

Fishguard tidal power feasibility study

TBG Report 04/10/11

1 Executive Summary

A study has been initiated by Swanturbines and Transition Bro Gwaun with support from the Energy Saving Trust to consider the feasibility of tidal power in the Fishguard area. The project duration was from April to July 2011 and comprised consideration of environmental aspects, an informal stakeholder consultation, and an engineering assessment.

The area of interest is surrounded by many Natura sites with designations for both habitat and species. Geographically the closest Natura sites are the Cardigan Bay and Pembrokeshire Marine SACs. These sites have qualifying features including sandbanks, reefs, submerged or partially submerged sea caves and species including Bottlenose dolphin, Sea lamprey, River lamprey and Grey seal. If this feasibility study was to proceed to the next stages then a full assessment of environmental aspects is likely to be required in support of an EIA process and potential Appropriate Assessment. Evidence is likely to be required to establish the strength of any link between designated species and the Strumble Head area.

29 organisations have been contacted about the project during the informal stakeholder consultation process and feedback has been incorporated into the study work. Fishguard RNLI did not express any concerns over the potential of tidal turbines in the area. StenaLine ferries did not express any concerns over the initial proposal having considered draft and route of their vessels. Sea Trust (S&W Wales) provided guidance to the study and highlighted the importance of the area to marine mammals in general and in particular Harbour Porpoise. The Countryside Council for Wales has provided a check list which would form the basis of the required areas to be addressed in any future Environmental Impact Assessment should any proposals continue beyond the feasibility stages.

A flow velocity and bathymetry survey was conducted on 19th and 20th May 2011, measuring flow patterns throughout the diurnal tidal cycle from Pen Brush to Pen Anglas. Peak flow speeds of 3.2 kts, 5.2 kts and 3.0 kts were measured at Pen Brush, Strumble Head and Pen Anglas respectively.

The highest flow speeds and hence peak kinetic flux densities are shown to occur at Strumble Head.

2 Intellectual property and disclaimer

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Ownership of intellectual property from the feasibility study, this report and associated documents is defined in confidential quotation document "STTBG1102_V2_TB_ApJO_3_070211.pdf".

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4 Introduction

This project has been initiated by Swanturbines and TBG with support from the Energy Saving Trust. Swanturbines Ltd is a leading tidal stream energy company, developing technology and tidal sites around the UK. Transition Bro Gwaun is a community initiative seeking to promote economic and social resilience in response to the challenges of peak oil and climate change.

The project considered the feasibility of tidal power in the Fishguard area and comprised of engineering assessment, informal stakeholder consultation and consideration of environmental aspects. The project duration was from April to July 2011.

This report details the environmental aspects.

5 Project Requirements

5.1 Engineering

- Perform a site survey and design study to understand:
- Site survey covering bathymetry and current velocities

5.2 Community stakeholders

Conduct early discussions with key local organisations, including:

- Councils
- Conservation groups
- Coastguard
- Fisheries
- Shipping and yachting
- Marine archaeology

Understand potential concerns and take this information into account when performing concept design.

5.3 Environmental considerations

Identify environmental and social factors, including:

- Marine life
- Navigational issues
- Impact on fishing
- Archaeological sites

6 Survey

Flow speed and bathymetry survey was undertaken in the area of Strumble Head on 19th and 20th May 2011 by Swanturbines and Razorbill RIB Charter.



Figure 6.0 – Razorbill RIB and test equipment

A Garmin 451S (GPS and depth sounder system) was used for recording position and bathymetry and a Valeport model 106 current meter used to measure flow velocities. The flow meter was connected to a laptop to display real time information and to log data (figure 6.0).

6.1 Test objectives

Three survey objectives were defined:

1. Understand flow patterns throughout a 12 hour diurnal tidal cycle for the area of interest
2. Determine cross stream variation in flow velocity
3. Measure bathymetry in the area off Strumble Head (figure 6.1 blue box)

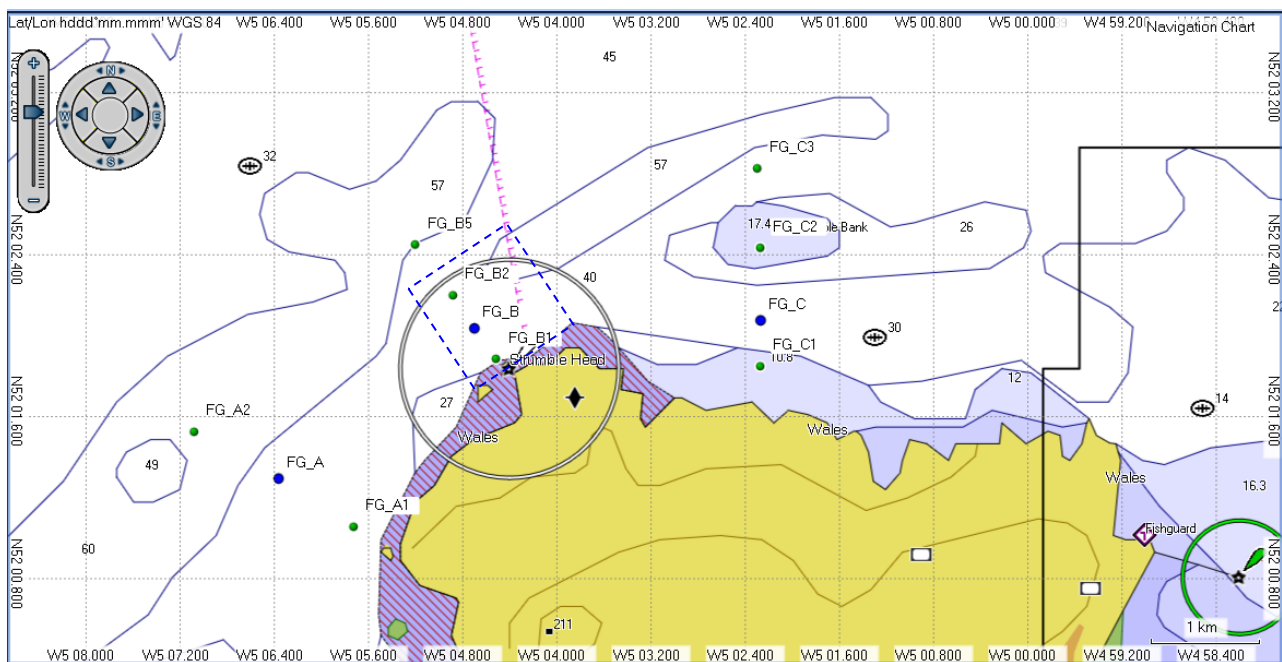


Figure 6.1 – Chart showing survey waypoints

Tidal stream data exists to the West of Penbwdy and at Pen Anglas but there is an absence of data for the area of interest from Pen Brush to Strumble Bank. Discussion with Fishguard RNLI suggested complex flow patterns in this area including back eddies and re-circulations. The proposed test methodology was therefore to define three Waypoints, A, B and C as shown on figure 6.1 and to measure flows at each of these at approximately hourly intervals during a 12 hour cycle. This data will provide a general understanding of the flow patterns in the area and provide velocity data for each of the three areas of interest.

It is also important to understand variations in flow velocity across the main direction of tide. (In this case the variation with distance away from shore). Three series of Waypoints were defined to achieve this; A1-A-A2, B1-B-B2-B5 and C1-C-C2-C3.

Appendix A shows the test schedules for 19th and 20th May respectively.



Area A (Pen Brush)

Area B (Strumble Head)

Area C (South of Strumble Bank)

Figure 6.2 – Photographs of areas of interest

6.2 Tidal data during test

The 19th and 20th May 2011 represent mean spring tide conditions with predicted ranges of 4.2m and 3.9m respectively. These compare to ranges of 1.4m and 4.0m for mean neap and mean spring tides respectively.

Figure 6.3 shows the predicted high and low water times at Fishguard for the proposed test dates. These are relevant for launch and recovery windows. Figure 6.4 shows predicted high and low water times for Milford Haven, applicable to tidal diamond data.

	LW			HW			LW			HW		
	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)
Thu 19th May 2011	02:36	03:36	0.67	08:15	09:15	4.76	14:54	15:54	0.88	20:35	21:35	4.88
Fri 20th May 2011	03:23	04:23	0.79	09:00	10:00	4.57	15:36	16:36	1.07	21:20	22:20	4.73

Figure 6.3 – Predicted high and low water times for Fishguard (19/20th May 2011)

	LW			HW			LW			HW		
	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)	Time (GMT)	Time (BST)	Height (m)
Thu 19th May 2011	01:09	02:09	0.59	07:12	08:12	7	13:30	14:30	0.78	19:32	20:32	7.1
Fri 20th May 2011	01:54	02:54	0.74	07:56	08:56	6.78	14:12	15:12	1.01	20:16	21:16	6.89

Figure 6.4 – Predicted high and low water times for Milford Haven (19/20th May 2011)

7 Tidal stream results

7.1 Description of tidal streams

7.1.1 Southern Cardigan bay tidal streams

The tidal streams in the southern part of Cardigan Bay (extending offshore to St George's Channel) are broadly rectilinear with slack water at around 1 hour before and 4.5 hours after HW Milford Haven. From HW-1 to HW+4 the flow is in a north easterly direction and from HW+5 to HW-2 the flow is in a South Westerly direction. Peak flows are 2.4 kts and 2.5 kts on flood and ebb tides respectively for a mean spring tide.

7.1.2 Strumble Head tidal streams

Closer inshore the flow patterns in the area of Strumble Head and Strumble bank become more complex. Figure 7.0 and 7.1 show the flow patterns in this area throughout a 12 hour tidal cycle. These figures and the descriptive text below all refer to time relative to HW Milford Haven. For reference, HW Fishguard is typically between 1 hour and 1 hour 15 minutes after HW Milford Haven).

The area from Pwllcrochan to Fishguard Harbour is all relatively slack at 2 hours before HW Milford Haven. The east-going flow then builds quickly with peak flows off Strumble Head seen at HW-1. The flow is in an East to North-easterly direction from Pwllcrochan to Fishguard Harbour with no large scale re-circulations measured. Mean spring flow speeds are 1.7 kts at Pwllcrochan and Pen Anglas but are accelerated around Strumble head with flows of 3.2 kts measured off Pen Brush (HW-1) and locally 5.2 kts off Strumble Head.

By high water, the flow is still strong (4.2 kts) at Strumble Head and in an easterly direction. However, at Pen Anglas the flow has reduced to 0.8 kts (easterly) and to the south of Strumble bank the flow direction has reversed, flowing 1.1 kts westerly.

By HW+1 the flow reversal has extended to Pen Brush and strengthened to around 1.7 kts whilst the flow at and to the west of Strumble Head remains easterly in direction at between 2.5 and 3.0 kts.

At HW+3 the flow is almost slack to the west of Strumble Head and the south of Strumble bank the recirculating flow continues in a westerly direction and builds to 3.0 kts.

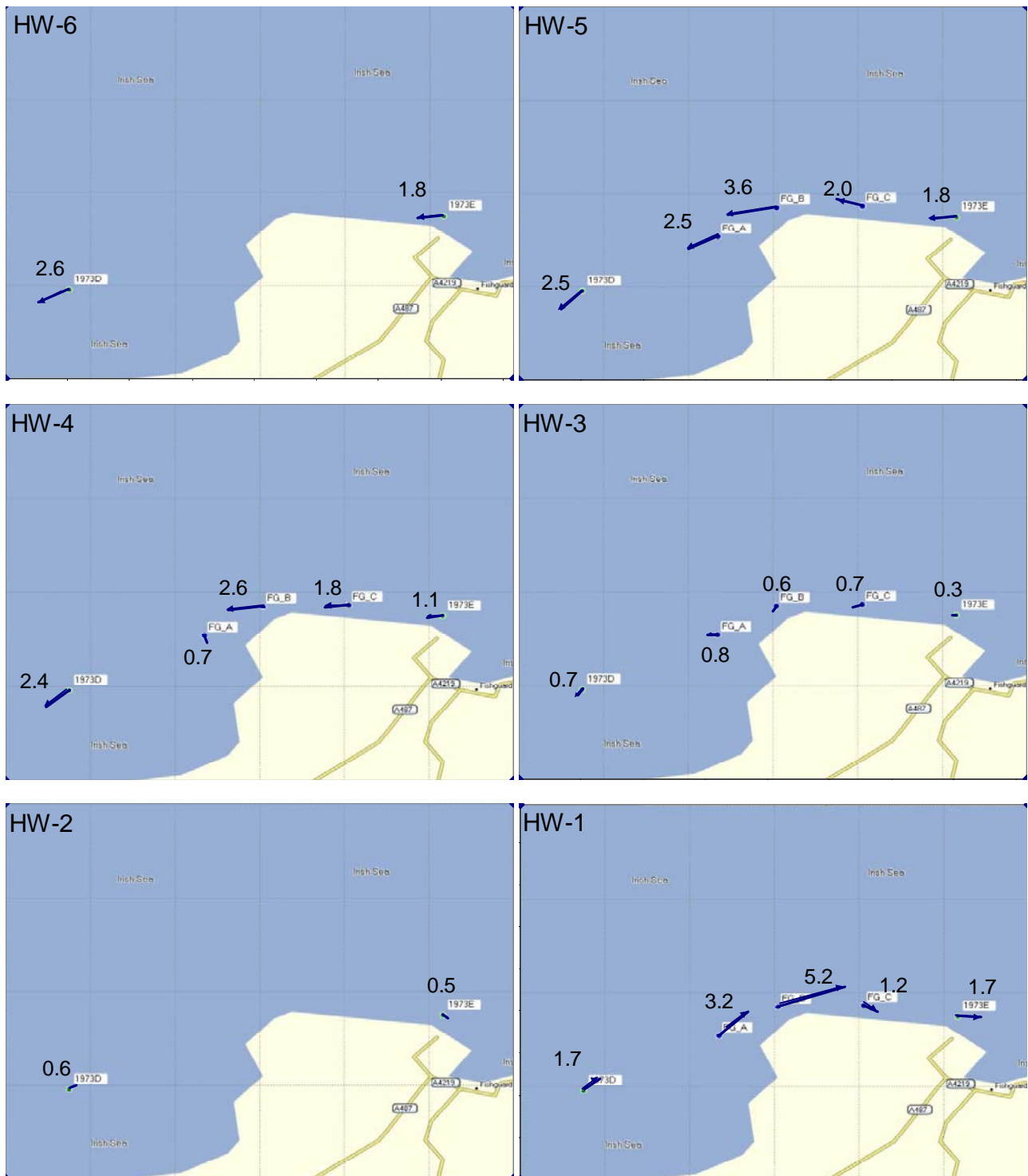
By HW+5 the ebb flow is established in a westerly direction throughout the area of interest and this flow pattern remains until HW-4. The peak flows are again seen off Strumble Head with 3.6 kts measured on a mean spring tide. Either side of Strumble Head reduced flow speeds of 2.0 kts and 2.5 kts are seen to the south of Strumble bank and off Pen Brush respectively.

The flow goes slack first at Pen Anglas at around HW-3 will small westerly flows (0.7-0.8 kts) remaining to the west of Strumble Head.

STRUMBLE HEAD TIDAL STREAMS (HW-6 to HW-1)

Notes

Times are relative to HW Milford Haven
 Figures represent surface velocities for a mean spring tide
 Arrow length is proportional to current speed
 Direction arrows not shown for speeds below 1.0 knot
 Refer to data table for exact times of measurement



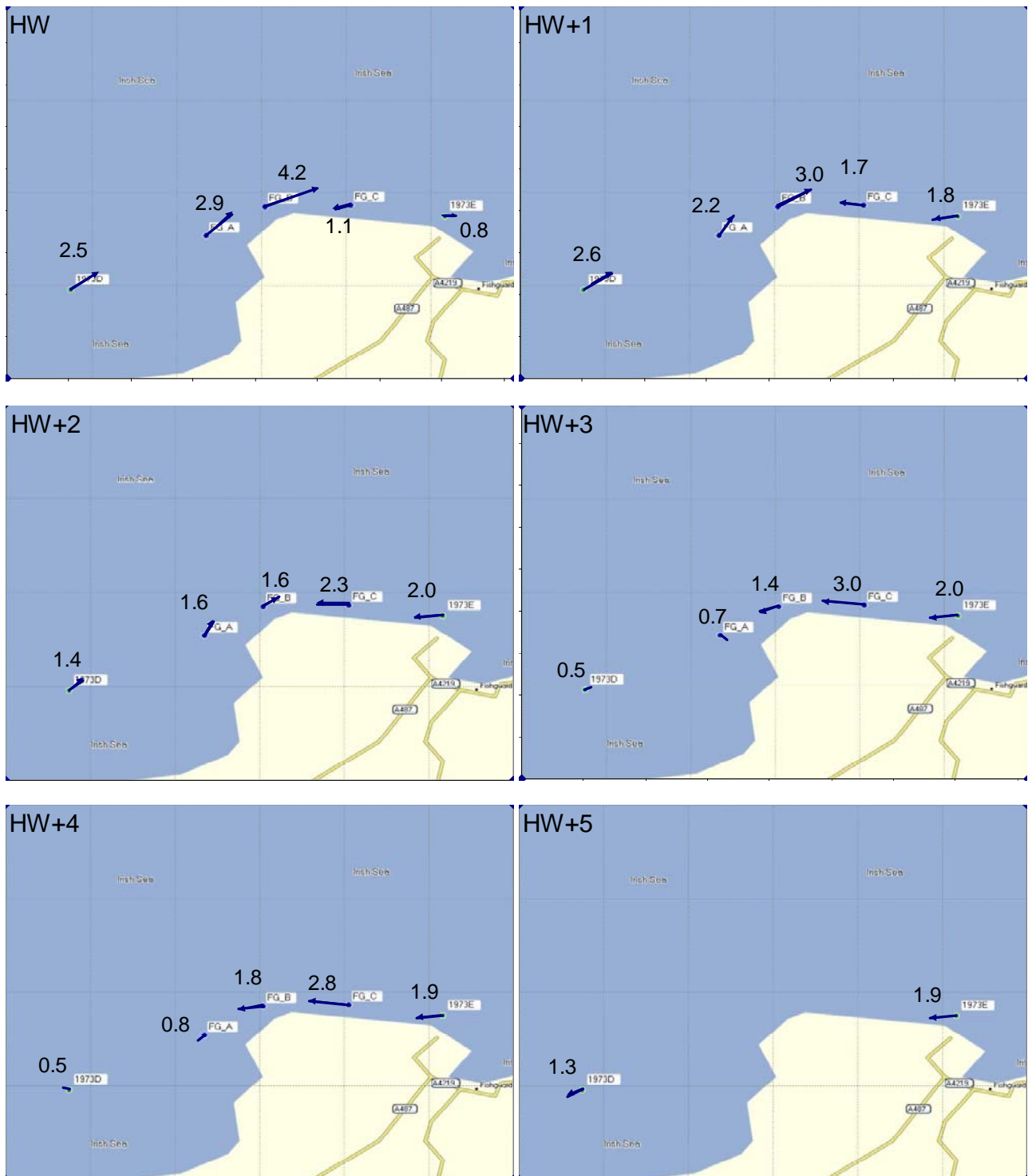
Data for points A, B and C is Swanturbines survey 19th/20th May 2011
 Data for points 1973D and E are from Admiralty chart 1973 tidal diamonds (Crown Copyright 2002)

Figure 7.0 – Strumble head tidal streams (HW-6-HW-1)

STRUMBLE HEAD TIDAL STREAMS (HW to HW+5)

Notes

Times are relative to HW Milford Haven
 Figures represent surface velocities for a mean spring tide
 Arrow length is proportional to current speed
 Direction arrows not shown for speeds below 1.0 knot
 Refer to data table for exact times of measurement



Data for points A, B and C is Swanturbines survey 19th/20th May 2011
 Data for points 1973D and E are from Admiralty chart 1973 tidal diamonds (Crown Copyright 2002)

Figure 7.1 – Strumble head tidal streams (HW-HW+5)

7.2 Flow speed data

The flow speed test data is tabulated in Appendix A showing time, speed and direction after analysis.

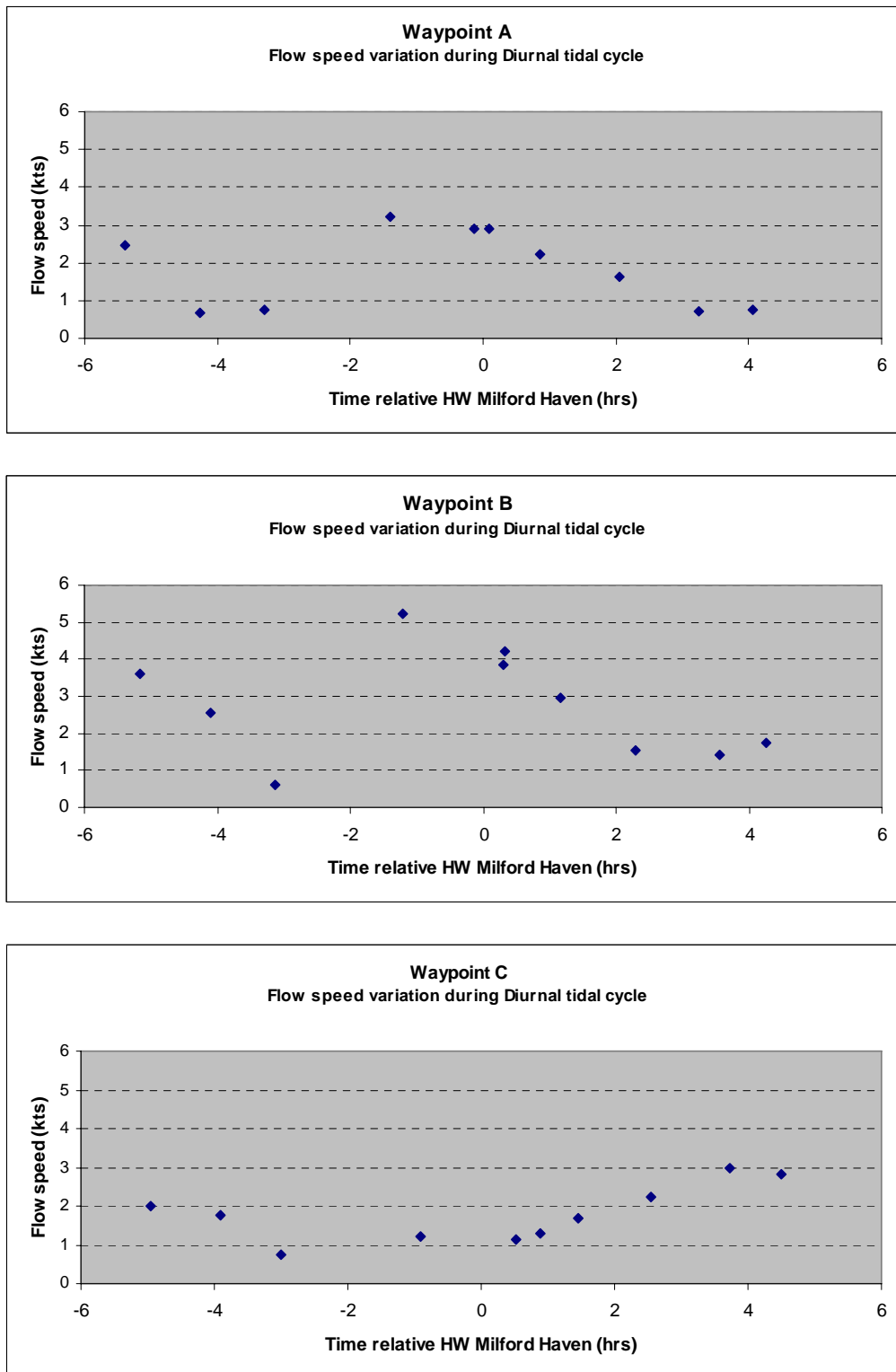


Figure 7.2 – Diurnal variation of flow speed at Waypoints A, B and C for a mean spring tide

Figure 7.2 shows the variation in flow speed for a mean spring tide for areas of interest A, B and C. Peak flow speeds of 3.2 kts, 5.2 kts and 3.0 kts were measured at A (Pen Brush), B (Strumble Head) and C (Pen Anglas) respectively.

9 Stakeholder consultation

The following organisations were contacted during the project and asked for any comments or feedback about the proposed area of interest. A copy of the initial information sheet is shown in appendix B.

Marine navigation

Maritime and Coastguard Agency (MCA)
RNLI (Fishguard Lifeboat Station)
Fishguard Bay Yacht Club
Pembrokeshire Cruiser Racing Club
Pembrokeshire Yacht Club
Local fishing clubs (TBA)
Fishguard Harbour
Stena Line
Trinity House
Celtic Divers dive school

Environmental

Countryside Council for Wales
Council for British Archaeology Wales
Sea Trust (S&W) Wales
Pembrokeshire Coast National Park
Wildlife Trust of South and West Wales
Environment Agency
Joint Nature Conservation Committee
Cadw
RSPB

General

Fishguard and Goodwick Town Council
Pembrokeshire County Council
The Crown Estate
Western Power Distribution
Pembrokeshire Coastal Forum
Ministry of Defence
Receiver of Wreck
Welsh Assembly Government

Fishing

Welsh Federation of Sea Anglers
Cardigan Bay Fishermen's Association

Details of the key responses are included in the following sections.

9.1 Sea Trust (S&W) Wales

The Sea Trust have provided comments and advice at a number of meetings during the project.

9.1.1 Notes from meeting of 10th May 2011

- A presentation was shown referencing data from the annual Stena Europe Reports and other Sea Trust publications
- Stumble Bank is made up of sand and shingle and is a good habitat for sandeels
- Harbour Porpoise are the only marine mammal that is seen regularly

- In the summer months the Porpoise feed with the tide on mackerel and garfish. They are near to the surface and so are more obvious to an observer. In winter months they feed on Whiting at deeper depths and so are less obvious.
- The Porpoise are likely to breed and feed in the same areas.
- The Stena Line ferry track is approximately 1.5nm to the North of Strumble Head.
- There are proposals for a new 600 berth marina at Fishguard and modernisation and enlargement of the ferry terminal.
- Scallop dredging is still allowed in the SAC with limits on time of year and area.
- There were no common dolphin sightings by the Sea Trust prior to 2000 but they are now seen between June and September. There have been occasional sightings of Risso's dolphin and one sighting of a Humpback Whale.
- Guillemot, Razorbill and Gannets are common birds in this area. The Sea Trust was not concerned about the potential for collision of diving birds with turbine blades at this location.
- The Sea Trust did not highlight any particular location as more or less sensitive than others with the area of interest of the study expect that they would have potential concerns if Strumble Bank was considered.
- The key concern expressed was that if the turbines were to extract sufficient energy to alter tidal characteristics in the area, this could affect food chain and overall ecology.

9.1.2 Further comments regarding the narrowed area of interest (22 June 2011)

- The Sea Trust would have been less happy if area C (inside Strumble bank) had been proposed as this is a more sheltered area suitable for mothers and calves.
- The Sea Trust commented that they were happy that Swan had approached the consultation in a both reasonable and responsible manner.
- Swan intends to stay in close contact with the Sea Trust in the event that proposals are taken on to the next stages.

9.2 RNLI

Initial contact was made via at divisional level within the RNLI who put the project in touch with the RNLI lifeboat station at Fishguard.

9.2.1 Notes from meeting of 10th May 2011 at Fishguard station

- Marine traffic in the area typically consists of the following:
 - Stena Line ferry (draught 6 m)
 - Fishing boats
 - Naval vessels
 - Survey vessels (Fisheries Protection)
 - There is some pot fishing but no trawling in the area
 - Coasters occasionally come in to Fishguard but for shelter only.
- Fishguard RNLI is generally supportive of the potential of tidal turbines.
- The area is not suitable for anchoring so there is no concern over entanglement with a turbine and no call out as ever required anchoring in that area.

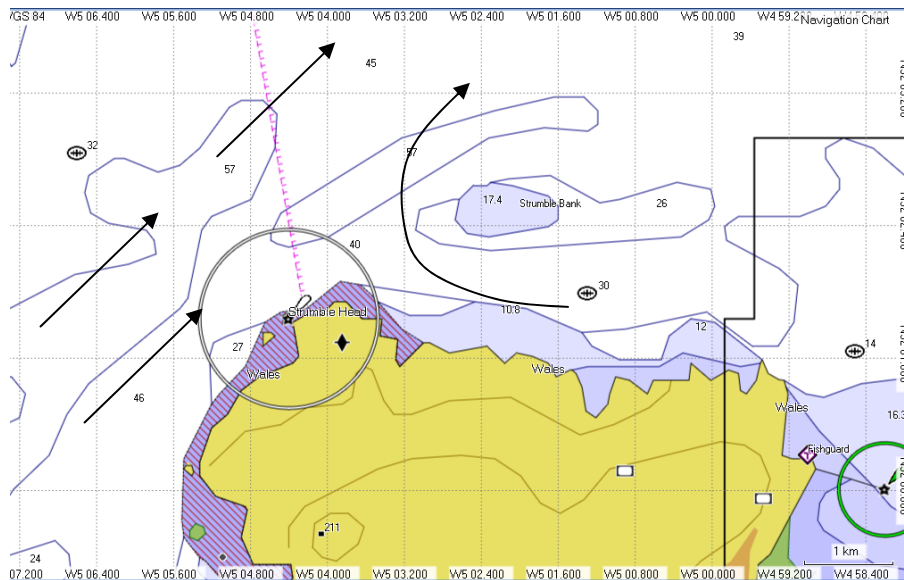


Figure 10.0 – Sketch of tidal flows around Strumble Bank (HW-HW+2)

- There is a recirculating flow around Strumble Bank between HW and HW+2 (Fishguard). The flow is West going to the south of the bank and turns clockwise to join the main North Easterly flow to the North of the bank (figure 10.0)
- There are overfalls in the area around the bank on the ebb tide (but not the flood), particularly in Northerly to Westerly wind directions.

9.3 Celtic Dive Base

Notes from informal meeting on 19th May 2011

- Area B is too deep for a drift dive (57 m) so no conflict is expected with recreational diving.
- Coastal diving takes place but there would be no conflict if any proposed tidal turbines are more than 500 m offshore.
- In general Celtic Dive Base are not concerned by the outlined potential proposal.
- Note on fishing activity: Potting and netting take place in area B.

9.4 Fishguard harbour/Stena Line

The Fishguard Harbour Master and Route Director for the Stena Line Fishguard to Rosslare route were consulted about the project.

The comments received were that “Our ferries passage plans takes them 1.5`nm North of Strumble Head. The deepest one draws just over 6m and so in this depth of water I don’t believe we have any concerns with this initial proposal”.

The area of interest extends to 0.7 nm North of Strumble Head so does not overlap with the ferry passage plan and any potential turbines would have adequate surface clearance for a vessel of that draught to pass safely over them.

9.5 Marine Consents

The Marine Consents Unit advice that they are responsible for the administration of marine licence applications under Part 4 of the Marine and Coastal Access Act 2009, on behalf of the Welsh Ministers, for Welsh territorial waters (out to 12 nautical miles).

Marine Licences are required for marine licensable activities that fall below the level of mean high water springs. Applications for a marine licence take approximately 12 weeks to process, however, this can be longer depending on the size, nature and location of the project.

From 6th April 2011 a marine license replaces a number of licensing regimes under the:

- Food and Environment Protection Act 1985 (FEPA): Part 2;
- Coast Protection Act 1949 (CPA): Section 34; and
- Environment Impact Assessment (Extraction of Minerals by Marine Dredging) (Wales) Regulations 2007.

Now, instead of applying for a FEPA license, CPA consent and/or a Marine Minerals Dredging Permission, applicants need to apply for marine license.

9.6 Countryside Council for Wales

The Countryside Council for Wales has provided guidance to the feasibility study and have provided a check list covering the headings below which would form the basis of the required areas to be addressed in any future Environmental Impact Assessment should any proposals continue beyond the feasibility stages. The full check list is included in appendix B.

- DESIGNATED SITES – SSSI, SAC, RAMSAR
- DESIGNATED SITES AONB, HERITAGE COAST, NATIONAL PARK, SPECIAL LANDSCAPE AREA
- SEABED
- INTERTIDAL HABITATS
- MARINE MAMMALS
- FISH & FISHERIES
- BIRDS
- ACCRETION
- EROSION
- COASTAL PROCESSES
- GEOMORPH. FEATURES
- NAVIGATION
- WATER QUALITY
- COASTAL & TERRESTRIAL HABITATS
- VISUAL INTRUSION
- SEASCAPE AND COASTAL CHARACTER
- HISTORIC LANDSCAPE
- AMENITY & WATER USE

9.7 RSPB

Conservation Officers within the RSPB were consulted and advice was received that the following document should be used in relation to ornithological assessment: "MRESF Stage 2 Diving Birds and Underwater Renewable Devices Site Surveys".

Should the site be shown to be of interest, further work would be undertaken in which the RSPB would be consulted again.

9.8 Local business support

An important part of this project was to identify any local businesses which could potentially support the supply chain of any future development.

No manufacturing facilities were located within Fishguard or the immediate surrounding area that would be appropriate for turbine or foundation fabrication. The potential of the dockside at Fishguard was considered but it is not large enough for the required size of installation vessels. Within Pembrokeshire, there are appropriate dock facilities and manufacturing organisations including Ledwood Mechanical Engineering Ltd at Milford Haven. The preliminary installation planning for this project assumed the load out port to be Milford Haven.

If a development was to proceed then further survey work would be likely including engineering and environmental assessment. Typical engineering survey may include flow speed, bathymetry and geotechnical data and environmental survey would be likely to take place pre and post installation covering marine mammal and bird observations, benthic and habitat surveys. There would be potential for local involvement during such survey work and some potential local organisations have been identified including Razorbill RIB Charter and the S&W Wales Sea Trust. There would also be some potential for local involvement in turbine operations and maintenance procedures.

10 Environmental considerations

10.1 Sites of international importance

There are two key sections of European legislation relating to nature conservation in consideration of Environmental Impacts of marine energy devices.

1. The Birds Directive protects all wild birds, their nests, eggs and habitats within the European Community.
2. The Habitats Directive builds on the Birds Directive by protecting natural habitats and other species of wild plants and animals.

A Special Area of Conservation is a site designated under the Habitats Directive. These sites, together with Special Protection Areas are called Natura sites and they are internationally important for threatened habitats and species.

Although the feasibility study area is not within an SAC or SPA, any potential effects on Natura sites must still be considered. Figure 11.0 shows the neighbouring SACs and SPAs to the study area including the Cardigan Bay SAC and the Pembrokeshire Marine SAC.

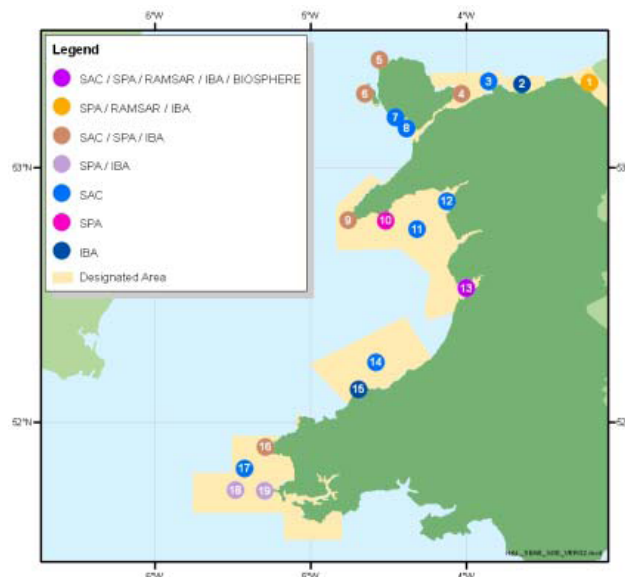


Figure 11.0 – SAC and SPAs adjacent to the study area

The SACs and SPAs surrounding the area of interest have designations for both habitat and species with many similarities. There are many designations for marine mammals including Bottlenose dolphin, Otter and Grey seal. If this study was to proceed to the next stages then evidence is likely to be required to establish the strength of any link between these species and the Strumble Head area.

The qualifying features for habitats include mudflats, sand flats and coastal lagoons. Any potential effects would require full evaluation including assessment of changes to coastal flows and sedimentary patterns. At this stage coastal process effects are considered less likely due to the localised nature of flow changes, the small potential energy extraction and the distances to the protected areas.

The following sections highlight the qualifying features of the SACs and SPAs in figure 11.0.

10.1.1 Lleyn Peninsula and the Sarnau SAC

- Habitat qualifying features: Sandbanks, Estuaries, Coastal lagoons, Large shallow inlets and bays, Reefs, Mudflats and sandflats, *Salicornia*, Atlantic salt meadows and Submerged or partially submerged sea caves
- Species qualifying features: Bottlenose dolphin, Otter and Grey seal

10.1.2 Cardigan Bay SAC

- Habitat qualifying features: Sandbanks, Reefs and Submerged or partially submerged sea caves
- Species qualifying features: Bottlenose dolphin, Sea lamprey, River lamprey and Grey seal

10.1.3 Ramsey, St David's Peninsula and Strumble Head SAC / SPA / IBA

- Habitat qualifying features: Vegetated sea cliffs of the Atlantic and Baltic coasts and European dry heaths
- Species qualifying features: Floating water-plantain
- SPA qualifying features: Chough
- IBA qualifying features: Peregrine Falcon and Razorbill

10.1.4 Pembrokeshire Marine SAC

- Habitat qualifying features: Estuaries, Large shallow inlets and bays, Reefs, Sandbanks, Mudflats and sandflats, Coastal lagoons, Atlantic salt meadows and Submerged or partially submerged sea caves
- Species qualifying features: Grey seal, Shore dock, Sea lamprey, River lamprey, Allis shad, Twaite shad and Otter

The grey seal colony is the largest breeding colony on the west coast south of the Solway Firth, representing over 2% of annual UK pup production.

10.1.5 Grassholm SPA / IBA

- Qualifying features: Gannet

10.1.6 Skokholm and Skomer Islands SPA / IBA

- Qualifying features: Chough, Short-eared Owl, Storm Petrel, Lesser Black-backed Gull, Manx Shearwater and Puffin

The area qualifies as a seabird assemblage of international importance by regularly supporting at least 20,000 seabirds. During the breeding season, the area regularly supports 67,278 individual seabirds.

10.2 Sites of national importance

10.2.1 Pembrokeshire Coast National Park

The coastline around Strumble Head is within the area of the Pembrokeshire Coast National Park. The Park Authority has responsibilities for the coast and inland areas, building conservation, planning, agriculture, forestry and sustainable development so are a key stakeholder for any potential developments within this area. The sensitive nature of the area has particular importance in the consideration of any land based structures such as a shore sub station or electrical cabling.

10.2.2 SSSI

There are three sites of Special Scientific Interest in the area of interest that should be considered in any Environmental Impact Assessment process (figures 11.1 and 11.2).

Map number	Site name	Grid reference	Interest
4	Aber Mawr	SM 8821 3462	Geology
31	Creigiau Abergwaun (Fishguard Cliffs)	SM 9583 3750	Geology
84	Strumble Head - Llechdafad Cliffs	SM 8927 3840	Coastal habitats, Birds, Geology

Figure 11.1 – Table of Sites of Special Scientific Interest

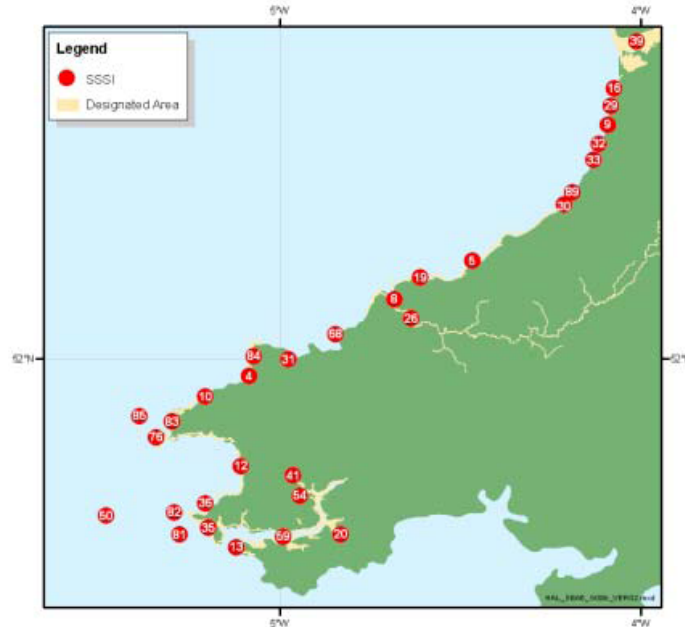


Figure 11.2 – Map showing Sites of Special Scientific Interest

10.3 Marine mammals

Seven marine mammal species are known to occur regularly in the Irish Sea: grey seal, harbour seal, harbour porpoise, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin and minke whale.

In the area off Strumble Head Harbour Porpoise are abundant, shown by the SMRU data in figure 11.3 and confirmed by many years of research by the South and West Wales Sea Trust.

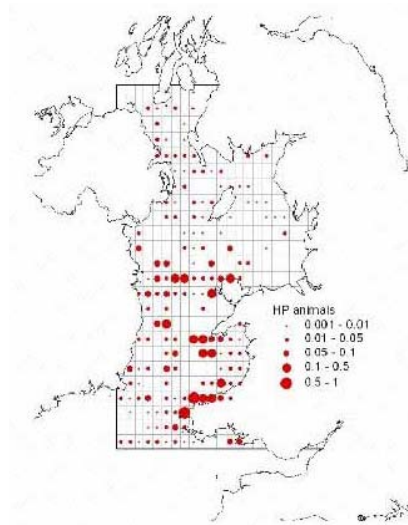


Figure 11.3 – SMRU data - Harbour porpoise sighting rates

A wealth of baseline data also exists for other species, in particular grey seal and bottlenose dolphin from both the Sea Trust and SMRU. It would be important to establish any potential links between any proposed site at Strumble Head and the Pembrokeshire Marine and Cardigan Bay SACs for these species. GPS track data, abundance and haul out site location data exists for grey seals. In addition, potential effects on European Protected Species must be considered.

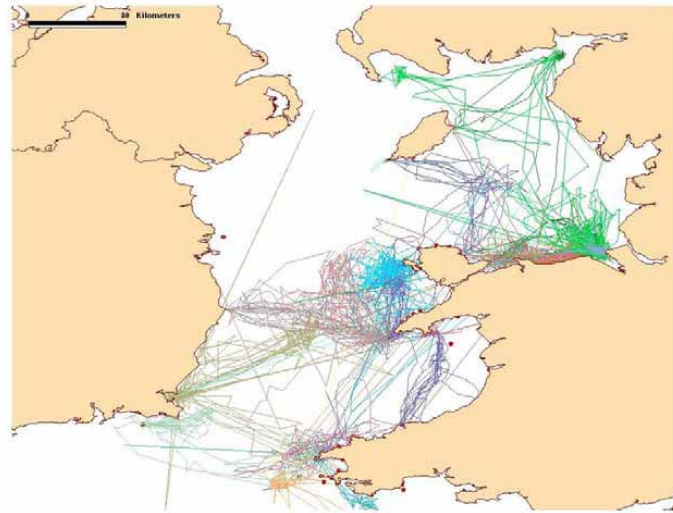


Figure 11.4 – SMRU data – GPS tracks of grey seals

- The key potential impacts to marine mammals are injury from collision with blades, disturbance from noise or vibration and barriers to movement. These aspects would require a full assessment.

10.4 Fish

There are no designated fish species within the area of interest but potential impacts on fish remain an important consideration due to potential indirect effects on other species within the food chain.

Potential impacts to fish include injury due to collision, injury from pressure effects, displacement or barriers to movement.

10.4.1 Commercial fishing

The principal source of fishing effort in the Irish Sea derives from otter trawling and a reduced amount of fishing is seen in Cardigan Bay

A limited amount of Scallop dredging occurs off the south west Wales coast in Cardigan Bay although the inshore component of this fishery is subject to a seasonal closure between July and December.

Between 1998 and 2003, less than 3% of the vessels sighted in the Irish Sea were potters. Effort was distributed primarily in Cardigan Bay and around Anglesey.

Consultation has informed this study that Coasters only occasionally come in to Fishguard and for shelter reasons but that some potting and netting takes place in area of interest B.

10.5 Birds

During informal consultation the RSPB highlighted the document “Assessment of Risk to Diving Birds from Underwater Marine Renewable Devices in Welsh Waters” which identifies theoretical categories of risk to diving birds, shown below:

- Direct loss of habitat for diving birds due to installation of devices;
- Displacement of birds from the development area;
- Direct risk of collision between diving birds and moving parts of the device;
- Direct risk of entrapment within enclosed parts of the device;
- Direct impacts of construction/operational noise and pressure changes;
- Indirect impacts due to construction/maintenance/operational disturbance; and
- Indirect impacts due to habitat loss for prey, depletion (as a result of collision),
- Displacement or aggregation of prey.

Guillemot, Razorbill and Gannets are common birds in the area of interest. The Gannet is a qualifying feature of the Grassholm IBA and the Razorbill is a qualifying feature of the Ramsey, St David's Peninsula and Strumble Head IBA.

If this proposal was to proceed to the next stages then a full assessment of risk and potential effects would be required.

10.6 Benthic habitat

The southern part of Cardigan Bay is mostly rocky and exposed to intense wave and tidal currents. The littoral zone is typically contains barnacles, limpets and dog whelks and diverse flora. Algal communities are present within intertidal rock pools including *Ahnfeltia*, *Polyides*, *Audouinella*. and *Corrallina* species.

If this proposal was to proceed to the next stages then a benthic habitat survey is likely to be required. This would inform the EIA process of any potential direct habitat loss due to the turbine structures and potential indirect impacts on species due to foraging and feeding behavioural changes.

10.7 Coastal processes

Initial flow speed survey and bathymetry have been conducted as part of this study. If the proposal was to proceed to the next stages then further data on flow speeds, bathymetry, sediment type and size is likely to be required.

Tidal turbines locally reduce the velocity of the flow in the wake region which has the potential to alter local sediment and scour patterns. The overall affect of a tidal array is also a reduction in flow velocity which has the potential to alter coastal flow patterns and near and far field sedimentary patterns. Qualifying features of local SACs include Estuaries, Large shallow inlets and bays, Reefs, Sandbanks, Mudflats, sandflats and Coastal lagoons so a full assessment of any potential effects is likely to be required.

10.8 Marine Archaeology

10.8.1 Legislation

Maritime archaeological sites in the UK can be protected by the Protection of Wrecks Act 1973, the Protection of Military Remains Act 1986 or the Ancient Monuments and Archaeological Areas Act 1979.

Section one of the Protection of Wrecks Act deals with wrecks of historic or archaeological importance and is administered by the relevant heritage agency. In Wales, Cadw is responsible for archaeological and built heritage matters, extending offshore to the 12 mile territorial limit. Section two of the Protection of Wrecks Act deals with dangerous wrecks and is administered UK-wide by the Maritime and Coastguard Agency. The Protection of Military Remains Act is administered UK-wide by the Ministry of Defence.

10.8.2 Possible effects

1. The issues with putting something on the sea bed are not just with undiscovered finds but also with disturbing the pre-historic environment. A pile foundation would have a higher impact than our proposed gravity foundation but this still may change sediment patterns and could require modelling to understand it. Cut in cables are also a potential issue for these reasons.

2. The process for the archaeological part of the EIA could range from a desk based study to geophysical survey looking at sub-bottom features and anthropogenic material on the sea bed.

10.8.3 Charted wrecks in area of interest

There are no designated wrecks in the study area under either the Protection of Wrecks Act or the Protection of Military Remains Act.

There are two non-designated wrecks within the overall study area, charted by the UKHO. Neither is within the proposed area of interest (area B, off Strumble Head).

Description	Lat	Lon	Depth
Wreck (1.7nm NW of Strumble Head)	N 52 02.843	W 5 06.611	32.0 m
Wreck (South of Strumble Bank)	N 52 02.014	W 5 01.374	30.0 m

Figure 11.5 – Charted wrecks within the study area

11 Conclusions

1. 29 organisations have been contacted about the project during the informal stakeholder consultation process and feedback has been incorporated into the study work.
2. Fishguard RNLi did not express any concerns over the potential of tidal turbines in the area.
3. Stena Line ferries did not express any concerns over the initial proposal having considered draft and route of their vessels.
4. Sea Trust (S&W Wales) provided guidance to the study and highlighted the importance of the area to marine mammals in general and in particular Harbour Porpoise.
5. The area of interest is surrounded by many Natura sites with designations for both habitat and species.
6. Geographically the closest Natura sites are the Cardigan Bay and Pembrokeshire Marine SACs. These sites have qualifying features including sandbanks, reefs, submerged or partially submerged sea caves and species including Bottlenose dolphin, Sea lamprey, River lamprey and Grey seal.
7. If this feasibility study was to proceed to the next stages then a full assessment of environmental aspects is likely to be required in support of an EIA process and potential Appropriate Assessment. Evidence is likely to be required to establish the strength of any link between designated species and the Strumble Head area.
8. Flow patterns throughout the diurnal tidal cycle have been measured for the area of interest from Pen Brush to Pen Anglas.
9. During the east-going tide, a flow re-circulation has been observed in the area of Strumble Bank.
10. Peak flow speeds of 3.2 kts, 5.2 kts and 3.0 kts were measured at Pen Brush, Strumble Head and Pen Anglas respectively.

12 References

1. Strategic Environmental Assessment Area 6: Irish Sea
DECC 2005
2. MRESF Stage-2 Diving Birds and Underwater Renewable Devices Desk Top Review
28th February 2011
Ref: JER3688
3. Fishguard stake holder information sheet_V1_TB_ApJO_4_020211
April 2011
Swanturbines Ltd and TBG

13 Appendix A – Flow test data

ANALYSED DATA						
Waypoint No.	Index	Pressure (dB)	Flow (m/s)	Direction (M)	Time relative HW Milford Haven	Flow (kts)
A	1	2.64	1.488	39.3	0.10	2.92
B	2	1.85	2.150	63.6	0.33	4.22
C	3	3.59	0.577	244.6	0.53	1.13
A	4	2.79	1.142	26.9	0.85	2.24
B	5	2.66	1.510	53.1	1.17	2.96
C	6	3.44	0.856	279.3	1.45	1.68
A	7	3.38	0.837	25.3	2.05	1.64
B	8	3.54	0.795	47.3	2.28	1.56
C	9	3.23	1.148	272.4	2.55	2.25
A	10	3.59	0.368	136.0	3.25	0.70
B	11	3.59	0.723	247.1	3.55	1.42
C	12	2.65	1.528	278.3	3.73	3.00
A	13	3.73	0.384	218.7	4.07	0.75
B	14	3.40	0.898	260.1	4.25	1.76
C	15	2.88	1.435	276.7	4.50	2.81
A	16	2.81	1.258	238.3	-5.38	2.47
B	17	2.21	1.838	258.1	-5.17	3.60
C	18	3.28	1.025	289.9	-4.95	2.01
C1	19	3.37	1.056	278.6	-4.83	2.07
C2	20	3.14	1.195	266.3	-4.70	2.34
C3	21	3.16	1.161	253.7	-4.55	2.28
A	22	3.66	0.353	165.2	-4.27	0.69
B	23	2.93	1.305	261.2	-4.10	2.56
C	24	3.44	0.905	262.0	-3.92	1.78
A	25	3.71	0.393	273.7	-3.28	0.77
B	26	3.85	0.309	209.3	-3.13	0.61
C	27	3.87	0.370	244.9	-3.00	0.73

Figure 17.1 – Test data 19th May 2011

ANALYSED DATA						
Waypoint No.	Index	Pressure (dB)	Flow (m/s)	Direction (M)	Time relative HW Milford Haven	Flow (kts)
A	100	2.65	1.635	39.3	-1.40	3.21
B	101	1.61	2.666	67.0	-1.20	5.23
C	102	4.05	0.613	126.0	-0.92	1.20
A2	104	2.88	1.611	46.5	-0.25	3.16
A	105	2.98	1.474	31.5	-0.13	2.89
A1	106	2.32	1.795	73.9	0.03	3.52
B1	107	4.03	0.579	129.8	0.22	1.14
B	108	1.95	1.971	53.6	0.30	3.86
B2	109	2.00	1.818	45.1	0.45	3.57
B5	110	2.57	1.716	58.3	0.57	3.36
C1	111	4.11	0.483	223.7	0.77	0.95
C	112	4.09	0.651	254.1	0.88	1.28
C2	113	3.97	0.487	237.0	0.98	0.95

Figure 17.2 – Test data 20th May 2011

14 Appendix B – Stakeholder feedback from Countryside Council for Wales

CYNGOR CEFN GWLAD CYMRU
COUNTRYSIDE COUNCIL FOR WALES

13 June 2011

OFFSHORE RENEWABLE ENERGY CHECKLIST – SWAN TURBINES STRUMBLE HEAD TO FISHGUARD SITE

IMPACTS ON	IMPACTS OF OR ISSUE	SITE SPECIFIC
DESIGNATED SITES – SSSI, SAC, RAMSAR	Construction Operation Decommissioning	<ul style="list-style-type: none"> The JNCC web site www.jncc.gov.uk contains information on all of the UK Special Areas of Conservation (SAC) and Special Protection Areas (SPA). St. Davids SAC – designated for features including Vegetated Sea Cliffs. The eastern boundary of the SAC extends to eastern end of Porthsychan. Pembrokeshire Marine SAC and Cardigan Bay SAC should also be considered for potential effects on mobile species features. Grey seal are a feature of Pembrokeshire Marine SAC and bottlenose dolphin and grey seal are features of Cardigan Bay SAC. See also ‘Marine mammals’ section. Special Protection Areas (SPA) with wide ranging diving bird features (e.g. gannet, puffin, Manx shearwater) may also need to be considered for potential effects. Lists of protected sites with diving bird features in Wales can be provided by CCW. See also ‘Birds’ section). Possible effects on Sites of Special Scientific Interest (SSSI) will need to be considered. Sites of relevance are Strumble Head – Llechdafad Cliffs SSSI, notified for a number of features including maritime cliffs, ledges and crevices, coastal heath and various rare plants and Fishguard Cliffs geological SSSI, notified for ordovician rocks. Full feature lists for these sites can be provided by CCW. Since there are a number of Special Areas of Conservation (SAC) and Special Protection Areas (SPA) within the possible area of impact of the proposed development there will be a requirement for the Competent Authorities to carry out a Significance Test under Regulation 48 of the Conservation (Natural Habitats, &c.) Regulations 1994. Depending on the outcome of the Significance Test, there may be a need for an Appropriate Assessment. Consequently, it is important that the EIA contains sufficient information to allow the Competent Authorities to carry out these assessments if required.
DESIGNATED SITES AONB, HERITAGE COAST,	Construction	<ul style="list-style-type: none"> Pembrokeshire Coast National Park, Heritage Coast in Ceredigion. Refer to Local Authorities for details of Local Nature Reserves.

NATIONAL PARK, SPECIAL LANDSCAPE AREA	Operation Decommissioning	
SEABED	Construction & Decommissioning Footprint Operation – energy regime changes Sediment plumes Mooring installation / presence / maintenance / decommissioning	<ul style="list-style-type: none"> • CCW holds limited biological survey data for this area. It is likely that the seabed in this area is a mosaic of rocky substrate and sediment. • An assessment would be needed of the importance of biological communities in the area to be impacted (both at the proposed device location and along the cable route). This would need to include an assessment of the potential loss or alteration of the benthic habitat and would need to be linked to the possible impacts of construction and changes in hydrodynamic regime. To carry out this assessment benthic surveys would be required, preferably taking the form of an acoustic survey (sidescan and / or multibeam) at the development site and along any proposed cable route, followed by appropriate macrofaunal sampling. This would allow the most appropriate location for the device deployment and cabling, to be identified whilst ensuring minimal impact on benthic communities. • The possible impacts on the benthic community of any anti-fouling methods to be used would also need to be assessed. • Sediment plumes during construction and maintenance must be controlled and their potential impacts assessed.
INTERTIDAL HABITATS	Cables to shore Device construction Transport to site Changes to energy regime (exposure and sediment supply)	<ul style="list-style-type: none"> • Impacts would depend on the final landfall route chosen, construction methods and access to the site, which would need to be considered. The use of directional drilling is encouraged. • The chosen cable route and construction sites would preferably avoid any sensitive, rare or specialised intertidal communities such as crevice, gully and rock pool communities which are known to occur along this stretch of coast. • The area contains a range of shoreline types from exposed to moderately exposed shores, with some more sheltered embayments and coves. CCW holds intertidal survey data for this section of coast. • Consideration should be given to the St. Davids SAC, Strumble Head – Llechdafad Cliffs SSSI and Fishguard Cliffs SSSI (see 'Designated sites' section).
MARINE MAMMALS	Disturbance / displacement Underwater noise Collision	<ul style="list-style-type: none"> • Grey seals regularly use this area. Local seal haul-outs occur along this stretch of coast. • This is an important area for harbour porpoise where they are present all year round and adult females and young calves are regularly seen in spring and summer. Harbour porpoise rely heavily on high energy tidal areas for feeding. Other cetacean species sighted here include bottlenose dolphin and less regularly short-beaked common dolphin and Risso's dolphin.

		<ul style="list-style-type: none"> • Collision risk/assessment would be a key concern for both seals and cetaceans and must be addressed. It is likely that the distance over which the device can be detected / seen will be site and species specific and vary with different environmental conditions affecting spread and loss of sound, background noise levels, and tidal flow speeds. • There are unknowns about the levels and impacts of the operational noise of the turbines, the hearing capability of marine mammals and their likely behavioural response. This would need to be examined. • Indirect effects would need to be examined for example changes to food/fish availability/distribution. • Since the proposal may have the potential to cause disturbance to cetaceans which are European Protected Species and which are protected by The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) the applicant may wish to seek advice from the Welsh Government, as the licensing authority about whether this proposed activity could cause an offence under The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) and may therefore require a licence under Regulation 44.
FISH & FISHERIES	<p>Exclusion areas</p> <p>Displacement</p> <p>Electrical interference</p>	<ul style="list-style-type: none"> • Within the area fishing boats operate mainly from Fishguard. The coast is popular with recreational sea anglers and hire boats take anglers further out to sea. • Elasmobranchs (sharks, skates and rays) depend on electrical detection to find food and navigate. The importance this area for egg deposition sites and nursery areas is unknown at present. Work is ongoing to identify the areas used by rays during their lifecycle. The possible effect associated with cables to offshore renewable energy developments is being investigated under COWRIE see www.offshorewindfarms.co.uk and ways of mitigating (e.g. by burying cables) would need to be considered. • Assessment of the impact on local fisheries and nursery areas would be needed and the knock-on effects on benthos of displacing any fisheries elsewhere.
BIRDS	<p>Disturbance</p> <p>Habitat loss</p> <p>Lighting</p> <p>Collision risk</p>	<ul style="list-style-type: none"> • Issues of concern which must be addressed include; collision with diving birds, habitat loss (intertidal/subtidal), bird disturbance and indirect effects such as changes to food/fish availability and distribution. • This area may be important for diving birds from protected colonies (e.g. puffins, guillemots, razorbills, Manx shearwaters and gannets). These birds are known to dive to the depths at which these devices could be sited. North Cardigan Bay supports significant populations of wintering scoters (seaducks) and red-throated diver. • Potential impacts on all existing SPAs and SSSIs and possible marine SPAs, including extensions to sea bird colonies, inshore areas for non breeding sea ducks and divers and offshore feeding areas would need to be

		<p>addressed. CCW can provide information on protected sites n Wales with diving seabird species features.</p> <ul style="list-style-type: none"> • Some data are available from WeBs, local bird reports. BTO hold data for wintering birds and CCW hold some seabirds at sea data for this area.
ACCRETION EROSION COASTAL PROCESSES GEOMORPH. FEATURES	<p>Structures</p> <p>Changes in flows</p> <p>Changes in waves</p> <p>Sediment processes</p>	<ul style="list-style-type: none"> • Depending on the scale of the development the potential impacts on the near and far field hydrodynamic regime would need to be addressed. • Where changes are sufficient to modify the sediment transport regime consideration needs to be given to the extent to which coastal processes (including sediment erosion, transport, distribution and accretion) could be modified by the development. • If structures such as gravity foundations were deployed over a large area consideration may need to be given to their potential to modify the wave climate and associated coastal processes. However the rocky nature of much of this part of the coast means that the sensitivity to change may be limited.
NAVIGATION	<p>Collision hazard</p> <p>Exclusion area</p>	<ul style="list-style-type: none"> • A collision risk assessment during construction and operation would be needed. • A marine pollution contingency plan would be needed.
WATER QUALITY	<p>Discharges during construction and maintenance</p>	<ul style="list-style-type: none"> • The water quality in the area is generally good. • A pollution contingency plan for construction and operation would be needed. • Dilution and mixing would be expected to be high but effects of the development on these processes would have to be examined.
COASTAL & TERRESTRIAL HABITATS	<p>Cables and onshore structures</p> <p>Onshore construction</p> <p>Transport to site</p>	<ul style="list-style-type: none"> • Protected species surveys may be needed but this depends on the landfall and route chosen. • The route of the cable, any on shore infrastructure and construction sites would need to address designated sites, habitat and species issues inland. • Justification to demonstrate choice of cable route, of least impact, would be needed. • Photomontages and visual impact assessment would be needed for any overhead cable routes and substations should they be needed. This should include assessment of location and design options to minimise visual impacts.
VISUAL INTRUSION	<p>Structure</p> <p>Size</p> <p>Distance</p> <p>Layout</p>	<ul style="list-style-type: none"> • This section relates only to that part of the development that lies above the water surface, plus any supporting infrastructure such as land fall substation and power lines or navigation marker poles or night lights, or any significant change to the appearance of the water surface that is visible from land (for example white trails or an alteration to wave character). • The need for assessment depends on the scale and visual prominence of the development. For a highly visible development the zone of visual

	<p>Visibility</p> <p>Design</p> <p>Lighting</p> <p>Colour</p>	<p>influence would have to be defined and a visual impact study would be needed. An assessment would have to be made of the effect the development would have on visual receptors, whether this is positive or negative, to what magnitude, and the significance of this. Explanation would be required on how potentially negative visual impacts have been minimized during the design process and how any remaining negative visual impacts are to be mitigated for. There will be a need to effectively illustrate the proposals with photomontages from a small selection key view points, so that an assessment can be made on the development within context of the setting. These should include popular viewing locations, elevated viewing locations, higher ground viewpoints from the hills or designated landscapes, the effect of morning, high sun and low evening lighting conditions, night lighting, high and low tide differences. The likely locations of sensitive visual receptors (people) in the vicinity of the proposed site should be identified. Receptor types should be identified and located, both from communities or interest and communities of place, both land and water based. Significance will depend on numbers and sensitivity.</p> <ul style="list-style-type: none"> • The most sensitive landscape receptors along the Cardigan Bay coast are Pembrokeshire Coast National Park, Heritage Coast in Ceredigion and along and the Pembrokeshire Coast. Many have elevated viewing points and the visibility of the sea is high. Views from areas designated for the landscape quality must be addressed. Siting should seek to maximize the distance of the development from sensitive areas whilst layout should not appear regular to the setting of complex irregular landscape character.
SEASCAPE AND COASTAL CHARACTER	As above	<ul style="list-style-type: none"> • The need for assessment depends on the scale and visual prominence of the development, but it is likely that an assessment will be needed since much of the coastline is undeveloped. • A large development with many markers and night lighting may become a significant scale of change and a seascape character assessment might then be needed. This would need to assess the effects of the development on seascape character, through defining the character and identifying the effects. • A small scale or wholly underwater project with very few visual impacts unlikely to change the character of the seascape, may not require a seascape assessment apart from during the construction and maintenance events.
HISTORIC LANDSCAPE	As above	<ul style="list-style-type: none"> • The need for assessment depends on the scale and visual prominence of the development. • Historic landscapes are non-statutory, but are a material consideration in the planning process and local authorities are asked to take information on the Registers of Landscapes of Historic Interest in Wales, into account when

		<p>considering the implication of developments which are of such a scale that they would have more than local impact on an area on the Register (WAG, Planning Policy Wales, March 2002, section 6.5.23).</p> <ul style="list-style-type: none"> Register of landscapes of outstanding historic/special interest in Wales (CCW/Cadw) includes Newport and Carningli, Pen Caer, St. David's peninsular and Ramsey Island. There are a large number of wreck sites in Cardigan Bay including the designated wrecks of the Diamond and Talybont.
AMENITY & WATER USE	<p>Exclusion areas</p> <p>Collision hazard</p> <p>Enjoyment</p>	<ul style="list-style-type: none"> Personal watercraft, yachts and kayaks regularly use this area and potential impacts of this development would need to be assessed. There are large marinas in Cardigan Bay with commercial and leisure boat traffic, in particular from Aberystwyth and New Quay. Fishguard Harbour in particular receives large vessels including the Rosslaire passenger ferry.

Other issues:

1. The relative importance of many of the issues raised will vary depending on the precise location being considered and the scale and number of units proposed.
2. Information will be required on possible impacts (particularly on designated, BAP, and Nationally Important habitats and species) during the construction, operation, maintenance and decommissioning phases of the development.
3. Details of the power transmission route will be required to assess the likely terrestrial impact of the proposal.
4. The environmental impacts of sourcing the material for construction of the proposed development need to be assessed.
5. Cumulative and in combination impacts with other developments e.g. other renewable energy devices could be a key issue.
6. Data are available from CCW for some of the constraints/sensitivities given in this table.

Please note this list is not a definitive guide nor does it constitute a CCW position statement on the proposed development.