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Ecological Impact Assessment (EcIA) for a Foreshore Licence Application for pre-installation survey and main lay for a fibre optic cable with a landfall at Ballyloughane Strand, Galway Bay for Deep Sea Fibre Networks Ltd.

20th June 2018

Prepared by:

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On behalf of:
Deep Sea Fibre Networks Ltd.

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Document Control Sheet			
Client	Deep Sea Fibre Networks Ltd		
Project	Ecological Impact Assessment (EcIA) for a Foreshore Licence Application for pre-installation survey and main lay for a fibre optic cable with a landfall at Ballyloughane Strand, Galway Bay for Deep Sea Fibre Networks Ltd.		
Report	Ecological Impact Assessment		
Date	20th June 2018		
Project No:		Document Reference: EcIAMDMFO06	
Version	Author	Reviewed	Date
Draft 01	Bryan Deegan	SC/TMcM	5th June 2018
Draft 02	Bryan Deegan		20th June 2018

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INTRODUCTION

Background

Ecological Impact Assessment (EcIA) has been defined as 'the process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components (Treweek, 1999). EcIA is a key component of Environmental Impact Assessments (EIAs), which are carried out to meet the requirements of Council Directive 85/337/EEC on the Assessment of the effects of certain public and private projects on the environment(CEC, 1985), as amended by Council Directive 97/11/EC (CEC, 1997). The purpose of EcIA is to provide decision-makers with clear and concise information about the likely ecological effects associated with a project and their significance both directly and in a wider context. Protecting and enhancing biodiversity and landscapes and maintaining natural processes depends upon input from ecologists and other specialists at all stages in the decision-making and planning process; from the early design of a project through implementation to its decommissioning (IEEM, 2010). The following EcIA has been prepared at the request of the National Parks and Wildlife Service (NPWS) for a proposed marine fibre optic cable installation from Bilboa, Spain to make landfall at Ballyloughane Beach, Galway City, Ireland.

Study objectives

The objectives of this EcIA are to:

1. Outline the project and any alternatives assessed;
2. Undertake a baseline ecological feature, resource and function assessment of the inshore (<12nm) and landfall route and evaluate the nature conservation importance of the route and zone of influence;
3. Assess and define significance of the direct, indirect and cumulative ecological impacts of the project during its construction, lifetime and decommissioning stages;
4. Refine, where necessary, the project and propose mitigation measures to remove or reduce impacts through sustainable design and ecological planning; and
5. Suggest monitoring measures to follow up the implementation and success of mitigation measures and ecological outcomes.

The following guidelines have been used in preparation of this EcIA:

- Guidelines on the information to be contained in Environmental Impact Statements (EPA 2002);
- Advice Notes on current practice in the preparation of EIS's (EPA, 2003);
- Institute of Ecology and Environmental Management Guidelines for EIA (IEEM 2005).
- Institute of Ecology and Environmental Management Guidelines for EcIA- Britain and Ireland-Marine and Coastal (IEEM, 2010).
- Institute of Ecology and Environmental Management Guidelines for EcIA- Britain and Ireland-Terrestrial, Freshwater and Coastal (IEEM, 2016).

Planning background to the application

The process of bringing a fibre-optic cable ashore in Ireland involves the Foreshore Acts 1933-2011. It requires that "before the commencement of any works or activity (including the erection of any structures) on State-owned foreshore a licence or lease must be obtained from the Minister for Agriculture, Food and the Marine for works." The foreshore is classed as the land and seabed between the high water of ordinary or medium tides (shown HWM on Ordnance Survey maps) and the twelve mile limit.

As outlined by IEEM (2010) "where an application for consent is sought for which EIA is not required, EcIA can be used to guide the development brief and inform the management plan." This EcIA forms part of such a consenting process. As part of an application for a foreshore licence, the Department of Environment, Community and Local Government (NPWS), in addition to requesting Natura Impact Statement, have requested an EcIA to be carried out, to assess the potential impact of the pre installation burial assessment survey and main lay of a fibre-optic cable on habitats and species of conservation significance. This includes species and habitats of both National and international conservation importance. **This EcIA forms a supplementary report**

to the Natura Impact Statement and concentrates on marine and landfall elements of the project. In order to reduce repetition, reference is made to the Natura Impact Statement where necessary. Terrestrial elements of the project from the beach manhole at Ballyloughane Beach will form part of a separate application. An ecological assessment of the terrestrial elements will be carried out as part of that process and the impacts of both the marine and terrestrial elements will be aggregated so as to provide a composite ecological assessment of the project as a whole.

1) PROJECT DESCRIPTION

1.1 Background

DeepSea Fibre Networks Ltd. is planning to construct a new sub-sea telecoms cable system linking Galway, on the west coast of Ireland to Bilbao on the north coast of Spain. This is referred to as the WINS System (Western Ireland Northern Spain) and the general line of the route is presented in Figure 1. A detailed description of the main-lay procedure, post-lay inspection and cable characteristics are seen in the NIS. The following represents a high level summary:

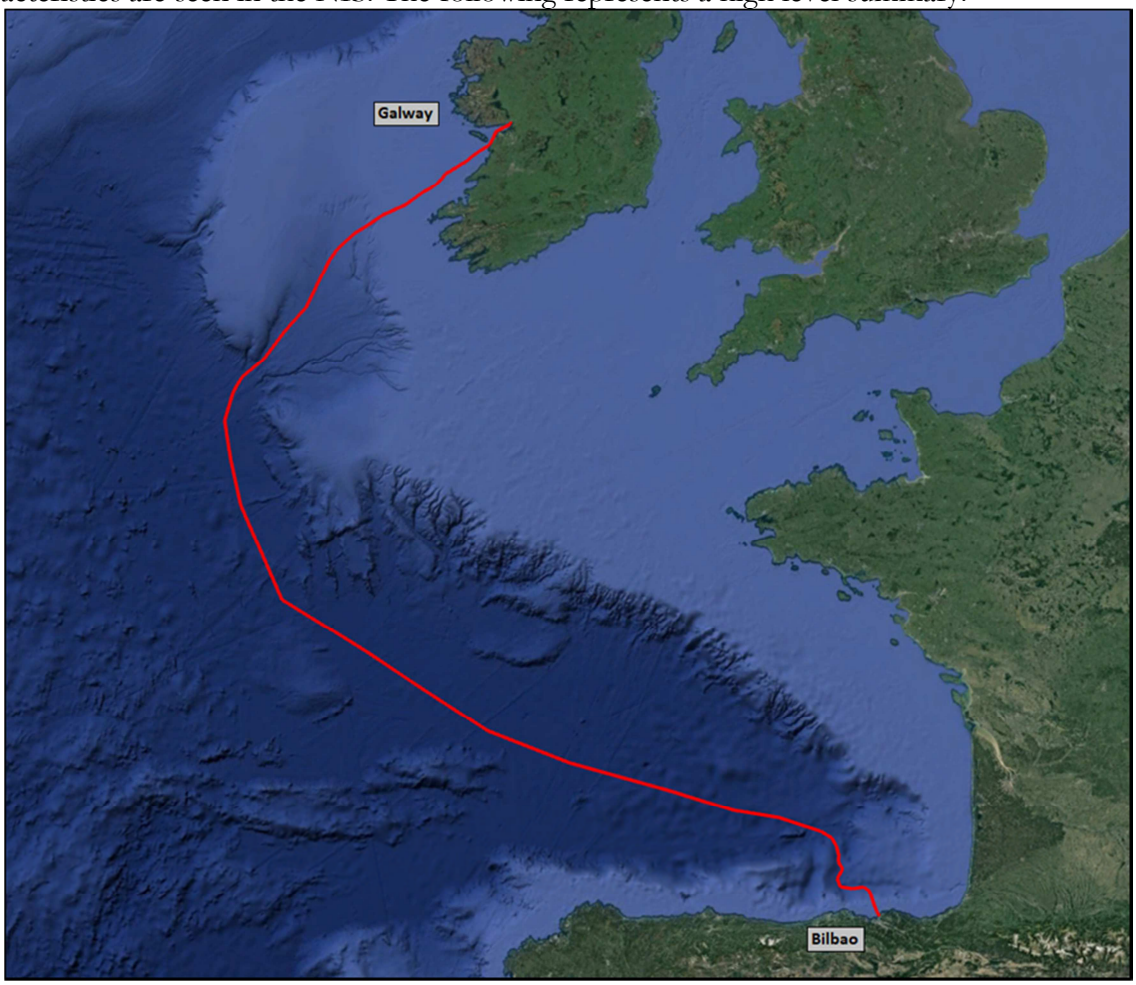


Figure 1. Schematic of the planned network.

1.2 Route

The overall planned route extends south west from Galway Bay, south of the Aran Islands (Figure 2), before dropping into the deep water of the Porcupine Seabight and then turning south on to the Porcupine Abyssal Plain before turning south east to the Bay of Biscay and the landfall at Bilbao. The system is 1774 km in length with the majority of the system routed in deep water off the continental shelf. The objective of this routing is to minimize installation difficulties and maximizing security of the system during its life. Of the 1774 km overall length only 325 km of the system is in water depth of less than 1500m. All of the cable crossings are also in deep water negating the need for plough up / plough down activities, guard vessels, post lay inspection and burial and associated weather delays and potential for cable damage during installation. At Galway the WINS system will make land fall at Ballyloughane Beach (Figure 3) and be tied-in to existing fibre optic cable networks which will provide resilient backhaul throughout Ireland and will connect with a selected PoP location in Dublin.

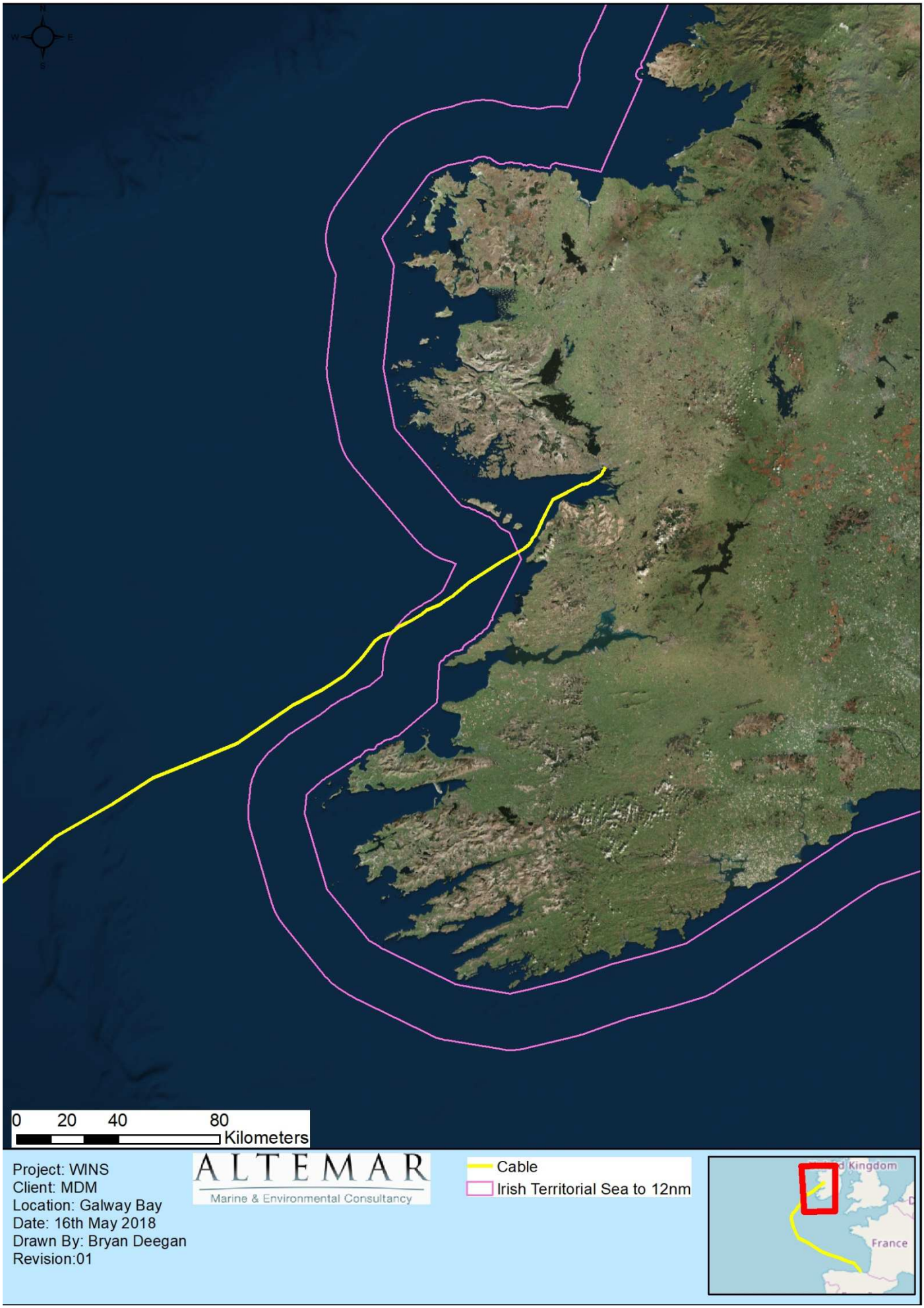


Figure 2. The proposed route passing through the Irish Territorial Waters, past the 12nm limit.

Figure 3. Landfall location at Ballyloughane Beach, Co. Galway.

1.3 Summary of cable laying methodology

As previously stated, this EcIA pertains to the subtidal and landfall elements of the fibre-optic cable within the Irish 12nm Limit and is a supporting document to the NIS as requested by NPWS. Full details of the methodology for the laying of the fibre optic cable have been provided in the text of the NIS. However, a brief summary is provided for clarity.

The project has previously investigated many landfall sites on the south west and west coast of Ireland. Following a desk based and visual review, Ballyloughane Beach was selected as the optimal route. As part of the route selection process a route has been selected targeting soft sediments, allowing for burial of the cable. Burial is the preferred option in order to ensure that the cable is protected from anthropogenic activities including fishing, shipping lanes, dredged channels, anchoring etc. Prior to the cable laying an intertidal and marine survey will take place to confirm baseline data and fine-tune the route, if necessary. As outlined in the NIS, this will involve an intertidal survey and a marine acoustic and sidescan survey.

For the shore end operation the beach preparations will consist of a "drill and leave" Horizontal Direction Drill (HDD), 200m in length from the amenity grassland area to the north of the road at the back of Ballyloughane Beach (Figure 3), which is located outside areas of conservation. It is estimated that the HDD drill will take 1 day to cover the 200m. A beach manhole is to be constructed onshore at the site of the HDD, to a depth of 2.5m approximately, 1m below the level of final HDD duct, the seaward end of which will be within the SAC, SPA, pNHA and Ramsar site. The intertidal burial will be carried out by plough to a depth of 1.5m also within the SAC, SPA, pNHA and Ramsar sites.

In the subtidal element, prior to the laying of the cable, the route will be cleared of any sea-bed debris by way of a pre-lay grapnel run which has a width of less than 1 metre. Cable installation is achieved by a cable ship with a marine plough, stationing offshore near its minimum working depth. Based on initial assessments a marine plough will be used for the entire length of the cable, except in areas where reef (cable will be laid passively on reef surface) or in the vicinity of other infrastructure (burial will be by ROV). The subtidal element of the project will be within the Galway Bay Complex SAC/pNHA and Inner Galway Bay SPA/Ramsar site.

1.4 Alternatives

Alternative Sites

The project has previously investigated a number of landfall sites on the west coast of Ireland. Following a desk based and visual review and a needs assessment, Ballyloughane Beach was selected as the proposed landfall location.

Cable Routing

The route has been selected to primarily facilitate burial of a cable, with the cable being laid passively over reef/bedrock when required. No destructive methods are proposed in reef areas. In the area from the Ballyloughane Beach to the mouth of Galway Bay sediments are soft allowing for burial. A small area of reef is located on the west coast of Co. Clare and the cable will be laid passively over this reef area. Once this area is passed the remainder of the route is in soft sediment.

It should be noted that the sediments in Galway Bay (Galway Bay Complex SAC (site code: 0268)) were examined for sensitive communities and the proposed route modified to avoid known sensitive communities. A detailed diving survey of the SAC was carried out in 2006 for NPWS as part of the Surveys of Sensitive Subtidal Benthic Communities in SAC's (MERC, 2006). Bryan Deegan of Altemar was a diving member of the survey team. The GIS outputs of these surveys included a detailed geospatial inventory of the dives and the boundaries of habitats encountered. The project used this geospatial habitat data to refine the cable routing within the SAC to assist in the avoidance of the sensitive communities. Following this routing revision a drop down video camera survey was carried out as part of this project on the revised route, to further fine tune and groundtruth the cable routing, particularly in areas outside the surveys carried out in 2006. Further

details of the communities encountered are detailed. It should be noted however that discussions took place with Galway Port's Harbour Master in relation to future expansions of the Port. The routing of the inshore element took into account these habitat and potential anthropogenic influences.

Alternative Methodologies

Best Available Techniques (BAT) have been used in the planning and implementation stages of this project and they "represent a key measure for avoiding environmental impacts" (OSPAR, 2012). An assessment was carried out on BAT and the methodologies to be used in the fibre optic cable installation. As outlined in OSAPR (2012) the possible mitigation measures to minimise or avoid environmental impacts of various anthropogenic pressures due to underwater cable laying and operation are seen in Table 1. Priority in this project to reduce the environmental impact was concentrated on route selection, construction times, burial technique, cable type and a reduction in potential sources of contamination during cable laying. The choice of using a HDD and plough at the landfall is that it ensures a rapid and minimally invasive technique to place the cable 1.5m below the sediment level, and the impacts would be expected to visually invisible within one to two tides, depending on the weather conditions.

The target burial depth of the cable will be to 1.5m but in hard ground a minimum of 0.4m will be attained. This is considered a depth that would have no significant long term impact on the intertidal or subtidal benthos.

Table 1. Possible mitigation measures to minimise or avoid environmental impacts of various anthropogenic pressures due to underwater cable laying and operation (OSPAR, 2012).

	Mitigation Measures					
Environmental impacts	Route selection	Construction times	Burial technique	Burial depth	Cable type	Removal
Disturbance	**x**	**x**	**x**	(x)	(x)	
Noise	(x)	(x)	(x)			
Heat emission[1]	(x)			x	x	
Electromagnetic fields[1]				x	x	
Contamination	x		(x)	(x)	x	x
Cumulative effects*	x	x	x	x	x	

x: important measure; (x) less important measure; * knowledge insufficient

1.5 Phasing of the Project

Phasing of the project involved assessing and understanding the potential environmental impacts of the project, reviewing the sensitive species and habitats in the vicinity of the landfall area and the subtidal environment out to the 12nm limit. It also involved consultation with statutory authorities (National Parks and Wildlife Service & Inland Fisheries Ireland) and selecting a time of year that would have minimal impact on the species that are of conservation importance. It should be noted that all site investigations and main lay elements will take place outside of the overwintering bird season (September to March).

Works	*Date*
Site Investigations	April 2019
Shore-End Installation	June 2019
Main-Lay	June - August 2019

Environmental Characteristics of SL Cable Operating Current

The SL 17 and SL 21 cables that are to be used in the project are designed to conduct system power for repeatered cable systems with a maximum operating DC current of up to 10 amps. The extremely high insulating properties of the outer polyethylene jacket prevent current leakage. Therefore, environmental effects associated with current leakage are negligible. Localized temperature effects in the vicinity of undersea cable systems have been evaluated based on the maximum powering characteristics of a cable system. The fundamental relation governing the maximum power dissipated P, in a length of cable with resistance R, and applied current I, defines the maximum value for heat dissipation. TE SubCom's SL cables exhibit very minimal temperature increase due to powering with heat dissipation rates of less than 3 watts per kilometre of cable. As a point of reference, if a 3 watt power source is used to heat a tank containing 1,000 litres (1 cubic meter) of water, it would take more than 387 hours to heat the water one degree Celsius. The low heat output, large quantity of water surrounding the cable, and movement of water due to currents and tides result in a negligible environmental effect. Double Armour Cable will be used in Irish waters. TE Subcom's SL cable is an industry standard core cable which is utilized in all present TE Subcom fibre optic telecommunications cable systems throughout the world. Information such as high-speed data and voice is transmitted via lightwave through the optical fibres contained within the central Unit Fibre Structure (UFS). A cut-away section of the Double Armour Cable is shown in Figure 4. The double armour, consisting of two layers of galvanised wire wrapped around the cable, is coated with hot-blown petroleum asphalt and wound with asphalt-soaked yarn. The finished DA Cable has an outer diameter of 35.9mm.

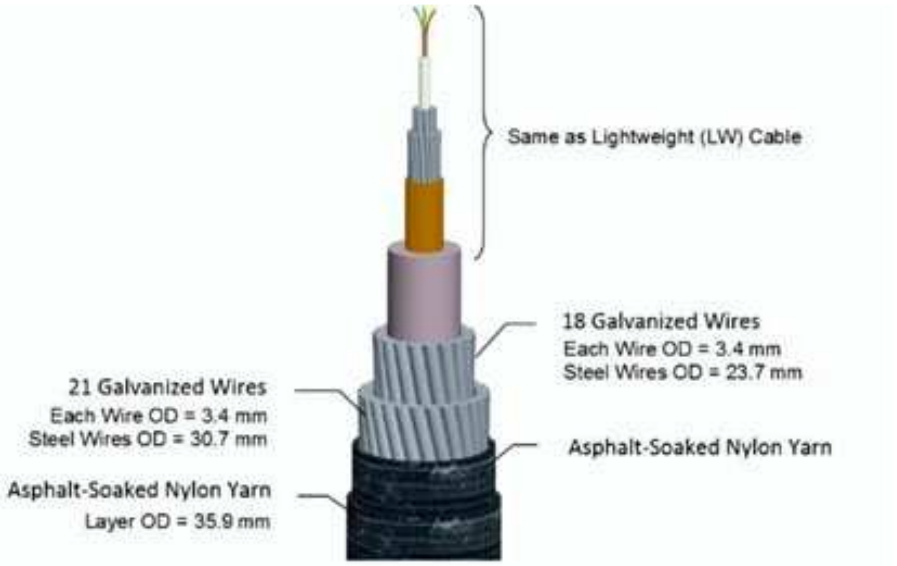


Figure 4. Cut-Away Section of Double Armour Cable

The fibre-optic cable will have Repeaters approximately 80km apart. For details of the repeaters that are to be used see Appendix I. These are "Optical Amplifiers" whose primary purpose is to boost the optical signal along the route. The copper conductors inside the cable power these Repeaters. There will be only one repeater within the 12 mile limit at approximately Kp 80.

Environmental Characteristics from SL Cable Magnetic Fields

An extremely low magnetic field may be generated at the exterior of the SL cable surface during normal operation. The maximum magnetic field intensity is at the exterior cable surface and decreases inversely with distance from the cable. The magnetic fields induced by cable powering are on the order of 30 to 38 microtesla (μT) at the cable surface. These values are lower than the background magnetic field produced by the earth (60 μT). Scientific literature suggests that few species are able to detect and differentiate features of weak magnetic fields from background noise. Therefore, the magnetic fields produced by TE SubCom's SL undersea cables would not be expected to disrupt marine organisms. As an example of how the magnetic field decreases with distance from the cable, at 1 metre the magnetic field would be .30 to .38 μT or 1/100th of what it is at the surface of the cable.

2) ECOLOGICAL ASSESSMENT METHODOLOGY

2.1 Desk study

A desk study was undertaken to gather and assess ecological data prior to undertaking fieldwork elements. Sources of datasets and information included:

- The National Parks and Wildlife Service
- Geological Survey of Ireland (Bedrock)
- National Biodiversity Data Centre
- Satellite, aerial and 6" map imagery
- Inland Fisheries Ireland
- INFOMAR (Lidar, backscatter and multibeam) (WMS data)
- Irish Whale and Dolphin Group
- Bord Iascaigh Mhara
- Environmental Protection Agency (Water Quality Data)
- Biomar Project
- Bing Maps (ArcGIS)

A provisional desk based assessment of the potential intertidal and subtidal habitats was carried out. This included a detailed assessment of INFOMAR data (backscatter, multibeam and LIDAR) in addition to Marine Strategy Framework Directive habitat mapping of the inshore and off-shore area, Admiralty charts and satellite imagery and NPWS Rare and Protected Species Data.

2.2 Field survey

An intertidal field survey was carried out by Altemar Ltd. on the 2nd April 2018 following completion of the desk based assessment. The survey covered intertidal and terrestrial elements of the project up to the beach manhole, along with habitat mapping of areas in the vicinity of the cable. This was at a low/high water springs of 0.9m i.e. LAT. The purpose of the field survey was to identify habitat types according to the Fossitt (2000) / Habitats Directive habitats classification schemes and map their extent. In addition, more detailed information on the species composition and structure of habitats, conservation value, threats, and other data was gathered particularly in the immediate vicinity of the cable route. A second field survey for subtidal elements along the cable route within the SAC was carried out on the 25th May 2018. This involved a video camera survey of habitats along the proposed route within the SAC. The purpose of this was to assess the habitats encountered within the proposed cable lay route and refine the route if sensitive species or habitats were encountered.

Survey Limitations

Intertidal field surveys were carried out in April 2018, outside the over-wintering bird season. In light of this, additional detail was gleaned from the desk based review particularly in relation to the conservation objectives supporting documents for both the SPA and SAC. The subtidal video survey was carried out within the proposed route within the Galway Bay Complex SAC only. Where sensitive species or habitats were encountered, additional transects were carried out perpendicular to the proposed cable route in a north westerly direction towards the navigation channel, until the habitat changed. No detailed boundary habitat mapping was carried out of these habitats.

2.3 Consultation

The National Parks and Wildlife Service were consulted in relation to species and sites of conservation interest. ArcGIS shapefiles of rare and threatened species were acquired from NPWS. Verbal consultation tool place with David Lyons (NPWS). David Harrington, Senior Fisheries Environmental Officer, Inland Fisheries Ireland was also consulted in relation to the proposed project (Appendix I).

2.4 Spatial Scope and Zone of Influence

IEEM (2006) defined the zone of influence as "the areas/resources that may be affected by the biophysical changes caused by activities associated with a project". In order to define the extent of the study area for ecological assessment, all elements of the project were assessed and reviewed in order to identify the spatial scale at which ecological features could be impacted. Due to the limited temporal and geographical scale of the project, conservatively it is not considered that the impacts of the proposed works would extend beyond 1km of the intertidal, primarily extended beyond the project footprint due to noise generation and 500 m of the subtidal elements of the project due to noise generation and potential disturbance of sediment. However, as outlined in IEEM (2010) "in the marine environment it is more difficult to define the geographical framework precisely and to accommodate all factors that should influence the definition of value, e.g. size or conservation status of populations or the quality of habitats." As a result, "it is very unlikely that the impacts on integrity can be evaluated without considering functions and processes acting outside the site's formal boundary." In light of this and based on the localised nature of the cable survey and laying the Zone of Influence in the subtidal was extended to 2.5 km either side of the cable route. However, a search area of 15 km was used for the gathering of information for nationally and internationally designated sites and marine mammal species.

2.4 Ecological evaluation criteria

The ecological significance of the potential zone of influence was determined using the site evaluation scheme provided by the EPA EIAR Guidance, modified to include additional parameters outlined in IEEM EcIA guidelines for Marine and Coastal Waters (IEEM, 2010) (Table 2).

2.5 Impact assessment significance criteria

As outlined in IEEM (2010) "assessment of impacts should be undertaken in relation to the baseline conditions within the zone of influence of the proposed development." Impacts during survey, site preparation, construction, occupation and decommissioning upon ecological receptors were quantified and characterised based on IEEM impact characterisation (IEEM, 2010) (Table 2) Following an evaluation of ecological receptors, the potential impact (positive, neutral or adverse) of the fibre-optic cable project on the terrestrial, intertidal and subtidal ecological receptors was carried out based on the criteria in an impact significance matrix (based on EPA, 2017)(Table 4). However, it should be noted that IEEM (2010) state that "an ecologically significant impact is an impact that has a negative, or positive, effect on the integrity of a site or ecosystem and/or the conservation objectives for habitats or species populations within a given geographical area." In this way significant impacts are distinguished from other, lesser effects. Potential impacts of the project on species and habitats were assessed in the context of how the predicted baseline conditions within the zone of influence might change between the survey times and the start of project.

Table 2. Site Evaluation Scheme (EPA, 2017) modifications to original IEEM guidance (2010)

a) Quality of Potential Impacts on Biodiversity

	Impact Description
Negative /Adverse Impact	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Neutral Impact	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Positive Impact	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).

b) Significance of Impacts

Significance of Impact	Description of Potential Impact
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An impact which obliterates sensitive characteristics.

c) Duration of Impact

Duration of Impact	Description
Momentary	Effects lasting from seconds to minutes
Brief	Effects lasting less than a day
Temporary	Effects lasting less than a year
Short-term	Effects lasting one to seven years.
Medium-term	Effects lasting seven to fifteen years.
Long-term	Effects lasting fifteen to sixty years.
Permanent	Effects lasting over sixty years
Reversible	Effects that can be undone, for example through remediation or restoration

Rating	Qualifying Criteria
A	**Internationally important** Sites designated (or qualifying for designation) as SAC* or SPA* under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries.
B	**Nationally important** Sites or waters designated or proposed as an NHA* or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Water bodies with major amenity fishery value.
C	**High value, locally important (Regional, County & River Basin District)** Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species. Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive.
D	**Moderate value, locally important (Regional, County & River Basin District)** Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
E	**Low value, locally important (Regional, County & River Basin District)** Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value.

*SAC = Special Area of Conservation SPA= Special Protection Area NHA= Natural Heritage Area

Table 3: Impact Matrix

Impact level	Site Category				
	A sites Internationally important	**B sites Nationally important**	**C Sites High value, Locally important**	**D sites Moderate value, locally important**	**E Sites Low value, locally important**
Severe adverse	Any permanent impacts	Permanent impacts on a large part of a site			
Major adverse	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site		
Moderate adverse	Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site	
Minor adverse	Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site	
Negligible	No impacts	No impacts	No impacts	No impacts	Permanent impacts on a small part of a site
Minor beneficial				Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site
Moderate beneficial			Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site	
Major beneficial		Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site		

3) RESULTS

3.1 Proximity to designated conservation sites

Designated conservation sites (National and international) within 15km of the proposed inshore elements of the cable route were examined. Detailed imagery of the landfall at Ballyloughane Beach in relation to the boundaries of the conservation sites which the cable enters can be seen in Figure 5. As can be seen from this figure, the landfall area has four overlapping conservation designations SAC, SPA, Ramsar and pNHA. The SPA terminates at the concrete wall above the high tide limit and goes into the subtidal, while the SAC goes into the grassland area above the HWM and terminates in the subtidal. The pNHA mirrors the SAC while the Ramsar boundary is slightly above the HWM. The distance of travel of the cable within each of the conservation sites is as follows; SAC/pNHA (6.2km), SPA (6.6km), Ramsar (6.2km). The conservation sites within 15km of the in the vicinity of the cable and the proposed landfall are seen in Figures 6-9.The distance of the proposed cable route to conservation sites are seen in Table 4.

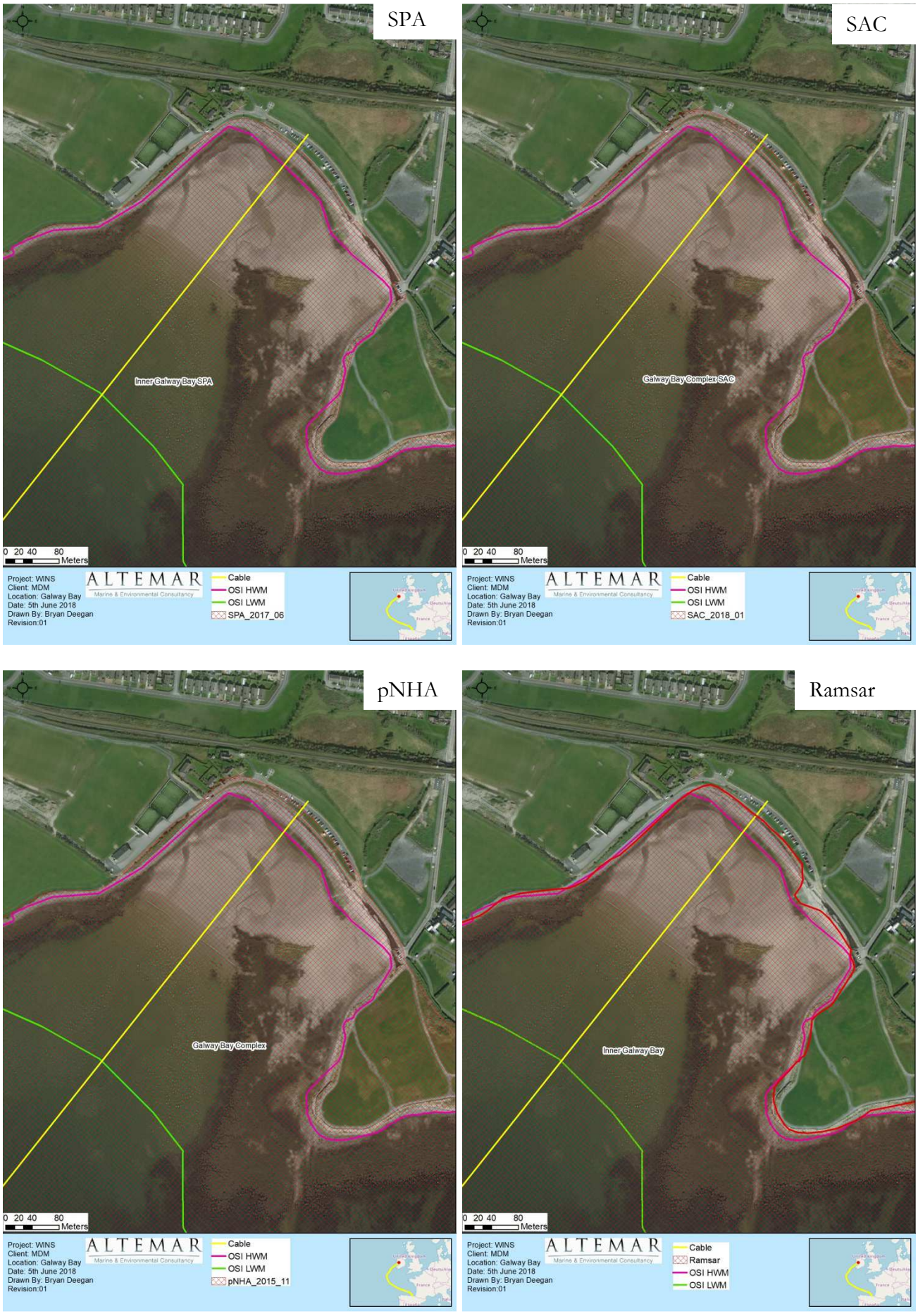


Figure 5. Designated conservation sites, LWM, and HWM in the vicinity of the proposed cable landfall at Ballyloughane Beach, Co. Galway.

Figure 6. Special Areas of Conservation within 15 km of the proposed route and landfall.

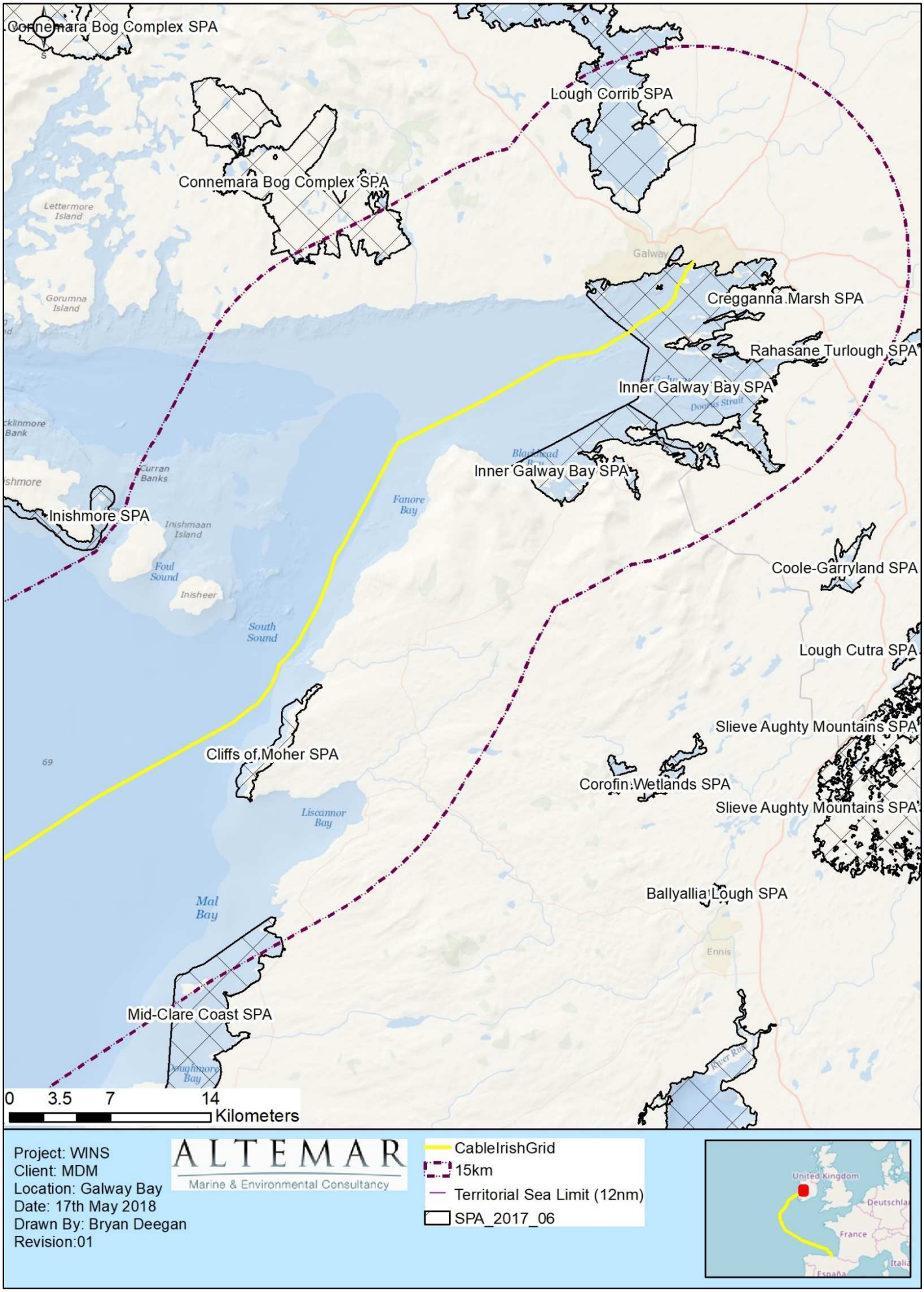


Figure 7. Special Protection Areas within 15 km of the proposed route and landfall.

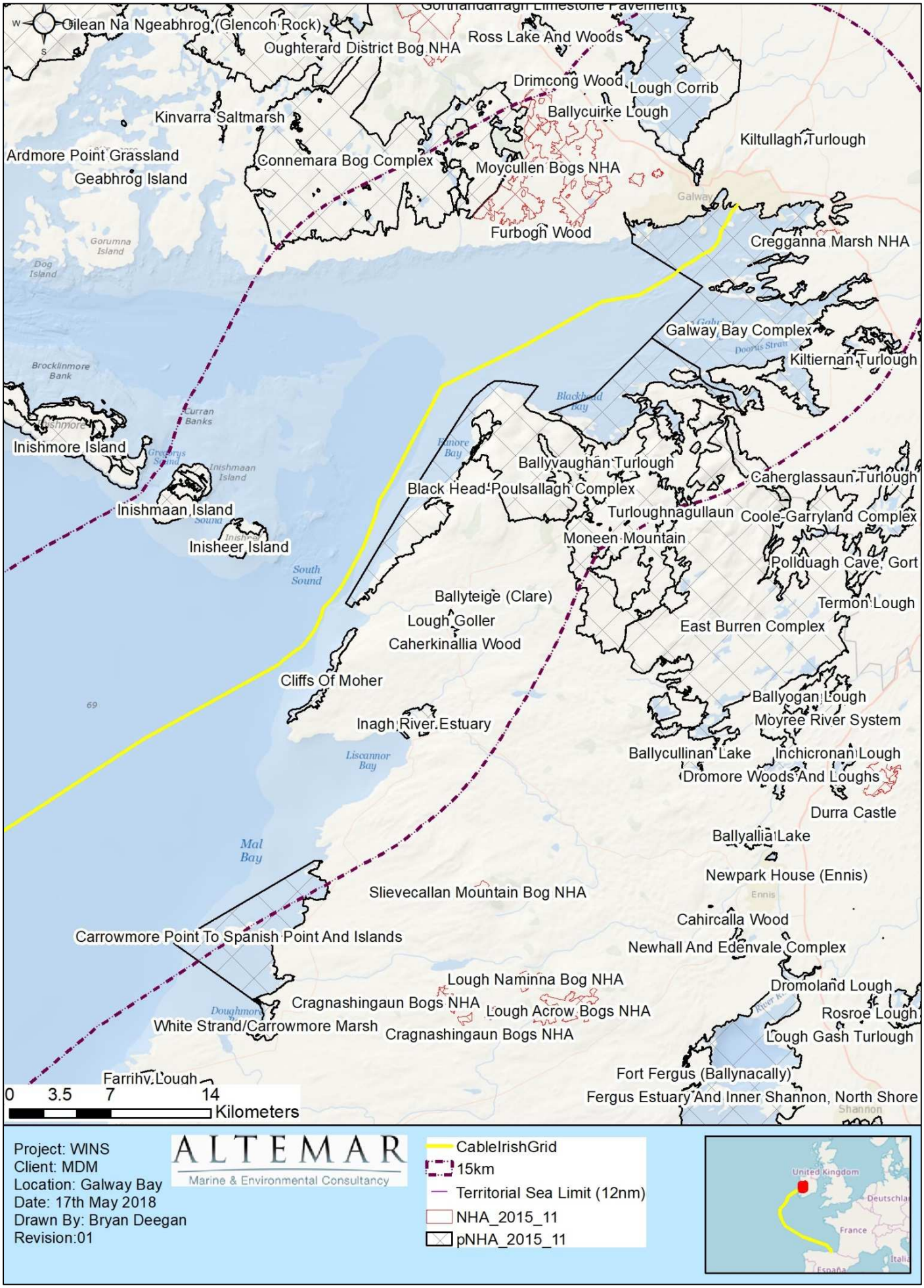


Figure 8. Natural Heritage Areas within 15 km of the proposed route and landfall.

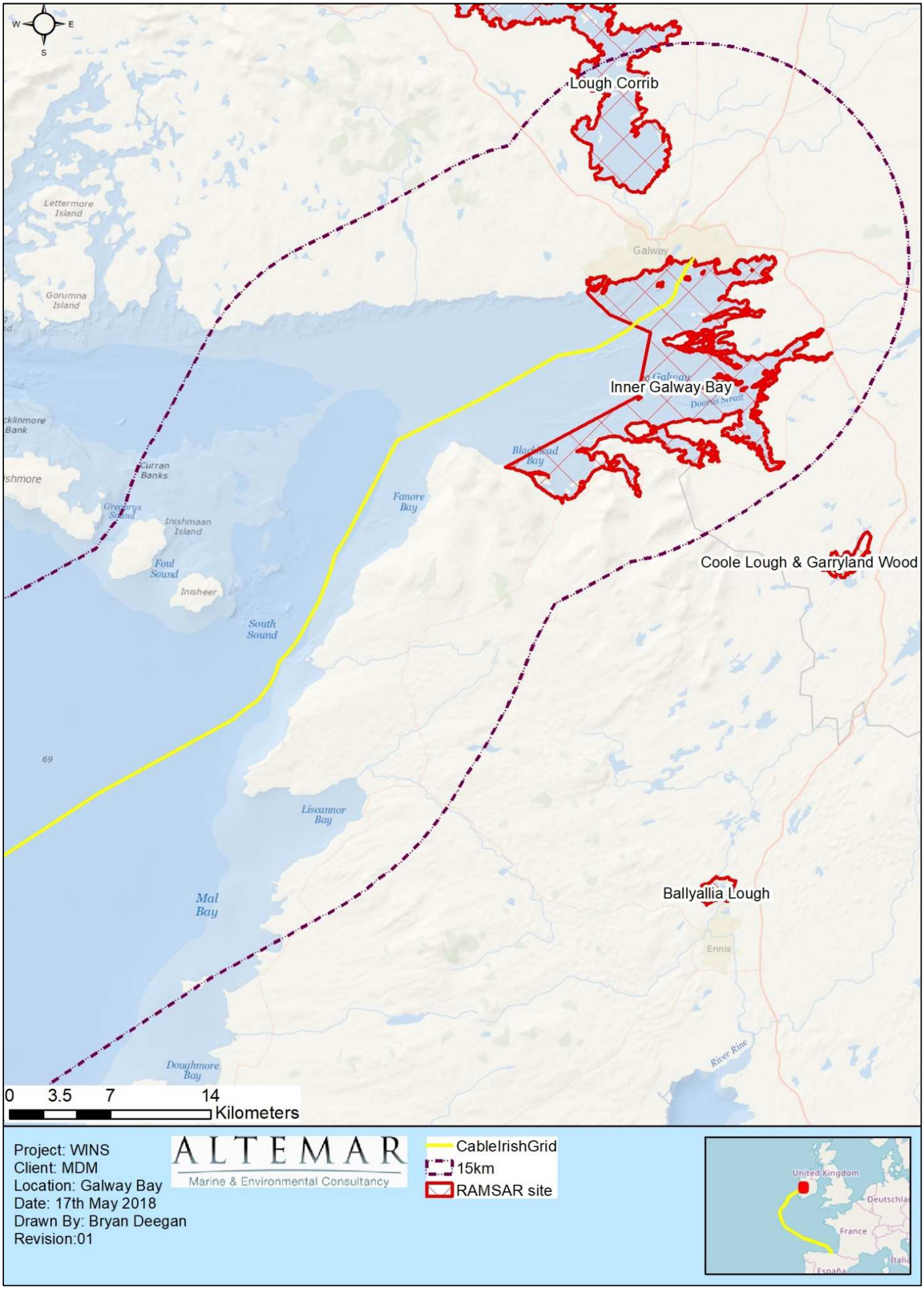


Figure 9. RAMSAR Sites within 5km, of the proposed route and landfall.

Table 4. Conservation sites within 15km of the proposed route

	Special Areas of Conservation (Natura 2000)
1	Galway Bay Complex SAC (proposed cable route and survey corridor pass through this SAC)
2	Lough Corrib SAC (3 km from cable route corridor)
3	Connemara Bog Complex SAC (13 km from cable route corridor)
4	Lough Fingall Complex SAC (11 km from cable route corridor)
5	East Burren Complex SAC (11.5 km from cable route corridor)
6	Moneen Mountain SAC (9.1 km from cable route corridor)
7	Ballyvaughan Turlough SAC (9 km from cable route corridor)
8	Black Head-Poulsallagh Complex SAC (1 km from cable route corridor)
9	Ballyteige (Clare) SAC (8 km from cable route corridor)
10	Inagh River Estuary SAC (8.4 km from cable route corridor)
11	Carrowmore Point To Spanish Point And Islands SAC (12.7 km from cable route corridor)
12	Inisheer Island SAC (6.1km from cable route corridor)
13	Inishmaan Island SAC (11 km from cable route corridor)
14	Inishmore Island SAC (14.9 km from cable route corridor)
	Special Protection Areas (Natura 2000)
1	Inner Galway Bay SPA (proposed cable route and survey corridor pass through this SPA)
2	Connemara Bog Complex SPA (12 km from cable route corridor)
3	Lough Corrib SPA (5.0 km from cable route corridor)
4	Cregganna Marsh (6.3 km from cable route corridor)
5	Cliffs of Moher SPA (1.3 km from cable route corridor)
6	Mid Clare Coast SPA (13.6 km from cable route corridor)
	Natural Heritage Areas
1	Galway Bay Complex pNHA (proposed cable route and survey corridor pass through this pNHA)
2	Lough Corrib pNHA (3 km from cable route corridor)
3	Ballycuirke Lough pNHA (10.3 km from cable route corridor)
4	Drimcong Wood pNHA(14 km from cable route corridor)
5	Killarainy Lodge, Moycullen pNHA (10.4 km from cable route corridor)
6	Furbogh Wood pNHA (6 km from cable route corridor)
7	Kiltullagh Turlough pNHA (6.1 km from cable route corridor)
8	Connemara Bog Complex pNHA (13 km from cable route corridor)
9	Lough Fingall Complex pNHA (11 km from cable route corridor)
10	Turloughnagullaun pNHA(14 km from cable route corridor)
11	East Burren Complex pNHA (11.5 km from cable route corridor)
12	Moneen Mountain pNHA (9.1 km from cable route corridor)
13	Ballyvaughan Turlough pNHA(9 km from cable route corridor)
14	Black Head-Poulsallagh Complex pNHA (1 km from cable route corridor)
15	Ballyteige (Clare) pNHA (8 km from cable route corridor)
16	Cliffs of Moher pNHA (2.1 km from cable route corridor)
17	Inagh River Estuary pNHA (8.4 km from cable route corridor)
18	Carrowmore Point To Spanish Point And Islands pNHA (12.7 km from cable route corridor)
19	Inisheer Island SAC (6.1km from cable route corridor)
20	Inishmaan Island SAC (11 km from cable route corridor)
	Ramsar Sites
1	Inner Galway Bay (proposed cable route and survey corridor pass through this Ramsar Site)
2	Lough Corrib (5.7 km from cable route corridor)

3.1.1 Subtidal –Desk based

As previously stated, the proposed Zone of Influence (ZoI) within the subtidal is expected to be extremely narrow due to the narrow width of the plough (4m) and slow vessel speeds (1kn). However, as this project includes survey elements, it was conservatively extended to 2.5km either side of the cable, out to the 12nm limit as "it is very unlikely that the impacts on integrity can be evaluated without considering functions and processes acting outside the site's formal boundary" (IEEM, 2010). The assessed ZoI is calculated as 50km^2 (100km x.5km) out to the 12nm Limit (Figure 10) It should be noted however that the cable is only 38mm in diameter. The proposed fibre-optic cable route within the 12 nm limit is approximately 102km long and reaches a maximum water depth of approximately 90m within Irish Territorial waters.

Habitats

Data from the NPWS 2006 Surveys of sensitive subtidal benthic communities in Slyne Head Peninsula SAC, Clew Bay Complex SAC and Galway Bay Complex SAC (MERC, 2006) was interrogated.

Infomar backscatter, multibeam in addition to satellite imagery, Admiralty Charts and BioMar data were assessed, where available and relevant, for the entire route within the 12nm. Backscatter imagery is seen in Figure 12. Shallow subtidal areas were examined using Orthophotography (OSI-1995, 2000 and 2005) in addition to satellite imagery (Google (historic) & Bing). Such imagery has proved useful in the 2004-2010 NPWS sensitive subtidal benthic communities surveys project to highlight potential seagrass areas (*Zostera marina*) and allow for confirmation by ground truthing.

As can be seen from Figure 11, based on a desk top evaluation, distinct habitats were distinguishable (MSFD data) along sections of the cable route out of Galway Bay. Within the Bay these were classed as mainly mud and mixed sediment. From here out to the 12nm limit the seabed type appears to be mainly medium to fine sand (Figures 11 & 12), with two reef areas.

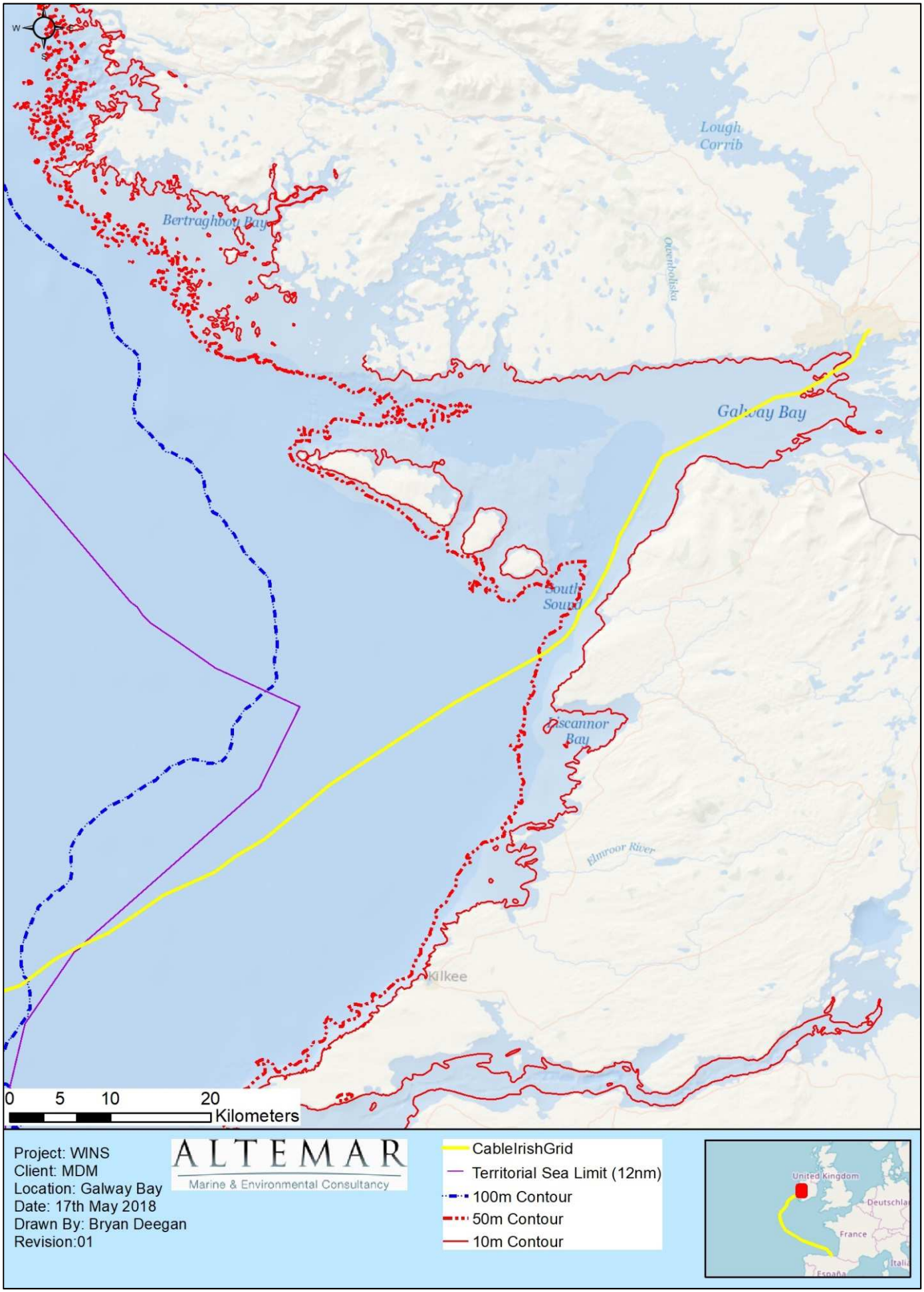


Figure 10. Proposed cable route within the territorial waters (& 12nm limit), LWM, 10m, 50m and 100m contours.

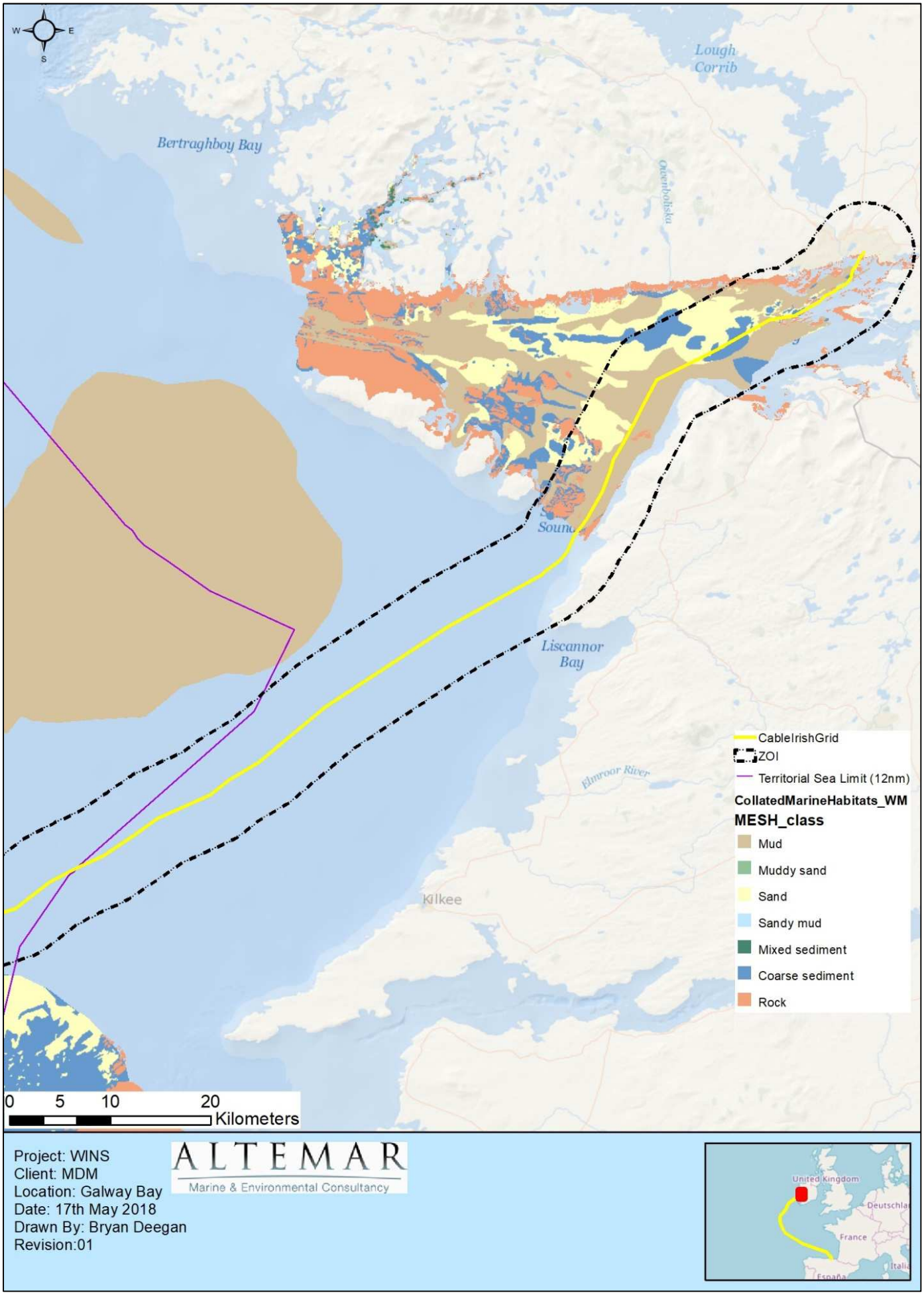


Figure 11. Infomar habitat classification in the inshore and offshore areas in the vicinity of the cable route.

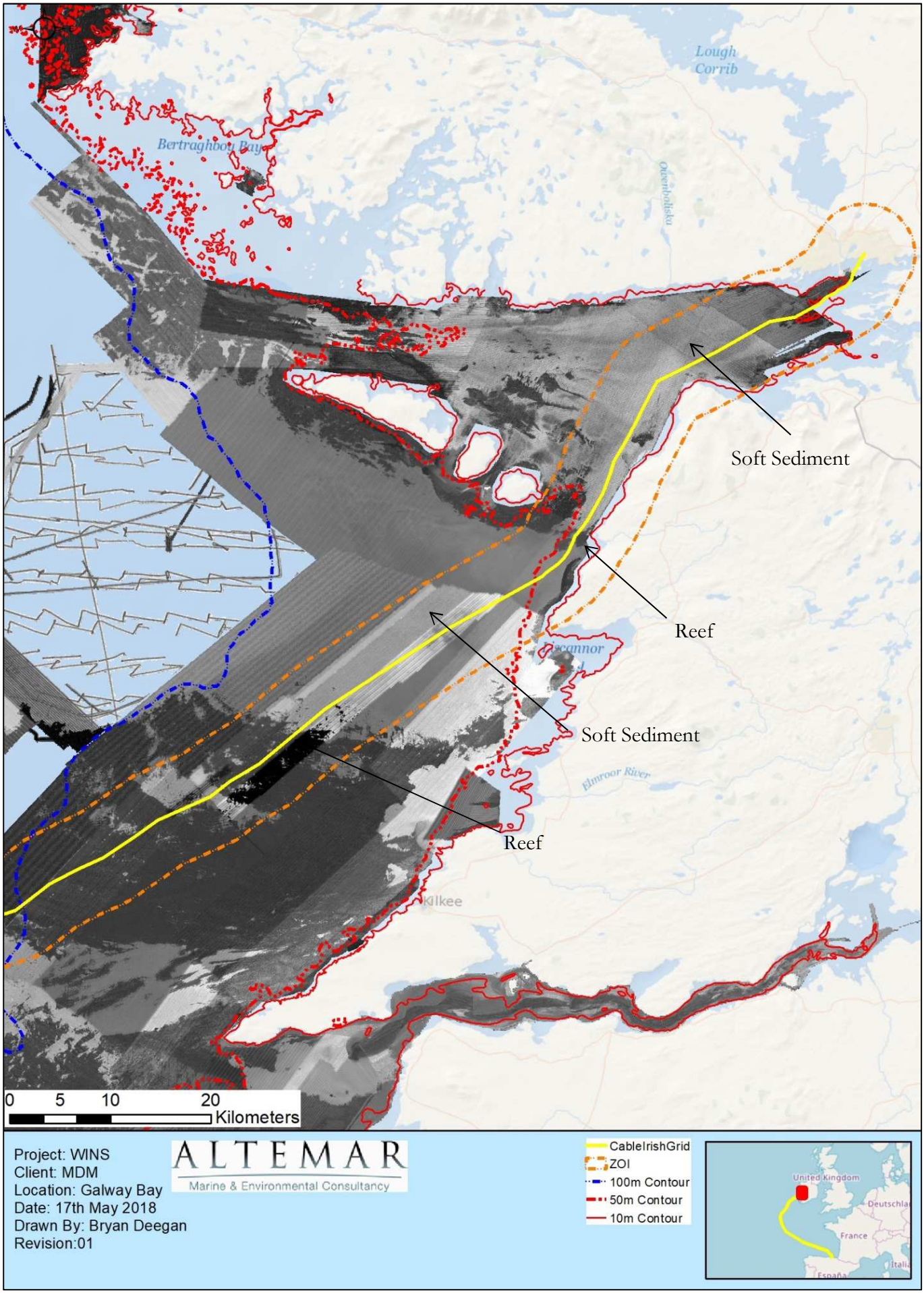


Figure 12. INFOMAR backscatter indicating substrate types, 50m and 100m contour and ZoI overlaid on Bing imagery.

Fisheries

Data from the inshore fisheries atlas was obtained and is shown in Figure 13. Fisheries based activity is carried out from the landfall area right up to the edge of the territorial waters. In the vicinity of the landfall Line Fishing (hook and line) and crustacean potting are carried out, with mobile nets and Nephrops within Galway Bay. Mobile and Static nets are used out in waters deeper than 50m along the route out to the 12nm limit.

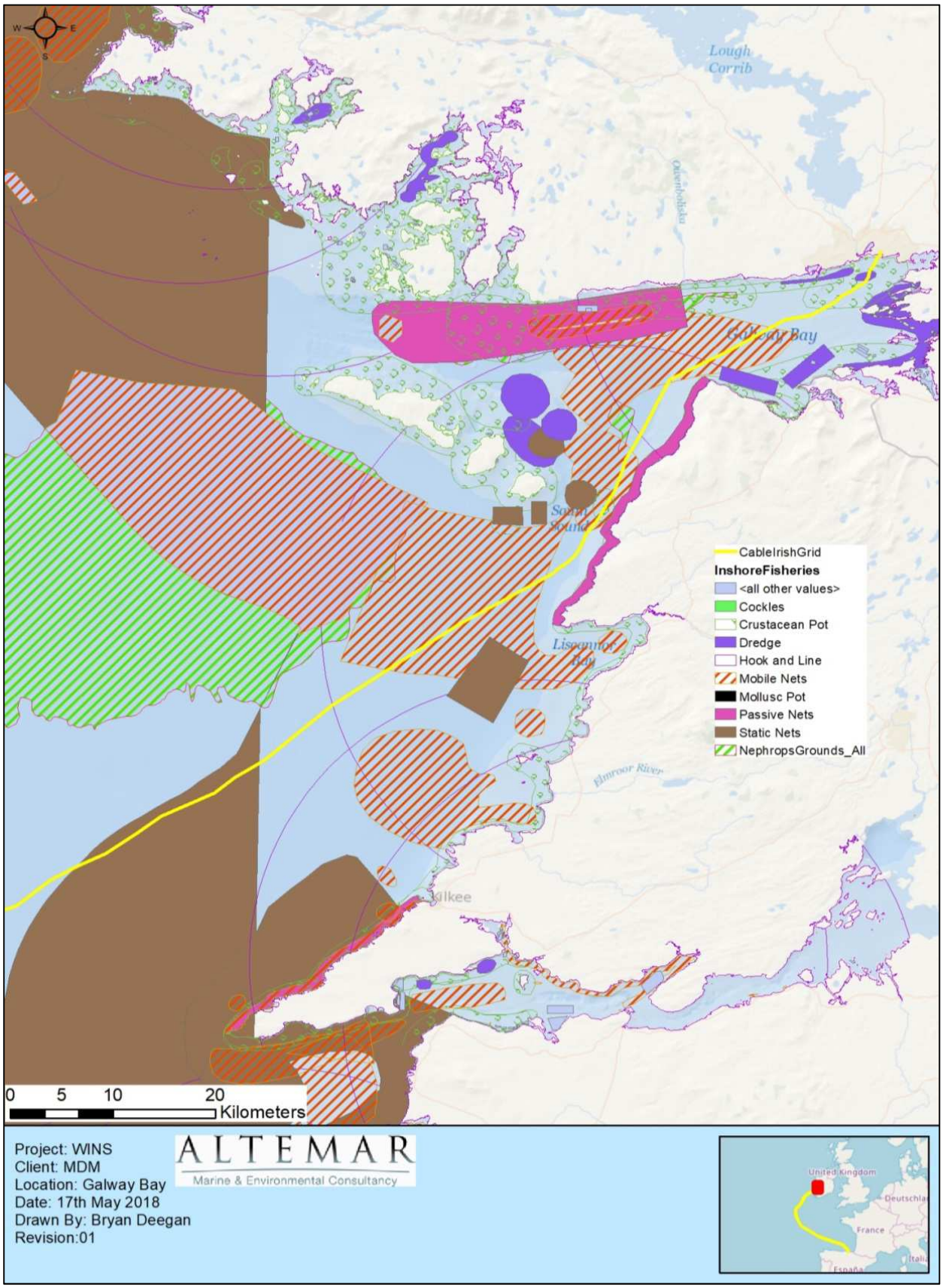


Figure 13. Fisheries based activity from landfall to territorial waters (Inshore Fishing Atlas).

3.1.2 Habitats and Species on site- Fieldwork

Intertidal

During fieldwork, habitats in the vicinity of the intertidal route were classified according to Fossitt (2000) (Figure 14). Observations on species were made on a receding tide, as well as at Low Water. Weather conditions were relatively poor with mist and rain showers.

GA2-Amenity Grassland

Amenity grassland was found in the vicinity of the proposed HDD and beach manhole site (Plate 1) and between the road and beach (Figure 14). This habitat is approximately 2m above the OSI high tide limit and is behind a concrete seawall of approximately 1.2m high. The site is well maintained and appears to be regularly cut. Species diversity is poor with daisy (*Bellis perennis*), dandelion (*Taraxacum spp.*), clovers (*Trifolium spp.*), plantains (*Plantago spp.*), creeping buttercup (*Ranunculus repens*), nettle (*Urtica dioica*) and docks (Rumex spp.).

Plate 1. Proposed position of the HDD on Amenity grassland.

BL-Built Land

Built land in the vicinity of the proposed works included the roads, footpaths, walls and car parking areas, (Figures 3 & 14). These areas are of low biodiversity importance and will not be impacted by the proposed works. It is proposed to use the HDD to go under these areas and not impact on the structural integrity of these areas.

LS1-Shingle and gravel shores

The upper part of the beach is dominated by a gravel and cobble beach approximately 10-20m wide, which backs up to a concrete retaining wall (Plate 2 inset). The presence of this gravel/cobble area would tend to indicate that the beach is moderately exposed to wave action and storms that have sufficient strength to form a storm beach. Algal drift lines were present on the cobble storm beach and at the time of survey and were dominated by Fucoids and Laminaria species.

LS2 Sand Shores

The majority of the intertidal cable route consists of Littoral Sediment- Sand shores. Invasive investigations were not carried out. Casts of juvenile *Arenicola marina* were noted in the wetter portion of the habitat where water appeared to drain from the upper part of the beach and was retained on the surface(Plate 2). The proposed HDD will be located in the amenity grassland area on the north side of the road (Plate 1) will finish below the foreshore (Plate 2) in the upper intertidal, within this habitat.

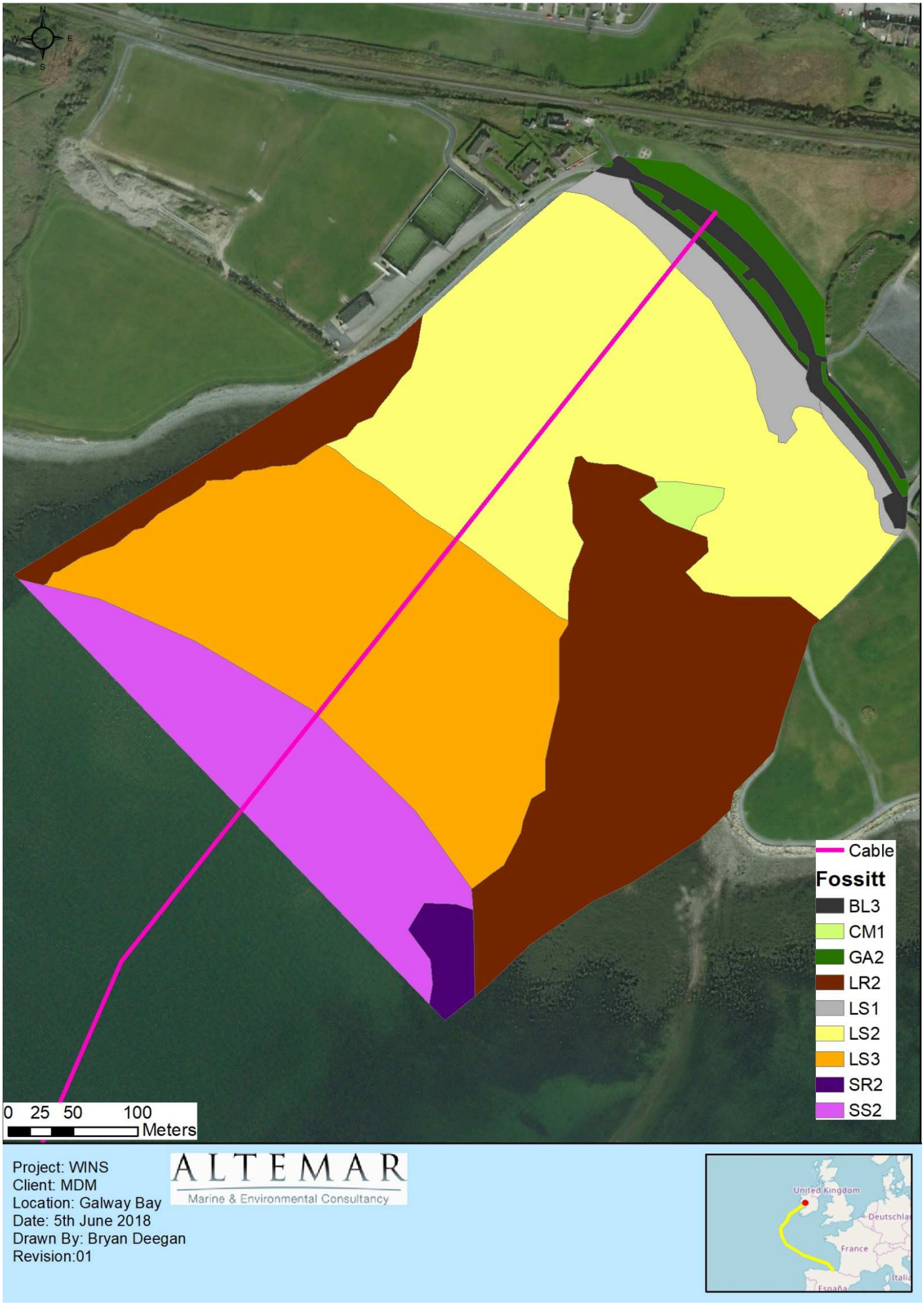


Figure 14. Habitats in the vicinity of the intertidal route classified according to Fossitt (2000).

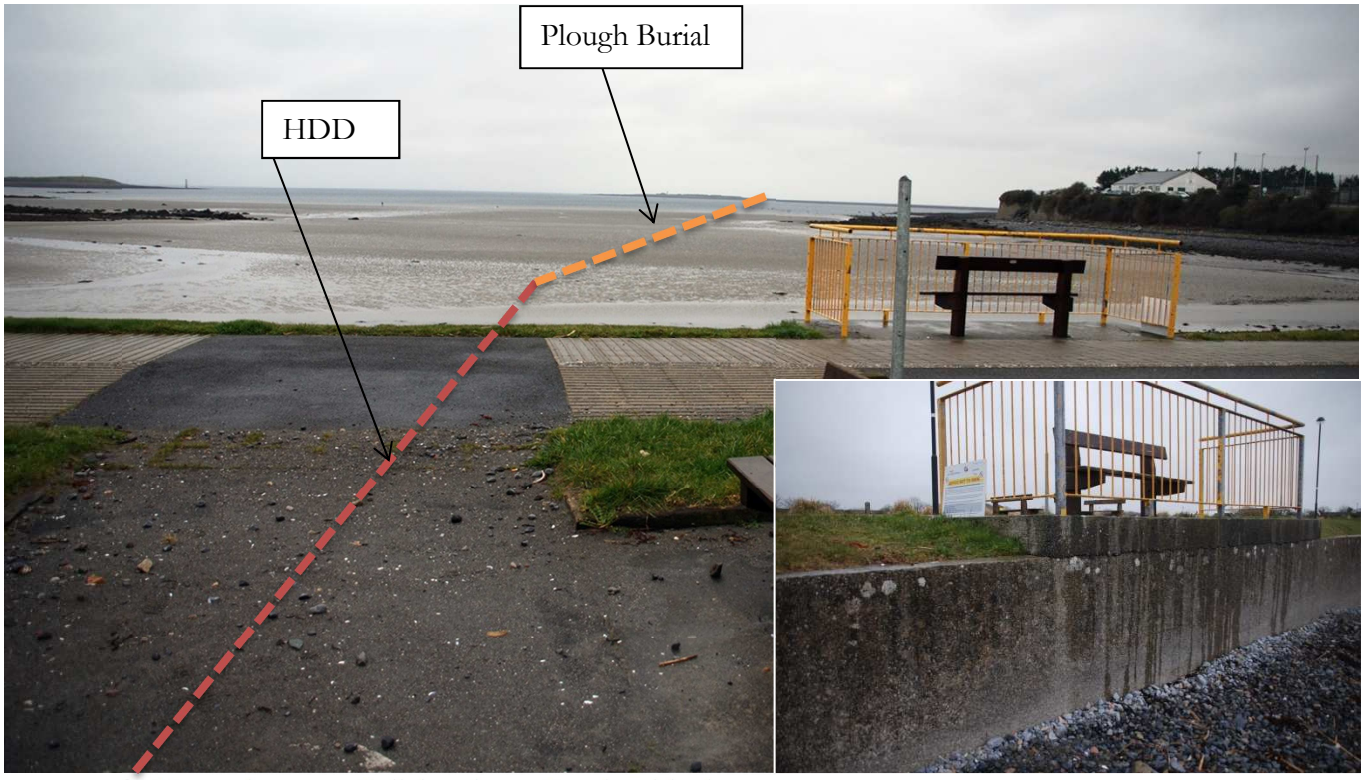


Plate 2: Uppershore on Ballyloughane Beach with the approximate location of the cable route (wall inset).

LS3-Muddy sand shores

Further down the beach towards the LWM the beach became more of a muddy sand and numerous juvenile *Arenicola marina* casts and areas of brown microalgae were noted (Plate 3). This area extended to the sublittoral i.e. SS2 Infralittoral muddy sands, which was surveyed by boat and video camera. No seagrass (*Zostera sp*) was seen in either of these habitats. A small stream was located in this area on the western portion of the beach.

Plate 3: Mid-Lower shore on Ballyloughane Beach with the approximate location of the cable route

LR2 Moderately exposed rocky shores
On either side of the sandy beach habitat are areas an intertidal reef. On the western side of the proposed cable route this area is primarily of boulders while on the eastern side this area is made up of cobble and boulders with varying amounts of sand interspersed between the rocks. This area is at minimum 35m from the proposed cable route. Species were typical of rocky shore, species encountered included *Fucus vesiculosus*, *Fucus serratus, Fucus spiralis, Elachista fucicola, Ulva intestinalis*, *Palmaria palmata*, *Mastocarpus stellatus*, *Ceramium sp., Chondrus crispus*, *Cladophora rupestris, Ascophyllum nodosum* and at lower levels *Laminaria digitata*. This area extended to the sublittoral i.e. SR5 Moderately exposed circalittoral rock, which was not surveyed.

CM1-Lower Salt Marsh
A small area of saltmarsh was noted on the eastern side of the beach. This area is in a small elevated portion of the beach, nestled behind the rocky shore and would be expected to be covered at high tide spring tides. This habitat appears to be relatively recent as it is not seen on 1995 orthography but is present in 2000 and is relatively stable in extent since 2000. This habitat is not in vicinity of the proposed cable route.

Additional Habitats
A range of habitats of conservation importance have been recorded and mapped in this area by NPWS. These are detailed in the NIS. The distribution maps of these habitats in the NIS indicate that the proposed cable route is not proximal to the majority of habitats of conservation interest including Coastal lagoons, Reefs, Perennial vegetation of stony banks, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows (Glauco-Puccinellietalia maritimae), Mediterranean salt meadows (*Juncetalia maritimi*), Turloughs, *Juniperus communis* formations on heaths or calcareous grasslands, Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia, Calcareous fens with *Cladium mariscus* and species of the *Caricion davalliana* or Alkaline fens saltmarsh areas. However, the cable route passes through the habitats Mudflats and sandflats not covered by seawater at low tide (on Ballyloughane Beach) and subtidal elements of the habitat Large shallow inlets and bays.

Species
Birds
The proposed landfall is an important area for overwintering birds. Please see main NIS document for information on the species of importance in this area. The site was visited outside of overwintering bird season. Bird species noted on site included black-headed gull (*Larus ridibundus*), little egret (*Egretta garzetta*), grey heron (*Ardea cinerea*) and pied wagtail (*Motacilla alba yarrellii*)

Amphibians
The common frog (*Rana temporaria*) was not observed in the amenity grassland or surrounding terrestrial areas. NPWS records of rare and threatened species in addition to the NBDC sightings records were investigated and showed no records in proximity of the landfall or beach area. No streams or drainage ditches were observed in the terrestrial element of Ballyloughane Beach. No amphibians of conservation importance are recorded on NPWS data.

Terrestrial Mammals
No badger setts or evidence of terrestrial mammals of conservation importance were seen in the vicinity of the landfall area. Records of sightings of the badger, pine marten, otter and hedgehog were examined from the NBDC and NPWS rare and threatened species records showed no records in proximity of the landfall area. However, the conservation objectives supporting document highlights a 250m buffer from High Water as otter habitat within the SAC. Otters were not observed on site.

Sensitive Subtidal Communities

The habitats and factors impacting on the shallow subtidal element of the proposed cable route in the vicinity of the landfall are relatively complex. In order to understand the distribution of sensitive subtidal communities within the Galway Bay Complex SAC, data from the NPWS 2006 Surveys of sensitive subtidal benthic communities in Slyne Head Peninsula SAC, Clew Bay Complex SAC and Galway Bay Complex SAC (MERC, 2006) were interrogated (Figure 15). The raw GIS scuba diving mapping data (thick lines) and the defined Conservation Objectives habitat boundaries (polygons) from this survey were overlaid on the initial proposed cable route. This original route (most southern) was deemed proximal to recorded mearl sites. The cable is not in the vicinity of recorded *Zostera marina* sites.

Following this initial assessment the route was modified and moved northwards, towards the navigation channel, to avoid recorded sensitive communities. A follow up drop-down video survey of the revised route was then carried out within the SAC in May 2018 to 1km beyond the SAC boundary, to identify the communities present and fine tune the proposed routing to avoid sensitive communities. *Virgularia mirabilis* and maërl communities (sprinkling on mixed sediment) were noted in several locations (Plates 4 & 5) outside areas previously surveyed. Where these were encountered along the route, additional video drops were carried out, perpendicular to the route in a northwards direction, towards the shipping lane. Note was taken of where the communities were no longer present along this transect. The proposed cable route was revised again (Figure 15-Cable route Proposed) to avoid these sensitive communities where possible. It should be noted that in discussions with the Harbour Master of Galway Port the proposed port expansion shapefile was acquired and overlaid in relation to the proposed cable route and sensitive subtidal communities.

As outlined in MERC (2006) "The over-riding feature of many of the maërl communities in this part of Galway Bay appears to be their nature. Rather than forming large beds of dense living and non-living maërl, in many cases the communities form a thin and broken veneer on top of various sedimentary seabed types, including fine and coarse sand, gravels, cobbles and muds in some instances. Where the veneer of maërl occurs with coarse gravel and cobbles, the maërl tends to occupy the spaces between grains. The covering frequently is only one layer thick (i.e. the thickness of a single rhodolith). Within these communities, the surface area covering of maërl can vary from 100% to as little as 10% and they were seen to stretch over very large areas of the seabed. Within these areas significant variability in the nature of the underlying sediments was also recorded. However the covering of maërl can be seen to extend throughout all such variability in sediments. In many cases it is perhaps questionable as to whether the occurrence of maërl in this manner actually constitutes a maërl community or not." Despite this, the route was revised to avoid areas where maerl was found on the video survey.

MERC 2006 also stated that the "species of maërl recorded included the discoidal form of *Lithothamnion corallioides* to the north of Finavarra and to the east and north of Aughinish Island. Also recorded was *Phymatolithon calcareum* in Muckinish Bay. Further deposits of the finely branched form of *Lithothamnion coralloides* were recorded in Doorus Strait, as well as to north of *Tawin Peninsula*" (in the vicinity of the proposed cable route) "where maërl communities formed an extensive veneer over underlying muddy and muddy sand sediments. No *Lithophyllum dentatum* was recorded during the survey of Galway Bay Complex SAC."

In relation to the *Virgularia mirabilis* MERC 2006 stated that "despite conducting a number of specific dives in order to investigate other 'known' sensitive communities – most notably for *Neopentadactyla mixta* and the Sea Pen *Virgularia mirabilis* in the area to the north of Tawin Peninsula and south of Mutton Island, no such communities were recorded. Indeed, other than very occasional individual *Lanice conchilega* no other significant subtidal species or communities were encountered during the survey at this site." The area where the *Virgularia mirabilis* was noted during the 2018 camera survey, was not covered by the 2006 surveys. No *Neopentadactyla mixta* was noted during these surveys. As stated previously the proposed route was modified to avoid these sensitive areas. It should be stated that the camera survey carried out as part of the EcIA/NIS extends the current known distribution of Maerl but has now identified the location of *Virgularia mirabilis* within Galway Bay Complex SAC.

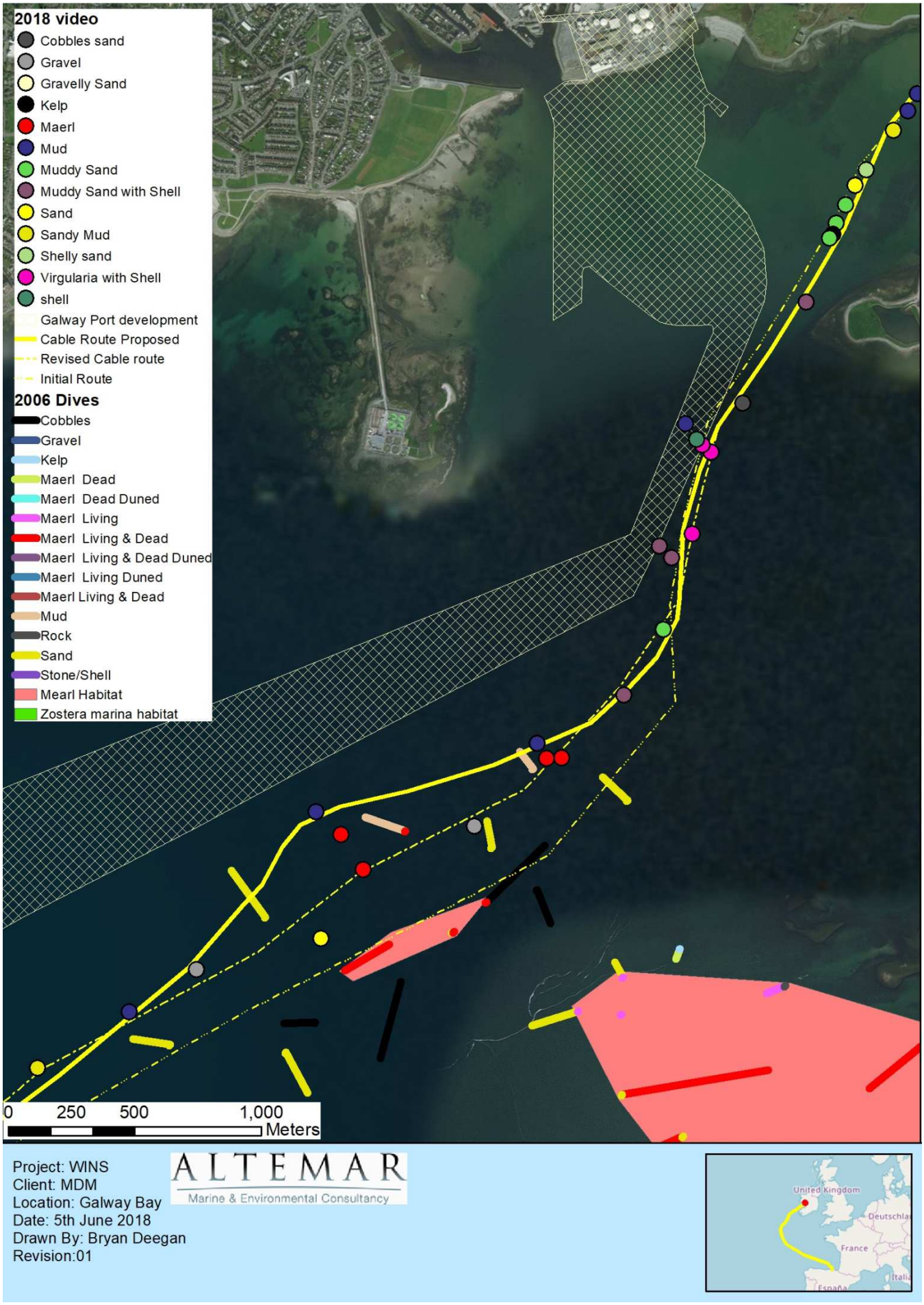


Figure 15. Inshore subtidal communities recorded, routing options assessed and future expansion plans for Galway Port.

Knowing the proposed future expansion of the port and navigation channel has allowed for the movement of the cable to avoid primary sensitive habitats while ensuring the future safety of the cable. In one pinch point area the cable was moved to 20m within the proposed dredged channel in an attempt to avoid an area of *Virgularia mirabilis* found during the May 2018 video survey. This area is particularly constrained by the future navigation channel and it may not be possibly to avoid this habitat in this specific area. As discussed with NPWS, it is proposed that as part of the routing assessment survey that additional video is acquired in this specific area and discussions take place with NPWS to assess the optimal route for the cable in this area taking into account the future development plans of the port and the distribution of *Virgularia mirabilis*. It should be noted however that the plough (4m wide) is on skids and stays on the seabed surface while only the blade itself penetrates deep into the sediment. As speeds are slow (1kn) it would be expected that the laying of the cable in this habitat would be short-term impact and would not impact on the medium & long-term integrity of this habitat.

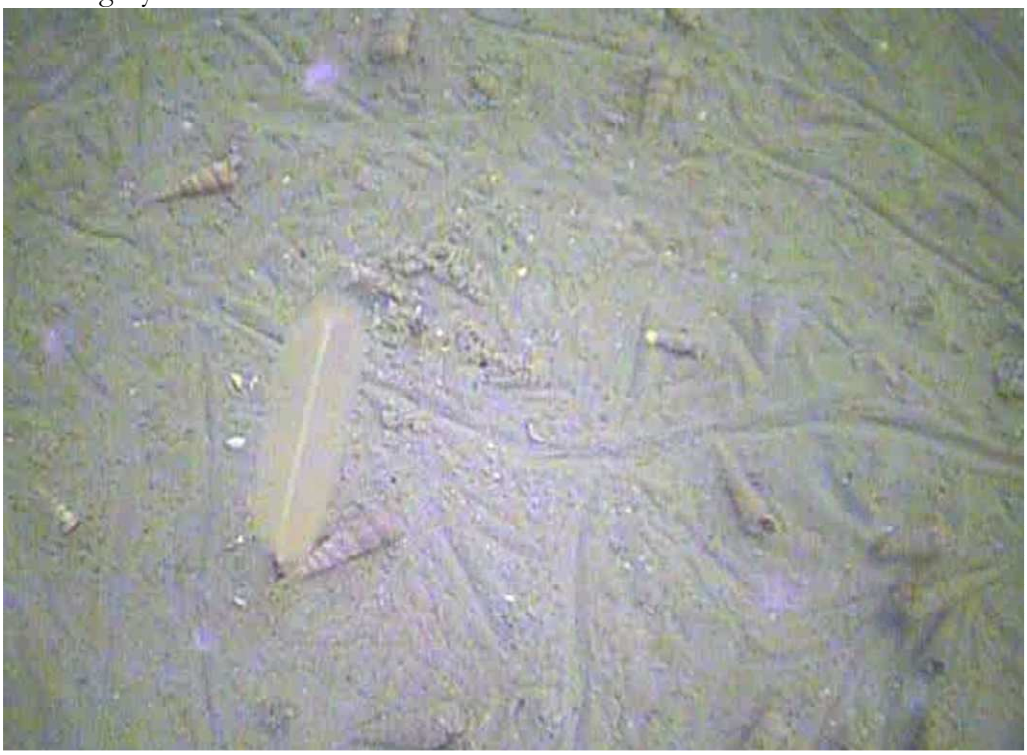


Plate 4. *Virgularia mirabilis* noted during this camera survey.

Plate 5. *Mearl* noted during this camera survey.

Cetacean Species

In O'Brien (2013) "a total of 28 dedicated land-based visual watches were carried out from Spiddal Pier (2700 minutes/45 hours) between March 2005 and February 2007. Cetaceans were recorded during 10 of the 27 watches (37%). A total of 16 sighting were recorded during watches comprising of three species; including, harbour porpoise (81%), bottlenose dolphin (13%) and Minke whale (7%). Only a single sighting of two harbour seals was recorded on one occasion. All sightings recorded were within a 5km radius of Spiddal pier. Most sightings (75%) were recorded between the months June to December with only 25% of sightings recorded in the period January to May, highlighting mid-summer through to December as the months when porpoises are most active at the site.

The OE Test site was again the target of long-term Static Acoustic Monitoring (SAM) as part of the PReCAST project, when monitoring commenced in January 2009 and continued until September 2010. During this time a total of 572 days were monitored at the site. SAM monitoring from January 2009 to September 2010 at the test site show that, on average, harbour porpoises were recorded on 95% of days monitored, while dolphins were rarely recorded (4%days). These results reflect those of the SAM I. Over the 572 days monitored, a total of 27,902 porpoise Detection Positive Minutes (DPM) were recorded (4,515 Detection Positive Hours; DPH). As dolphin sightings were rare, only the porpoise data were analysed to identify factors influencing their presence at the site.

Results from visual and acoustic monitoring are very similar as all show that autumn and winter months are when porpoises are most active at the site. Visual data shows that in comparison with other sites in the bay subjected to land-based watches, Spiddal is not the most important, with a greater relative abundance recorded from Black Head on the south shore. This is most likely due to the tidal nature at Black Head as porpoises are known to use tidal races when feeding."

Figure 16 shows all cetacean species, and Figure 17 shows monthly activity trends, in the area as recorded by IWDG sightings scheme. Cetacean activity has been seen in the vicinity of the cable route corridor . Species seen in the area and along the cable route include bottle-nosed dolphin (*Tursiops truncates*) (especially in inner Galway Bay and inshore areas along route), harbour porpoise (*Phocoena phocoena*), common dolphin (*Delphinus delphis*), minke whale (*Balaenoptera acutorostrata*, and a single killer whale (*Orcinus orca*). During the months of proposed survey and cable laying (July-August) bottle-nosed dolphin (*Tursiops truncatus)* harbour porpoise (*Phocoena phocoena*), common dolphin (*Delphinus delphis*) have been recorded.

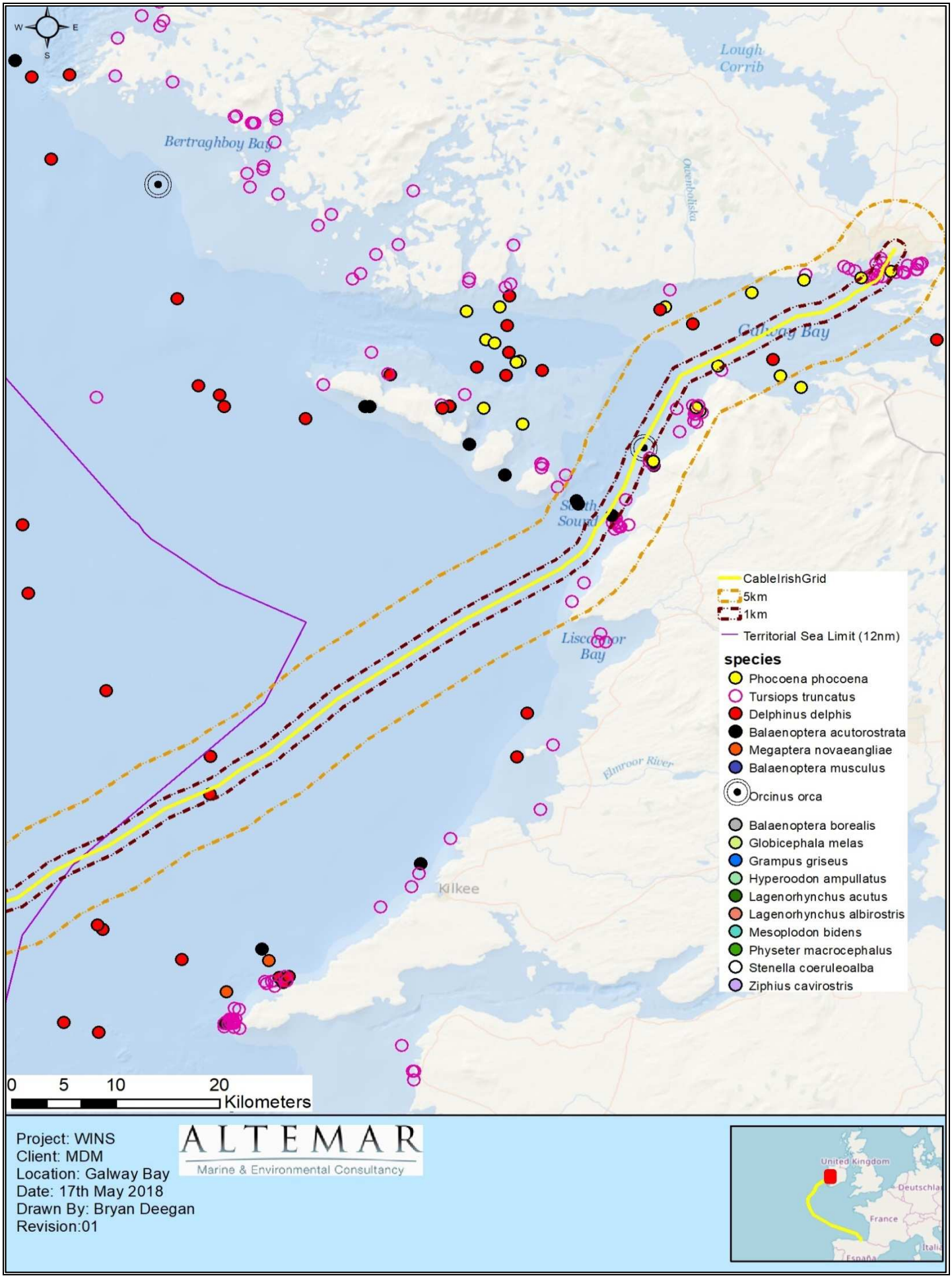


Figure 16. Recorded Cetacean species sightings (Source IWDG Sightings Data) in the inshore.

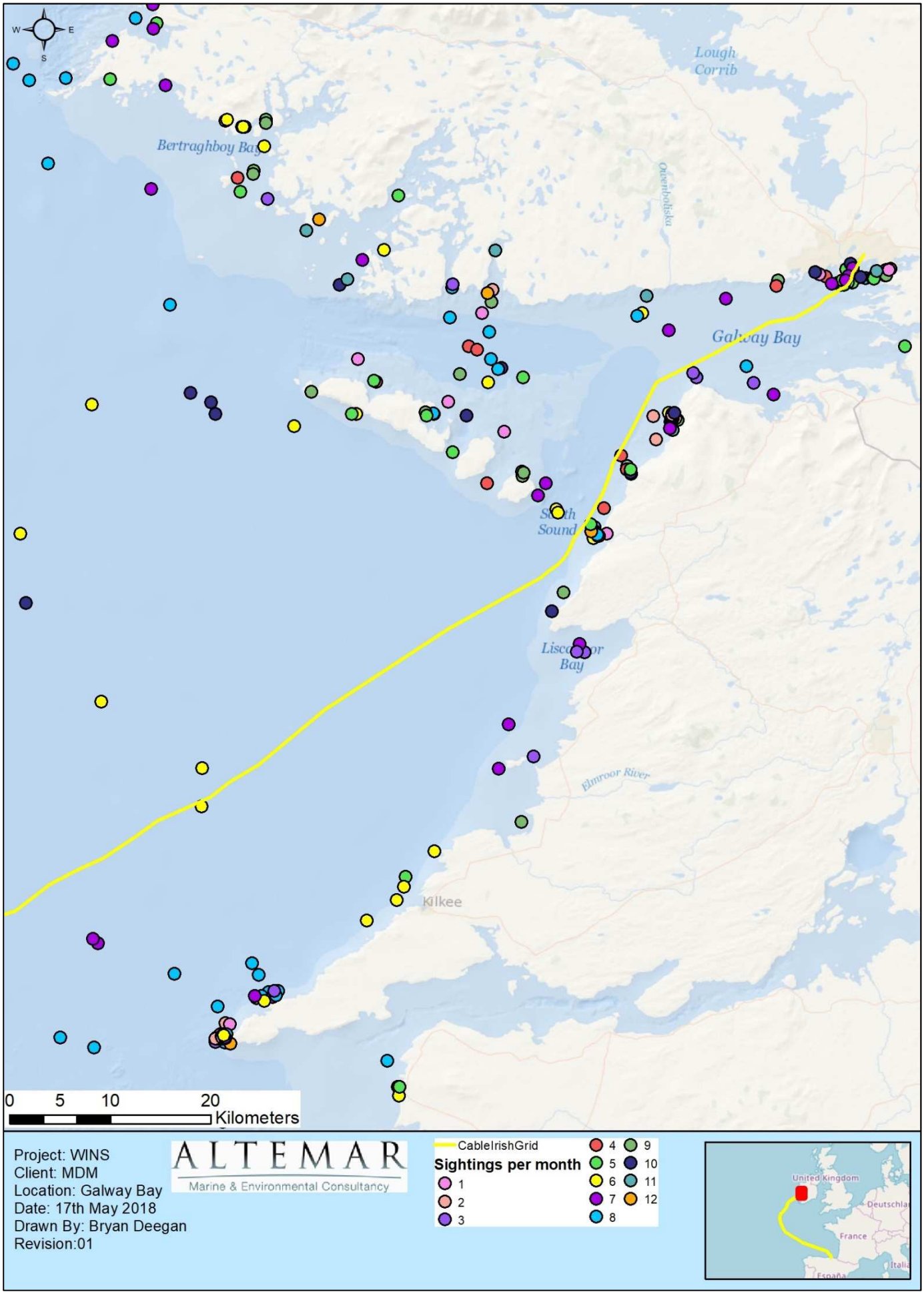


Figure 17. Recorded Cetacean sightings (Source IWDG Sightings Data) in the inshore area recorded during the 12 months of the year within the 12nm limit.

Harbour Seals

Inner Galway Bay is an important site for harbour seals but, not for grey seals (Figure 18). As outlined in the Galway Bay Complex SAC (site code: 0268) Conservation objectives supporting document - Marine habitats and species, "harbour seals in Galway Bay Complex SAC occupy both aquatic habitats and intertidal shorelines that become exposed during the tidal cycle. The species is present at the site throughout the year during all aspects of its annual life cycle, which includes breeding (May to July approx.), moulting (August to September approx.) and non-breeding foraging and resting phases. In particular, comparatively limited information is available from the last period in the annual cycle spanning the months of October to May.

Harbour seals are vulnerable to disturbance during periods in which time is spent ashore or in shallow waters by individuals or groups of animals. This occurs immediately prior to and during the annual breeding season which takes place predominantly during the months of May to July. Pups are born on land usually on sheltered shorelines, islets or skerries and uninhabited islands removed from the risk of predation and human interference." "Current known sites are broadly within the following areas: Oranmore Bay, Kinvarra Bay, Aughinish Bay, Poulnaclogh Bay, Ballyvaghan Bay, Rabbit Island, Earl's Rock, St. Brendan's Island, Ardfry Point, Tawin Island, Glasheen Island and Deer Island.

The necessity for individual seals to undergo an annual moult (i.e. hair shedding and replacement), which generally results in seals spending more time ashore during a relatively discrete season, provides an opportunity to record the minimum number of harbour seals occurring in a given area (i.e. minimum population estimate). Moulting is considered an intensive, energetically-demanding process which incurs further vulnerability for individuals during this period. Terrestrial or intertidal locations where seals can be found ashore are known as haul-out sites. The harbour seal moult season takes place predominantly during the months of August to September. A total of 317 harbour seals were recorded ashore within Galway Bay Complex SAC in August 2003 during a national aerial survey for the species. Suitable habitat for the species along with known moult haul-out locations in Galway Bay Complex SAC. "This broadly consists of Oranmore Bay, Kinvarra Bay, Aughinish Bay, Poulnaclogh Bay, Ballyvaghan Bay and on Black Rock, Earl's Rock and St. Brendan's Island, Tawin Island and Glasheen Island, Ringeelaun Point and Deer Island."

The proposed location of the cable survey and main lay are not in the vicinity of resting, moulting or breeding sites (See NIS). However, it is noted that as outlined in NPWS 2013 "in acknowledging the limited understanding of aquatic habitat use by the species within the site, it should be noted that all suitable aquatic habitat is considered relevant to the species range and ecological requirements at the site and is therefore of potential use by harbour seals." As a result, despite the location of the survey and cable outside key activity areas, the survey and main lay teams will need to be cognisant of this and take into account due diligence in relation to seal disturbance when deploying and recovering equipment.

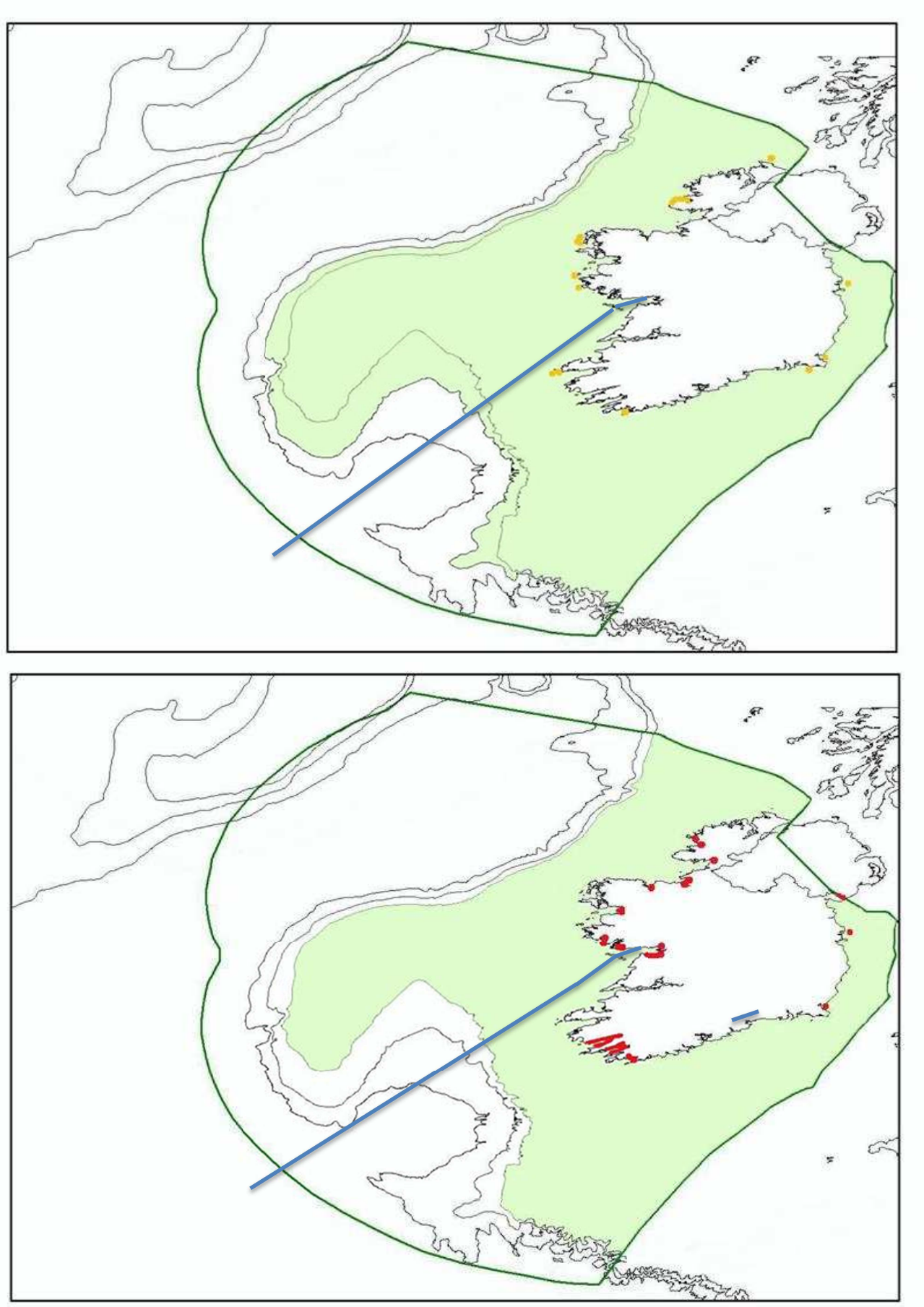


Figure 18. Harbour seal (red) and grey seal (yellow) distribution (green) and haul-out sites in the inshore area. (NPWS). Proposed cable route is the blue line.

Offshore Area (12nm-limits to limits of EEZ)

The proposed fibre optic cable route in relation to the Irish EEZ, designated Irish Continental shelf, 12nm Limit and Offshore SAC's for Cold Water Corals are seen in Figure 19. Information on mounds which could potentially host biogenic reef (*Lophelia pertusa*) populations, not currently afforded protection are seen in Figure 20.

The entire route, within the Irish EEZ, was examined using shaded relief service of bathymetry data collected by INFOMAR (where available). The closest the fibre optic cable route comes to mounds, or obvious anomalies that could potentially host significant biogenic reef forming populations of *Lophelia pertusa*, is 19km (Figure 20). The closest designated area to the proposed cable route in the offshore area is 30km, due south of the Hovland Mound Province SAC (Figure 21).

Predicted marine habitat data for the offshore section of the fibre optic cable route is shown in Figure 22 (Source MSFD mapping Marine Institute). Figure 23 shows offshore cetacean activity as recorded by IWDG sightings scheme, in addition to all sightings during August the month of the proposed routing of the fibre optic cable.

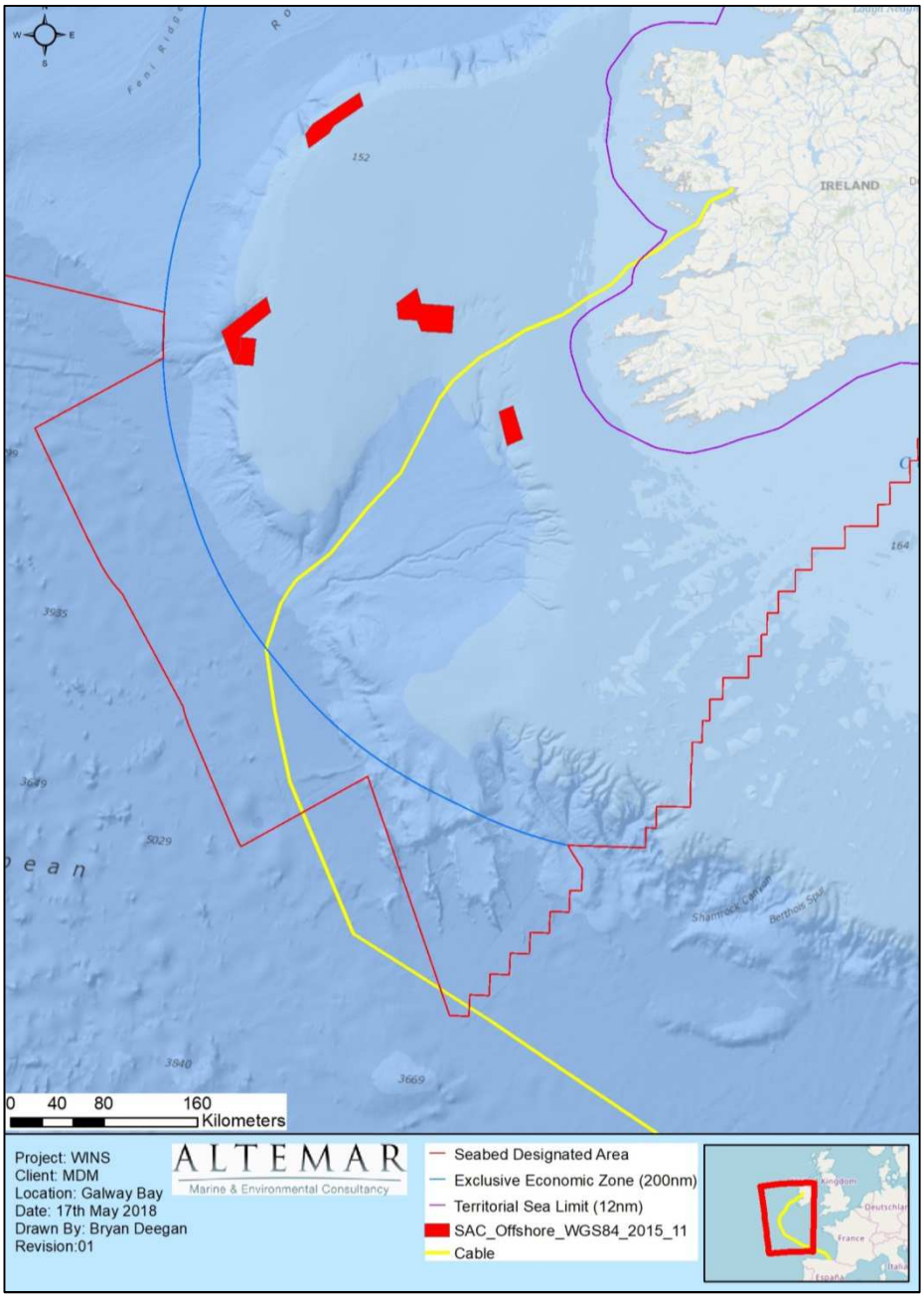


Figure 19. Position of offshore fibre optic cable route in relation to the Irish EEZ, Designated Irish Continental shelf and Offshore SAC's.

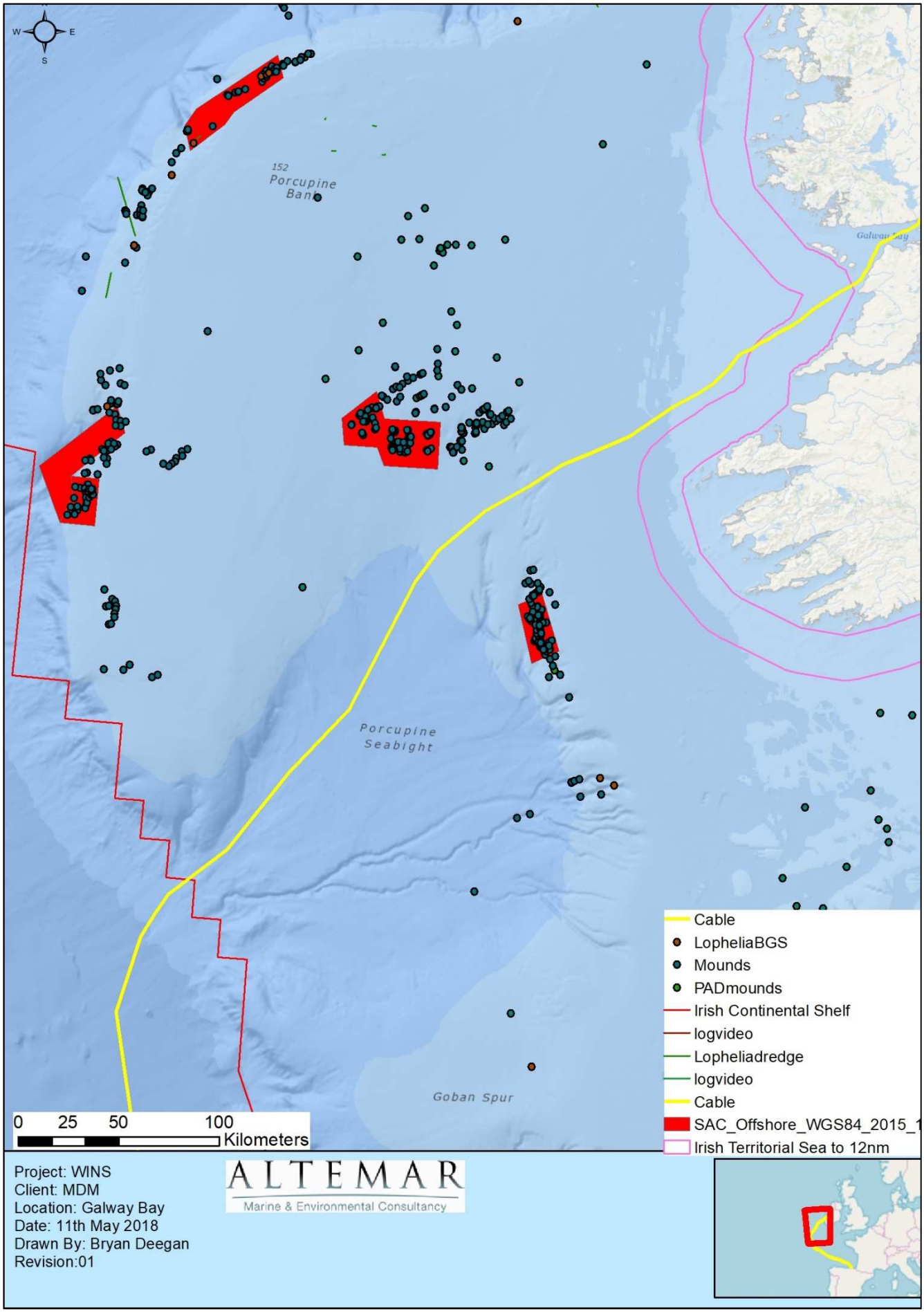


Figure 20. Proposed location of the fibre optic cable route in relation to SAC's, carbonate mounds or potential biogenic reefs in the offshore area.

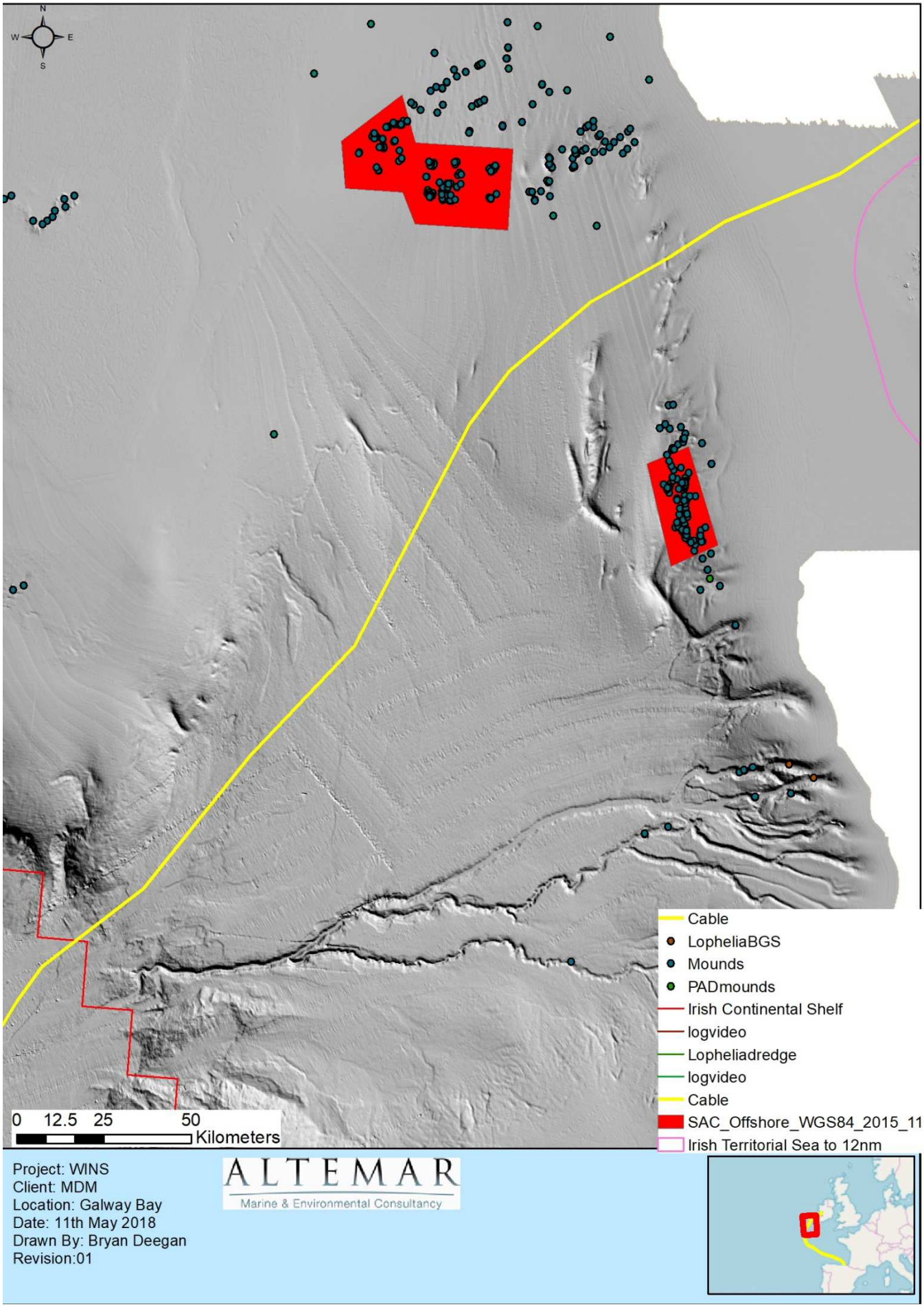


Figure 21. Location of the fibre optic cable route to SAC's, carbonate mounds or potential biogenic reefs in the offshore area on INFOMAR backscatter.

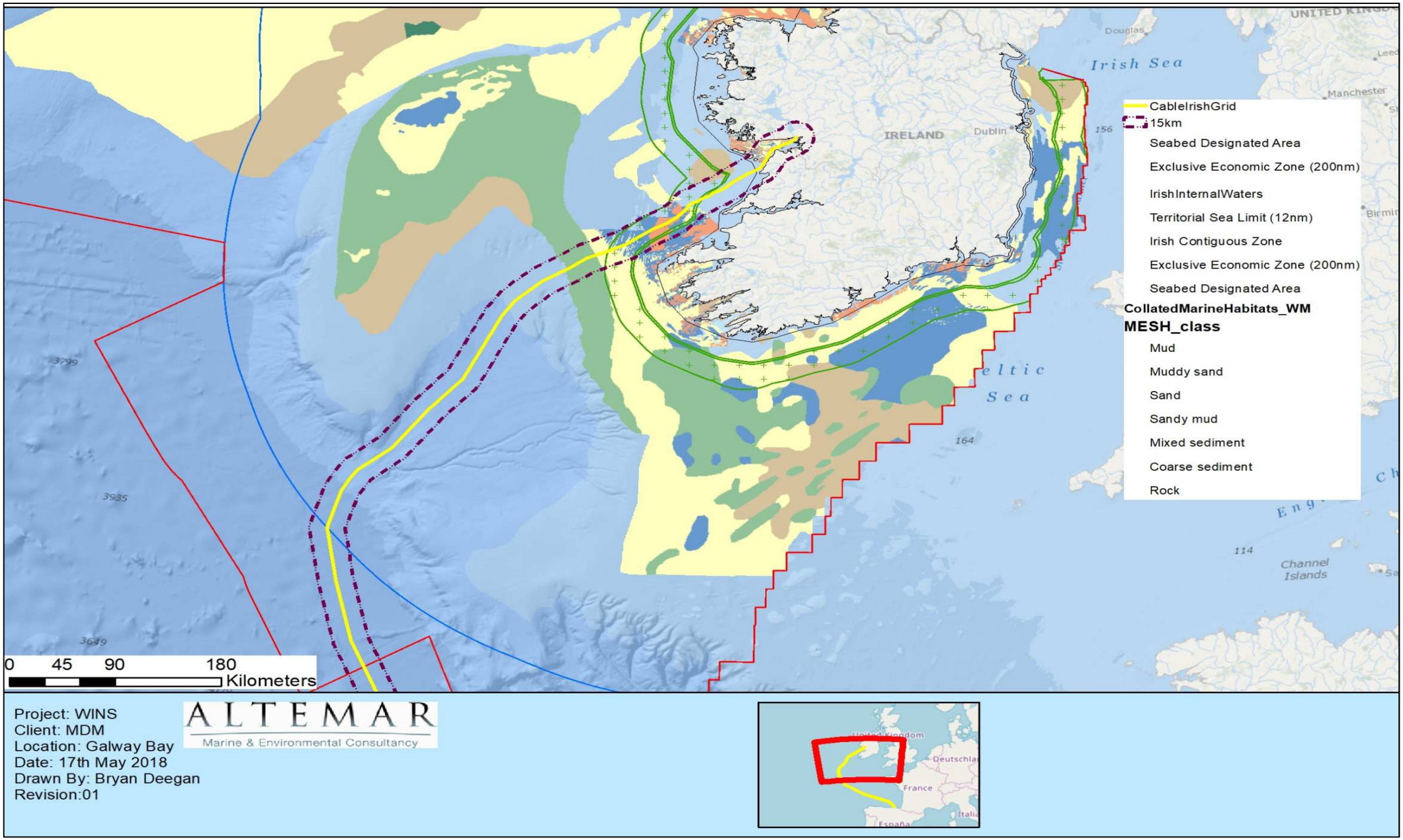


Figure 22: Predicted marine habitat data for the offshore section of the fibre optic cable route (Source MI MSFD Habitat mapping).

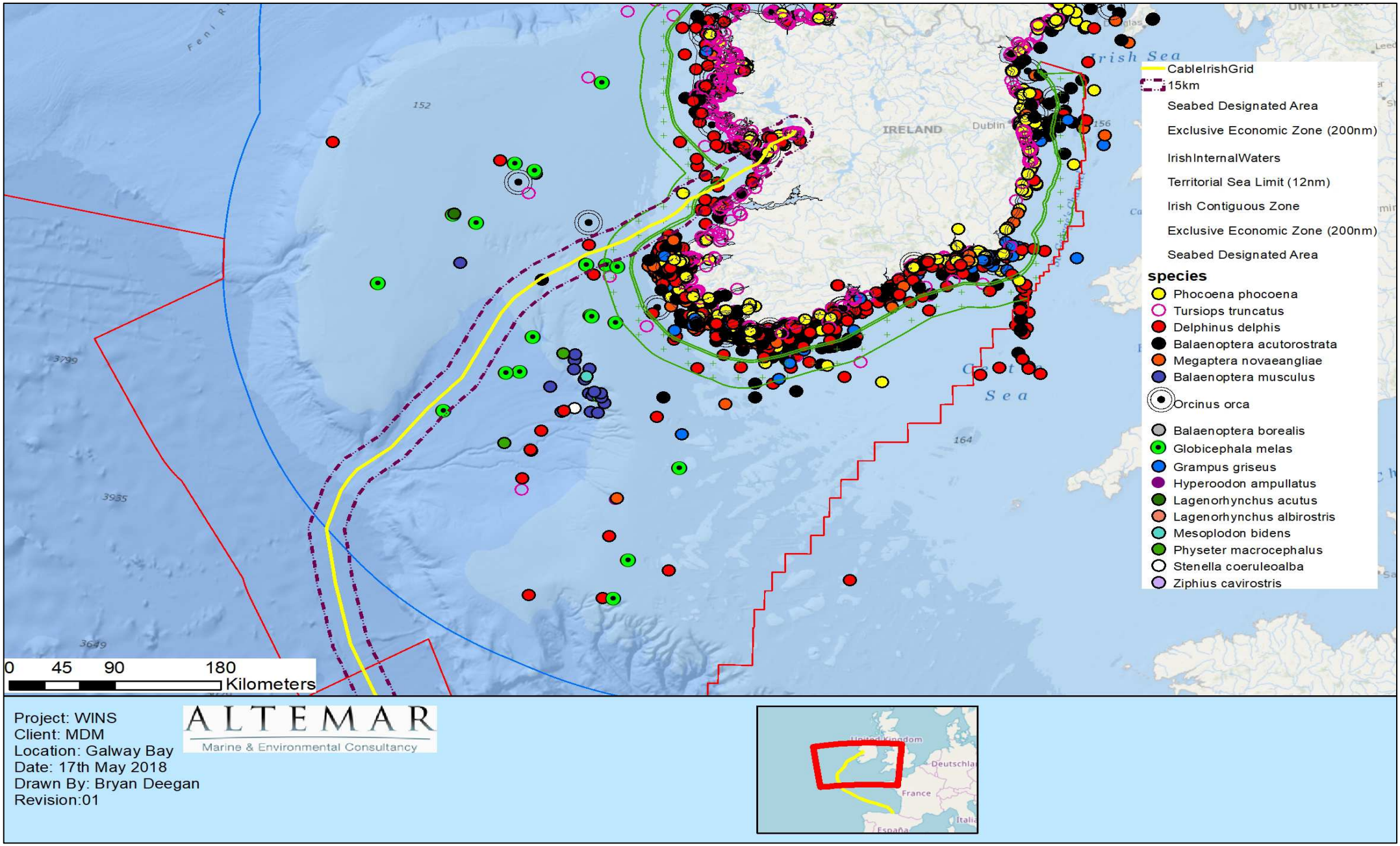


Figure 23. Recorded Cetacean sightings of Mayo Coast and Porcupine Bank/Rockall Trough (Source IWDG Sightings Data). Inset historical sightings in the offshore area of the cable route recorded during the month of April with 12nm limit.

ANALYSIS OF THE POTENTIAL IMPACTS

Introduction

The installation of a deep sea fibre-optic cable is a complex and challenging procedure. From the beginning of the planning stage to the final installation the cable, careful thought has gone into ensuring the longevity of the cable and uninterrupted service. This, in tandem with foreshore licencing and environmental legislation results in the placement of the cable in as stable an environment as possible that will have minimal impact on the environment and threat of anthropogenic disturbance. In summary, within the 12nm limit, the laying of the cable will involve ploughing in sediment, surface laying on hard substrate (if encountered) and elements of diver works in the shallow subtidal. The intertidal elements will involve plough burial, followed by back-blading. Even though there are two distinct elements to this project i.e. subtidal and intertidal, both elements are inextricably linked are treated together for the analysis of potential impacts. Terrestrial elements of this project from the beach manhole are treated in a separate application process.

Construction Impacts

Ploughing will involve the disturbance of the seabed to 1.5m where possible. Immediate backfilling is a feature of the plough to be used. In the subtidal the process will involve a ship moving at a speed of <1kn and generating acoustic noise akin to dredging activity. A plume of sediment will be generated. However, due to the speeds and equipment (on skids) involved this plume is excepted to be very localised. Disturbance of cetaceans may occur due to the presence of the vessel however, at the speeds involved injury to marine mammals is unlikely. There is only little information on potential noise impacts due to the installation (or removal) and operation of sub-sea cables (OSPAR 2008a). Sound emissions associated with the installation, removal or operation of submarine cables are considered as less harmful compared to activities such as seismic surveys, military activities or construction work involving pile driving. Generally, maximum sound pressure levels related to the installation or operation of cables are moderate to low (OSPAR, 2012). Though modern equipment and installation techniques can reduce the re-suspension of sediment during cable burial or removal, remaining suspended sediment may nonetheless - depending on percentage of silt fraction and background levels - obstruct the filtration mechanisms of some benthic and pelagic organisms at least temporarily (OSPAR 2009). It can also affect the growth of the macrobenthos and may have a lethal effect on some species. Some mobile benthic species (for example, crabs) are able to avoid most disturbance whereas sessile (bivalves, tubeworms etc.) and sensitive species (such as slower growing or fragile species) will be more impacted (OSPAR, 2012). Contamination arising from seabed disturbance is only a risk in heavily contaminated locations (OSPAR 2009, COOPER et al. 2007a, 2007b). By surface laying over hard ground the cable will only create a narrow footprint on the seabed that may inhibit growth of marine flora and fauna due to the presence of the cable. No rock armour will be carried out in these areas.

The presence of machinery and personnel in the intertidal may temporally disturb wildlife. Disturbance of the sediments in the intertidal will occur due to ploughing. Construction of the beach manhole will be carried out in the grass area to the north of the road. The preparation of a beach manhole will also generate noise in the vicinity of the beach. Pollution generated from machinery/construction activities could potentially impact the intertidal habitat. Mitigation measures are proposed.

Habitats and Species

Potential impacts on habitats and species and the extent of these impacts that could potentially be encountered during the construction phase are seen in Table 8a (habitats) and 8b (species).

Cetaceans

Cetaceans have been recorded near the proposed survey route, out to and beyond the 12nm limit. The proposed survey would be expected to impact on cetaceans primarily through the emission of noise due to the vessel and acoustics from survey equipment including multibeam. As outlined by O'Brien (2005), "sound travels 4.5 times faster in water than in air and low frequency sounds travel farther underwater than high frequency sounds. Multi-beam can be defined as Low frequency (<1 kHz), Mid-frequency (1-10 kHz) and High Frequency (>10 kHz). The hearing ranges and sensitivity of marine mammals differ from one species to another depending on their audiogram. For example, harbour porpoises are sensitive from 3 kHz to 130 kHz, with peak sensitivity at 125-130 kHz, and bottlenose dolphins from 5-110 kHz, with peak sensitivity at 40 and 60-116 kHz (Southall et al., 2007). Common seals are sensitive to 4-45 kHz (peak sensitivity at 32 kHz) and grey seals to 8-40 kHz. Humans are sensitive only to

frequencies from 20 Hz to 16-18 kHz but with peak sensitivity from 2-4 kHz. Most small cetaceans, excluding harbour porpoise, have an auditory bandwidth of 150 HZ to – 160 kHz, while harbour porpoise to frequencies within 200 Hz to 180 kHz. Pinnipeds in water are thought to have an auditory bandwidth of between of 75 Hz to 75 kHz and from 75 Hz to 30 kHz in air (Southall et al. 2007)."

The cetacean species observed along the route of the proposed marine survey are high frequency (harbour porpoise), mid-frequency (common dolphin) and low frequency (Minke whale) cetaceans. Common Seals may also be present. Southall *et al.* (2007) outlined in their publication "Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations" that for discrete noise events such as multi-beam, for mid-frequency and high frequency cetaceans maximum peak pressure level of **230** dB re 1 uPa and a maximum received sound pressure level of **198** dB re 1 uPa^2-s (Table 10)

Table 10. Southall *et al.* (2007) Proposed injury criteria for individual marine mammals exposed to "discrete" noise events (either single or multiple exposures within a 24-h period).

	Sound type		
Marine mammal group	Single pulses	Multiple pulses	Nonpulses
Low-frequency cetaceans	Cell 1	Cell 2	Cell 3
Sound pressure level	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa^2-s (M_{lf})	198 dB re: 1 μPa^2-s (M_{lf})	215 dB re: 1 μPa^2-s (M_{lf})
Mid-frequency cetaceans	Cell 4	Cell 5	Cell 6
Sound pressure level	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa^2-s (M_{mf})	198 dB re: 1 μPa^2-s (M_{mf})	215 dB re: 1 μPa^2-s (M_{mf})
High-frequency cetaceans	Cell 7	Cell 8	Cell 9
Sound pressure level	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)	230 dB re: 1 µPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa^2-s (M_{hf})	198 dB re: 1 μPa^2-s (M_{hf})	215 dB re: 1 μPa^2-s (M_{hf})
Pinnipeds (in water)	Cell 10	Cell 11	Cell 12
Sound pressure level	218 dB re: 1 µPa (peak) (flat)	218 dB re: 1 µPa (peak) (flat)	218 dB re: 1 µPa (peak) (flat)
Sound exposure level	186 dB re: 1 μPa^2-s (M_{pw})	186 dB re: 1 μPa^2-s (M_{pw})	203 dB re: 1 μPa^2-s (M_{pw})
Pinnipeds (in air)	Cell 13	Cell 14	Cell 15
Sound pressure level	149 dB re: 20 µPa (peak) (flat)	149 dB re: 20 µPa (peak) (flat)	149 dB re: 20 µPa (peak) (flat)
Sound exposure level	144 dB re: (20 µPa)^2-s (M_{pa})	144 dB re: (20 µPa)^2-s (M_{pa})	144.5 dB re: (20 µPa)^2-s (M_{pa})

Note: All criteria in the "Sound pressure level" lines are based on the peak pressure known or assumed to elicit TTS-onset, plus 6 dB. Criteria in the "Sound exposure level" lines are based on the SEL eliciting TTS-onset plus (1) 15 dB for any type of marine mammal exposed to single or multiple pulses, (2) 20 dB for cetaceans or pinnipeds in water exposed to nonpulses, or (3) 13.5 dB for pinnipeds in air exposed to nonpulses. See text for details and derivation.

The proposed survey equipment and the noise frequency emissions are seen in Table 11. The high frequencies emitted from the equipment (210 kHz and 400 kHz) are above the auditory range of the mid frequency but within the hearing range of high frequency cetaceans observed and on the proposed cable route (Table 12).

Table 11. Proposed survey equipment.

Equipment Type	**Frequency (Energy level in dB re 1 µPa)**
Dual Frequency Single Beam Echosounder – Reson Navisound 420	33 and 210kHz (168 – 174)
Dual Frequency Side Scan Sonar - Edgetech 4200 Sidescan Towfish	100 and 400kHz (226 effective)
Sub-bottom Profiler - Geoacoustics 4 x 4 Hull-mounted SBP Pinger System	3 – 7.5kHz (-225)

The 100 kHz (Edgetech 4200 Sidescan towfish) and 33 kHz (Reson Navisound 420mid-frequencies of) emit mid-range frequencies within the hearing ranges of small cetaceans (and seals). The Geoacoustics 4x4 hull mounted sub-bottom profiler Pinger (3-7.5kHz) emits low frequency noise, within the auditory range of harbor porpoise, minke whale and the lower detection range of dolphins. The Reson Navisound 420 (168-174 dB) emits noise below the acceptable received source level (db) and should not adversely affect cetaceans. As the Geoacoustics Sub-bottom Profiler and Edgetech 4200 Sidescan towfish emit noise of 225 dB (re 1 uPa^2) at 4-7.5k Hz and 226 dB (re 1 uPa^2) at 11 kHz, which is above the 198 (re 1 uPa^2) proposed injury levels indicated by Southall *et al.* (2007), negative impacts

may be foreseen if cetaceans are close enough to the equipment to receive sound levels above this indicative threshold.

Table 12. Marine Mammal Functional Hearing Groups and Estimated Functional Hearing Ranges Proposed by Southall *et al.* (2007)

Functional Hearing Group	Estimated Auditory Bandwidth	Genera Represented (Number Species/Subspecies)	Frequency-Weighting Network
Low-frequency cetaceans	7 Hz to 22 kHz	*Balaena, Caperea, Eschrichtius, Megaptera, Balaenoptera* (13 species/subspecies)	M_{lf} (lf: low-frequency cetaceans)
Mid-frequency cetaceans	150 Hz to 160 kHz	*Steno, Sousa, Sotalia, Tursiops, Stenella, Delphinus, Lagenodelphis, Lagenorhynchus, Lissodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Orcacella, Physeter, Delphinapterus, Monodon, Ziphius, Berardius, Tasmacetus, Hyperoodon, Mesoplodon* (57 species/subspecies)	M_{mf} (mf: mid-frequency cetaceans)
High-frequency cetaceans	200 Hz to 180 kHz	*Phocoena, Neophocaena, Phocoenoides, Platanista, Inia, Kogia, Lipotes, Pontoporia, Cephalorhynchus* (19 species/subspecies)	M_{hf} (hf: high-frequency cetaceans)
Pinnipeds in water	75 Hz to 75 kHz	*Arctocephalus, Callorhinus, Zalophus, Eumetopias, Neophoca, Phocarctos, Otaria, Erignathus, Phoca, Pusa, Halichoerus, Histriophoca, Pagophilus, Cystophora, Monachus, Mirounga, Leptonychotes, Ommatophoca, Lobodon, Hydrurga, Odobenus* (41 species/subspecies)	M_{pw} (pw: pinnipeds in water)
Pinnipeds in air	75 Hz to 30 kHz	Same species as pinnipeds in water (41 species/subspecies)	M_{pa} (pa: pinnipeds in air)

Lurton (2016) modelled the sound field radiated by multibeam echosounders for acoustical impact assessment. He stated that "considering the injury criteria, the results illustrate that injury hazards are possible only at very short distances from the source: e.g. about 5 m for SPL and 12 m for SEL in the case of a 240-dB source level, considering cetaceans. For behavioural response criteria, the corresponding values are 9 m and 70 m." The survey would comply with the DoEHLG's Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters[1] . These guidelines require a 1000m distance which would be deemed adequate to mitigate the negative impacts of the proposed survey. In addition, cetaceans in the vicinity of the vessel during start up procedures would be given ample time to leave the site with the soft start procedures outlined in the guidelines.

[1] http://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf

Table 8a. Construction Impacts on habitats

Habitat	Fossitt	Habitats Directive	Rating	Construction Impact	Impact Significance
Moderately Exposed Infralittoral Rock	SR2	"Reef - 1170"	A	Laying of the cable will not occur in the vicinity of this habitat. No impact is foreseen on the structural integrity of this habitat. Temporary disturbance would occur due to cobbles, if present, being turned over.	Minor Adverse/ localised/short-term
Moderately Exposed Circalittoral Rock	SR5	"Reef - 1170"	A	Surface laying will occur on this habitat in offshore bedrock areas. In areas of cobble ploughing may be carried out. No impact is foreseen on the structural integrity of this habitat. Temporary disturbance would occur due to cobbles, if present, being turned over.	Minor Adverse/ localised/short-term
Sand Shores	*LS2*	"Estuaries – 1130"and "Mudflats and sandflats not covered by seawater at low tide-1140"	A	These habitat is classed as Mudflats and sandflats not covered by seawater at low tide and do form part of sites of conservation interest and are the feeding habitat of the over wintering birds of conservation importance. As a result this sandflat habitat is classed as internationally important. However the cable route is an area of significant existing disturbance (See NIS). Temporary displacement of birds may occur in the vicinity of the cable route. Works will be outside of overwintering period. Short term impacts would be expected on infauna due to compression/redistribution of sediments. Mitigation measures are proposed.	Minor Adverse/ localised/short-term
Shingle and gravel shores	LS1		B	Ploughing will not occur in this area. The HDD will go under this habitat. Machinery may cross this habitat to access beach.	Minor Adverse/ localised/short-term
Muddy sand shores	LS3		D	These habitat is classed as Mudflats and sandflats not covered by seawater at low tide and do form part of sites of conservation interest and are the feeding habitat of the over wintering birds of conservation importance. As a result this sandflat habitat is classed as internationally important. However the cable route is an area of significant existing disturbance (See NIS). Temporary displacement of birds may occur in the vicinity of the cable route. Works will be outside of overwintering period. Short term impacts would be expected on infauna due to compression/redistribution of sediments. Mitigation measures are proposed.	Minor Adverse/ localised/short-term
Circalittoral gravels and Sands	SS5		D	Ploughing will occur in this area offshore. A temporary alteration in sediment layering would follow the ploughing process. Infauna may be damaged or displaced in the vicinity of the plough.	Minor Adverse/ localised/short-term
Circalittoral Mixed sediments	SS8		D	Ploughing will occur in this area offshore. A temporary alteration in sediment layering would follow the ploughing process. Infauna may be damaged or displaced in the vicinity of the plough.	Minor Adverse/ localised/short-term
Built Land	BL		E	All works will be away from BL3. The HDD will be under the road.	Neutral
Amenity Grassland	GA2		E	Machinery will be placed on the amenity grassland during HDD operations. The habitat is of low biodiversity importance and will be reinstated.	Neutral

Table 8b. Construction Impacts on species

Species	Rating	Construction Impact	Impact Significance
Mammal-Cetaceans	A	Subtidal survey and cable laying may be carried out in vicinity of cetaceans. Localised disturbance may occur due to the presence of the vessel and acoustic noise generated from cable laying activities on the sea floor. A MMO will be on vessel at all times (Seen NIS for more detail).	Minor Adverse/ localised/short-term
Mammal-Seals	A	Subtidal survey and cable laying may be carried out in vicinity of seals. Localised disturbance may occur due to the presence of the vessel and acoustic noise generated from cable survey and laying activities. Cable laying is to be carried out outside of breeding and haul out areas for Grey, but will be carried out during breeding period for Harbour seals. Vessel speeds will be slow. A MMO will be on board the vessel to enforce mitigation measures.	Minor Adverse/ localised/short-term
Mammal-Bats	A	There was no evidence of bat species at this site. Construction in the intertidal will be carried out during daylight hours and will not involve additional lighting or noise after dusk. It will not impact on the food source for bat species or habitats important for roosting. If HDD operations extend beyond daylight hours the temporary presence of lighting or noise would not significantly impact bat populations.	Neutral
Mammals-Terrestrial	A-D	Construction in the intertidal and the HDD area will be carried out during daylight hours and any impacts would be primarily due to disturbance. There was no evidence of terrestrial mammal species at this site. However it is assumed that mammal species could be present including otters, even though this is a popular area for dog walking etc. An ecologist will be present during intertidal and HDD works.	Minor Adverse/ localised/short-term
Birds-Over wintering	A	Survey and construction in the intertidal and HDD area will be carried out during daylight hours and impacts would be primarily due to disturbance. During the survey and construction period the over wintering birds will be absent from the site.	Neutral
Birds-Summer	B	Construction in the intertidal and HDD area will be carried out during daylight hours and impacts would be primarily due to disturbance. An ecologist will be onsite during the HDD and cable laying to ensure birds and the intertidal sandflat habit are not significantly impacted.	Minor Adverse/ localised/short-term
Birds-residential	D	Survey and construction in the intertidal and HDD area will be carried out during daylight hours and impacts would be primarily due to disturbance. An ecologist will be onsite during the HDD and cable laying to ensure birds and the intertidal sandflat habit are not significantly impacted.	Minor Adverse/ localised/short-term
Amphibians-Frogs	B	The intertidal area is not a habitat for amphibian species. Amphibians were not noted in the amenity grassland area. An ecologist will be on site to ensure species of conservation importance are not impacted.	Neutral
Terrestrial Flora	-	The terrestrial element of this project is solely in amenity grassland area. No flora of conservation importance were noted.	Neutral
Marine algae	D	Intertidal marine algae are not located along the proposed route. 35m to the east is an area of intertidal reef. Subtidal marine algae are primarily associated with hard substrata and will be impacted by surface laying. Localised displacement of marine algae may occur within the footprint of the cable in the subtidal if reef is encountered but the route has been selected to avoid these areas.	Minor Adverse/ localised/short-term
Fish Species	A	Ballyloughane Beach is not an important salmonid habitat. Localised disturbance of marine species may occur due to ploughing and ROV based burial activities. Vessel speeds are very slow and significant impacts on fish would be expected to be avoided during works. Post works, fish may be attracted to the area due to the disturbed sediment.	Minor Adverse/ localised/short-term

Designated Conservation sites

The landfall for the cable is within a SPA, SAC, pNHA and Ramsar site. These are overlapping designations primarily for overwintering birds in addition to saltmarsh and sensitive subtidal species. The noise generated from construction activities could cause disturbance in the vicinity of the cable route within these designated sites. However, construction will take place during summer, a time of high recreational activity at the beach, in the absence of over wintering birds. The impact on the mudflat/sandflat would be seen to be localised and short term to the immediate vicinity of the cable route primarily due to compression by machinery along the route and laying by the plough for 450m. An ecologist will be present throughout works. As discussed with NPWS an additional video survey will be carried out to optimise the route in the shallow subtidal in relation to the habitat distribution of *Virgularia mirabilis* (sensitive subtidal community that is not a feature of interest/conservation objective of the Galway Complex SAC).

Post lay/Operational Impacts

A fibre-optic cable on the seabed is passive with no moving parts and as a result there will be minimal operational impacts. Potential impacts on habitats and species and the extent of these impacts that could potentially be seen during the operational phase are seen in Table 9a (habitats) and 9b (species). The cable is powered to provide power to the repeaters that are placed at approximately 80km intervals. No significant impacts are foreseen from the cable which will be buried to 1.5m in the majority of the waters to 1500m (except in reef areas where it will be laid on the surface).

No servicing of the cable is foreseen unless in exceptional circumstances where damage to the cable has occurred due to anthropogenic such as trawling or anchor damage. In the event of a fault or break in the cable over its working lifespan, depending on its location, it would entail repair in situ by divers or the partial lifting of the cable to repair it on board a ship. Post lay burial of the cable may be necessary by ROV in the substrate, particularly in areas where the cable crosses existing subsea infrastructure.

End of life/decommissioning Impacts

The lifespan of the cable is 25-40 years and decommissioning will involve best practice at that time. This could involve leaving in situ, partial removal or complete removal. "Cable removal involves additional environmental impacts that roughly correspond to those during construction. Removal may not take place, or should be restricted, if it generates greater adverse environmental impacts than would be the case if the cable were left in the seafloor" (OSPAR, 2012). Removal and recycling of seabed cables is currently carried out worldwide.

Table 9a Operational Impacts on habitats.

Habitat	Fossitt	Habitats Directive	Rating	Operational Impact	Impact Significance
Moderately Exposed Infralittoral Rock	SR2	"Reef - 1170"	A	No significant heat or EMF emissions in to the marine environment are foreseen. The structural integrity of the habitat will not be impacted.	Neutral
Moderately Exposed Circalittoral Rock	SR5	"Reef - 1170"	A	No significant heat or EMF emissions in to the marine environment are foreseen. The structural integrity of the habitat will not be impacted.	Neutral
Sand Shores	*LS2*		A	The cable will be buried in the marine sediment and no impacts are foreseen.	Neutral
Shingle and gravel shores	LS1		B	The cable will be buried in the marine sediment and no impacts are foreseen.	Neutral
Muddy sand shores	LS3		B	The cable will be buried in the marine sediment under this habitat and no impacts are foreseen.	Neutral
Circalittoral gravels and Sands	SS5		D	The cable will be buried in the marine sediment and no long term impacts are foreseen. Invertebrate biodiversity may be negatively impacted in the short term by ploughing..	Minor Adverse/ localised/short-term
Circalittoral Mixed sediments	SS8		D	The cable will be buried in the marine sediment and no long term impacts are foreseen. Invertebrate biodiversity may be negatively impacted in the short term by ploughing..	Minor Adverse/ localised/short-term
Built land	BL		E	The cable will be located under built land i.e. road and no impact is foreseen.	Neutral
Amenity Grassland	GA2		E	The cable will be located under this habitat. Access to the beach manhole may be required.	Neutral

Table 9b Operational Impacts on species.

Species	Rating	Operational Impact	Impact Significance
Mammal-Cetaceans	A	No acoustic noise is generated from the cable whilst in operation. Studies have shown that the danger of entanglement in modern cables is extremely remote due to the use of BAT in surface laying, burial and cable design.	Neutral
Mammal-Seals	A	No acoustic noise is generated from the cable whilst in operation. Studies have shown that the danger of entanglement in modern cables is extremely remote due to the use of BAT in surface laying, burial and cable design.	Neutral
Mammal-Bats	A	The cable will be buried beneath the intertidal and grassland area. No impact is foreseen on bat species.	Neutral
Mammals-Terrestrial	A-D	The cable will be buried beneath the intertidal and grassland area. No impact is foreseen on terrestrial mammal species.	Neutral
Birds-Over wintering	A	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral
Birds-Summer	B	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral
Birds-residential	D	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral
Amphibians-Frogs	B	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral
Terrestrial Flora	-	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral
Marine algae	D	The cable will be buried beneath the intertidal and subtidal areas. No impact is foreseen.	Neutral

MITIGATION OF IMPACTS (AS SEEN IN NIS)

G) Mitigation Measures (as seen in NIS)

Minor short term impacts may result as a consequence of the survey and mainlay phases of the project, but these are believed not to be at the scale to impact on the integrity of the Natura 2000 sites, species or the SSCO's. However, following the precautionary principle, substantial mitigation measures have been developed to minimise the ecological impacts of the project, not only in relation to Natura 2000 Annex habitats and species, but also additional species and habitats of conservation importance that have been recorded in the area.

Pre cable laying mitigation

Route Planning

A strict route selection process was carried out to assess the optimal route and landing site across the east coast of Galway Bay, taking into account the lowest environmental impact, highest resource efficiency and wave exposure on the basis of sound and comparable data. This included addressing engineering issues as well as environmental concerns and assessing existing subsea infrastructure.

The landfall location is within 4 overlapping sites of conservation significance (SAC, SPA, pNHA and RAMSAR). The conservation significance of the habitats and location of the important feeding grounds for overwintering birds was assessed. The route through the conservation sites was deemed to be the optimal route of satisfying conservation significance (within the designated sites) based on the assessment of NPWS ratings data, the optimal from an engineering perspective and for the stability and longevity of the cable. All saltmarsh and sand dune habitats were avoided as part of the route selection process. Initial routing used NPWS data to avoid subtidal communities. However, a video survey was carried out within the SAC to fine tune this data and avoid sensitive subtidal communities in areas not covered by previous NPWS data. Further optimising and fine tuning of the route will be carried out in discussion with NPWS following an additional video survey to be carried out in the shallow subtidal element of Galway Bay Complex SAC to optimise the route in relation to the distribution of *Virgularia mirabilis* not recorded in this area prior to the May 2018 survey.

Timing of Cable Lay

The assessment of environmental factors within the landfall area was critical to the timing of the project and mitigation of impacts on species of conservation importance. The primary conservation interest of the SPA at the landfall is over-wintering birds. The cable lay is to be carried out in summer, after all over-wintering birds have left and prior to the arrival of species for the overwintering season. Terns are also listed as a conservation interest and are not located in the vicinity of the proposed cable route.

Works	*Date*
Site Investigations	April 2019
Shore-End Installation	June 2019
Main-Lay	June - August 2019

Harbour Seals will be at breeding sites during summer months. The cable survey is at minimum 1.5km from the nearest breeding site. As discussed with Inland Fisheries Ireland the proposed cable laying timeline (July 2019) will coincide with the main salmon run returning through Galway Bay into the River Corrib catchment for the purposes of spawning. The salmon smolt run is from mid-April to the end of May (outside the timeline of the proposed cable laying works). There is no significant noise generation during ploughing operations. As the cable installation by plough is relatively slow it produces only a minor plume of suspension of seabed sediments in the water column and this is transient and localised due to the nature of the ploughing and natural backfill activities. The cable laying operation from Ballyloughane Beach to the Aran Islands should only take approximately three days.

Laying Procedure
Subtidal burial of the cable will involve the use of a marine plough. Ploughing entails disturbing a wedge of seabed and the placing of the cable within the wedge in one pass. The seabed then backfills over the laid cable.

As outlined by OSPAR (2012) "As far as the burial technique is concerned, installation via jetting by means of sledge or ROV or use of a plough involves the lowest environmental impacts. Jetting fluidises the seabed using high power jets, and material may suspend to the water column for prolonged periods (a number of hours), and have the capacity to be transported over longer distances, increasing the number of potential receptors. Ploughing usually entails lifting a wedge of seabed and the seabed backfills over the laid cable. The level of sediment disturbance is, therefore, lower using ploughing compared to jetting techniques."

Construction phase mitigation measures

Terrestrial

It is proposed to use a HDD to travel under the car park, beach wall, drift line, cobble upper shore and into the upper intertidal. The following will need to be provided or confirmed to the project ecologist prior to HDD commencement:

a) Supervision and Notification

An ecologist with previous experience with HDD operations in the intertidal/subtidal should observe all works from planning, initial site setup to reinstatement. NPWS and IFI should be notified of pending operations at least 1 week before operations commence and of any breaches of compliance. An Ecological Clerk of Works report should be submitted to IFI/NPWS.

b) Timing of drill

It is estimated that the HDD will take one day to drill the duct for the cable. The timing of the HDD in the intertidal should be that no water is over the drill head during drilling. This would mean that the drill should be done on a receding tide to that there would be water in the vicinity of the bore. This would allow for observation of the drill progress by the ecologist and the rapid completion of the operation in a single tide.

c) Frac-out Contingency Plan

A Frac-out Contingency Plan should be discussed with the ecologist before works commence. The HDD operators will be need to be equipped with a tracked hydraulic excavator, straw or hay bales, stakes to secure bails, silt fence, sand bags, shovels, pumps, and any other materials or equipment necessary to contain and clean up inadvertent releases.

d) Corrective Actions for an Inadvertent Release

In the event of an inadvertent release to the surface, the following actions will be taken:

- If the release is large, mud circulation will cease immediately. If the spill is small to moderate, the contractor will continue circulation in order to maintain pressure in the hole.
- Maintaining circulation will also be necessary if the native material does not have the frictional characteristics necessary to maintain hole stability without the presence of mud provided under pressure.

In all cases, the contractor will also proceed as follows:

- Contain any drilling fluid that has surfaced.
- Notify all on-site representatives.
- Reduce circulation pressure and evaluate the circumstances leading to circulation loss to determine if the fracture can be sealed.
- Thicken the drilling fluid to attempt to seal off the location of the release as reasonably practical.

d) Containment of Drilling Fluid Release

Immediately following the detection of any inadvertent drilling fluid release, containment and clean-up operations shall commence. For releases on land, Contractor shall use straw bales, silt fences, sand bags and earth berms to prevent fluid from migrating or flowing from the immediate area of the discharge. If the volume released is too small for containment measures or, if the release occurs in an environmentally sensitive area where release of containments can cause additional damage, the

receiving area will be allowed to dry naturally. If there is a threat to a sensitive resource, or a threat to public safety, HDD activities will cease immediately until a plan to proceed is discussed.

Other containment measures include the following:

- Additional berms may be constructed around the release area as directed by the Engineer In Charge to prevent release of materials.
- If the amount of fluid released is large enough to prevent practical collection, the affected area will be diluted with fresh water and allowed to dry. Measures will be implemented (berm, silt fence, and/or hay bale installation) to prevent silt laden water from flowing into the sea.
- If hand tools cannot contain a small on-land release, small collection sumps may be constructed to pump the released material into the mud processing system.

The decision to proceed with the drilling operation will be at the sole discretion of the Engineer In Charge after all practical methods to seal off the location of the discharge have been attempted. Underwater releases are not expected as HDD operations in the intertidal will be carried out in the dry.

e) Clean-up of Releases

The clean-up shall commence after the release is contained. Clean-up shall include removal of all visible drilling fluid located in accessible areas. Removal methods will vary based on the volume of the release and the site specific conditions. Removal equipment may include vacuum trucks, loader and back hoe buckets, small pumps, shovels and buckets. After removal of the released drilling fluid, the release area will be reinstated as close to the original condition as possible.

f) Notification

In the event of a frack-out NPWS and IFI should be informed immediately.

Pollution

The presence of machinery on the intertidal could pose a threat of pollution. Toilet facilities will need to be provided on site. In order to minimise pollution the following should take place:

1) All machinery should only be fuelled on the hard stand area of a car park or road at least 10m from a drain or gulley.
2) All waste from the beach manhole operations should be removed from the site.
3) Any fluid leaks/spills should be cleaned up immediately.

Intertidal

As was seen during the fieldwork, the beach at which the intertidal ploughing is to be carried out on is moderately exposed. This can be seen by the evidence of 10m wide storm beach and the presence of a concrete wall at the top of the shore. Even though the construction phase of the project is outside over-wintering bird season and during the summer when there is increased human visitor activity on the beach, disturbance of resident birds, summer visiting birds, otters and harbour seals may occur and the integrity of these conservation interests must be maintained. As a result mitigation of impacts in the intertidal should concentrate on minimising the following:

Disturbance

The proposed route is within a popular beach which will have increased activity during summer months. As a result the presence of additional personnel on the shore during summer would not be thought to cause a significant additional disturbance. However, the presence of machinery and digging generated noise could cause a localised disturbance to bird populations. In order to minimise disturbance of the intertidal habitat and species the following mitigation measures would be carried out:

1. An ecologist would be onsite for the ploughing and back blading process in order to minimise disturbance and ensure site integrity is maintained. If roosting birds are present on the shore, the cable lay should be postponed until the birds depart, without provocation.

2. Drift lines in close proximity to the proposed route would contain the highest proportion of potential food source for bird species. If present, these should be avoided by machinery and personnel.

3. Noise generated from machinery could cause a disturbance. The bucket of the digger used in gaining access to the HDD should have teeth, so as to minimize scraping of metal against the cobble or boulders (if present).

4. The cable route on the shore should be plough buried on a receding tide, as soon as practical to go along the upper shore. This is to ensure all operations are done within one tide. Operations must be completed before an incoming tide when many of the birds return to feed. This should result in the cable route being imperceptible following a single or several tidal cycles.

5. The HDD operations in the intertidal will take one day and should commence under the intertidal element, on a receding tide when the area above the HDD has no water and should be completed within one tidal cycle. HDD operations in the intertidal should not be carried out while the HDD is covered with water, so that any potential leak of bentonite can be easily seen, isolated and cleaned.

6. Any temporary access arrangements or structures that are put in place to allow machinery access to the beach area should be prepared in consultation with an ecologist and the site should be fully reinstated post works.

7. *Reinstatement*
   Reinstatement of the terrestrial and intertidal habitat should be carried out to pre-construction conditions. Any concerns in relation to the trenching process or resulting reinstatement of the habitat to pre construction conditions will be raised with NPWS by the project ecologist prior to the removal of personnel from the site. A report on the trenching and reinstatement of the intertidal habitat, with imagery, will be submitted by the project ecologist to NPWS within 1 week of the completion of works.

Subtidal

Mitigation impacts are primarily concerned with the survey and construction phases of the project as minimal impacts are foreseen during the operation phase, with the exception of human intervention in relation to a break or fault in the cable. Impacts in a decommissioning stage are similar to those of the construction phase. Repairing the cable may involve several scenarios, from *insitu* repair with divers to the use of a grapnel to lift the cable on board so that repairs can be carried out at sea. As a result the following mitigation measures would be enforced during construction, repair and decommissioning.

1. Under no circumstance should seals hauled out in the area be disturbed such that they enter the water. This is unlikely, as this area is not recognised as a haul out area. Cable laying is to be carried out outside of breeding and haul out areas, but will be carried out during haul out period. A MMO will be onboard the vessel at all times in Irish waters to enforce mitigation measures. "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" will be applied to ensure noise introduced into the marine environment have minimum effect.

2. During the site survey a detailed video survey of the proposed cable route within the SAC should be carried out by a marine ecologist to provide higher resolution and habitat mapping data on the species present within the survey corridor within the SAC. The route will be further optimised in discussion with NPWS.

3. No hydroacoustics are to be used during the cable lay so as to limit disturbance to cetaceans.

4. Additional permissions would be sought from NPWS in the case of repair/removal of the cable etc. prior to carrying out works.

5. In order to ensure the integrity of Annex habitats and additional habitats and species of conservation importance are retained in the vicinity of the planned project a marine ecologist

should be onsite during all intertidal works including the final making good of site, including back filling, beach manhole completion and removal of machinery. The ecologist should also ensure that birds of conservation importance roosting on the shore should not be disturbed during works.

6. An additional video survey of the subtidal area of the Galway Bay Complex SAC should be carried out to map communities and refine further the routing of the cable within the SAC in consultation with NPWS in order to limit the impact on sensitive subtidal communities.

7. Mitigation measures will include the presence of a MMO onboard the vessel. The purpose of the MMO is to ensure that there is no disturbance of seal /cetacean populations, to ensure that the vessel stays within 250m of the cable route and that vessel generated noise is restricted to engines and winches only.

8. On approaching the landfall area the cable ship should approach its closest point to shore at the lower end of an incoming tide. No discharges from the vessel should be made from the ship within 5km of landfall. The MMO/ecologist should ensure that mitigation measures are carried out. Sufficient resources should be made immediately available on the vessel to deal with accidental oil spills including hydraulic hoses bursting etc. and reported to the on board ecologist.

9. Laying of the cable should be carried out in calm weather to ensure that there is no risk of vessel grounding. The vessel should not carry out the landfall operations in strong northerly winds (>force 3) due to the presence of intertidal reef to the south.

10. The cable lay vessel should at all times be within 500m of the cable lay route in order to minimise disturbance of breeding birds in the surrounding SPA's.

11. Due to the presence of sensitive subtidal communities in the Galway Bay Complex SAC NPWS should be informed of the final proposed route prior to mainlay.

Post-lay Monitoring

Given the location of the cable, buried in marine sediments or the small footprint it creates across reef areas, monitoring of the cable would pose more of an impact on the marine environment than just leaving the cable *insitu* unmonitored. Underwater cables by their nature are passive on/within the seabed. It is would not be expected that the cable will move, deteriorate or impact on marine/intertidal habitats over time, unless impacted by anthropogenic /storm influence. Problems, if they arise would be expected to result in a loss of signal and subsequent location of the break/damage and repair.

Monitoring of the intertidal could take place to assess the levels of sediment cover over the cable across the intertidal. However, the plough method ensures effective burial and reinstatement within one or several tides depending on weather conditions.

Ecological supervision

In order to ensure the integrity of Annex habitats and additional habitats/species of importance are retained in the vicinity of the planned project, the following is recommended:

a) An ecologist should be onsite for the initial set up of HDD machinery and commencement of drill.
b) An aquatic ecologist should be onsite to observe the HDD drill operations to ensure that no bentonite escapes into the intertidal/marine environment.
c) An ecologist should be onsite to observe the making good of site, including back filling of drill pit and removal of machinery Images should be taken of the process and submitted to NPWS as part of an ecological report.

A MMO should be present during marine survey and ship cable laying to minimise any impact on marine mammals.

H) Cumulative Impacts

"Cumulative effects, the combined effect of more than one activity, may reinforce the impacts of a single activity due to temporal and/or spatial overlaps" (OSPAR, 2012). The proposed site is in a populated area and is a popular destination for the local community. It is a location with a regular stream of dog walkers and pedestrians on the shore. Once *in situ* the cable will be unperceivable to the public, with the exception of the beach manhole lid outside the conservation areas. The laying or presence of the cable would not be seen to have an impact on water quality of the area including impacting the water quality status.

The intertidal section of this project will involve laying of the cable by plough (in SAC/SPA/pNHA & Ramsar site) and a HDD (outside conservation sites) that will enter the uppershore (within the conservation sites). The beach manhole in the amenity grassland area outside the Natura 2000 sites and is the termination of this aspect of the project. From here the cable will be connected to the terrestrial element of the project which will utilise existing ducting where available along the road network. Galway City Council planning permissions were examined for potential cumulative impacts due to development in the area. No planning applications have been received in the past four years in the vicinity of the proposed cable route on Ballyloughane Beach.

This report pertains to the terrestrial, subtidal and intertidal elements of the fibre-optic cable route within Irish waters. As can be seen from using the Best Available Techniques (see EcIA) and the development of mitigation measures prior to cable lay, including site selection, timing of the main lay in addition to mitigation measures during main lay considerable effort has gone into minimising the potential environmental impact of the project. "Generally all mitigation measures applied for individual cables also contribute to reduction of cumulative impacts" (OSPAR, 2012).

RESIDUAL IMPACTS AND CONCLUSION

Residual impacts are impacts that remain once mitigation has been implemented, or impacts that cannot be mitigated against. As previously outlined from the early stage of this project use of Best Available Techniques (BAT) have been used in the planning and implementation of the project as they "represent a key measure for avoiding environmental impacts" (OSPAR, 2012). This has included optimal site selection, methodologies of cable laying and phasing of the project outside key ecological times such as the over-wintering bird season in order to reduce the ecological impact of the project on, not only the designated sites at the landfall location, but also the additional habitats out to, and beyond the 12nm limit out to the Irish EEZ. The use of BAT will also help to ensure the longevity and stability of this important piece of infrastructure.

Surveying and cable laying will be outside over-wintering bird season and will not be close to tern nesting sites, for which this site is designated as an SPA. Works will be carried out during harbour seal breeding season. The nearest breeding site is 1.2km from the cable survey route and an MMO will be present for all surveys and the cable laying. Works are not proposed in the majority of the sensitive habitats listed as features of interest of the Galway Bay Complex SAC. However, the cable does pass through mudflat/sandflat in the intertidal and the impacts in these areas are deemed to be minor adverse short-term. In the subtidal areas classed as Large Shallow Inlets and Bays, considerable lengths have been taken to avoid undocumented sensitive communities that were encountered during a video survey for the project, specifically carried out to assess habitats in the subtidal within the SAC. Impacts to these habitats are deemed at worst to be minor adverse short-term. However, mitigation measures as discussed with NPWS are proposed and include further video surveys and refining the route in this area in consultation with NPWS.

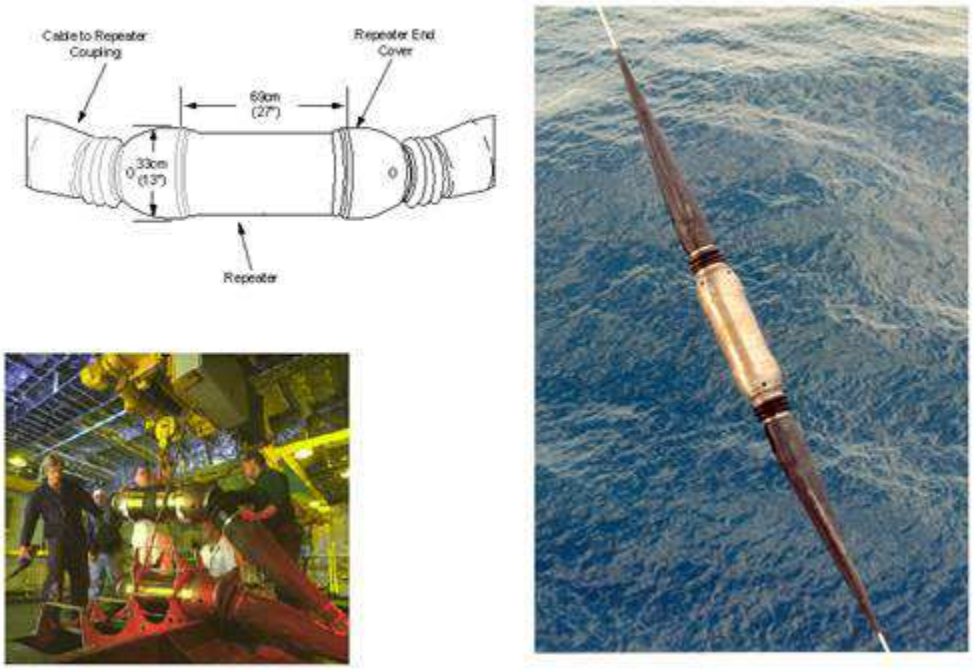
However, despite the use of BAT in addition to the outlined mitigation measures, residual impacts will remain. The laying, operation and subsequent decommissioning of the cable, if required, will have no significant impact on the integrity of a conservation site or its site specific conservation objectives. Impacts are primarily related to short-term minor adverse impacts due to disturbance over the period of the HDD, 1 day cable burial on the beach and the ploughing by the vessel in the shallow subtidal (1-2 days in the SAC). Mitigation measures have been proposed to minimise/eliminate negative impacts on species or habitats of conservation importance.

Appendix I. Environmental Characteristics of Repeater and PSBU Housing Material.

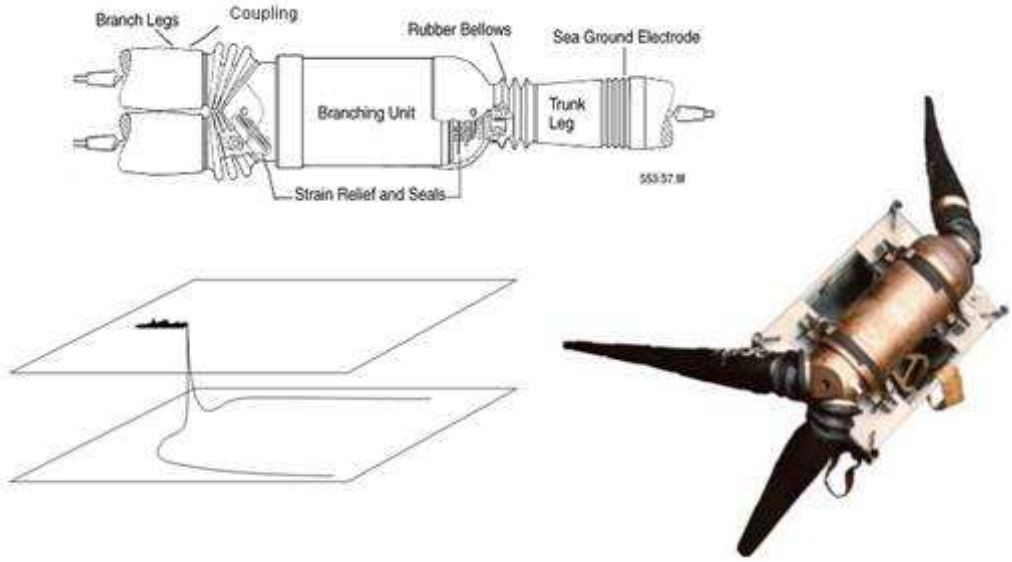
TE SubCom repeater and power switched branching unit (PSBUs) designs consist of a hydrostatic pressure sealed housing made from a copper beryllium (CuBe) alloy (1.65-1.85 wt% Be). These vessels are designed to remain water tight, resist corrosion and hydrostatic pressure, and survive mechanical stresses from aggressive handling during deployment. Copper beryllium alloys are well suited for both fresh and saltwater environments due to a low corrosion rate and resistance to biological fouling. Undersea communication housings using CuBe have been employed for several decades without evidence or reports of detrimental effects to marine environments. In part, this can be attributed to the very low corrosion rate of less than 2 mils per year in seawater. The corrosion process is one defined by selective dissolution of the copper constituent presenting a very minimal toxicological concern especially when in comparison to the ocean as a whole.

Operational Characteristics of Repeaters and Power Switched Branching Units (PSBUs)

TE SubCom's undersea cable system designs may also include power-dissipating components such as TE SubCom's repeaters and the TE SubCom power switched branching unit (PSBU). In general, repeaters, or "Optical Amplifiers", are inserted into undersea cable systems at a nominal spacing interval of 50 to 120 kilometers within the as-engineered routing. The primary purpose is to amplify the optical signal along the cable route as it travels from Cable Station A to Cable Station B. The copper conductors inside the cable power these repeaters. Branching Units are optical bodies that are inserted into a cable system so as to allow for the insertion of a "Branch Leg" which would provide connectivity to an additional cable station.



SL Repeater / Optical Amplifier



SL Power Switched Branching Unit

Evaluations of the *maximum* heat dissipation for these components are also addressed by consideration of the maximum power ratings of the components.

The below table summarizes the maximum operating current and maximum heat dissipation for the TE SubCom PSBU and the 4 amplifier pair repeater designs. The spacing of repeaters and branching units results in only very localized heating and negligible environmental effect.

	DC Current (Amps)	Power Dissipation (Watts)
PSBU	1.6 max	148
Repeater, 4 amp pair	1.6 max	48

Power Dissipation of TE SubCom's PSBU and 4 Amp Pair Repeaters.

Appendix II- Consultation with Inland Fisheries Ireland

From: David Harrington [mailto:David.Harrington@fisheriesireland.ie]
Sent: 03 May 2018 15:07
To: Bryan Deegan
Cc: John Conneely; Seamus Hartigan
Subject: RE: Fibre Optic Cable Galway

Good Afternoon Bryan,

Please see below IFI's comments on the proposed fibre optic cable routing through Galway Bay SPA & SAC:

As previously discussed during our telecom, the proposed cable laying timeline (July 2019) will coincide with the main salmon run returning through Galway Bay into the River Corrib catchment for the purposes of spawning.
I am aware that Dr William Roche has already advised that the salmon smolt run is from mid-April to the end of May (outside the timeline of the proposed cable laying works).

However, I note from your summary information that *"there is no significant noise generation during ploughing operations. As the cable installation by plough is relatively slow it produces only a minor plume of suspension of seabed sediments in the water column and this is transient and localised due to the nature of the ploughing and natural backfill activities"*. It is also noted that the cable laying operation from Ballyloughane Beach to the Aran Islands should only take approximately three days.

IFI will need to be notified at least one week before the cable lay from Ballyloughane Beach in order to monitor the operation to ensure there are no negative impacts on returning Salmon.

Any acoustic surveys associated with the site investigations (April 2019) will obviously require appropriate mitigation measures given the sensitivity of the habitat in question.
The opinion of the Sea Fisheries Protection Authority (SFPA) in regard to timing of the survey is critical from the spawning/larval life stages of commercially-important fish species using the area.

On a side note, I presume that the proposed extension of Galway Harbour has also been accounted for and will not affect the cable?

I look forward to reviewing a copy of the Foreshore Licence Application in due course.

Kind Regards,

David

David Harrington
Senior Fisheries Environmental Officer
Western River Basin District - Galway

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