing craft and related features, since geophysical prospecting is unable to detect such anomalies that are buried. The pipeline route will however not traverse the palaeo-channel.

This report recommends that further in-water work in advance of construction is not required. The pipeline will be inserted by tunnelling under the Bay, avoiding all archaeological features, and no impact on marine archaeology is anticipated. However, this method of pipeline insertion requires the excavation of a launch pit on one side of the bay and a reception pit on the over side. These works represent a potentially significant impact on the existing environment and it is recommended that a programme of archaeological monitoring be conducted during construction, with the proviso to resolve fully any archaeological material that is observed at that point. It is also recommended that archaeological monitoring be undertaken should an intervention pit be required for the purposes of this tunnelling work.

LIST OF FIGURES

LIST OF PLATES

1.0 INTRODUCTION

The Archaeological Diving Company Ltd (ADCO) was appointed by RPS on behalf of Shell E&P Ireland Ltd, to undertake an interpretation of marine geophysical and geotechnical data along with foreshore/inter-tidal survey and underwater archaeological assessment along the proposed route of the pipeline as part of the Environmental Impact Statement (EIS) being prepared for the Corrib Gas On-shore Pipeline Project. The following report relates to the foreshore and in-water areas impacted by the Proposed Pipeline Route.

The proposed pipeline will reach landfall within Glengad townland and travel eastwards to cross Sruwaddacon Bay at its narrowest point (c.425m NW-SE), between Glengad Townland and the Rosdoagh Townland. The route then continues eastwards along the northern side of the Sruwaddacon Bay, before turning to the southeast and crossing the waterway between Rosdoagh townland, on the north side of the bay, and Aghoos townland on the south. The pipeline crossing will run in a NNW to SSE direction for c. 1000m to reach landfall within Aghoos townland, before travelling eastwards for a distance of 670m and transecting a small inlet located in the southeast corner of Sruwaddacon Bay. This inlet is the discharge location for two small streams and forms the boundary between Aghoos townland and Bellagely South townland (Figures 1-2).

Sruwaddacon Bay forms a narrow estuarine inlet off Broadhaven Bay and south of Rossport, Co. Mayo. It is fed by the Glenamoy River to the southeast, and measures c. 4.5km long and c. 0.7km wide, extending northwestwards to its confluence with the lesser Ross Bay before emptying into Broadhaven.

The marine geophysical data was acquired by Osiris Projects Ltd for Shell E & P (Ireland) Ltd. A total of twenty-nine anomalies were visually inspected to ascertain their archaeological potential as part of the onsite archaeological foreshore/inter-tidal and underwater assessment. Only two anomalies, SS7 and SS29, were located within the potential impact zone identified for the proposed pipeline crossings. None of the anomalies are deemed to retain archaeological significance.

ADCO sought to:

- identify and record the location, nature, and dimensions of any archaeological features, fabric or artefacts that may be impacted by the proposed pipeline.

- make detailed recommendations for the mitigation of any archaeology present within Sruwaddacon Bay.
- make recommendations as to the options available to the client in the event of archaeology being present.

Particular attention was paid to recording seabed and foreshore topography, bottom composition, and highlighting any material concentrations. The inter-tidal survey of Sruwaddacon Bay was undertaken on the 11th and 12th September 2007. The underwater assessment and diver-truthing of the side-scan sonar anomalies was carried out on 11th and 12th of October 2007. Both surveys were carried out by a team of three maritime archaeologists and a certified Dive Supervisor. In addition, an experienced boatman and tender were provided to expedite the surveys. The assessment was carried out under licence from the Department of the Environment, Heritage and Local Government (DoEHLG), licence numbers: 07D038, 07D040, and 07R169, 07R170.

2.0 PROPOSED DEVELOPMENT

The proposed Corrib onshore Gas Pipeline consists of the following elements:

- Onshore Gas Pipeline
- Landfall valve installation
- Umbilicals and Services
- Outfall Pipeline.

The proposed development will comprise 9.2km onshore gas pipeline extending from a landfall (located approximately 50m from the landfall in Glengad) to the Gas Terminal at Bellanaboy Bridge. Umbilicals will extend from the Gas Terminal to the landfall (and continue to the sub sea manifold at the Corrib Field in a single consolidated umbilical). Next to these will be a separate fibre optic cable and an electrical signal cable that extend from the Terminal to the Landfall. The outfall pipeline will extend from the Gas Terminal to the landfall (and continues to a permitted location 12.5km offshore).

Construction Techniques

It is proposed to construct both the lower (approximately 600m) and upper (approximately 1,000m) crossings of Sruwaddacon Bay using a trenchless technique generally know as ‘Direct Pipe’. In addition, it is proposed to transect a small inlet located in the southeast corner of Sruwaddacon Bay. It is understood that an open-cut method will be adopted for this estuarine crossing.

Trenchless methods are those where a pipeline (or casing pipe into which the pipeline is subsequently installed) is inserted below a watercourse generally without excavating from the surface. These methods are designed to minimise the amount of surface disturbance during construction.

The trenchless method will involve the construction of a launch pit at one side of the bay and a reception pit at the other side of the bay for both crossings. The operation is carried out from the launch pit and proceeds towards the reception pit.

If a problem is encountered, it may be required to install an intervention pit to remove the object from below ground. Generally, an intervention pit would be constructed using sheet piles or other such method from a pontoon/barge. The intervention pit would provide access to the problem from the surface and ensure that an excavation there could be kept open. Alternatively, it may be simpler, faster and less disruptive to remove such an obstruction by excavating from the surface directly in front of the machine using conventional land based excavation equipment. A temporary jetty may be required as a marine access/egress point to handle construction traffic/materials to and from the pontoon/barge. If required, the temporary jetty will be located at a point where the working area meets the shoreline of Sruwaddacon Bay.

3.0 SURVEY METHODOLOGY

A desktop assessment of cartographic and archival information was conducted in advance of presenting on site. This included examination of the Ordnance Survey mapping for the area since the First Edition six-inch series in 1839, as well as an examination of the topographical files in the National Museum of Ireland and Record of Monuments and Places files in the Department of the Environment, Heritage and Local Government, with specific attention to the Inventory of Historic Shipwrecks.

The following legislation, standards and guidelines were considered and consulted for the purposes of this evaluation:

- National Monuments Acts, 1930-2004;
- The Planning and Development (Strategic Infrastructure) Bill, 2006;
- The Heritage Act, 1995;
- Guidelines on the information to be contained in Environmental Impact Statements, 2002, EPA;
- Advice Notes on Current Practice (in preparation of Environmental Impact

Statements), 2003, EPA;

- Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes, NRA
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, (formerly) Department of Arts, Heritage, Gaeltacht and Islands;
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000;
- Code of Practice between Bord Gáis Éireann and the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Department of Environment Heritage and Local Government), 2002.

The assessment was carried out under licence from the Department of the Environment, Heritage and Local Government (DoEHLG), licence numbers: 07D038, 07D040, and 07R169, 07R170.

Interpretation of the marine geophysical data acquired by Osiris Ltd is described below in section 3.2. ADCO was provided with a full and complete record of the data available and examined this information with a view to highlighting particular anomalies that may be considered as retained archaeological potential. The examination also sought to present overview images of the nature of the sub-surface portion, as indicated in the side-scan sonar data. The features identified were made available to the dive team in advance of diving Sruwaddacon Bay.

The full extent of the inter-tidal foreshore of Sruwaddacon Bay was field-walked at Low Water and included the two proposed Bay crossings and the associated estuarine crossing. The field-walking was undertaken by a team of three archaeologists, supported by boat cover from a rigid inflatable boat (RIB), skippered by a third party. A detailed written record, supplemented by photographic record, of the foreshore environment was made and a hand-held GPS was used to position-fix the survey route and any observations made.

The sub-surface or sub-tidal element of the survey was conducted in a similar manner. Visual inspection was employed to assess the archaeological potential of the seabed within Sruwaddacon Bay. A team of two maritime archaeologists (certified to a minimum of HSE Part III diving certification) and a certified dive supervisor conducted the work, using a mobile surface-supplied diving set-up. Maximum coverage of the underwater inspection area was achieved using a diver-towed survey

method. The dive survey was carried out to HSE/HSA standards using Surface Supplied Diving Equipment and all relevant safety equipment.

Inspection of the sub-tidal geophysical anomalies was undertaken using circular searches from an anchored down-line that was centred on the anomaly coordinates, which were pinpointed using the boat's Differential GPS receiver. Geophysical anomalies located within the inter-tidal zone were inspected at Low Water and position-fixed using a hand-held GPS.

Magnetometry survey by hand-held metal-detection was undertaken across two areas deemed suitable for metal-detector use, as identified in Figure 9; strong currents within the bay made metal-detection use impractical along much of the underwater survey area. However a geophysical survey carried out by Osiris supplemented this information and the absence of metal detection information did not form a constraint to the study. A Fisher Aquanaut 1280X underwater metal-detector was used to conduct the survey (Plate 1).

Both the underwater and the inter-tidal survey areas (Figures 2 and 8) were examined. Detailed descriptions were made of topography and bottom composition. A photographic record of the existing environment was made and, where possible, metal-detector anomalies were inspected and mapped.

Limitations

No limitations were encountered as part of the surveys and the full extent of the inter-tidal foreshore of Sruwaddacon Bay was field-walked at Low Water, and the sub-tidal zone was dive inspected. Specific attention was paid to assessing the archaeological potential of the proposed crossings.

Classification of Impacts

The impact categories listed below have regard to those set out in the 'Guidelines on the information to be contained in Environmental Impact Statements', 2002, EPA, 'Advice notes on Current Practice (in preparation of Environmental Impact Statements), 2003, EPA, and Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes, National Roads Authority.

Impacts are generally categorised as either being a direct impact, an indirect impact or as having no predicted impact:

> **Direct impact** occurs when an item of archaeological heritage is located within the centreline of the proposed route alignment and entails the removal of part, or all, of the monument.

Indirect impact may be caused where a feature or site of archaeological interest is located in close proximity of the proposed development.

No predicted impact occurs when the proposed route option does not adversely or positively affect an archaeological heritage site.

These impact categories are further assessed in terms of their quality i.e. positive, negative, neutral (or direct and indirect).

Negative Impact: a change that will detract from or permanently remove an archaeological monument from the landscape.

Neutral Impact: a change that does not affect the archaeological heritage.

Positive Impact: a change that improves or enhances the setting of an archaeological monument.

A significance rating for these impacts is then given i.e. slight, moderate, significant or profound.

Profound: applies where mitigation would be unlikely to remove adverse effects. This is reserved for adverse, negative effects only. These effects arise where an archaeological site is completely and irreversibly destroyed by a proposed development.

Significant: an impact which, by its magnitude, duration or intensity alters an important aspect of the environment. An impact like this would be where the part of a site would be permanently impacted upon leading to a loss of character, integrity and data about the archaeological feature/site.

Moderate: a moderate direct impact arises where a change to the site is proposed which though noticeable, is not such that the archaeological integrity of the site is compromised and which is reversible. This arises where an archaeological feature can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.

Slight: an impact which causes changes in the character of the environment which are not significant or profound and do not directly impact or affect an archaeological feature or monument.

Imperceptible: an impact capable of measurement but without noticeable consequences.

In addition, the Duration of Impacts is assessed and has been sub-divided into the following categories.

Temporary Impact:	Impact lasting for one year or less
Short-term Impacts:	Impact lasting one to seven years
Medium-term Impact:	Impact lasting seven to fifteen years
Long-term Impact:	Impact lasting fifteen to sixty years.
Permanent Impact:	Impact lasting over sixty years

4.0 THE RECEIVING ENVIRONMENT

4.1 Cartographic Information

The earliest detailed map of Sruwaddacon Bay is provided in the Ordnance Survey First Edition six-inch map series dated to 1839 (Figure 3). The maps show the estuarine nature of the bay with large expanses of tidal mudflats and sandbars. In contrast with the present-day bay topography however, the river channels appear to be somewhat wider, and there was a second channel running along the southern shore of the bay below a large mudflat expanse. Today that southern channel has all but disappeared and waters flowing from the Glenaboy and Muingabo rivers are directed northwards along the only main channel through the bay at Low Water.

From an archaeological perspective, one can expect certain discrete indicators of maritime cultural heritage on nineteenth century maps, such as fish traps and eel weirs, if not actual shipwreck sites. The locations of traps and weirs on tidal mudflats in an estuarine context is to be expected, where advantage is taken of the access provided to fish during the tidal cycle.[1] However, there are no such indicators from the 1839 maps in Sruwaddacon Bay. The only feature indicated along the foreshore is a ferry crossing point at the north end of the bay. The small house located beside the crossing on the east shore was no doubt for the use of the ferryman.

In the time since 1839, the bay has seen certain change, both in terms of the infilling of the southern channel, and the more extensive development of the ferry crossing

[1] The potential of intertidal archaeology is perhaps most comprehensively set put in Aidan O'Sullivan, *Foragers, Farmers and Fishers in a Coastal Landscape. An intertidal archaeological survey of the Shannon Estuary* Discovery Programme Monograph 5 (Dublin 2001), especially chapters 5-6.

point at the north end of the bay (Figure 4). Little else has changed and the tongue-like sand-bars remain very much as they were in the 1830s.[2]

4.2 Desktop Data

There are no artefacts recorded in the topographical files of the National Museum of Ireland provenanced to Sruwaddacon Bay.

Terrestrial Sites

The land-based archaeological record in the area around Sruwaddacon Bay is focused at the head of the bay in Glengad where there is an interesting selection of largely prehistoric period monuments (Figure 4). These include a wedge tomb grave (MA004-023) that is located c. 350m west of the shoreline, and a cist grave (MA004-017) situated only 125m from the shore. These sites present a clear sense of the appreciation of access to the shore by peoples in the distant past and suggest the potential for settlement and other remains in the immediate area. A little to the south, in Kilcommon or Pollotomish and Carnhill townlands, the cluster of sites relating to a church, graveyard and Holy Well (MA011-005, 006) indicate that access to the bay and through the bay remained important into the historic period. Perhaps it is due to the presence of blanket bog that there are few charted sites as one moves into the bay area, and indeed the north shore is quite barren. The absence of settlement here on the 1836 map suggests too that the clearance of bog to create the ribbon of development along both shores that is noticeable today is of very recent date.

The clearance of bog raises a most important facet of the archaeology of northwest Mayo, since it is below the blanket bog at Céide, Belderrig and at Behy/Glenulra that Seamas Caulfield has championed the discovery of a prehistoric agricultural landscape that reaches back to the first moments of sedentary existence in the Neolithic period.[3] Caulfield's innovative field techniques realized that the blanket bog grew over and buried an actively managed landscape, and has preserved much of it intact. The piecemeal exploitation of the bog as a source for turf, and its cutting away to create new areas for houses presented important opportunities to see the lines of stone walls and the sites of settlement and burial associated with the prehistoric landscape. The extension of such bogland into Sruwaddacon Bay cautions

[2] The present-day aerial views reproduced in Figure 2 continue to show this pattern, and it should be noted that the photographs were taken at a time when the tide was high, whereas the mapped data reproduced on Figures 3-4 show the Low Water levels.

[3] S. Caulfield, R. G. O'Donnell, P. I. Mitchell, '14C dating of a Neolithic field system at Céide Fields, County Mayo, Ireland', *Radiocarbon* 40 (1998): 629-40; see also Graeme Warren, Fieldwork in 2006 at Belderrig, Co. Mayo, 04E0893, unpublished report.

archaeologists and suggests the possibility of similarly rich insight to the distant past. As it happens, however, there has not been any discovery reported of buried prehistoric landscapes in the area immediately surrounding the bay, and as such the known potential is low. While one may conclude that the existing archaeological record highlights activity on either side of the entrance to Sruwaddacon Bay, and that the insights are less clear as one proceeds into the bay, especially on the north side, the absence of known sites should not be considered to correspond to an absence of archaeology. The presence of so much blanket bog may simply be serving to mask these features.

The Record of Monuments and Places lists seventeen sites for the townlands surrounding Sruwaddacon Bay and these are tabulated below (Table 1/ Figure 4):

RMP Number:	National Grid Reference:	Townland:	Site Type:	Approximate distance from Crossings
MA004-007	820185E, 339670N	Currawn Bay	Burial (s), possible	1.5km
MA004-010-001	798870E, 338190N	Glangad or Dooncarton	Promontory Fort	2.7km
MA004-010-002	798870E, 338190N	Glangad or Dooncart0n	Castle, Unclassified	2.7km
MA004-010-003	798870E, 338190N	Glangad or Dooncarton	Building (s)	2.7km
MA004-010-004	798870E, 338190N	Glangad or Dooncarton	Hut site	2.7km
MA004-011	802380E, 338441N	Glangad or Dooncarton	Promontory Fort	2.1km
MA004-012	810656E, 335215N	Glangad or Dooncarton	Megalithic Tomb	1.1km
MA004-013	810405E, 338215N	Glangad or Dooncarton	Stone Circle	1km
MA004-015	817176E, 338416N	Glangad or Dooncarton	Enclosure	800m
MA004-016-001	827207E, 338291N	Rosdoagh	Megalithic Tomb	300m
MA004-016-002	827207E, 338291N	Rosdoagh	Enclosure	300m
MA004-017	821439E, 338140N	Glangad or Dooncarton	Cist	280m
MA004-023	819934E, 337889N	Glangad or Dooncarton	Megalithic Tomb	600m
MA004-024	826705E, 339720N	Rosdoagh	Ringfort/ Cashel	1.5km
MA011-005-001	826454E, 337012N	Kilcommon or Pollatomish	Church	900m
MA011-005-002	826454E, 337012N	Kilcommon or Pollatomish	Graveyard	900m
MA011-006	852785E 333752N	Kilcommon or Pollatomish	Ritual site, Holy Well	1.4km

Table 1: List of RMP sites located within the general vicinity of Sruwaddacon Bay.

Shipwreck Sites

The Shipwreck Inventory in the Department of the Environment, Heritage and Local Government's archive is a list of recorded instances of wrecking since 1750. The details provided describe the type of vessel, the journey it foundered on, and information on the ultimate plight of the vessel and its crew, where possible. In describing the wrecking event, the records will locate the incident in relation to the nearest headland or other topographic marker where known. This is not however a record of where the wreckage lies, since the historic records generally only deal with the vessel before it sunk. Such finer details emerge from other sources, such as fishermens' records of snag points and diver records of sites located underwater. These are included in the Inventory wherever possible but it is true to say that most entries lack this final level of data. It should also be pointed out that while the Inventory provides a record of wrecking incidents since 1750, it does not claim to be a comprehensive record for earlier events, and therefore the medieval and prehistoric periods are not represented in this archive.

In searching the Inventory for wrecks in Sruwaddacon Bay, a wider net was cast to include Broadhaven Bay in general (Table 2). The results suggest that recorded wreckings on this stretch of coastline are relatively few, but this might have more to do with the under-populated landscape than anything else, since there would have been fewer people regularly observing shipping movements than on the more densely populated stretches of coastline. If this was true for the active coastline, the relative absence of settlements on Sruwadacon Bay even up to 1839 might explain the lack of wreckings reported in the bay.

Vessel Name:	Date of loss:	Location:	Description:
Albion	12th November 1847	Broadhaven Bay	Sailing Vessel
Alliance	15th October 1902	Inver	Schooner
Annie	14th January 1893	Broadhaven Bay	Brig
Ann Worthington	October 1841	Broadhaven Bay	Brig
Arab	18th December 1823	Broadhaven Bay	Brig
California	5th October 1853	Broadhaven Bay	Emigrant Ship
City of Limerick	29th November 1850	Broadhaven Bay	Schooner
Emerald	12th January 1847	Broadhaven Bay	Sailing Vessel
Favourite	17th March 1807	Broadhaven Bay	------
First Come	16th October 1905	Broadhaven Bay	Rowing Boat
Hawk	21st November 1881	Portacloy Beach	Wooden Lugger
John Willey	10th February	Broadhaven Bay	------
Magdala	14th April 1882	Broadhaven Bay	Brigantine
Maid of Mayo	1899	Porturlin Creek	Steel-hulled ship
Mary	16th July 1853	Broadhaven Bay	Sloop
Rain	24th april 1770	Erris	------
Ranger	12th July 1847	Erris Head	Sailing Vessel
River Nith	1892	Broad Haven Bay	Barque, Towed Off
Saint Anthony	27th May 1905	Brandy Point	Cutter
Sinai	1st January 1877	Inver	Brig
Santiago	1588	Poulatomsih	Armada Ship

Vessel Name:	Date of loss:	Location:	Description:
Thetis	25th November 1819	Broad Haven Bay	------
Three Brothers	22nd March 1847	Broad Haven Bay	Sailing Vessel
Unknown	1588	Kid Island	Tender Vessel
Unknown	8th February 1822	Erris	------
Unknown	------	Inver Point	Dutch East Indiaman
Unknown	1851	Broad Haven Bay	Schooner
Unknown	*Unknown*	Inver	------
Unknown	*Unknown*	Inver	Two-masted vessel
Unknown	*Unknown*	Inver	Dutch warship
Unknown	*Unknown*	Inver	------
Unknown	*1640*	Poulatomish	Dutch East Indiaman

Table 2: Instances of shipwrecking recorded in the general area, based on the DoEHLG Shipwreck Inventory.

Conclusions

The cartographic and desktop information indicate that the known archaeological potential within Sruwaddacon Bay in general is low, and that the areas of the proposed crossings are equally low. However, the circumstances of under population on the one hand, and the extension of blanket bog to the Bay edges must be taken into account and serve as a cautionary note when assessing the possible archaeological potential that could be exposed.

4.3 Areas of Archaeological Potential

While the present archaeological assessment is focused on the estuarine environment within Sruwaddacon Bay, separate assessment of the terrestrial landscape by Margaret Gowen and Company Ltd has identified three areas of archaeological potential for the proposed pipeline route, as: the Dooncartoon Td to Rosdoagh Td crossing, listed as **Area B**; Rosdoagh Td to Aghoos Td crossing, **Area E**; and the inlet crossing point, **within Area F**. In order to maintain numeral consistency within the EIS, the above ID references are used in the present report when referring to the three crossing points associated with the proposed pipeline route.

ID:	Area B
Townland:	Dooncarton and Rosdoagh
Site type:	Watercourse crossing, townland boundary
Description:	The proposed route crosses Sruwaddacon Bay, an area of archaeological potential. This Bay is also the townland boundary between Dooncarton and Rosdoagh.
ID:	**Area E**
Townland	Rosdoagh and Aghoos
Site type	Watercourse crossing and townland boundary
Description	The proposed route crosses Sruwaddacon Bay for c. 1.2km from Rosdoagh townland until it reaches landfall in Aghoos townland. This Bay is an area of archaeological potential. It also forms the townland boundary between all the townlands to the north and south of the Bay.

ID:	Within Area F
Townland:	Aghoos and Bellagelly South
Site type:	Watercourse crossing and townland boundary
Description:	A watercourse forming the townland boundary between Aghoos and Bellagelly south is crossed by the proposed route. The watercourse is a tributary of Sruwaddacon Bay.

Table 3: Areas of Estuarine Archaeological Potential identified for the proposed pipeline route.

4.4 Marine Geophysical Data Review

The sources for assessment included:

- Side-scan Sonar Data Files on CD-ROM with CODA Geosurvey – Windows Version 4.0.2 operating system
- Magnetometer Profiles on CD-ROM
- Project Drawings showing tracklpots and position fixing, overlaid with Latitude and Longitude and Irish Universal Transverse Mercator grids.
- J. Walters, *Sruwaddacon Bay Geophysical Survey Report*, Preliminary Draft, September 2007, Osiris Projects Ltd.

The data was acquired by Osiris Projects Ltd. The survey operation was inspected by Dr. Niall Brady during the fieldwork phase on 13th July 2007, where it was possible to review the data acquisition process and discuss the project directly with the Osiris team. The record is comprehensive. The survey was collected in significant detail using side-scan sonar and magnetometry, supported by bathymetry.

Equipment Used

1. Single beam echo sounder
2. Multi-beam echo sounder
3. Side-scan sonar, operating at dual frequency, towed
4. sub-bottom profiler, Applied Acoustics AA200 Boomer System
5. Magnetometer, Geometrics G882, Caesium system

Survey Grid

The survey lines provide an ample and adequate buffer area for a valid assessment. Figures 5-7 are reproduced from Osiris Projects Ltd showing the vessel trackplot maps, divided between the lower, the upper, and the outer sections of the bay. The maps show the extent of the cover conducted, with the main axis being along the length of the bay where a multitude of parallel surveys lines were conducted. A system of crosslines was weaved at right angles tightly through the bay. The side-scan sonar and sub-bottom profile data was acquired simultaneously. The magnetometry data was acquired separately. The trackplot maps distinguish between the deployments. Vessel fix points are indicated on the maps, with periodic fixes numbered on the maps to make them legible. Data was acquired using Irish Transverse Mercator, and this grid is overlaid onto the project drawings, as is that of

Latitude and Longitude. It may be concluded that the survey was comprehensive and has provided ample opportunity to observe the same sections of seabed from an array of different angles.

Bathymetry

Sruwaddacon Bay is mostly exposed at Low Water as an array of intertidal sand- and mudflats. Water depths are shallow throughout, and are deepest in the narrow channel areas, where depths are all less that -4.5m Chart Datum. Comparison between the 1839 map and modern soundings, as reported by Osiris Ltd, not only shows the infilling of the southern channel through the inner half of the bay, but also reveals the mobile nature of the channel in upper mid section of the bay, where it is reworking the northwestern tip of the main mudflat island. If the bay is relatively impeded with sand- and mudflats, these features are constantly being modified by the water passing through.

Side-scan Sonar Data

The data reveals a seabed within the survey area that is predominantly sand and mudflats. There is little evidence for rock exposure but perhaps one of the features particular to this part of the country is the presence of peat. Given the preservation of prehistoric landscape below the raised bog areas in nearby Behy/Glenulra and the Ceide Fields site, the presence of peat below the water surface in Sruwaddacon Bay is an obvious source of archaeological interest. The side-scan sonar imaging is very clear but it did not indicate features that might be associated with buried archaeological landscapes, such as lines of stone walls that might jutting out from the edges of peat expanses. The peat was nevertheless noted and highlighted as locations that warranted inspection during the diving of the Bay.

A number of anomalies were identified in the data, and these are presented below in Appendix 2 and referred to in the text as SS #. They are mapped on Figures 10-12. Only one anomaly however suggested that it retained significant archaeological potential, ss 20. This anomaly is not located within Sruwaddacon Bay, and is one of four anomalies detected by the surveyors off Ballyglass Pier. The anomalies that were identified within Sruwaddacon Bay have all been dive inspected, and the findings are described in Appendix 2. While they are located throughout the bay, they are concentrated in the mid section with perhaps a focus towards the southern shore. The anomalies range in type from natural features such as tree trunks (SS 6-7) and kelp-festooned rock (SS 4 and SS 8), to modern debris (SS 3 a car wheel; SS 16-17 a machine part; SS 25 an abandoned dog hutch), a pier head (SS 28), and modern shoreline features, such as service pipes (SS 29). Only two anomalies, SS7 (Tree

debris) and SS29 (Drainage pipe), were located within the impact zone identified for the proposed pipeline crossings. The side-scan sonar data has not revealed material of archaeological significance in Sruwaddacon Bay.

Sub-bottom Profile Data

The sub-bottom profile survey was conducted in tandem with the side-scan sonar deployment. The detail reveals a sequence of natural variations at depth but there is an absence of archaeological indicators in the surface levels, where one might otherwise expect indications of buried manmade features, such as boats and ships. Figure 8 shows a typical sub-bottom profile acquired. The continuous horizontal alignment of the surface strata indicates the absence of manmade intrusions, while the arch-like shape of the reflected strata at depth indicates the presence of natural features which in this instance is interpreted as the rising east bank at the south end of the bay. The profile imaged in Figure 8 is taken from a sinuous trackplot that zig-zags across the bay. The central feature is where the vessel approached the shore from the southwest, and then proceeded away from it in a northwesterly direction.

Magnetometer Data

Magnetometry provides a different opportunity to assess the nature of the sub-surface environment. Specifically, magnetometry highlights variations in the metallic content of the underlying levels, and therefore is suitable for identifying ferrous metal objects or features as well as natural geological variations. Magnetometry also penetrates below the seabed and can locate items that are buried.

The magnetometer survey in Sruwaddacon highlights natural variations within the bay that are explained geologically. The survey identified a single localised anomaly that may be related to human agency, located by Osiris at 84860mE, 336280mN, in the middle of the upper bay area, and to the southeast of ss24. The side-scan sonar data does not indicate a surface anomaly in this location and the dive survey conducted through the bay, which included this area, did not observe any feature on the seabed. The magnetic anomaly may be deemed to be buried.

The magnetometer has a focussed survey capability. Unlike side-scan sonar, which extends its beam to capture data either side of the survey device, magnetometry acquires its data directly below the instrument and therefore does not capture information that may lie on either side. This explains why, in the present context, the metallic debris identified in the side-scan sonar data (ss3 and ss16-17) were not highlighted in the magnetometry data. As Figure 9 shows in relation to ss3, the

trackline of the magnetometer (in red) ran some distance to the northeast of the side-scan sonar anomaly location, and therefore did not highlight the feature.

Conclusion

The marine geophysical data acquired across Sruwaddacon Bay does not indicate archaeologically significant material on the seabed. However, this data works within its own limitations: side-scan sonar scans the surface of the seabed/riverbed but does not penetrate below the surface layers and cannot therefore indicate the presence or absence of material that is buried. While sub-bottom profiling and magnetometry both counter this limitation by identifying buried strata, they acquire data on a direct vertical section below the acquisition device. Therefore the devices only capture thin sections through any given area, and consequently there remain gaps in the record. In addition, magnetometry detects ferrous metal and does not claim to identify non-ferrous metal objects, such as copper and bronze. The possibility therefore remains that archaeological material survives undetected in Sruwaddacon Bay.

5.0 ARCHAEOLOGICAL ASSESSMENT

The archaeological assessment has been divided into four sections to allow separate discussion of the inter-tidal survey, sub-tidal survey, the pipeline crossing points, and geophysical anomaly inspection.

5.1 Inter-tidal Zone

Foreshore topography

The inter-tidal zone at Low Water extends to cover the majority of Sruwaddacon Bay, leaving only a small central-channel that remains sub-tidal. Approximately 90% of the tidal seabed was inspected at Low Water and series of reference points were taken during the inter-tidal survey. These reference points, coupled with topographic observations made, aim to highlight the existing inter-tidal environment and are listed below:

Reference Point 1, NGR: 857038E, 336089N (Plates 2-3, Figure 10): the upper foreshore is delineated by a >1m high raised peat-bog covered with tufted sedge-grass, hawthorn, and other low-lying vegetation. The foreshore measures 29m in width at this location and is composed of a coarse sands and gravels (<2mm) with frequent larger sub-angular and sub-rounded stones (size range: 0.04m x 0.05m – 0.08 x 0.10m). Larger rocks are also frequent within the foreshore make-up, ranging in size from 0.20m x 0.30m to 0.40 x 0.50m. These larger rocks are predominately

found close to the High Water Mean (HWM), smaller rocks being more frequent along the upper reaches of the foreshore. Seaweed (*Bladderwrack* species) predominates along the inter-tidal zone between the HWM and the Low Water Mark (LWM); approximately 90% surface-coverage.

Reference Point 2, NGR: 854568E, 336221N (Plates 4-6, Figure 10): the upper foreshore is 12m in width at this location and is composed of a thin (>0.10m), grass-covered deposit of peat with frequent rounded and sub-rounded stones (<0.10m x 0.10m). This area of foreshore is delineated by a 1m+ high deposit of silty-sand (fine-coarse sediments), light brown in colour, with frequent coarse gravel and rounded to sub-rounded stone inclusions. This deposit lies beneath a 1.25m deposit of raised peat-bog, covered by hawthorn, tufted sedge-grass, and mixed heather species. The inter-tidal zone measures 15m in width at Low Water and comprises of angular to sub-angular rocks covered with *bladderwrack* seaweed.

Reference Point 3, NGR: 852765E, 336404N (Plates 7-9, Figure 10): a mid-brown, silty-sand deposit measuring 0.75m in height delineates the foreshore at this location. A 0.30m deposit of topsoil overlies this deposit and mixed grasses and low-lying vegetation line the top of the bank structure. The upper foreshore is composed of sub-angular and sub-rounded stones ranging in size from 0.05 x 0.08m – 0.10m x 0.14m. The upper foreshore measures 5-8m in width along this section, while the inter-tidal area has an increased in width to 30m+.The inter-tidal area is composed of silty-sand (40%60% mix) with frequent stone, gravel, and crushed shell inclusions. As with the previous reference points there is a thick covering of seaweed (*bladderwrack*) across most of the inter-tidal zone; only becoming patchy towards the LWM.

Reference Point 4, NGR: 849893E, 336639N (Plates 10-12, Figure 10): the upper foreshore at this location is characterized by an isolated bedrock outcrop that shelves from a small rock-face (4m max. height) for a distance of c.10m to meet the HWM. At this point the topography changes, the inter-tidal zone being composed of coarse angular gravels and angular stones/ rocks; most likely eroded from the adjacent rock outcrop. Seaweed (*Bladderwrack*) is present across this area and covers approximately 70% of the inter-tidal zone.

Reference Point 5, NGR: 849890E, 336881N (Plates 13-15, Figure 10): this area of foreshore is delineated by a 1.5m-2.5m high deposit of silty-sand (fine-coarse sediments), light brown in colour, with frequent coarse gravel and rounded to sub-rounded stone inclusions. The deposit is pot-marked, and has small, cave-like,

depressions in its face (average size 1mx 1m x 0.50m); most likely caused by the erosional effect of spring tides and storm waters within the bay. A thin layer of topsoil overlies this deposit which is covered with gorse bushes, hawthorn, and mixed grasses. The upper foreshore is composed of angular to sub-angular stones (size range: 0.02m x 0.04m x 0.08m x 0.12m), coarse gravels, and frequent concentrations of *saltmarsh* grasses. The upper three quarters of inter-tidal zone is of similar composition to the upper foreshore, although the grass is replaced with extensive seaweed (*bladderwrack*) cover. The lower reaches of this zone is composed of a silty-sand (10%/90% mix) that extends 5-10m to meet the LWM.

Reference Point 6, NGR: 846722E, 336881N (Plates 16-18, Figure 10): this area is characterized by an extensive sand bank that extends c.135m to the bays central flow-channel. The sandbank is completely exposed at Low Water. It is flat and featureless; only occasional scouring being present around the rocks that infrequently dot its expanse. The upper reaches of the inter-tidal zone, measuring 20m in width, are composed of rounded to sub-rounded cobbles and large patches of seaweed. The upper foreshore area is delineated by a gently rising 1m+ high bank covered with long grasses and rushes. This upper area is composed of saltmash vegetation.

Reference Point 7, NGR: 839868E, 337119N (Plates 19-21, Figure 10): as with the previous reference point, this area is characterized by sandbank exposure at Low Water. Its extent measures 1480m east-west and a 450m north-south (at widest point); the central-flow channel meandering to the southern side of the bay to accommodate the sandbank. This sand deposit, while largely flat and featureless, has a number of large scour holes caused by modern debris protruding from the surface. Patches of kelp are evident within these scour holes, where the seaweed has anchored to the debris.

The sandbank is composed of a medium to fine-sand with quartz inclusions and fine crushed-shell fragments. Isolated, water rolled/ worn lumps of peat dot the sandbank, eroded from upstream peat deposits located at the confluence of the Glenamoy and Muingabo Rivers. The upper reaches of the inter-tidal zone are composed of sub-angular stone and rocks (size range: 0.02m x 0.04m x 0.08m x 0.12m) with occasional larger rocks measuring up to 0.40m x 0.50m in size. Seaweed covers much this zone, which measures approximately 12m in width. The upper foreshore area measures 10m in width and is delineated by a grass-covered bank measuring 2m+ in height.

Reference Point 8, NGR: 824673E, 3381851N (Plates 22-24, Figure 10): this area of foreshore is located at the waterways narrowest point, c.1.4km from the mouth of Sruwaddacon Bay. The inter-tidal extent is greatly reduced along this section, measuring 10m in width, and is delineated by a steep, almost vertical, cliff-face measuring 5m+ in height. In several places the shelving-bedrock runs from the cliff-face down to the LWM. There is no upper foreshore zone along this stretch, the HWM extending to the base of the cliff. The inter-tidal zone is composed of large angular rocks interspersed with smaller rocks and fragments of bedrock eroded form the cliff-face. Seaweed coverage is approximately 60-70% along this section.

Reference Point 9, NGR: 822662E, 339189N (Plates 25-26, Figure 10): this section of foreshore is located at the mouth of the Gweendany River Estuary, as it flows into the northwest extent of the bay, approximately 600m to the east of the bay's mouth. The inter-tidal zone measures 30m in width and is composed of fine sand deposits with frequent, large, angular rocks located along the upper reaches of the HWM. There is no upper foreshore area between the HWM and the base of a sloping grass covered bank, measuring 4-5m in height, which delineates the shoreline.

Reference Point 10, NGR: 822594E, 338480N (Plates 27-28, Figure 10): this reference point is located on the south-eastern limit of a large sand bank and sand dune system (c.300m x 300m area), located on the southern side of the mouth of Sruwaddacon Bay. This area is composed of a silty-sand (40%/60% mix) with frequent stone and crushed shell inclusions (approximately 30%). The silt content is increased along this area due to the deposition of river sediments along the eastern extent of the sand bank; these sediments being washed downstream through the central-flow channel from the Glenamoy and Muingabo Rivers. In addition, it was noted that due to this river deposition, several deposits within the sand bank comprise of 60% silt content with frequent tree branch and waterborne debris inclusions, including clumps of peat and other organic matter. Large sand dunes are located along the western limit of this area.

Reference Point 11, NGR: 822973E, 338067N (Plates 29-31, Figure 10): this section of foreshore is located on the southern side of the bay, adjacent to reference point 8, and is similar in composition to that of the northern side of the bay. A steep-sided, 60º degree, rock-face (8-10m in height) delineates the HWM along this section of shoreline. The rock-face is largely covered with overhanging vegetation and small trees. The inter-tidal zone measures 13m in width and is composed of shelving bedrock with overlying deposits of angular stone and coarse gravels. Large, angular rocks are intermittently located along this are and represent rock-fall from the

adjacent rock-face. The inter-tidal zone is covered with a thick growth of *bladderwrack* seaweed and a large number of cockles and mussels were located along the LWM.

Reference Point 12, NGR: 824312E, 3378426N (Plates 32-33, Figure 10): the topography described for reference point 11 continues along this section for a distance of 200m (running eastwards). However, the inter-tidal zone increase in width to 20m and a 4m wide area of upper foreshore no begins to be present. This upper area is composed of bedrock and overlying saltmarsh vegetation.

Reference Point 13, NGR: 824993E, 337704N (Plates 34, Figure 10): the rock face that previously delineated the shoreline is replaced by a tree lined, grass covered, embankment. A small stream runs through a ravine at NGR: 82468E, 337691N to discharge into the bay. The upper foreshore is composed of coarse gravels (<2mm), rounded to sub-rounded stones (size range: 0.04m x 0.04m – 0.10m x 0.12m), and patches of saltmarsh vegetation is taking hold. The inter-tidal zone increases in width to 28m along this section and is composed of silty-sand (30%/70% mix) with frequent gravel inclusions. Occasional large, sub-angular rocks, are dotted along its extent. A thick growth of *bladderwrack* seaweed covers the inter-tidal zone (approximately 80% coverage).

Reference Point 14, NGR: 826127E, 337211N (Plates 35-37, Figure 10): this section of foreshore is characterized by a 110m north-south x 205m east-west inlet where a tributary of the Bellanboy River discharges in to the bay. The upper foreshore is composed of rounded to sub-rounded cobbles, below which a 10m band of *bladderwrack* seaweed is located; along the HWM. The inter-tidal zone measures 110m in maximum with and is composed of water-sorted sediment deposition from the river discharge. The upper area of the inert-tidal zone is composed of a 40%/60% silt-sand mix. This sediment mix changes, with the silt content greatly increasing, the further north you travel across the foreshore. The greatest silt content being present along a 30m band above the LWM, 70% silt /30% sand mix. This deposit measures 2m+ in depth.

Reference Point 15, NGR: 82912E, 336995N (Plates 38-40, Figure 10): the foreshore is delineated by a shallow peat deposit (0.25m height) with an overlying cover of saltmarsh vegetation. The HWM is compose of sub-rounded gravels and small sub-rounded stones (>0.04m x 0.05m) overlying a silty-sand (30%/70%). This composition extends into the inter-tidal zone where it becomes extensively covered with *bladderwrack* seaweed. The inter-tidal zone is 31m in width at this location.

Reference Point 16, NGR: 835839E, 336647N (Plates 41-43, Figure 10): this section of foreshore is similar to that found at the previous reference point. The inter-tidal zone measuring 33m in width and is composed of sub-rounded gravels and small sub-rounded stones (>0.04m x 0.05m) overlying a silty-sand (30%/70%). *Bladderwrack* seaweed covers 70% of this zone.

Reference Point 17, NGR: 861885E, 335222N (Plates 44-46, Figure 10): This section of foreshore is located at the eastern limit of Sruwaddacon Bay. It is delineated by a steep sided, undulating, peat deposit measuring 2.5m+ in height. Slatmarsh vegetation covers this deposit and extends 7-8m east towards the HWM. The HWM is composed of a mass of angular rocks, largely uniform is size (measuring between 0.04m x 0.05m and 0.06m x 0.06m). This rocky deposition extents below the HWM for a distance of 11-12m and is completely covered with *bladderwrack* seaweed. A silty-sand (30%/70% mix) forms the seabed along the LWM.

Observations

A number of modern objects were encountered during the survey and all represented modern, dumped debris. The majority of were located within the sandbank areas, and are believed to have been used as fastening points for mono-filament netting; discarded mono-filament netting being found either attached to or located close by to these objects. Only two features of note were encountered during the survey:

Feature 1 comprises an artificial, linear, deposit of rocks located at NGR: 826197E, 337967N (Plate 47, Figure 12). This feature runs northwest to southeast from the upper foreshore for a distance of 8m to end just below the HWM. The structure comprises of a single course of un-faced stone blocks; average size 0.40m in length x 0.30m in width x 0.30m in depth. It is of dry-stone construction and no trace of mortar bonding was present. This structure is thought to represent a simple, ninetieth or early twentieth-century, boat-slip or landing place; suitable for a rowing boat, *curragh*, or similar size vessel.

Feature 2 comprises the upstanding remains of a ninetieth-century boathouse, located at NGR: 826143E, 33851N. (Plates 48-49, Figure 12). The boathouse is of roughly-coursed masonry construction, bonded with a coarse lime mortar. The structure is rectangular in form, running northeast to southwest for a distance of approximately 6m. Both the back wall (north side) and the eastern wall survive to a height of 1.25m, while the west and south walls survive to a maximum height of

2.75m. Collapsed masonry from the boathouse is located to the east and south of the structure. The boathouse is almost certainly associated with an adjacent, ruined, two-storey house of nineteenth-century date; the boat house lying within its field boundary.

Conclusion

The inter-tidal assessment was comprehensive. No material/ deposits/ structures of archaeological significance were observed as part of the survey. While the presence of Features 1 (possible slipway) and 2 (ruined structure; boathouse) is of historic interest, providing an insight into the nineteenth-century and early twentieth century use of the foreshore, they hold no inherent archaeological value.

The inter-tidal zone was largely clear of man-made surface debris; only occasional modern debris being found across the foreshore and sandbank areas. Given the compact and rocky topography, comprising much of the upper foreshore area, a poor archaeological holding-content can be ascribed. This, coupled with a lack of any physical evidence from the survey, has resulted in poor archaeological potential. A medium archaeological holding-content can be ascribed to the inter-tidal sandbank areas. While they lie within a high-energy environment, one that would move any portable objects downstream, the sandbank areas provide a good holding-content for larger, non-portable, objects or structural remains; these would be quickly buried within the shifting sands of the bank structure. As such, the possibility that archaeological material/deposits may lie buried *in-situ* within the sandbank areas still remains.

5.2 Sub-tidal Zone

Seabed Topography

The sub-tidal zone is limited to the central-flow channel which meanders westwards between a series of large sandbanks. This central flow-channel measures 30-40m along much of its extent, reaching a maximum width of 140m between Reference Points 8 and 11. However, even at its widest point the channel is split into two sections, measuring 54m and 63m in width, with an intersecting 23m wide sandbank. A water depth of between 0.30-0.40m was recorded for the shallowest parts of the channel, increasing to a maximum depth of 2m along the deepest parts.

The seabed between NGR: 860114E, 335228N and NGR: 850980E, 336158N (located across eastern quarter of bay) is composed of a silt-sand mix (30%/70% mix) with occasional cobble inclusions. It is flat and featureless with occasional scouring

around, water-rolled, peat deposits or larger rocks. The silt content present within the seabed decreases as you travel west across the bay; the silt being replaced by coarser sediments and crushed shell deposits. The seabed between NGR: 860114E, 335228N and NGR: 825003E, 337942N (the central half of the bay) is composed of a silt-sand (5%/95%) mix and remains largely flat and featureless. This bottom topography changes between NGR: 860114E, 335228N and NGR: 822782E, 338993N where water velocity is greatly increased and deep scour holes (1m+ in depth) are present. The natural bedrock is being exposed within the deeper scour holes. The seabed is composed of a coarse sand deposit, with frequent crushed shell, overlying a rocky bottom.

Observations

Only one man-made object was encountered as part of the underwater survey, located at NGR: 841635E, 336978N (Figure 9). The object represents a mass of iron measuring 3m (north-south) and 0.40m (east-west). The object is modern in origin and is believed to a machine part..

Magnetometer Survey

Magnetometer survey by hand-held metal-detector was undertaken across two areas, as identified in Figure 11. Area 1 is located at the eastern limit of Sruwaddacon Bay (Reference Point 17) and Area 2 represents a large sand bank located on the northern side of the bay (Reference Point 6).

A medium-low target ratio of 1 hit per 2m² was encountered across Area 1. The majority (90%) of the targets represented sub-surface hits. Surface finds included: fragments of barbed wire fencing, fishing weights/ hooks, drinks cans, etc. All material encountered was of modern origin.

A medium-low target ratio of per 2m² was encountered across the upper foreshore at Area 2. In contrast, a relatively low target ratio of 1 hit per 3-4m² was encountered across the inter-tidal sandbank area. As with Area 1, targets were mainly sub-surface. Surface hits included machine parts, a car wheel, and fragments from a metal drum. All material encountered was of modern origin.

5.3- Pipeline Crossings

The Bay crossings are listed as areas of archaeological potential, Dooncartoon Td to Rosdoagh Td crossing being listed as **Area B**, the Rosdoagh Td to Aghoos Td crossing as **Area E**, and the inlet crossing point as **within Area F**:

ID Area B, Lower crossing, western side of Sruwaddacon Bay, NGR: 820834E, 338476N (Plates 4-6): the impact area is located on the south-eastern limit of a large sand bank and sand dune system located on the southern side of the mouth of Sruwaddacon Bay. This area is composed of a silty-sand (40%/60% mix) with frequent stone and crushed shell inclusions (approximately 30%). The silt content is increased along this area due to the deposition of river sediments along the eastern extent of the sand bank; these sediments being washed downstream through the central-flow channel from the Glenamoy and Muingabo Rivers. In addition, it was noted that due to this river deposition, several deposits within the sand bank comprise of 60% silt content with frequent tree branch and waterborne debris inclusions, including clumps of peat and other organic matter. Large sand dunes are located along the western limit of this area.

ID Area B, Lower crossing, eastern side of Sruwaddacon Bay, NGR: 824565E, 338303N (Plates 23-24): this area of foreshore c.1.4km from the mouth of Sruwaddacon Bay. The inter-tidal extent is greatly reduced along this section, measuring 10m in width, and is delineated by a steep, almost vertical, cliff-face measuring 5m+ in height. In several places the shelving-bedrock runs from the cliff-face down to the LWM. There is no upper foreshore zone along this stretch, the HWM extending to the base of the cliff. The inter-tidal zone is composed of large angular rocks interspersed with smaller rocks and fragments of bedrock eroded form the cliff-face. Seaweed coverage is approximately 60-70% along this section.

ID Area E, Upper crossing, north side of Sruwaddacon Bay, NGR: 852689E, 336430N (Plates 27-28): the upper foreshore is 12m in width at this location and is composed of a thin (>0.10m), grass-covered (*Saltmarsh* grass), deposit of peat with frequent rounded and sub-rounded stones (<0.10m x 0.10m). This area of foreshore is delineated by a 1m+ high deposit of silty-sand (fine-coarse sediments), light brown in colour, with frequent coarse gravel and rounded to sub-rounded stone inclusions. This deposit lies beneath a 1.25m deposit of raised peat-bog, covered by hawthorn, tufted sedge-grass, and mixed heather species. The inter-tidal zone measures 15m in width at Low Water and comprises of angular to sub-angular rocks covered with *bladderwrack* seaweed.

ID Area E, Upper crossing, south side of Sruwaddacon Bay, NGR: 855216E, 335497N: the foreshore is delineated by a shallow peat deposit (0.15m height) with an overlying cover of saltmarsh vegetation. The HWM is composed of sub-rounded gravels and small sub-rounded stones (>0.04m x 0.05m) overlying a silty-sand

(30%/70%). This composition extends into the inter-tidal zone where it becomes extensively covered with *bladderwrack* seaweed. The inter-tidal zone is 27m in width at this location.

ID Area F, Inlet Crossing, Leenamore River, NGR: 859382E, 335188N (centre-point): the inlet measures c.60m in width and 51m in length. It is composed of gently undulating estuarine silts overlying a silty-sand deposit that forms the natural sub-strata. The build-up of estuarine silts at this location is due to sediment transportation from the Leenamore River, a shallow river that enters the inlet at NGR: 858799E, 335069N and forms the townland boundary between Aghoos and Bellagelly. On entering the inlet, the river divides into two 1m wide flow-channels that meander in a northerly direction for approximately 30m, after which they re-join each other to form a 5m wide central flow-channel. This channel flows for c.21m to its confluence with Sruwaddacon Bay. The inlet is largely submerged during high water and mid-water periods, the river-channel only being fully exposed at Low Water.

5.4 Geophysical Anomalies

A list of geophysical anomalies was identified in advance of dive work in Sruwaddacon Bay, and their details are set out below in Appendix 2. In only one instance (Anomaly 20) did the geophysical data suggest that the anomaly retained clear archaeological significance. However, as this feature and several other of the anomalies lay outside Sruwaddacon Bay itself they were also outside the dive inspection zone, which was restricted to the Sruwaddacon Bay. Such 'external' anomalies were not considered further. Dive inspection of the anomalies within the bay used the location coordinates to position over the feature. A measured line search around the feature was undertaken to assess fully the anomaly and its immediate context.

Conclusion

All side-scan sonar anomalies located were of natural of modern origin. Anomalies SS1, SS3, SS4, SS6, SS8, SS10, SS13 and SS26 were identified during the underwater survey, these anomalies being located within the sub-tidal zone. The remainder of the anomalies were located within the inter-tidal zone and were easily identified during the foreshore and sandbank walk-over.

5.5 Geotechnical Investigations

The geotechnical logs and data report on a series of rotary and percussive boreholes taken along the proposed pipeline crossing points in Sruwaddacon Bay identified a buried peat level in four locations (Table 4).

Borehole	Easting	Northing	Detail
Percussive 8	85441.4	336023.3	A 0.5m thick deposit of very soft brown peat/organic silt layer was located at between 9.30m and 9.80m below seabed
Percussive 10	85488.40	335819.43	0.7m thick deposit of soft peat located located at between 10.6m and 10.7m below seabed. Hazelnut shells were recovered.
Rotary 7	85370.56	336121.28	0.1m thick deposit of black plastic amorphous peat with a little mica located at between 5.80m and 5.90m below seabed.
Rotary 8	85441.35	336023.27	0.2m thick deposit of black plastic amorphous peat with a little mica located at between 10.1m and 10.3m below seabed

Table 4: Summary presentation of Geotechnical Borehole data showing buried peat horizons

The four instances where peat was identified are from boreholes situated along the crossing of the upper part of the bay. The peat is located at depth between 8.5m and 10.7m below current seabed level. In one instance hazelnut shell fragments were identified. The hazelnut shells have been set aside for further analysis. No archaeological artefacts were identified in the samples recovered.

Conclusion

The geotechnical logs identified a buried peat layer at some depth below current seabed level at four locations across the upper crossing for the pipeline. There is no indication that this layer retains archaeological material. The most appropriate mitigation strategy is to maintain a monitoring programme during tunnelling operations in this area, with special attention to the locations of the four boreholes.

6.0 POTENTIAL IMPACTS

Potential Impacts during Construction Phase

It is anticipated that a trenchless method of pipeline construction is to be used, a method designed to minimise seabed and foreshore disturbances. This method

requires the excavation of a launch pit on one side of the bay and a reception pit on the over side of the bay. These works represent potentially significant impact on the existing environment. The main tunnelling work however will be conducted at considerable depth (approximately 5m-15m), and should represent an imperceptible impact on the archaeological environment. The buried peat layer in the upper bay area may be traversed by the tunnelling, however this wont be known until the detailed design of the crossing has been completed. An intervention in the Bay may be required, and in this instance would represent a potentially significant impact.

Potential Impacts during Operational Phase

As no surface archaeological indicators were encountered as part of the archaeological assessment of the inter-tidal foreshore and underwater areas impacted by the proposed pipeline crossings within Sruwaddacon Bay, it is anticipated that any impact to archaeological features would take place during the site preparation or construction stage of the proposed pipeline development; thus all archaeology will be resolved prior to the operational phase of the site.

Impacts during Decommissioning Phase

There will be no impact on archaeological or cultural heritage during the decommissioning stage of the project as it is anticipated that all archaeological features and sites will be resolved in the preconstruction or construction stage of the proposed development.

Conclusion

The conclusion of the present survey is that the known archaeological potential within Sruwaddacon Bay is low. This assessment does not extend on land beyond the foreshore but it is understood that the landward side of the two bay crossings and the inlet crossing retain archaeological potential, as detailed separately by Margaret Gowen Ltd. The possibility remains that the subsurface deposits within the Bay and at the proposed crossing retain archaeological material. The mobile nature of the estuarine silts within the sandbank areas and the palaeo-channel on the south side of the bay in particular would be an ideal holding area for such material. (The pipeline route will however not traverse the palaeo-channel). This is especially the case for all-wooden constructions, such as log boats and other pre-modern sailing craft and related features, since geophysical prospecting is unable to detect such anomalies that are buried. This point was made in the course of the Irish Subsea 2025 Gas

Interconnector project at the Gormanston, Co. Meath landfall, when a 7m long logboat was encountered during dredging 1km offshore.[4] Despite detailed geophysical survey in advance of the work, it was impossible for the suite of instruments to detect the wooden vessel. It is therefore recommended that all ground disturbances, on land and at sea, are archaeologically monitored, with the proviso to resolve fully any archaeological material observed.

7.0 RECOMMENDATIONS

Pre-construction Measures

No further archaeological measures are not necessary in advance of construction works commencing.

Construction Phase Measures

ARCHAEOLOGICAL MONITORING. It is recommended that archaeological monitoring licensed by the Department of the Environment, Heritage and Local Government is conducted during all seabed and inter-tidal/foreshore disturbances associated with the development, including temporary features and permanent features. Licence applications take a minimum of three weeks to process through the Department, and advance planning is required to ensure that the necessary permits are in place before site works commence.

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

THE TIME SCALE for the construction phase will be made available to the archaeologist, with information on where and when 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 construction works commencing. This will allow for prompt arrival on site to monitor the 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.

[4] Niall Brady, Archaeological Monitoring and Excavation. Gas 2025 Irish Subsea Interconnector Gormanston Landfall, Co. Meath, 02E0467, 02E0948, Interim Report, The Archaeological Diving Company Ltd, 27 November 2002; Reported by Niall Brady in Eoin Grogan, Lorna O'Donnell and Penny Johnston, *The Bronze Age Landscapes of the Pipeline to the West* (Dublin 2007), pp 325-6.

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 be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.

ARCHAEOLOGICAL DIVE TEAM. It is recommended that an archaeological dive team is retained for the duration of any inwater disturbance works on the basis of a twenty-four or forty-eight hour call-out response schedule, to deal with any archaeologically significant/potential material that is identified in the course of the ground disturbance activities. The permits necessary for this aspect of the site work are additional to the excavation licence required by the archaeological monitor, and are generally held by the dive-team leader. The archaeological dive licence takes a minimum of 3-5 weeks to process. It is necessary to ensure that all permits are in place before site works commence.

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

BUOYING/FENCING of any such areas would be necessary if 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 will be restricted to avoid any identified archaeological site/s and their environs.

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

PLEASE NOTE: Recommendations are subject to the approval of The Department of the Environment, Heritage and Local Government.

Operational Phase Measures

It is not anticipated that any archaeological measures should be necessary in during the operational phase.

Decommissioning Phase Measures

It is not anticipated that any archaeological measures should be necessary in during the operational phase.

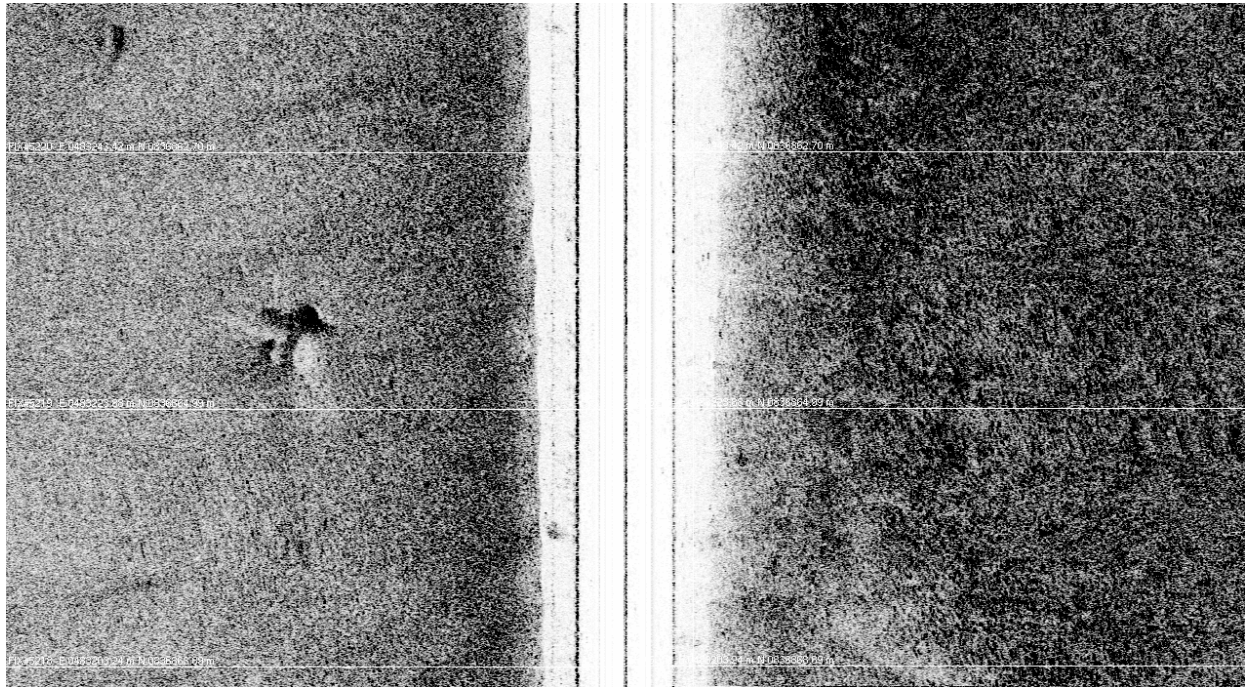
Residual Impacts

There will be no residual impacts on archaeological features or sites encountered as it is understood that any archaeology encountered will be resolved in the construction stage of the proposed pipeline development.

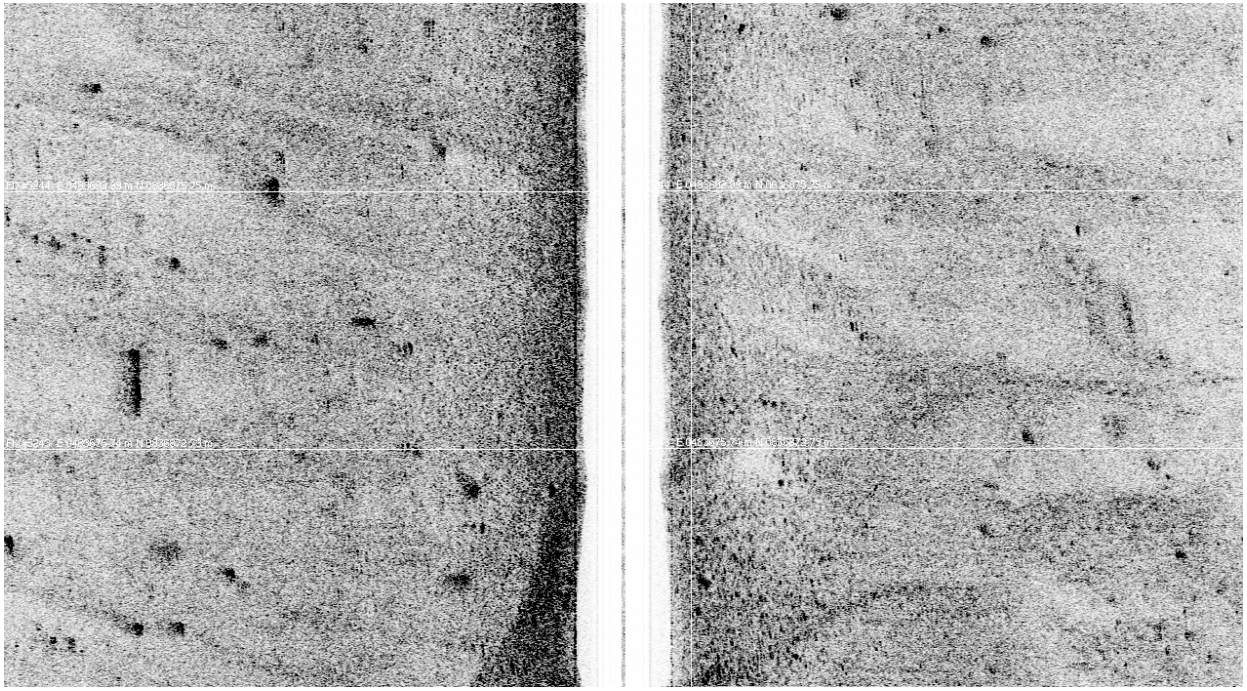
APPENDIX 1

Table of Side-scan Sonar anomalies Identified

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
4	5283-4	483226.69	836878.66	83250.3	336873.255	54	16	2.5475	9	47	33.57058	Irregularly shaped anomaly occupying c. 2m square area in sandy/muddy environment



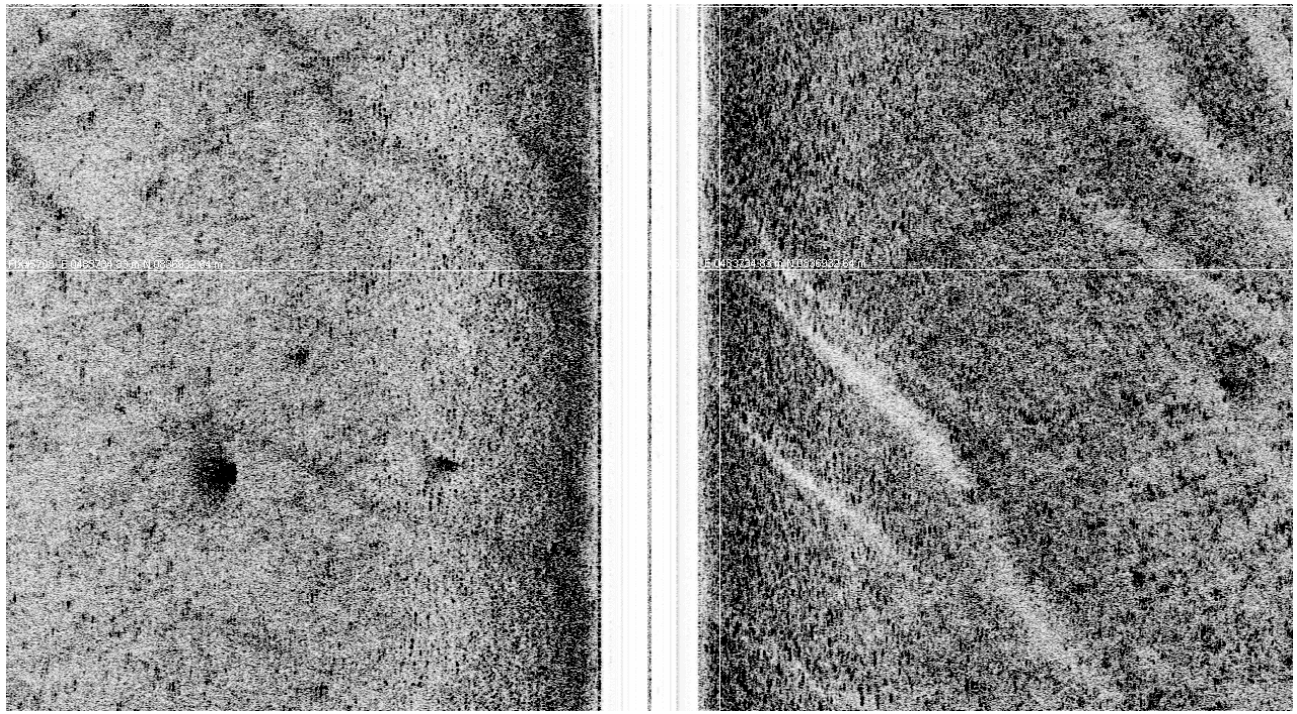
Diver Inspection Identification: Kelp anchored to large rock.

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
6	5244	483675.67	836894.46	83699.376	336889.058	54	16	3.42645	9	47	8.79279	2m long linear anomaly on silt bed. Debris/pipe piece
												**Diver Inspection Identification:** Tree branch debris
7		485128.35	836422.67	85152.368	336417.167		15	49.3535		45	47.89993	6m long narrow irregular feature, possibly a ridge/outcrop of peat in a muddy bottom
												Diver Inspection Identification: Tree branch debris

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
8	5606	483228.6	836877.71	83252.211	336872.304	54	16	2.51835	9	47	33.46375	c. 6m long object partly buried in silt/mud with scour pockets either side. Probable debris

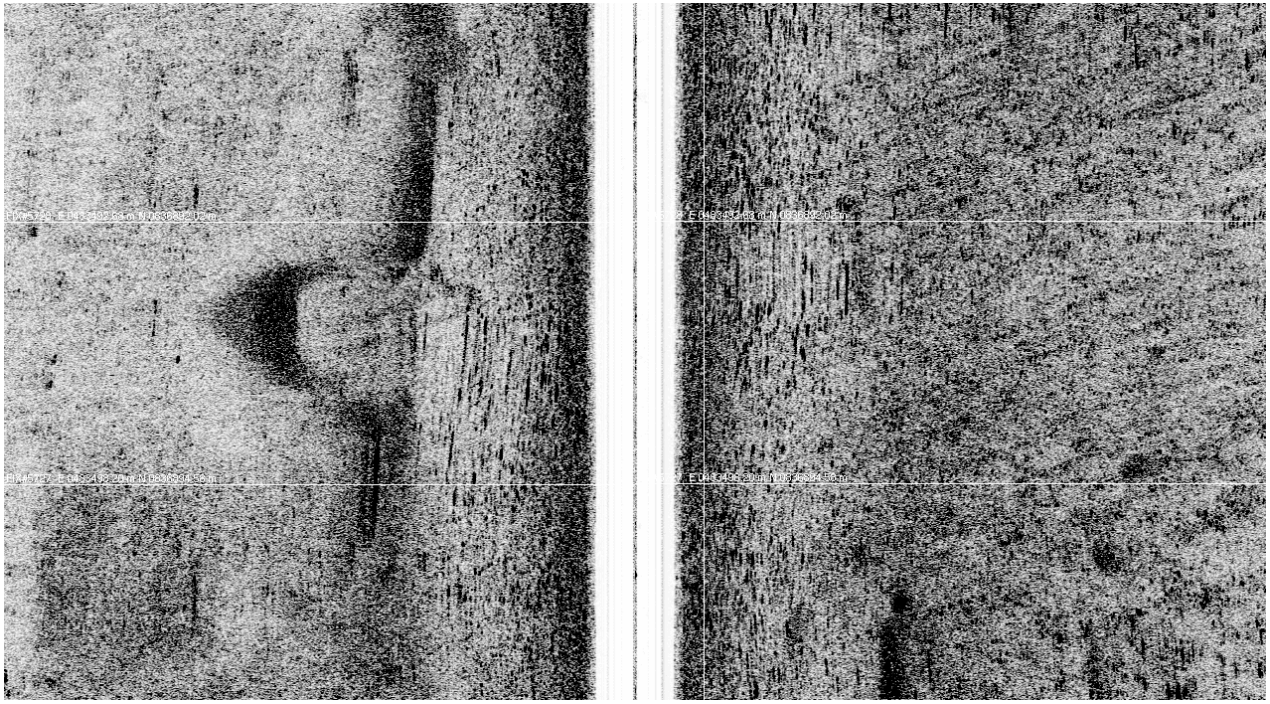
Diver Inspection Identification: Kelp anchored to large rock; Same as SS4.

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
9	5708	483745.57	836916.4	83769.29	336911.003	54	16	4.193	9	47	4.96242	Short defined anomaly rising clear of the seabed. Debris or turf clod



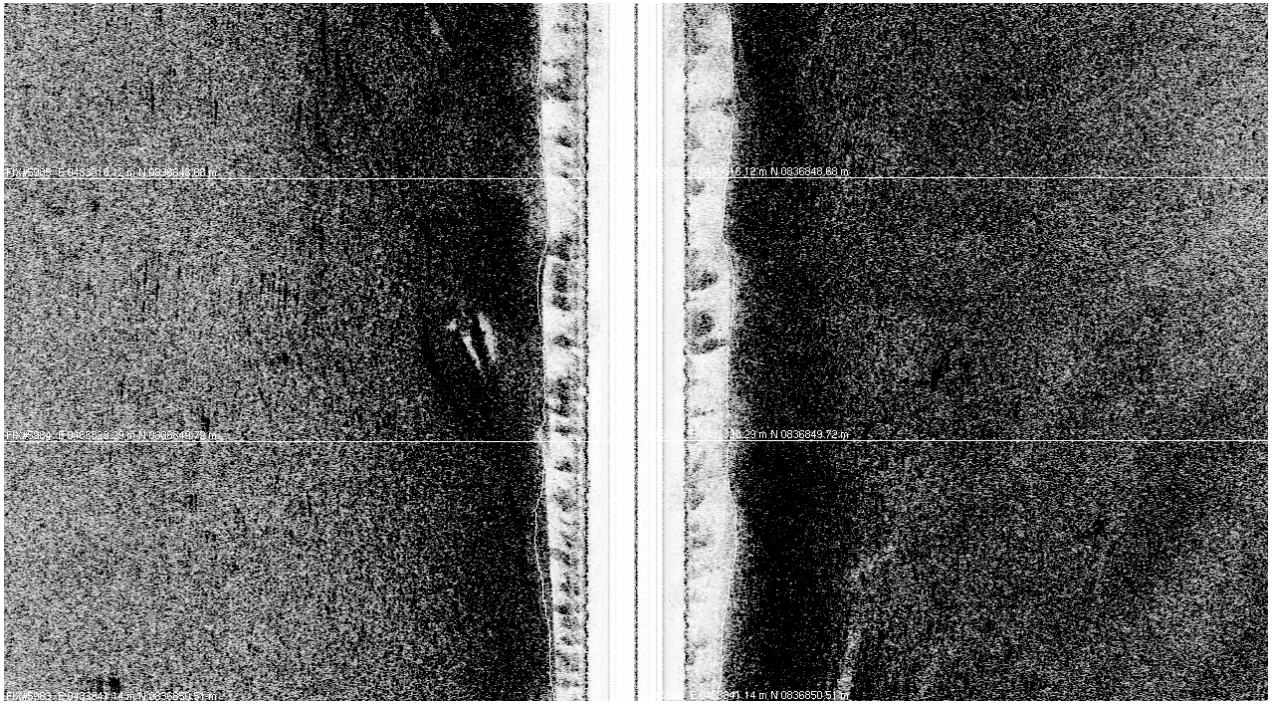
Diver Inspection Identification: Large Lump of water-rolled Peat

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
10	5727	483499.03	836879.44	83522.698	336874.035	54	16	2.79617	9	47	18.52871	Probable natural feature, forming bow-shaped extrusion from a linear ridge-like area of the seabed



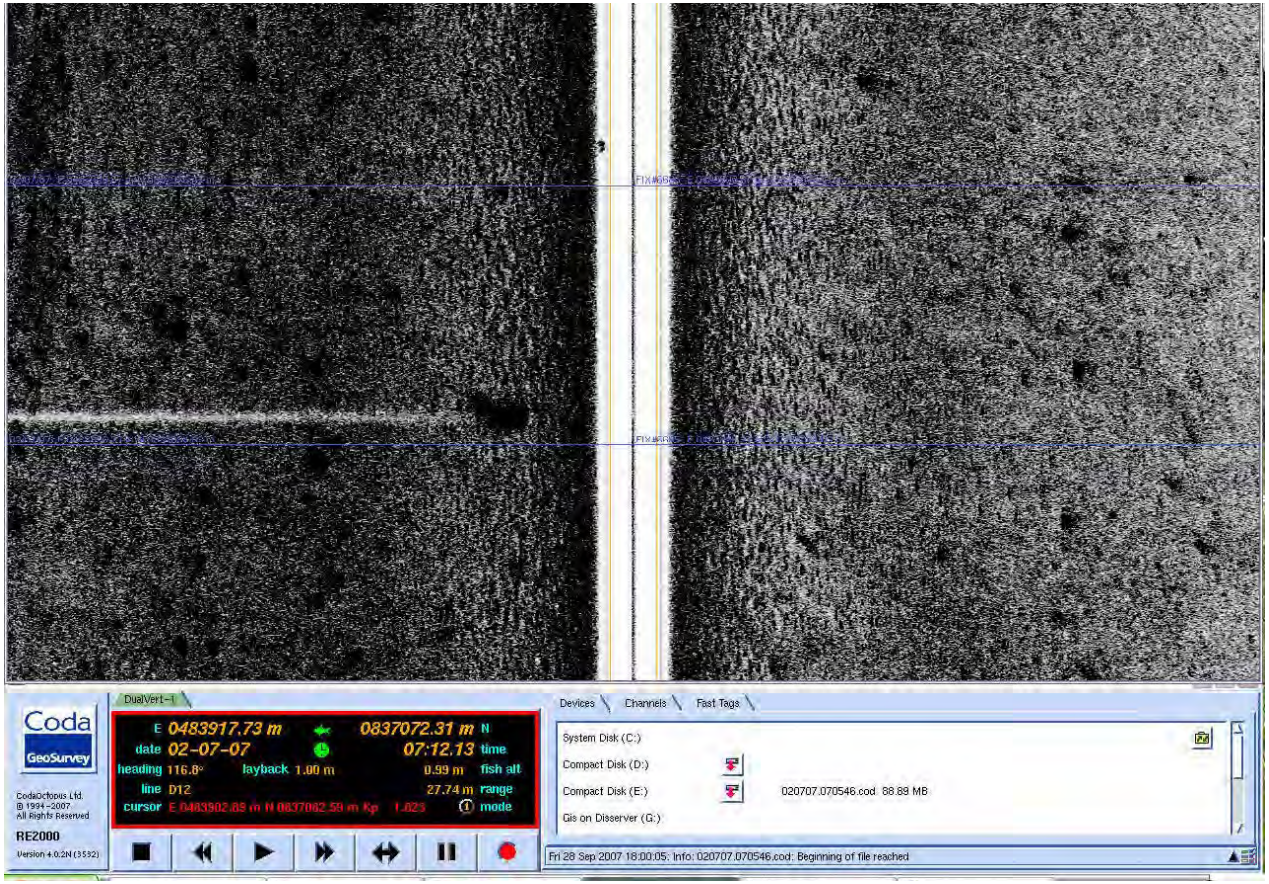
Diver Inspection Identification: Scour hole around large rock

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
11	5985	483823.78	836843.65	83847.517	336838.237	54	16	1.90477	9	47	0.54078	3-4m long irregularity in muddy seabed area, indicative of partly buried feature, perhaps debris



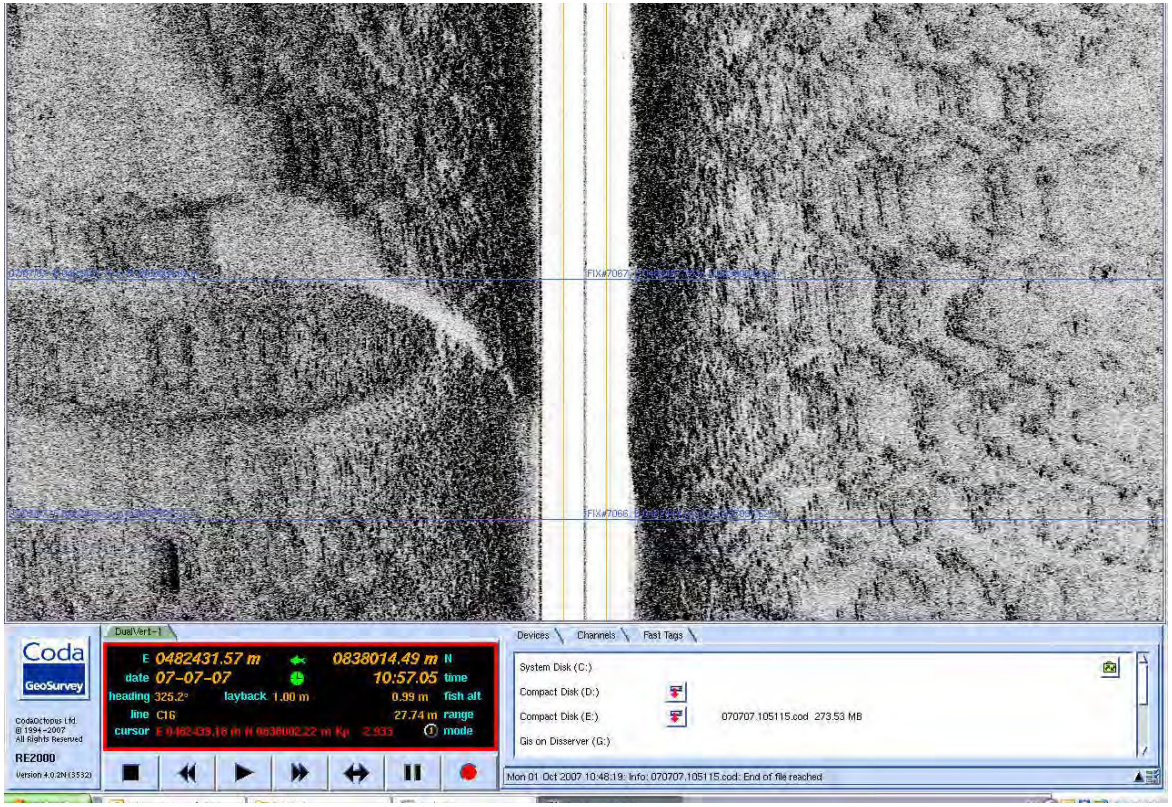
Diver Inspection Identification: No anomaly encountered during diver-truhting of SS11.

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
12	6665	483898.69	837088.32	83922.441	337082.961	54	16	9.8767	9	46	56.74445	Sharply defined anomaly with strong echo indicative of rising above seabed; probable pole



Diver Inspection Identification: Seaweed covered Breeze-Block and small scour hole, Plate 50.

Anomaly No.	Fix No.	ITM Easting	ITM Northing	ING E	ING N	WGS84 Lat N			WGS84 Long W			Description
13	7066-7	482435.28	837997.53	82458.712	337992.368	54	16	38.0703	9	48	18.86582	Localized anomaly that presents a bow-shaped scour pattern in SW direction



Diver Inspection Identification: Scour-hole with small rocks at its base.