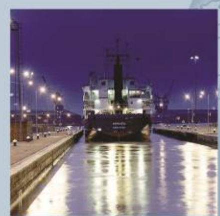
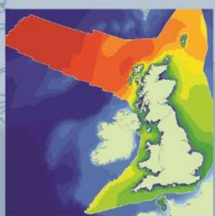
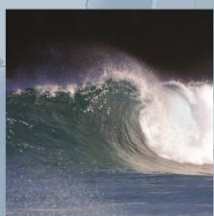
Alderney Commission for Renewable Energy

Alderney Regional Environmental Assessment of Renewable Energy: Environmental Report

Report R.2129

March 2014

Creating sustainable solutions for the marine environment

Alderney Commission for Renewable Energy

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Summary

The Alderney Commission for Renewable Energy (the Commission) has commissioned ABP Marine Environmental Research Ltd (ABPmer) to undertake a strategic assessment of the potential environmental impact of possible future renewable energy development (the 'Draft Plan') within Alderney and its territorial waters.

Alderney is not subject to European environmental directives and therefore there is no requirement to undertake a formal Strategic Environmental Assessment (SEA) or plan level Habitats Regulations Appraisal (HRA). However, the Commission is committed to adopting best practice and recognises the benefit that such plan level assessments can provide in seeking to minimise the adverse environmental effects of plans. Within the UK, comparable non-statutory assessments have been termed 'Regional Environmental Assessments' (REAs).

The scope of possible future renewable energy development (the 'Draft Plan') within Alderney and its territorial waters comprises the following key elements:

- The possible exploitation of Alderney's tidal energy resource;
- Potential export cables to Alderney and France and any associated infrastructure on Alderney; and
- The possible exploitation of onshore wind on Alderney.

Details of the Draft Plan (e.g. proposed programme, scheme design and construction methodology of individual tidal energy projects) are currently limited and/or unknown. Given the high level of uncertainty associated with the Draft Plan, worst case assumptions (i.e. where the magnitude of impacts is greatest) have been considered throughout the REA.

The REA has been undertaken in two phases: a scoping phase, followed by an assessment phase. The Scoping Report, which was published on the Commission's website on 19 April 2013, outlined the context of the REA, including providing details of the available baseline information and identifying potential pathways between pressures brought about by activities associated with the Draft Plan and environmental receptors. Given the uncertainties associated with the Draft Plan, a precautionary approach was applied and none of the potential impact pathways were scoped out as part of the process.

The assessment phase of the REA is presented in this report. Each of the topics identified in the scoping phase have been divided into distinct 'receiving environments' or 'receptors'. The effect of the Draft Plan on each of these has been assessed by describing in turn: the baseline environmental conditions of each receiving environment; the 'impact pathways' by which the receptors could be affected; the potential significance of the impacts occurring and the measures to mitigate for significant adverse impacts where these are predicted. This has considered the pre-construction (survey), construction, operational and decommissioning phases of each of the key elements of the Draft Plan i.e. tidal stream turbines, cable routeing (including intra and inter array cables, cables from arrays to substation and to shore, and also the interconnector export cable between Alderney and France), offshore substations, onshore substation and onshore wind turbines. Site-specific issues, which individual developers may need to take account of in environmental impact assessments (EIAs) undertaken at the project level, have also been identified. This includes the consideration of data gaps

and the further work that might be required to fill these gaps at the project level, including any potential survey and/or modelling requirements.

This REA has assumed that the full build out of the Draft Plan would potentially comprise the following:

- Approximately 4000 tidal turbines being installed in Alderney's territorial waters;
- A minimum of 367km of intra- and inter-array cabling;
- Approximately 30km cable routing for the export interconnector cable between Alderney and France;
- A minimum of four onshore substations/converter stations and/or six offshore substations; and
- One onshore wind turbine.

The tidal turbines are likely to be concentrated in the areas that have the highest flows and least constrained in terms of cost, physical constraints, environmental effects and grid connection. Should concurrent installations occur where there is a clustering of device arrays, the cumulative impacts could be of greater significance than if they are installed on separate occasions. The same applies if the installation of tidal device arrays is continuous over a longer period of time. The key potential cumulative effects of the Draft Plan alone have been taken into account as part of the assessment and reported within each of the relevant topic chapters. A separate cumulative impact assessment has also been undertaken to assess the potential combined effects of the Draft Plan together with any other relevant plans, projects and activities.

The assessment has drawn on existing guidance as appropriate, including the Marine Scotland Licensing and Consents Manual, covering Marine Renewables and Offshore Wind Energy Development (ABPmer, 2012), Marine Scotland's Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland (Emec and Xodus AURORA, 2010), and Countryside Council for Wales' (CCW) Potential Nature Conservation Impacts of Marine Renewable Energy Projects in Wales (ABPmer, 2005).

Potentially moderate or major significant adverse impacts that will require mitigation are summarised in the Table S1. These are the key impact pathways that will need particular consideration by individual developers at the EIA project level. It has not been possible to fully quantify the effects due to the levels of uncertainty associated with the Draft Plan. Consequently, the assessment of effects of tidal devices, cable routes, offshore and onshore substations and onshore wind turbine has been undertaken at a high strategic level.

Table S1. Key potential impacts

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
Marine geomorphology	Alteration of seabed form and features during operation, construction and decommissioning of tidal stream turbines	Insignificant to major	Insignificant to minor
Physical processes	Alterations to tidal regime and sediment transport during operation of tidal stream turbines	Insignificant to major	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
Benthic ecology	Direct loss and/or damage to benthic habitats during construction and operation of tidal stream turbines, cable routeing and offshore substations	Insignificant to major	Insignificant to minor
	Potential for non-native species introductions during construction of tidal stream turbines, cable routeing and offshore substations	Insignificant to moderate	Insignificant to minor
Fish and shellfish	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision/entrapment risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Insignificant to moderate	Insignificant to minor
Ornithology	Changes to foraging habitat availability during construction of tidal stream turbines and offshore substations	Insignificant to moderate	Insignificant to minor
	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Minor to major	Insignificant to minor
	Collision risk during operation of onshore wind turbine	Minor to moderate	Insignificant to minor
Marine mammals and turtles	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Moderate to major	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Minor to moderate	Insignificant to minor
Nature conservation	Loss/damage and/or disturbance during construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Loss or changes to foraging grounds during construction, operation and decommissioning of tidal stream turbines, cable routeing	Insignificant to moderate	Insignificant to minor
	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision risk during operation of tidal stream turbines and onshore wind turbine	Minor to major	Insignificant to minor
	Visual disturbance during construction of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Potential for non-native species introductions during construction of tidal stream turbines, cable routeing and offshore substations	Insignificant to moderate	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Insignificant to moderate	Insignificant to minor
Terrestrial ecology	Loss/damage and/or disturbance during construction, operation and decommissioning of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
	Noise/vibration during survey, construction and decommissioning of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Noise/vibration during operation of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Visual disturbance during operation of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Marine archaeology	Direct damage during survey, construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to major	Insignificant to minor
	Indirect damage during construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to major	Insignificant to minor
Terrestrial archaeology	Direct damage during construction and operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Visual impacts during construction and operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Exclusion areas during operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
Cables, pipelines and grid connectivity	Impact to existing grid during construction of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Commercial and recreational fisheries	Increased congestion during construction, operation and/or decommissioning of tidal stream turbines, cable routeing, offshore substations and onshore substation	Insignificant to moderate	Insignificant to minor
	Temporary and long term displacement during operation of tidal stream turbines, cable routeing and offshore substations	Moderate to major	Insignificant to minor
	Damage to fishing gear during operation of tidal stream turbines, cable routeing	Moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Damage to fishing gear during operation of tidal stream turbines, cable routeing	Insignificant to moderate	Insignificant to minor
Commercial and recreational shipping and navigation	Collision risk during construction, operation and decommissioning of cable routeing and offshore substations, and during construction and decommissioning of tidal stream turbines	Insignificant to moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Changes to commercial shipping movements during construction and decommissioning of tidal stream turbines, cable routeing, offshore substation, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Effects on small craft navigation during construction, operation and decommissioning	Insignificant to moderate	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
	of tidal stream turbines, cable routeing and offshore substation		
	Increased/altered steaming times and distances during construction and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to moderate	Insignificant to moderate
	Changes to risk management and emergency response during construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to moderate	Insignificant to minor
Recreation and Tourism	Decrease in the recreational quality of the environment during construction, operation and decommissioning of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Land use conflicts of interest and access issues during construction, operation and decommissioning of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Noise	Noise during operation of onshore substation	Insignificant to moderate	Insignificant to minor
	Noise associated with construction activities of onshore wind turbine	Insignificant to major	Insignificant to minor
Landscape and seascape	Increased boat/road traffic during survey, construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Requirements for temporary housing, work facilities during construction and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Lighting during construction, operation and/or decommissioning of cable routeing, offshore substations and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Alterations to existing landforms during construction and operation of cable routeing, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Introduction of permanent feature during operation of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Introduction of regular geometric, man-made forms during operation of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Construction of access roads and piers during construction and operation of onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Change in perception of an area during operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
Traffic and transport	Increased traffic during construction and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Increase in size of vehicles during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Increase in size and weight of vehicle loads during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Damage to roads during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Traffic congestion during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Potential road hazards during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Creation of dirt and dust by vehicles during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor

Established industry best practice procedures and impact reduction measures that have been considered as part of this REA to mitigate significant moderate or major impacts outlined in Table S1 above are summarised in Table S2.

Table S2. Key potential mitigation measures

Receptor	Potential Mitigation
Marine geomorphology	▪ Amendment of site design, including reduction in the number of tidal devices and/or array location to minimise energy extraction at those locations where the tidal regime controls key seabed features (e.g. sandbanks) or where protected features are present (i.e. Alderney South Banks Subtidal Sandbank); ▪ Optimisation of array design; ▪ Development of a cable burial / protection plan; ▪ Minimisation of cable, device and offshore substation footprints; and ▪ Use of scour protection measures.
Physical processes	▪ Amendment of site design, including reduction in the number of tidal arrays and/or change in the location of the array and substation to reduce potential shoreline and seabed effects; ▪ Optimisation of array design; and ▪ Development of a cable burial / protection plan.
Benthic ecology	▪ Reduction in the number of tidal devices and associated cables in order to minimise the area of substratum loss and/or damage; and ▪ Avoid any sensitive habitats (e.g. eelgrass beds) at the project planning and design phase. With a potential full build out of the Draft Plan, there will still be approximately 97% of the seabed across all the licence blocks available for micro-routeing. Such micro-routeing may need to be considered further at the EIA project-level by the developer.

Receptor	Potential Mitigation
Fish and shellfish	▪ Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Avoid construction during sensitive seasons, e.g. breeding/peak egg laying/spawning seasons, in feeding grounds and during migration times of migratory fish; ▪ Good construction practice to minimising noise and vibration; ▪ Minimise use of high noise emission activities such as piling; and ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).
Ornithology	▪ Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Mitigation that is likely to be required to protect marine mammals from collision risk will also protect diving birds. These include: o Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure; and o Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically. ▪ Restrict piling (if required) to periods of low species activity periods within annual and diurnal cycles as appropriate to avoid excessive displacement of species by underwater noise caused by infrastructure installation (piling); and ▪ Where appropriate to the local species ensuring that piling (if required) commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors.
Marine mammals and turtles	▪ Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure; ▪ Marine mammal monitoring undertaken for a defined period of time during initial operation with potential turbine shutdown when a mammal is within 50m of turbine rotors; ▪ Regular surveillance for carcasses and post mortem evaluation of carcass stranding and assessment of cause of death; ▪ Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically; and ▪ Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Restrict any piling to periods of low species activity within annual and diurnal cycles as appropriate to avoid displacement of species by underwater noise caused by infrastructure installation (piling); ▪ Where appropriate to the local species, ensure that piling commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors; ▪ Ensuring that piling activities do not commence until half an hour has elapsed during which marine mammals have not been detected in or around the site. The detection should be undertaken both visually (by Marine Mammal Observer) and acoustically using appropriate Passive Acoustic Monitoring equipment. Both the observers and equipment must be

Receptor	Potential Mitigation
	deployed at a reasonable time before piling is due to commence. This should include ensuring that at times of poor visibility e.g. night-time, foggy conditions and sea state greater than that associated with force 2 winds, enhanced acoustic monitoring of the zone is carried out prior to commencement of relevant construction activity; and ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).
Nature conservation	▪ Consider a zone of avoidance around designated sites (this will vary depending on the sensitivity of qualifying interest features and the spatiotemporal scale of pressures brought about by activities associated with specific projects); ▪ Minimisation of survey / construction / decommissioning works in designated sites; ▪ Consider alternative installation methods (including non-invasive measures such as Horizontal Directional Drilling (HDD)) to avoid an adverse effect on site integrity; ▪ Careful consideration of the design and placement of structures to minimise effects, e.g. for tidal turbines the number, size and spacing between and avoiding key migratory routes; ▪ Selection of device type to minimise effects such as collision/entrapment risk or visual; ▪ Avoid sensitive sites /species e.g. seabed habitats such as maerl beds, seagrass beds which have a particularly strong ecosystem function in supporting different life stages for fish and shellfish; ▪ Avoid siting devices in or near particularly sensitive areas e.g. seal haul out sites, seabed fish spawning/nursery grounds, key bird foraging/breeding sites; ▪ Avoid construction work during sensitive time periods for fish, e.g. breeding, migration and spawning events; ▪ Avoid cable-laying through sensitive areas, e.g. spawning and feeding grounds; ▪ Creation of new habitat creation e.g. where rock armouring has been used; ▪ Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable); and ▪ Reference should also be made to mitigation measures recommended for other specific receptor topics including Fish and Shellfish, Ornithology, Marine Mammals and Terrestrial Ecology.
Terrestrial ecology	▪ Re-routeing of cables and relocating development to less sensitive areas; ▪ Habitat creation schemes to compensate for the loss of terrestrial habitat with ecological value; and ▪ Relocation of sensitive faunal species.
Marine archaeology	▪ Careful consideration of the extent, number and layout of tidal devices and offshore substations to minimise both the direct and indirect impacts on receptors identified to be sensitive to the development; ▪ On selection of the development area, undertaking a geophysical survey of the seabed surface and subsurface with associated archaeological interpretation to identify potential maritime archaeology; ▪ On selection of the development area, undertaking a geotechnical survey with associated archaeological interpretation to investigate the potential for prehistoric land surfaces and characteristics; ▪ Locating tidal devices and offshore substations to minimise direct damage to identified archaeological sites; and ▪ Cable export design to minimise direct damage to identified archaeological sites; and ▪ Undertaking more detailed assessments to investigate the extents of indirect impacts.
Terrestrial archaeology	▪ Careful consideration of the location of the onshore development to minimise both the direct and visual impacts on the receptors identified to be sensitive to the development;

Receptor	Potential Mitigation
	▪ Siting of the onshore development to minimise effects on the built heritage and character, as well as on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible; ▪ On site selection, complete a more detailed archaeological assessment identifying the archaeological sites in proximity to the development area; and ▪ Locate the onshore substation and wind turbine to minimise direct damage to identified archaeological sites.
Cables, pipelines and grid connectivity	▪ Follow best practice measures, including the mapping of known infrastructure and the use of cable awareness technology (CAT) scans, and ▪ Consultation with Alderney Electricity Ltd in order to identify existing infrastructure at the project planning and design phase and requirements for replacing where necessary.
Commercial and recreational fisheries	▪ Reduction in the number of tidal devices and associated cables in order to minimise the displacement of fishing activities; ▪ Avoid sensitive sites/species/periods e.g. arrays and cable routes should where possible avoid identified fishing grounds; and ▪ Cable and device design should reduce snagging risks.
Commercial and recreational shipping and navigation	▪ All commercial vessels that operate within Alderney waters must comply with the IMO's: o International Convention for the Safety of Life at Sea (SOLAS); o International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW); and o The Convention on the International Regulations for Preventing Collisions at Sea (COLREGS). ▪ Carry out site specific planning, including a Navigational Risk Assessment (NRA) following industry best practice (for example; using UK Maritime and Coastguard Agency's (MCA) guidance in MGN 371, and the UK Department of Energy and Climate Change (DECC) guidance entitled 'applying for safety zones around offshore renewable energy installations'); ▪ In order to minimise disruption to mariners and other users of the sea, safety zones for construction, major maintenance and eventual decommissioning phases will be considered and applied if identified through the NRA process; ▪ Carry out site specific planning during operational phase to minimise collision risk, site selection to identify vessel routes, use of appropriate mitigation such as safety zones; ▪ Carry out hydrographic surveys to accurately establish depths and clearances over devices and quantify any effect on local tidal streams and directions; ▪ Marking of devices using the guidance provided in the International Association of Lighthouse Authorities (IALA) Recommendation 'O-139' on the Marking of Man-Made Offshore Structures; ▪ As stipulated in Trinity House guidance on 'provision and maintenance of aids to local navigation', undertake regular maintenance to ensure markers are properly lit, maintained and checked; ▪ Undertake a detailed site specific assessment of shipping traffic to determine most appropriate location for development; ▪ Avoid areas where there is risk of major disturbance to shipping traffic; ▪ Avoid development in shipping routes of importance to international and inter island navigation; ▪ Marine information dissemination (Notices to Mariners); ▪ Ensure mariners are aware of proposed works via the issue of chart update; ▪ Regular maintenance of devices part of operator licensing; and ▪ Review by the Coastguard of rescue provision, including monitoring capability to ensure operational commitments can be met.
Recreation and Tourism	▪ Best practice measures such as publicising the developments and any associated diversions during construction; and ▪ Careful consideration of the extent, number and layout of infrastructure to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development.

Receptor	Potential Mitigation
Noise	▪ Perform construction works on the onshore wind turbine during week days and daylight (social) hours; ▪ Fit or source plant with sound reduction equipment; ▪ Use screening, enclosures and mufflers to help buffer percussive piling noise; ▪ Investigate methods to improve sound insulation of substations; and ▪ Situate substations away from population centres.
Landscape and seascape	▪ Careful consideration of the extent, number and layout of tidal stream turbines and offshore substations to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development; ▪ Siting of onshore development to minimise effects on seascape and landscape character and on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible; ▪ Design of onshore development to fit with the scale and character of existing buildings and to minimise impacts on coastal features and on views; ▪ Use of existing infrastructure where possible, such as tracks and buildings, to avoid the introduction of new features; upgrading existing infrastructure where necessary; ▪ Screening of permanent features by planting (using native species), fencing or carefully designed earth bunds that relate to the coastal landforms of the site and its immediate context where appropriate; ▪ Reinstatement of vegetation following construction where temporary access tracks/compounds are required; ▪ Use of construction materials paying attention to their composition, texture, colour and form to blend into the surrounding landscape/seascape, including the use of local rock or stone; ▪ Minimise lighting requirements, where possible, particularly in more remote landscapes and seascapes.
Traffic and transport	▪ Preparation of a Traffic Management System (TMS) which details all of the mitigation measures proposed to be undertaken; ▪ Planned routes which will mean that development traffic avoids sensitive receptors or narrow sections of road (although this may not always be possible in rural areas); ▪ Widening of narrow sections of road or the introduction of passing places. Temporary widening should be fully considered where possible, including reinstatement options; ▪ Installation of a temporary road to avoid sensitive receptors such as a village centre; ▪ The developer is likely to be required to pre-agree to repair any damage caused to roads at the end of the project; ▪ Time separation between heavy goods vehicle (HGV) movements; ▪ The avoidance of peak traffic times; ▪ Monitoring of road damage; ▪ Increasing the number of axles of the vehicles used in order to reduce road damage and vibrations; ▪ Depending on the nature of works it may be necessary to install washing areas to prevent dirt and dust; and ▪ Loads may be covered and their size monitored.

It is particularly important to note that there are key gaps in understanding of how tidal arrays will affect a given feature of the marine environment. This is particularly the case for mobile features (including fish, birds and marine mammals), for example, damage/mortality of individuals as a result of collision with rotating blades of tidal energy devices. To manage such risks and to ensure that the Draft Plan can be implemented in a manner that avoids significant effects, a process of iterative plan review should be adopted. This process should collect and analyse monitoring data from initial deployments under the Plan and seek similar information from other regulators to inform the iterative review of the Draft Plan during its implementation. In this way, new information on the effects of the Draft Plan can be used to guide its future implementation and thus ensure that significant adverse effects can be avoided.

There are also several areas of uncertainty associated with characterising the baseline environment. The data gaps that will need to be considered by individual developers at the EIA project level are summarised in Table S3. It is recommended that developers discuss and agree any proposed survey and/or modelling approaches with relevant stakeholders and regulators (i.e. the Commission).

Table S3. Summary of potential data, survey and/or modelling requirements

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
Marine geomorphology	▪ Superficial seabed sediments (at a minimum including composition and particle size, geochemical properties and contaminants); ▪ Morphodynamic features (small- to large-scale); and ▪ Seabed geology	▪ Side scan sonar, video or photographic survey to identify the seabed sediments and geomorphology; ▪ Time series of swathe bathymetry which, placed into context using historical chart analysis, could determine the mobility of any seabed features; ▪ Seabed sediment grab samples to 'ground-truth' the surveys of sediment composition; and ▪ Geophysical surveys of the development area.
Physical processes	▪ Wave regime for approximately 6 months or until representative events have been captured; and ▪ Tidal regime for a minimum of a spring-neap tidal cycle.	▪ ADCP and/or wave buoy; and ▪ Possible numerical modelling (hydrodynamics and sediments).
Water quality	▪ Suspended sediment concentrations; ▪ Water quality measurements; and ▪ Seabed sediment contamination.	▪ ADCP for determination of suspended sediment concentrations; ▪ Water sample collection at pertinent tidal states to allow minimum and maximum contamination levels to be measures; and ▪ Seabed sediment sampling.
Benthic ecology	▪ Characterisation of intertidal and subtidal benthic communities where there is a paucity of data.	▪ Benthic grab samples for faunal and sediment analysis; ▪ Videos/photography surveys; ▪ Trawling surveys; ▪ Acoustic mapping (e.g. multibeam acoustic ground discrimination systems or sidescan data acquisition); ▪ Diver sampling; ▪ Intertidal Phase 1 habitat mapping techniques; and ▪ Intertidal quadrat sampling.
Fish and shellfish	▪ Characterisation of abundance and distribution of fish and shellfish.	▪ Videos/photography surveys; and ▪ Trawling surveys.
Ornithology	▪ Description of abundance and density of foraging seabirds, passage and overwintering waterbirds utilising coastal habitat; and ▪ Impacts of noise on prey species of birds.	▪ Established seabird at sea and coastal waterbird monitoring techniques; ▪ Power analysis of the boat-based seabird survey data; ▪ Collision risk modelling; ▪ OWF collision models and population models; and ▪ Habitat modelling.

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
Marine mammals	▪ Monitoring programme to understand potential impacts, particularly of tidal stream turbines.	▪ Aerial surveys; ▪ Land or boat based counts at haul-out sites; ▪ Vantage point surveys; ▪ Boat based surveys; ▪ Photo ID; ▪ Telemetry; ▪ Stranding and carcass ID; ▪ Towed Hydrophone array protocol; and ▪ Autonomous Acoustic Monitoring (e.g. cetacean pods (C-PODs)).
Terrestrial ecology	▪ Characterisation of terrestrial ecology.	▪ Phase 1 habitat surveys covering the terrestrial footprint of proposed works; ▪ Phase 2 survey or key species listing may be adequate in certain areas; ▪ Bat potential and bat activity surveys; ▪ Protected species surveys; and ▪ Invasive species surveys.
Marine archaeology	▪ Characterisation of the marine archaeological heritage and especially the maritime archaeology (e.g. location of protected wrecks).	▪ Videoing of the seabed; ▪ Multi-beam eco sounder survey (surface) ; ▪ Side-scan sonar survey (surface) ; ▪ Seismic profiling (sub-surface); ▪ Sediment coring (boreholes and vibrocores); ▪ Diver surveys/investigations; or ▪ Radiocarbon dating.
Terrestrial archaeology	▪ SMR data; and ▪ Presence of protected heritage, including Scheduled Monuments and Listed Buildings.	
Cables, pipelines and grid connectivity	▪ Proposed landfall sites of the tidal device export cables in Alderney and France; ▪ Inter-array cable configuration; and ▪ Existing terrestrial cable infrastructure.	
Commercial and recreational fisheries	▪ Up-to-date sea fisheries statistics for the Bailiwick of Guernsey registered fleet, and specifically the Alderney based fleet (including fish landings data, fishing effort data, fishing vessel movements and value of fishing industry to local economy).	
Commercial and recreational shipping and navigation	▪ Information on Marine Environmental High Risk Areas (MEHRAS); ▪ Potential search and rescue activity within the study area and the types of aircraft and vessels which may be used; ▪ AIS-A and AIS-B data for Alderney to characterise winter and summer activity; ▪ Military activity within the area by UK and European countries; and ▪ Information on racing areas in Alderney Waters and the wider study area to inform the understanding of recreational use.	
Infrastructure	▪ Proposed landfall sites of the tidal device export cables in Alderney and France; and ▪ Up-to-date information on the location of infrastructure.	

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
Recreation and Tourism	▪ Records on the number of visitors; and ▪ Value of tourism to Alderney.	▪ Site-based surveys of watersports activities; and ▪ Survey of community perceptions and values.
Noise	▪ Characterisation of background levels of noise.	▪ Noise baseline surveys.
Air quality	▪ Characterisation of background levels of air quality.	▪ Air quality baseline surveys.
Landscape and seascape	▪ Landscape character assessment; ▪ Landform and geological characteristics; ▪ Coastal shape and dynamics, nature of seascape; ▪ Relationship of coastline to hinterland, and coast to seascape; ▪ Vegetation pattern, extent and screening; ▪ Identification and understanding of human activity, trends and pressures on land and sea; ▪ Built development of settlement, houses, and other built infrastructure; and ▪ Designated or protected areas (biological and archaeological importance).	▪ Baseline field survey; and ▪ Additional field survey to key viewpoints to create photomontages.
Traffic and transport	▪ Baseline traffic conditions, including main traffic routes; and ▪ Identification of sensitive receptors.	▪ Swept path analysis (to ensure free passage of large vehicles and loads along the route, around bends etc.); ▪ A structural assessment of all roads and bridges; ▪ Automatic traffic counts by pneumatic tube or radar; ▪ Manual traffic counts; ▪ Video traffic surveys - generally undertaken by consultancies using specialised video equipment; ▪ Pedestrian survey conducted by trained staff or video equipment; ▪ Questionnaire designed to gather selected data, such as preferred route and mode of transport; ▪ Journey time survey - conducted manually or using technology, such as GPS; ▪ Parking Survey; and ▪ Junction/roundabout turning counts which can be undertaken manually or using video equipment.
Cumulative effects	▪ Up-to-date information on location and extent of other plans, projects and/or activities.	▪ Specific survey and/or modelling requirements may be required to quantify and assess key cumulative effects.

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Abbreviations

µT	Micro Tesla
AA	Appropriate Assessment
ABP	Associated British Ports
ABPmer	ABP Marine Environmental Research Ltd
AC	Alternating Current
ACRE	Alderney Commission for Renewable Energy
ADCP	Acoustic Doppler Current Profiler
AEL	Alderney Electricity Ltd
AIS	Automatic Identification System
AIS-A	Ship-borne mobile equipment intended for vessels meeting the requirements of IMO AIS carriage requirement.
AIS-B	Ship-borne mobile equipment intended for non-IMO AIS vessels (for example, small commercial vessels below 300 GT, fishing vessels, recreational vessels)
AON	Apparently Occupied Nests
ARE	Alderney Renewable Energy
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
BAP	Biodiversity Action Plan
BPEO	Best Practicable Environmental Option
BTO	British Trust for Ornithology
CARTHAM	CARtographie des HAbitats Marins
CD	Chart Datum
CEH	Centre for Ecology and Hydrology
CIEG	Channel Island Electricity Grid
C-POD	Cetacean Pod
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea, 1972
CRM	Collision Risk Modelling
dB_{ht}	Decibel Hearing Threshold
DC	Direct Current
DCNS	Direction des Constructions Navales Services
DECC	Department of Energy and Climate Change
DTI	Department of Trade and Industry
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ES	Environmental Statement
ESAS	European Seabirds at Sea
EU	European Union
FAB	France, Alderney, Britain
FAD	Fish-aggregating Devices
GDF	Gaz de France
GPS	Global Positioning Service
GREC	Guernsey Renewable Energy Commission

GW	Gigawatt
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
HRA	Habitats Regulations Assessment
HVDC	High Voltage Direct Current
ICES	International Council for the Exploration of the Sea
ICPC	International Cable Protection Committee
IFAW	International Fund for Animal Welfare
IMO	International Maritime Organization
ITZ	Inshore Traffic Zone
JNCC	Joint Nature Conservation Committee
LB	Listed Buildings
LWEC	Living With Environmental Change
MCCIP	Marine Climate Change Impact Partnership
MCRI	Marine Conservation Research International
MPA	Marine Protected Area
MW	Megawatt
NAO	North Atlantic Oscillation
NE	Natural England
NRMM	Non-Road Mobile Machinery
ODPM	Office of the Deputy Prime Minister
PACOMM	Programme d'acquisition de connaissances sur les oiseaux et les mammifères marins en France métropolitaine
PAH	Polyaromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
POP	Persistent Organic Pollutants
PTS	Permanent Threshold Shift
REA	Regional Environmental Assessment
RSPB	Royal Society for the Protection of Birds
RTE	Reseau de Transport d'Electricite
SAC	Special Area of Conservation
SAST	Seabirds at Sea Team
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCOS	Special Committee on Seals
SEA	Strategic Environmental Assessment
SM	Scheduled Monuments
SMR	Sites and Monuments Records
SMRU	Sea Mammal Research Unit
SPA	Special Protection Areas
SRDL	Satellite Relay Data Loggers
SSC	Suspended Sediment Concentrations
TMS	Traffic Management System
TSS	Traffic Separation Scheme
TTS	Temporary Threshold Shift

UK	United Kingdom
UKCIP	United Kingdom Climate Change Impact Programme
UNCLOS	United Nations Law of the Sea
VTS	Vessel Traffic Services
WDCS	Whale and Dolphin Conservation Society
WHO	World Health Organisation

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1. Introduction

The Alderney Commission for Renewable Energy (the Commission) has commissioned ABP Marine Environmental Research Ltd (ABPmer) to undertake a strategic assessment of the potential environmental impact of possible future renewable energy development (the 'Draft Plan') within Alderney and its territorial waters. Currently, the commercial focus is on the exploitation of the island's tidal resource, although some limited onshore wind development is also possible.

Alderney is the third largest and most northerly of the Channel Islands. The island is an independent British Crown Protectorate and a constituent part of the Bailiwick of Guernsey which is governed by its own assembly, the States of Alderney. The island is some three and a half miles long and one and a half miles wide with a resident population of around 2,400.

Although Alderney is not subject to European environmental directives, the Commission is committed to adopting best practice. Thus, while there is no requirement to undertake a formal Strategic Environmental Assessment (SEA) or plan level Habitats Regulations Appraisal (HRA), the Commission recognises the benefit that such plan level assessments can provide in seeking to minimise the environmental effects of plans and programmes. Within the UK, comparable non-statutory assessments have been termed 'Regional Environmental Assessments' (REAs) and a similar REA has previously been undertaken for marine renewable development in Guernsey waters. The REA for Alderney's possible future renewable energy development will effectively follow a similar process to an SEA and HRA, but will be taken forward on a voluntary basis.

The REA has been undertaken in two phases: a scoping phase, followed by an assessment phase. The Scoping Report, which was published on the Commission's website on 19 April 2013, outlined the context of the REA, including providing details of the available baseline information and identifying potential pathways between pressures brought about by activities associated with the Draft Plan and environmental receptors. Issues considered relevant have been scoped into the REA. The issues that were raised by consultees in their response to the Scoping Report and the relevant sections in this REA report where these issues have been addressed are presented in Appendix A.

This REA report is designed to inform renewable energy developers of the environmental considerations and risks associated with future development plans on the island or within its territorial waters. It should be used to support individual licence applications and environmental impact assessments (EIAs) that will need to be undertaken at the project level by individual developers. EIAs are likely to be required for each development as well as any interphase installations such as a Pre-phase 1 trial device.

This report has been structured as follows:

Section 1:	**Introduction:** An introduction to the Draft Plan including its need and consideration of alternatives;
Section 2:	**Scoping and Assessment:** A brief summary of the key issues identified in the Scoping Report and the REA methodology;

Section 3:	**Legislative Framework and Requirements:** A description of the legislative framework and requirements for REA;
Sections 4-7:	**Environmental Receptors:** for each of the key receptors comprising the physical, biological, historic and human environment a detailed baseline characterisation has been undertaken which has then used to inform the assessment, together with identification of limitations, data gaps and potential mitigation;
Section 8:	**Cumulative Effects:** An assessment of the cumulative impacts with other plans, projects and activities in the wider area;
Section 9:	**Summary of Impacts, Mitigation and Monitoring:** A summary of the significant moderate and major adverse impacts, requiring mitigation and/or monitoring measures to avoid or reduce potential impacts to acceptable levels; and
Section 10:	**Consultation:** A list of statutory and other key stakeholders and consultees that have been consulted.

1.1 Background

The Commission was established by The Renewable Energy (Alderney) Law, 2007, which was amended by The Renewable Energy (Alderney) (Amendment) Law, 2011, and its related Ordinances. It has a statutory responsibility for the licensing and regulation of the operation, deployment, use or management of all forms of renewable energy on the island of Alderney and its territorial waters. Ultimately, the Commission is responsible for ensuring that any renewable energy development does not:

- Represent a danger to human life;
- Result in detrimental environmental effects; and
- Impact upon other marine users, such as fishing, shipping and other lawful activities.

In 2008, Alderney Renewable Energy Ltd (ARE) secured an exclusive 65 year licence from The States of Alderney and the Commission to generate electricity from tidal flows around Alderney. The licence provides ARE with access to 48 square miles of Alderney's territorial waters, and permits ARE to install tidal turbines and infrastructure for renewable energy systems. The Commission has also been approached by other potential developers with an interest in exploiting the remaining tidal resource of Alderney's waters.

In 2011, ARE selected 48 of the 96 available square mile blocks that it intends to develop. The 48 blocks have been sub-divided into individual projects that fall within the 3 main tidal streams around Alderney: the Race, the Casquets and the Ortac Channel (Figure 1). Studies that have been commissioned by ARE have determined that the extractable energy contained within Alderney's territorial waters exceeds 4 GW. The tidal resource in this area alone is estimated to be capable of generating sufficient power for 1 million homes. Other studies indicate lower tidal resource estimates, e.g. the average constant extractable energy supply at the Alderney Race alone is predicted to be between around 70 and 850MW depending on the method used (Wilson, 2005; Black & Veatch, 2005; Caldwell, 2011).

ARE has partnered with Transmission Investment LLP to develop its existing connection agreements into an interconnector between France, Alderney and Britain (FAB Link project). This REA will only consider potential export cables to Alderney and France, including any associated infrastructure on Alderney (e.g. onshore substation) (Figure 1).

In addition to the proposed exploitation of Alderney's marine energy resource there is the potential for onshore wind to be exploited at some stage on the island, and hence this will need to be considered as part of the REA.

The Commission's Regulatory Framework is reviewed regularly to ensure it encompasses best practice in both the UK and EU within the evolving sector of renewable energy. The Commission has published guidance to the consents process for obtaining a licence in relation to land and marine based renewable energy systems under The Renewable Energy (Alderney) Law, 2007 (ACRE, 2011a, b). The REA is being carried out to strategically assess the potential effects that the development of renewable energy and associated infrastructure in Alderney and its waters described above (the Draft Plan) will have on the environment. It will build upon previous studies and form the basis for any renewable energy planning policy in Alderney. It will also, in turn, inform and provide guidance to individual developers undertaking project specific EIAs. In this way, it will act as an enabling tool to manage environmental risk from the development of renewable energy projects in Alderney and its territorial waters.

1.2 Draft Plan Description and Need

This section provides an overview of the key elements comprising the Draft Plan. Reference should be made to Figure 2 which depicts the main and wider study considered within the REA as well as Figure 3 which includes a map of Alderney with key place names that have been mentioned throughout this report.

1.2.1 Draft Plan Overview

At an international level, there are strong drivers to increase renewable energy generation to address issues of climate change and energy security. Alderney's marine waters possess a significant tidal energy resource. There is also potential to harness onshore wind energy. Sustainable exploitation of these resources will provide the island with alternative and secure sources of energy, reducing reliance on the existing diesel fired power station and also make a substantial contribution to economic development on the island.

The scope of possible future renewable energy development (the 'Draft Plan') within Alderney and its territorial waters includes the following key elements:

- The possible exploitation of Alderney's tidal energy resource by any developer, including under the existing licence to ARE (Section 1.2.2);
- Potential export cables to Alderney and France and any associated infrastructure on Alderney (Section 1.2.3); and
- A possible exploitation of onshore wind on Alderney (Section 1.2.4).

1.2.2 Marine Renewable Energy

The Draft Plan includes the consideration of future tidal development by any developer across all of Alderney's territorial waters. Studies that have been commissioned by ARE have determined that the extractable energy contained within Alderney's territorial waters exceeds 4 GW. Other studies indicate lower tidal resource estimates (e.g. Wilson, 2005; Black & Veatch, 2005; Caldwell, 2011). ARE currently has an exclusive licence for tidal energy generation with access to 48 of the 96 available square miles of Alderney's territorial waters (Figure 1). These 48 blocks are considered to have the greatest tidal energy resource and have therefore been the focus of survey studies to date. The Commission, however, has also been approached by potential developers with an interest in exploiting the remaining tidal resource of Alderney's waters.

The 48 blocks that are currently licensed to ARE can be sub-divided into the following individual projects that fall within the three main tidal streams around Alderney:

- Project 1: The Race;
- Project 2: The Casquets; and
- Project 3: The Ortac Channel.

ARE is proposing to take forward the development, consenting and deployment of devices within the Race in 5 phases. It is envisaged that an EIA will be undertaken for each of the 5 phases and will be reported within separate Environmental Statements (ES). The Casquets and Ortac Channel Projects will be submitted as 2 individual consenting applications and are not currently divided into individual phases. Based on ARE's high level tidal development programme plan, and subject to obtaining the necessary consents, it is anticipated that tidal farm construction will take place between 2015 and 2022. Details of the operational and decommissioning phases of the programme have not yet been fully defined.

As outlined in ARE's Business Development Plan (ARE, 2011), it has been assumed that the individual projects will comprise offshore tidal stream turbine deployments of the OpenHydro 16m diameter Open-Centre Turbine. The arrays will consist of Open-Centre Turbines which will be deployed on separate gravity based subsea foundations. The structure's own weight will be used to penetrate the sub-sea floor with rock spikes i.e. no drilling, piling or pining would be required. The dimensions of the entire structure (turbine and base) are 30m (l) x 26m (w) x 18m (h).

It is planned that the turbines will be installed using OpenHydro's especially designed Deployment Vehicle. This deployment process is claimed to take less than an hour (excluding cable connections) and comprises the following steps:

- The Deployment Vehicle is towed to site using a standard tug;
- Whilst being held in position by the tug, the turbine and Subsea Base are lowered by the Deployment Vehicle;
- Once on the seabed, the lifting lines are released and the Deployment Vehicle is towed back to harbour; and

- The Subsea Base will be located on the seabed with no part of the structure visible from the surface.

The engineering design and specification for the inter-turbine (i.e. intra-array) and inter-array sub-sea cables and connections have yet to be determined by ARE. Individual turbines will have interconnection to adjacent turbines to form an array. The individual arrays will have interconnection with adjacent arrays. The size and number of interconnected arrays, however, has yet to be defined. There are also currently no details available on the cables and connections to shore. It is considered likely, however, that these will all be alternating current (AC) cables.

In the case of the ARE development, a 40 x 200m grid is proposed by OpenHydro to avoid interactions between adjacent turbines. It is understood the turbines will be staggered front to back, resulting in an effective front to back spacing of 400m between units. Each licence block is one square nautical mile (3.4 km^2), resulting in an array layout of 23 by 9 units or a maximum of 207 devices per licence block, if the whole block is utilised.

The proposed programme, scheme design and construction methodology of any other potential developer wishing to exploit the remaining tidal resource of Alderney's waters is currently unknown. The REA has therefore made a number of assumptions which are specified in the assessment sections of this report. Given the high a level of uncertainty associated with this element of the Draft Plan, worst case assumptions (i.e. where the magnitude of impacts is greatest) have been considered.

It is possible that any tidal development in Alderney waters by ARE or another developer would require one or more offshore substations. With regards to the proposed ARE developments, there is likely to be a need for at least one substation at each of the three project sites (i.e. a minimum of three substations in total). The offshore substations would collect the power from the tidal turbine arrays before feeding it to shore via main export cables. Although no specific details relating to the requirements for offshore substations have been provided in ARE's business plan, it can be assumed that the substations would contain the following components: transformers to boost the power to a higher voltage before it is brought ashore (helping to reduce the amount of electricity lost during transmission), switch gear and emergency equipment (enabling safe operation), and back-up electrical generator and batteries. These components would be supported on a steel platform, the size of which would be determined by the final facilities required e.g. the estimated dimensions of the Robin Rigg 180MW offshore substations provided in the ES were between around 20m x 20m and 30m x 30m (see Image 1A). Boat access points would be required and some substations also provide a helicopter landing platform. Based on offshore windfarm substations, the foundation types for the offshore substation structures may be a monopile (Image 1A) or have multiple 'legs' supported on tubular piles (Image 1B). Construction techniques, similar to those used for offshore oil installations are likely to be employed.

a) 
b) 

(Source: 4C Offshore website http://www.4coffshore.com/windfarms/)

Image 1. Examples of 180MW and 300MW offshore substations respectively from a) Robin Rigg Offshore Windfarm and b) Thanet Offshore Windfarm

1.2.3 Interconnector Cable Routes and Onshore Substation

ARE is intending to develop its routes to market through connection agreements with RTE in France. ARE has partnered with Transmission Investment LLP to develop its existing connection agreements into a single interconnector. This interconnector will be a single multi-directional cable to allow electricity trading and export between France and Britain via Alderney (FAB Link project). This interconnector will also enable tidal energy from ARE's programme to be exported to both France and Britain. The proposed cables between France, Alderney and Britain will transmit up to 3,600MW of energy and no less than 2000 MW.

Given the uncertainties relating to the cable connection to Britain, this REA has only considered the potential export cable to France, including any associated infrastructure on Alderney (Figure 1). Considering the distance to France, the export cable from Alderney to France could be either AC or high voltage direct current (HVDC) cable, noting that the latter would require an HVDC converter station to be located on Alderney.

Onshore cables will be routed from landing site locations to an onshore substation, which will contain all the electrical, transforming and connection equipment. This substation may comprise an AC substation or HVDC converter station depending on the technology used to export power to France. ARE has investigated terrestrial sites on Alderney and has identified Mannez Quarry as a potential location for the onshore substation/converter station. Both AC but particularly DC converter stations are very large and would be likely to need to be delivered by barge, accessing a temporary jetty local to the substation/converter station location. The renewable energy generated from the tidal turbines would then be distributed within the island and/or exported via the substation/converter station to France.

Based on ARE's high level tidal programme plan, and subject to achieving the necessary consents, it is anticipated that the export cable construction phase will take place between 2015 and 2020.

The REA has assumed that any other potential developer wishing to exploit the remaining tidal resource in Alderney waters will link up to this interconnector cable route, subject to sufficient available capacity.

1.2.4 Terrestrial Renewable Energy

In addition to the proposed exploitation of Alderney's marine energy resource there is the potential for onshore wind to be exploited on the island at some stage, and hence this will be considered as part of the REA. However, there is currently no information on where this might take place on the island and therefore the REA has assumed as a worst case that it could be at any location. It is considered that an associated temporary construction compound is also likely to be required for the onshore windfarm.

1.3 Alternatives

The UK Government's Practical Guide to the SEA Directive outlines the need to develop strategic alternatives, and assess the effects of the Draft Plan and any alternatives (ODPM, 2005). The only alternative to the Draft Plan that has been considered as part of this REA is the 'do nothing' alternative (i.e. maintaining the status quo and the existing baseline environment). The 'do nothing' option has implications for the growing need to reduce reliance on fossil fuels and the potential to extract energy from more renewable and sustainable resources. Due to the need to find alternative renewable sources that will provide energy security in the future the 'do nothing' option is not considered viable and has been discounted at the plan level.

At the EIA project level, the developer will need to consider potential alternatives to meeting the specific project need in more detail, as well as consideration of the implications of not going ahead with the proposal i.e. 'do nothing'.

2. Scoping and Assessment

The REA has been undertaken in two phases: a scoping phase, followed by an assessment phase. The Scoping Report, which was published on the Commission's website on 19 April 2013 (ABPmer, 2013), included the following:

- A brief description of the baseline environment and the available baseline information that can be used to inform the assessment, together with potential data gaps;
- An initial view of the potentially significant environmental effects associated with the Draft Plan and the scope of the REA, including relevant spatial and temporal scales for each receptor. Potentially relevant issues have been scoped into the REA and are summarised in Section 2.1 of this REA;
- The approach to be adopted to the assessment, including the approach to cumulative effects assessment. This has been further expanded on in Section 2.2 of this REA; and
- The approach to consultation.

The Scoping Report was submitted to consultees including both statutory and other key stakeholders in accordance with The Renewable Energy (Alderney) Ordinance, 2008 (Section 7.1.a.i - 7.1.b), which was amended by The Renewable Energy (Alderney) (Amendment) Ordinance, 2013. The issues that were raised by consultees and the relevant sections in this REA report where these issues have been addressed are presented in Appendix A.

2.1 Key Issues to be Considered

Table 1 summarises the key assessment issues that were identified during the scoping phase. A precautionary approach was taken and none of the potential impact pathways were scoped out as part of the process. Further details on the relevance of the pathways at different phases of each of the key elements of the Draft Plan (i.e. tidal stream turbines, cable routing, onshore substation, offshore substation and onshore wind turbine) are provided in the Scoping Report.

Table 1. Key receptors and impact pathways that have been scoped in to REA

Topic	Pathways to be Assessed
Physical Environment	
Marine geomorphology (Section 4.1)	▪ Alteration of Seabed Form and Features.
Physical Processes (Section 4.2)	▪ Alteration to Tidal Regime and Sediment Transport; and ▪ Alteration to Wave Characteristics.
Water Quality (Section 4.3)	▪ Toxic Contamination (Spillage); ▪ Non-Toxic Contamination; and ▪ Toxic Contamination (Sediment Release).
Biological Environment	
Benthic Ecology (Section 5.1)	▪ Toxic Contamination (Spillage); ▪ Direct Loss and/or Damage to Benthic Habitats; ▪ Non-Toxic Contamination; ▪ Toxic Contamination (Sediment Release); ▪ Potential for Non-Native Species Introductions; and ▪ Introduction of New Structures.
Pelagic Ecology (Section 5.2)	▪ Toxic Contamination (Spillage); ▪ Non-Toxic Contamination; and ▪ Toxic Contamination (Sediment Release).
Fish and Shellfish (Section 5.3)	▪ Collision/ Entrapment Risk; ▪ Visual Disturbance; ▪ Noise/ Vibration Disturbance; ▪ Toxic Contamination (Spillage); ▪ Changes To/ Loss of Habitat; ▪ Non-Toxic Contamination; ▪ Toxic Contamination; ▪ Barrier to Movement; ▪ Introduction of New Structures; and ▪ Electromagnetic Field (EMF).
Ornithology (Section 5.4)	▪ Collision Risk; ▪ Visual Disturbance; ▪ Noise/ Vibration Disturbance; ▪ Toxic Contamination (Spillage); ▪ Changes To Foraging Habitat; ▪ Non-Toxic Contamination;

Topic	Pathways to be Assessed
	▪ Toxic Contamination (Sediment Release); and ▪ Barrier to Movement;
Marine Mammals (Section 5.5)	▪ Collision Risk; ▪ Visual Disturbance; ▪ Noise/ Vibration Disturbance; ▪ Toxic Contamination (Spillage); ▪ Changes To Foraging Habitat; ▪ Non-Toxic Contamination; ▪ Toxic Contamination (Sediment Release); ▪ Barrier to Movement; and ▪ Electromagnetic Field (EMF).
Nature Conservation (Section 5.6)	▪ Collision Risk; ▪ Visual Disturbance; ▪ Noise/ Vibration Disturbance; ▪ Toxic Contamination (Spillage); ▪ Loss/Damage and/or Disturbance; ▪ Loss or Changes To Foraging Grounds; ▪ Non-Toxic Contamination; ▪ Toxic Contamination (Sediment Release); ▪ Potential for Non-Native Species Introductions; ▪ Barrier to Movement; ▪ Introduction of New Structures; ▪ Seal Haul-Out Damage; and ▪ Electromagnetic Field (EMF).
Terrestrial Ecology (Section 5.7)	▪ Loss/Damage and/or Disturbance; ▪ Visual Disturbance; ▪ Noise/ Vibration Disturbance ; and ▪ Toxic Contamination (Spillage).
Historic Environment	
Marine Archaeology (Section 6.1)	▪ Direct Damage; ▪ Indirect Damage; and ▪ Exclusion Areas.
Terrestrial Archaeology (Section 6.2)	▪ Direct Damage; ▪ Indirect Damage; and ▪ Exclusion Areas.
Human Environment	
Cables, pipelines and Grid Connectivity (Section 7.1)	▪ Impact to Existing Grid
Commercial and Recreational Fisheries (Section 7.2)	▪ Temporary and Long Term Displacement; ▪ Collision Risk ▪ Damage to Fishing Gear; and ▪ Increased Congestion.
Commercial and Recreational Shipping and Navigation (Section 7.3)	▪ Collision Risk; ▪ Changes to Shipping Movement; ▪ Effects on Small Craft Navigation; ▪ Potential for Mooring Lines to Become a Navigational Hazard; ▪ Potential for Any Marker Buoys to Become a Navigational Hazard; ▪ Increased/ Altered Steaming Times and Distances; ▪ Reduced Visibility when Barges and Construction Equipment Obstruct Views; ▪ Increased Boat Traffic; ▪ Potential for Equipment Parts to Become Detached from Devices; ▪ Lighting on the Structure Causing Confusion to Passing Vessels; ▪ Changes to Risk Management and Emergency Responses; and ▪ Cable Route Risk in Respect of Vessel Anchoring, Burial Depth and Cable Protection.

Topic	Pathways to be Assessed
Infrastructure (Section 7.4)	▪ Cable Crossing Requirements with Existing Marine and/or Terrestrial Infrastructure; ▪ Direct Damage to Existing Terrestrial Infrastructure; and ▪ Reduced Access to Existing Infrastructure for Maintenance or Repair Activity Collision Risk.
Recreation and Tourism (Section 7.5)	▪ Sea/Land Use Conflicts of Interest and Access Issues; ▪ Public Safety; ▪ Damage of and/or Alteration to Existing Infrastructure; ▪ Decrease in the Recreational Quality of the Environment; ▪ Underwater Noise Affecting Recreational Diving or Swimming; and ▪ Changes to the Local Economy.
Noise (Section 7.6)	▪ Noise Associated with Increased Shipping Traffic; ▪ Noise Associated with Construction Activities; ▪ Noise Associated with Maintenance Activities; ▪ Noise During Operation; and ▪ Noise Associated with Decommissioning Activities.
Air Quality (Section 7.7)	▪ Emissions from Marine Vessels; ▪ Emissions from Road Traffic and Non-Road Mobile Machinery (NRMM); and ▪ Generation of Airborne Dust.
Landscape and Seascape (Section 7.8)	▪ Increased Traffic ▪ Lighting; ▪ Requirements for Temporary Housing and Work Facilities; ▪ Introduction of Permanent Feature; ▪ Introduction of Regular Geometric, Man-Made Forms; ▪ Change in Perception of Area; ▪ Alterations to Existing Land Forms; ▪ Construction of Access Roads and Pier; and ▪ Changes in Land Cover and Land Use Patterns.
Traffic and Transport (Section 7.9)	▪ Increased Traffic; ▪ Increase in Size of Vehicle; ▪ Increase in Size and Weight of Vehicle Loads; ▪ Damage to Roads ; ▪ Traffic Congestion; ▪ Potential Road Hazards; and ▪ Creation of Dirt and Dust by Vehicles.

2.2 REA Method

This REA has divided each of the topics in Table 1 into distinct 'receiving environments' or 'receptors'. The effect of the Draft Plan on each of these has been assessed by describing in turn: the baseline environmental conditions of each receiving environment; the 'impact pathways' by which the receptors could be affected; the potential significance of the impacts occurring and the measures to mitigate for significant adverse impacts where these are predicted. The assessment framework has been broken down into two main stages which are described in the following sections.

2.2.1 Stage 1: Baseline

The first stage involves a detailed baseline (pre-plan) characterisation for each relevant environmental receptor based on a desk-based assessment using all available existing information. The study area for each receptor has been defined having regard to the potential scale of relevant environmental changes introduced by the Draft Plan and the particular characteristics of the receptor (e.g. mobile receptors have been considered over the full extent of their spatiotemporal range in order to identify possible impacts to designated sites and to assess cumulative effects). Significant limitations and gaps in the data have also been identified and recommendations have been made concerning how these data gaps might be filled at the EIA project-level phase by individual developers.

The SEA Regulations require that information is provided on the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the Draft Plan. Therefore the future baseline for each of the receptors has been described. This considers that the marine and terrestrial environment exhibits natural variability with or without anthropogenic developments and any effects of these have been taken into account in the context of natural change.

2.2.2 Stage 2: Assessment

The second stage of the REA process involves an assessment of the potentially significant environmental effects of the Draft Plan on each relevant receptor using desk-based analyses which draw on the baseline data and current scientific understanding of the impacts. This has considered the pre-construction (survey), construction, operational and decommissioning phases of each of the key elements of the Draft Plan i.e. tidal stream turbines, cable routeing (including intra and inter array cables, cables from arrays to substation and to shore, and also the interconnector export cable between Alderney and France), offshore substations, onshore substation and onshore wind turbine. Site-specific issues, which individual EIAs may need to focus on, have also been identified.

The impact assessment has also taken account of the totality of pressures associated with the potential full build out of the Draft Plan. Extractable energy in Alderney has been estimated and modelled by Black & Veatch and Parsons Brinkerhoff on behalf of ARE at greater than 4 GW. The Race alone is estimated to have a potential tidal resource of 1GW, although other studies indicate lower tidal resource estimates (e.g. Wilson, 2005; Black & Veatch, 2005; Caldwell, 2011). Should the maximum estimated available tidal resource be fully exploited, it would result in approximately 4000 tidal turbines being installed in Alderney's territorial waters, assuming that 1MW turbines are used. If, however, 2MW turbines are used as is currently being proposed by ARE then the total number of devices would halve. This REA has assumed as a worst case that the full build out of the Draft Plan would result in 4000 tidal turbines being installed in Alderney's territorial waters. These are likely to be concentrated in the areas that have the highest flows i.e. the blocks that have already been selected by ARE and that fall within the 3 main tidal streams around Alderney: the Race, the Casquets and the Ortac Channel (Figure 1). However, other developers have approached the Commission with an interest in exploiting the remaining tidal resource of Alderney's waters.

It has also been assumed that the first tidal sites to be developed will be those that are least constrained in terms of cost, physical constraints, environmental effects and grid connection. Consequently this could lead to the clustering of tidal devices in certain locations where these conditions are most favourable. The clustering of arrays could potentially have moderate to major significant impacts on the marine environment, even if the impacts of a single array in the same location are negligible or minor (Scottish Executive, 2007). Should concurrent installations occur where there is a clustering of device arrays, the cumulative impacts could be of greater significance than if they are installed on separate occasions. The same applies if the installation of tidal device arrays is continuous over a longer period of time. The key potential cumulative effects of the Draft Plan alone have been taken into account as part of the assessment and reported within each of the relevant topic chapters.

In terms of intra and inter-array cabling requirements, based on the indicative turbine spacing proposed by ARE (see Section 1.2.2) and assuming that the entire licence block can be utilised (i.e. includes a maximum of 207 turbines), the minimum length of cabling required per square nautical mile licence block is estimated to be approximately 19km. This is also based on the assumption that multiple circuits can be used to allow power from more than one turbine to be exported in a single cable. Multiplying this distance up results in approximately 367km of cable length being required for the full build out of the Draft Plan. Given the existing nature of the seabed, cables are likely to be placed directly on the seabed and covered with protection (i.e. rock dumping or mattressing). The width of a typical concrete mattress is approximately 5m which would result in a seabed footprint of 1.8km^2, assuming mattressing is required along the entire length of the cables for the full build out of the Draft Plan.

The export interconnector cable route between Alderney and France is likely to comprise a number of AC cables (which may be laid in bundles), or a lesser number of HVDC cables. The number of cables will depend on the choice of AC versus HVDC and the rating of the cable. The existing cable route shown on Figure 1 is approximately 30km. Assuming that concrete mattressing is required along the entire length of the route, this would comprise a seabed footprint of approximately 0.15km^2 per cable.

With respect to substations, as outlined in Section 1.2, a combination of onshore AC substation or DC converter station and/or offshore AC substations will be required as part of the tidal energy developments. Assuming that the full build out of the Draft Plan occurs, this could result in a minimum of four onshore substations/converter stations of a maximum capacity of 1GW and/or six offshore substations with a maximum capacity of 630GW[1] being required. Both AC substations but particularly DC converter stations are very large. The area required for a typical onshore DC converter station is approximately 300 x 300m, with a maximum external infrastructure height of approximately 30m (The Crown Estate, 2013). Lower-voltage plants may require somewhat less ground area, since less air space clearance would be required around outdoor high-voltage equipment.

As stated in Section 1.2.4, there is the potential for onshore wind to be exploited on the island at some stage, and hence this has been included in the Draft Plan. There is currently no information on where this might take place on the island and therefore the REA has assumed as a worst case that it could be at any location. It is considered that only one onshore wind turbine and an associated temporary construction compound is likely to be required.

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[1] The highest capacity offshore substations that are known to occur in the UK are the 630GW substations for the London Array Phase 1 (4C Offshore website).

It has not been possible to fully quantify the effects due to the levels of uncertainty associated with the Draft Plan (e.g. where and when the clustering of devices will occur, how many arrays this would comprise, the size of the footprint of these arrays, the intra- and inter-array cabling configuration, and the location of the onshore wind turbine). It is also important to note that the gaps in understanding of how clustered arrays will affect a given feature of the marine environment further limit the ability to quantify these results. Consequently, the assessment of effects of tidal devices has been undertaken at a high strategic level.

This phase of the assessment has drawn on existing guidance as appropriate, including the Marine Scotland Licensing and Consents Manual, covering Marine Renewables and Offshore Wind Energy Development (ABPmer, 2012), Marine Scotland's Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland (Emec and Xodus AURORA, 2010), Countryside Council for Wales' (CCW) Potential Nature Conservation Impacts of Marine Renewable Energy Projects in Wales (ABPmer, 2005) and Plymouth University Marine Institute's Briefing Paper on Marine Renewable Energy (Attrill, 2012).

The REA methodology has followed the standard source-pathway-receptor approach to impact quantification which can be summarised as:

- Identifying both the environmental changes which can arise from the proposed activities (the magnitude of the source of effect) and the importance of features of interest that could be affected (importance of the receptors);
- Understanding the nature of the environmental changes in terms of the exposure characteristics to the receptors and the sensitivity of the receptors in the context of the natural conditions of the system (giving vulnerability);
- Identifying the significance of impacts based on the importance and vulnerability of the receptors;
- Managing any impacts which are found to be significant through impact reduction/mitigation measures; and
- Documenting the outcomes of the assessment including any potential mitigation measures and residual effects.

These are summarised in Tables 2, 3 and 4, and illustrated in Image 2.

Table 2. Exposure to change, combining magnitude and probability of change

Probability of Occurrence	Magnitude of Change			
	Large	Medium	Small	Negligible
High	High	Medium	Low	Negligible
Medium	Medium	Medium/Low	Low/Negligible	Negligible
Low	Low	Low/Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 3. Estimation of vulnerability based on sensitivity and exposure to change

Sensitivity of Feature	Exposure to Change			
	High	Medium	Low	Negligible
High	High	High	Moderate	None
Moderate	High	Moderate	Low	None
Low	Moderate	Low	Low	None
None	None	None	None	None

Table 4. Estimation of significance based on vulnerability and importance

Importance of Feature	Vulnerability of Feature to Impact			
	High	Moderate	Low	None
High	Major	Moderate	Minor	Insignificant
Moderate	Moderate	Moderate/Minor	Minor/Insignificant	Insignificant
Low	Minor	Minor/Insignificant	Insignificant	Insignificant
None	Insignificant	Insignificant	Insignificant	Insignificant

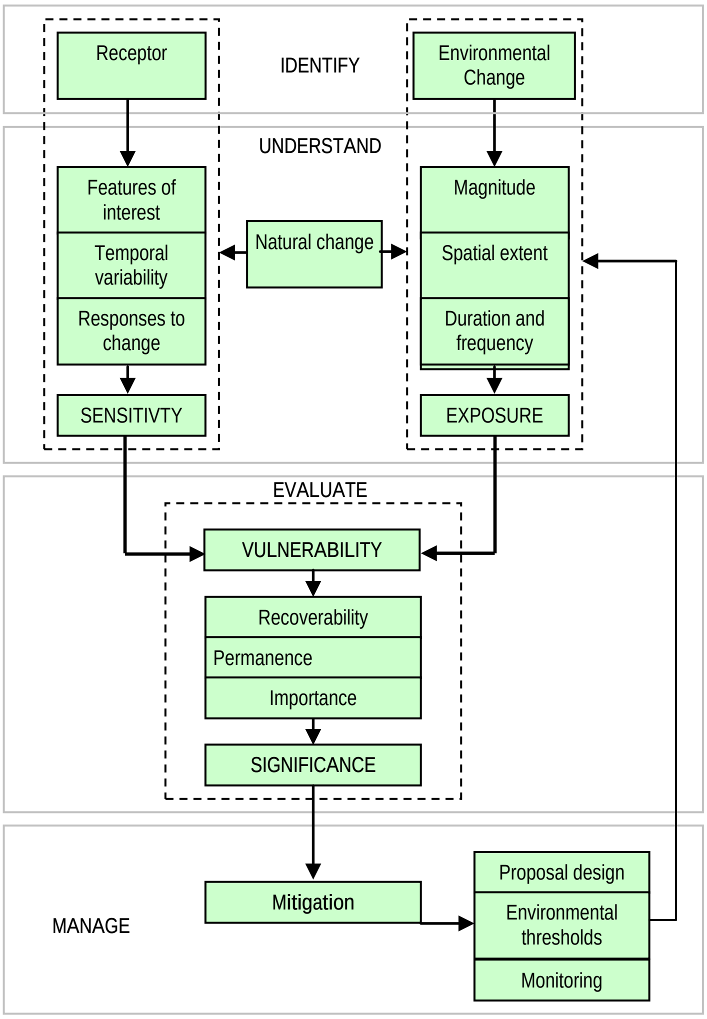

Image 2. Assessment process

Impacts can be either **beneficial** or **adverse** and are described as follows:

- **Insignificant:** Insignificant change unlikely to have a discernible impact;
- **Minor:** Impacts likely to be discernible but tolerable;
- **Moderate:** Where these changes are adverse they may require mitigation; and
- **Major:** Impacts have the potential to be highest in magnitude and reflect the high vulnerability and importance of a receptor (e.g. to nature conservation). Where these changes are adverse they will require mitigation.

The final stage of the assessment process relates to Annex I of the SEA Directive which requires the Environmental Report to include measures to prevent, reduce or offset any significant adverse effects on the environment of implementing the plan or programme. In addition Article 10 of the SEA Directive requires that the significant environmental effects of the implementation of plans and programmes are to be monitored in order, to identify at an early stage unforeseen adverse effects, and to be able to undertake appropriate remedial action.

2.2.2.1 Cumulative effects

Cumulative impacts are referred to in the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) on the assessment of certain plans and programmes on the environment. The Directive requires information to be provided on "*the likely significant impacts including cumulative and synergistic impacts… on the environment*."

Separately the EC Habitats Directive (92/43/EEC) requires that where a plan or project is likely to have a significant effect on a Natura 2000 site, Special Areas of Conservation (SAC) designated under the Habitats Directive or Special Protection Areas (SPA) classified under the EC Birds Directive (2009/147/EC codified version), either individually or in combination with other plans or projects, shall be subject to Appropriate Assessment (AA) (as part of an HRA) of its implications for the site in view of the site's conservation objectives. In accordance with the Directive, in-combination effects need to be considered for relevant Natura 2000 site features (habitats and species).

In addition, the Commission's Guide to the Consents Process for obtaining a Licence in relation to renewable energy systems under the Renewable Energy (Alderney) Law 2007 (ACRE, 2011a; ACRE, 2011b), includes the consideration of cumulative impacts as part of any EIA.

A list of the plans, projects and activities that have been scoped into the cumulative impact assessment was provided in the Scoping Report (ABPmer, 2013) and this has since been expanded to include the following:

- The Britain to Alderney interconnector part of the FABLink project;
- West Normandy Marine Energy is helping to coordinate and support all the marine renewable energy projects within the Basse-Normandie region which includes current and future regional developments. Current proposed tidal developments on the French side of the Race (Raz Blanchard) are detailed below and have been included in the cumulative impact assessment.

- GDF SUEZ has signed an industrial partnership agreement with four companies to develop a pilot tidal project on the French side of the Race (Raz Blanchard). Industrial maintenance specialist Cofely Endel, turbine manufacturer Voith Hydro, French shipbuilder Constructions Mécaniques de Normandie and ACE1 are joining GDF for the 3MW to 12MW development. GDF is aiming to secure the required approvals in order to install the three-to-six-turbine plant by 2016. The partnership has already selected the HyTide turbine designed by the manufacturer Voith Hydro to equip all or part of this future pilot plant;
- French naval defence company DCNS proposes to put 10 tidal turbines into the French side of the Race (Raz Blanchard) by 2016;
- Guernsey's Renewable Energy Commission's (GREC, currently referred to as the Renewable Energy Team) plan for marine renewable energy in Guernsey, Sark and Herm Waters (GREC, 2011);
- The States of Guernsey (SoG) plan to extend the island's territorial waters (TW) from three to 12nm which will potentially increase the possibility of exploiting offshore wind and other marine renewable energy sources;
- Potential designation of Marine Protected Areas (MPAs) in the wider area, including for the Gulf of Normandy and Brittany by the Agence des Aires marines Protegees;
- Ongoing fishing activities;
- Shipping activities; and
- Air travel.

An ecosystem approach has been adopted to the consideration of cumulative impacts in the REA. In other words, the cumulative impact assessment which is presented in Section 8 has identified and evaluated the influence of the totality of current and future human pressures on the marine environment and the extent to which this might cause changes from the current state. The main cumulative impacts associated with the potential full build out of the Draft Plan alone have been considered separately within each of the relevant topic chapters (see Section 2.2.2).

3. Legislative Framework and Requirements

The intention of an SEA is "*to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans*" […] (SEA Directive, Article 1). In the UK it is a legal requirement to produce an SEA for all spatial plans and programmes due to the application of European Directive 2001/42/EC "*the assessment of the effects of certain plans and programmes on the environment*" (the SEA Directive). In addition, there is a requirement under the European Wild Birds Directive 79/409/EEC and Habitats Directive 92/43/EEC to undertake a Habitats Regulations Assessment (HRA) for any plans or projects that are likely to have a significant effect on Natura 2000 site(s), either alone or in-combination with other plans or projects.

In Alderney, there is not the legislative requirement to undertake an SEA or plan-level HRA as it is not subject to UK or EU legislation. However, the Commission is committed to adopting best practice and recognises the benefit that such plan level assessments can provide in seeking to minimise the environmental effects of plans and programmes. Comparable non-statutory assessments in the UK have been referred to as 'Regional Environmental Assessments' (REAs). The REA for Alderney's possible future renewable energy development will effectively follow a similar process as an SEA and plan-level HRA, but will be taken forward on a voluntary basis. The key requirements of the SEA Directive have been met in this REA as indicated in Table 5.

Good practice guidance (ODPM, 2005) identifies two possible approaches to SEA, including a policy/objective led approach (which tests the conformance of a plan or programme with a set of predetermined policy objectives) and a baseline led approach (which seeks to assess the potential environmental effects of a plan or programme against an established baseline, similar to the process adopted for EIA). In some instances, the two approaches have been combined. This REA will adopt a baseline-led approach given that it will be more useful in helping to identify information gaps and uncertainties relating to key environmental effects and, thus, provide a focus for future assessment work undertaken at the project-level by individual developers.

Table 5. Key requirements of the SEA Directive that have been covered in this REA

Environmental Report Requirements	Section Covered
An outline of the contents, main objectives of the plan or programme, and relationship with other relevant plans and programmes.	Section 1.2 (Draft Plan overview) and Section 1.3 (Alternatives).
The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme.	Future baseline sections within each topic.
The environmental characteristics of areas likely to be significantly affected.	Baseline sections within each topic.
Any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC and 92/43/EEC.	Throughout report.
The environmental protection objectives, established at international, Community or national level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation.	Throughout report.
The likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. (Footnote: These effects should include secondary, cumulative, synergistic, short, medium and long-term permanent and temporary, positive and negative effects).	Impact assessment sections within each topic.
The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme.	Mitigation sections within each topic.
An outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was made including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information.	Section 1.3 (Alternatives) and limitations and data gaps sections within each topic.
A description of measures envisaged concerning monitoring in accordance with Article 10.	Mitigation sections within each topic.

Environmental Report Requirements	Section Covered
A non-technical summary of the information provided under the above headings.	Summary section at the front of the report.
The report shall include the information that may reasonably be required taking into account current knowledge and methods of assessment, the contents and level of details in the plan or programme, its stage in the decision-making process and the extent to which certain matters are more appropriately assessed at different levels in that process to avoid duplication of the assessment.	Throughout report.
Consultation: Authorities with environmental responsibility, when deciding on the scope and level of detail of the information to be included in the environmental report.	Appendix A.
Authorities with environmental responsibility and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the plan or programme and the accompanying environmental report before the adoption of the plan or programme.	Section 10 (Consultation).
Other EU Member States, where the implementation of the plan or programme is likely to have significant effects on the environment of that country	Section 10 (Consultation).
Taking the environmental report and the results of the consultations into account in decision-making.	Appendix A.
Provision of information on the decision: ▪ When the plan or programme is adopted, the public and any countries consulted shall be informed and the following made available to those so informed: - The plan or programme as adopted; - A statement summarising how environmental considerations have been integrated into the plan or programme and how the environmental report pursuant to Article 6 and the results of consultations entered into pursuant to Article 7 have been taken into account in accordance with Article 8, and the reasons for choosing the plan or programme as adopted, in the light of other reasonable alternatives dealt with; and - The measures decided concerning monitoring	Appendix A.
Monitoring of the significant environmental effects of the plan's or programme's implementation.	Mitigation sections within each topic.
Quality assurance: environmental reports should be of a sufficient standard to meet the requirements of the SEA Directive.	Throughout report.

4. Physical Environment

This section provides an assessment of the potential effects of the Draft Plan on the physical environment, specifically marine geomorphology, physical processes and water quality. A baseline description of each of these key features of the physical environment is presented and data gaps and limitations that will need to be considered further at the EIA project-level by the developer are identified. An assessment of the potential effects that could arise from the various phases of the Draft Plan (i.e. pre-construction, construction, operation and decommissioning) is included together with any mitigation measures that are required to reduce significant impacts to acceptable levels.

4.1 Marine Geomorphology

This section considers the coastal and seabed form and features within Alderney and its territorial waters, as well as the interconnector cable route. In particular, physical processes are influenced by the geology and shape the local geomorphology and therefore this section is inherently linked to Physical Processes (Section 4.2).

4.1.1 Baseline Description

The physical form within Alderney and its territorial waters is ultimately under the control of the aggressive hydrodynamic conditions experienced, as presented in Section 4.2, combined with the coastal orientation, marine geology, topography and sediment availability. Whilst there are similar types of morphological features present across the waters of Alderney, subtle differences have been identified in the characteristics, specifically between the licence blocks associated with the three project areas currently proposed by ARE and comprising the Draft Plan, where more detailed information is available.

4.1.1.1 Coastal characteristics

Alderney's coastline is mainly devoid of fine sediments, with high cliffs and rocky outcrops characterising the shoreline (Figure 4). However, finer sediments (for example muddy sands) are reported in those locations with protection from the hydrodynamics, for example shoreward of the Braye Bay breakwater (Wood, 2007). Sandy bays are located around the island where shelter from the prevailing waves and tidal races is afforded, most frequently between two hard rock headlands protruding offshore. The bays are backed by vegetated dune systems, high cliffs or shingle / pebble banks. Braye Bay is the largest of these bays formed between two headlands and further protected by an offshore breakwater. Sea defences and/or military defences are located at the back of some of the bays, an example being a hard seawall at Longis Beach. In places, the cliffs are subject to erosion with an example being those backing Telegraph Bay at the south-west tip of Alderney.

4.1.1.2 Alderney's territorial waters

Bathymetry

Water depths quickly increase seaward, with depths up to 40 m (Chart Datum (CD)) found approximately less than 1 km from the coast of Alderney in some locations (Figure 5). Under the control of strong tidal flows and high bed shear stresses, the seabed surrounding Alderney is characterised by exposed bedrock interspersed with sand and gravel populations.

Seabed Characteristics and Morphological Features

Small to large-scale bedforms are located around Alderney, the location of which is dependent upon a combination of favourable hydrodynamic conditions and available sediment. It is within the licence blocks associated with the Project 1 area (The Race) that the greatest level of detailed information is available. Geophysical surveys undertaken within Project 1 (specifically blocks T61 and T75) (Figure 5) along the southeastern flank of Alderney indicate the presence of fissures and weathered joints (Osiris Projects, 2009a). The seabed within Project 1 is characterised by exposed bedrock and rock pinnacles interspersed with sand and gravel populations of differing sizes. For the remaining seabed within Alderney's territorial waters, information is available from Admiralty Charts, which, combined with an understanding of the hydrodynamic and sedimentological regimes, allows a more generic assumption of the seabed form to be determined, as presented below.

Small and medium-scale morphodynamic features

Within Project 1 (specifically block T74), along the southeastern flank of Alderney, sand and gravel waves up to 4.5 m high with wavelengths of 160 m to 190 m have been observed. In addition smaller megaripples up to 1 m high with wavelengths between 3 m and 7 m have also been observed (Figure 5) (Osiris Projects, 2009b). These features have also been recorded both within and adjacent to the proposed interconnector route between Alderney and France (Osiris Projects, 2009c). It is also expected, given the similar hydrodynamic conditions and seabed sediments, that these features are present elsewhere within the area of the Draft Plan.

Large-scale morphodynamic features

There are a number of sandbank features within the territorial waters of Alderney. The most understood feature is South Banks, which is located within Project 1. This headland associated sandbank is located to the south of Alderney and extends for up to 4 km in length. Such banks are classified as 'banner banks' and are typically separated from the headland by a channel swept clear by tidal flows (Kenyon and Cooper, 2004). The location of such features is maintained by the tidal flows. In the instance of South Banks, it is the recirculation of tidal flows in the lee of Alderney, during the tide's ebb phase, that maintains this feature (Neill *et al*., 2012). Migrating sand waves with rates of 1.4 m per day (Haynes *et al*., 2013) are present on the flanks of South Banks, in addition to superimposed megaripples. The head and tail of South Banks is characterised by trains of sand waves (Figure 6). In contrast to the exposed bedrock on the surrounding seabed, South Banks represents a substantial reserve of sand and gravel material, which is interspersed with shell fragments (Figure 7).

A comprehensive suite of surveys undertaken by Seastar Survey Ltd have enabled the characteristics of and any changes in the size and shape of the South Banks and the long term pattern of movement to be further understood (Axelsson *et al*., 2011). It has been shown that, in response to the tidal flows, sand is continually circulated in a clockwise direction around South Banks with a bedload transport convergence zone present along the bank crest (Haynes *et al*., 2013). However, it is currently not possible to ascertain the sediment source for South Banks, with potential sources being the intertidal, an active scour area at the north of the island or further offshore towards the north-east (Haynes *et al*., 2013).

An example of a similar feature is the Casquets Banks (SSW and SSE) located within the licence blocks associated with the Project 2 area. It is reported that the SSE bank is composed of coarse sands and gravels, interspersed with shells. Historic documentation indicates that it is a large scale feature, having previously been surveyed at approximately 8 km long and 1 km wide (White, 1835).

The high energy environments within Alderney's territorial waters suggest that those features predominately recorded within Project 1 and 2 areas are also likely to be observed elsewhere. Further detail on the hydrodynamic conditions is provided in Section 4.2.

In addition to seabed features with positive relief, those with a negative relief are also present. An example would be Hurd Deep, which characterises the approach to the Casquets from the north to north-east. The depth of this feature, in places, exceeds 90 m water depth and it has been reported that it is characterised by black mud, in addition to coarser sediments (NGIA, 2004). The function of Hurd Deep as a fine sediment trap has also been observed at other similar features, for example Silver Pit in the North Sea (Proctor *et al*., 2001).

4.1.1.3 Future baseline

Over the short to medium-term, the future baseline is not considered to be markedly different from the present baseline and is anticipated to remain within the envelope of variability. This is demonstrated by the manner in which the coastal and seabed features respond to inter-annual variations in tides and the prevailing storm events. Therefore, in the absence of any other known significant past, present or future marine development in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the character of the marine geomorphology over these timescales.

It is over the medium to long-term that the effects of climate change may have the potential to influence coastal and seabed morphological characteristics. Climate change is predicted to lead to increases in mean sea level (see Section 4.2.1.3). Changes in storm surges are likely to be small in comparison to natural variability and as such would not constitute a measurable change. Along Alderney's coast, changes in water levels have the potential to lead to changes in the future baseline whereby any intertidal is reduced due to coastal squeeze. The predicted rise in sea level is unlikely to result in significant modifications to the existing hydrodynamic or sediment regime and therefore seabed features such as sandbanks are unlikely to be significantly affected.

4.1.1.4 Limitations and data gaps

There are several areas of uncertainty associated with defining the present baseline which relate to gaps in primary data. At the EIA project-level, it is recommended that developers undertake a desk-based review and fieldwork designed to provide more detail on the following:

- Superficial seabed sediments (at a minimum including composition and particle size, geochemical properties and contaminants);
- Morphodynamic features (small- to large-scale); and
- Seabed geology.

These could be collected using the following methods:

- Side scan sonar, video or photographic survey to identify the seabed sediments and geomorphology;

- Time series of swathe bathymetry which, placed into context using historical chart analysis, could determine the mobility of any seabed features;
- Seabed sediment grab samples to 'ground-truth' the surveys of sediment composition; and
- Geophysical surveys of the development area.

The collection of this information should provide further understanding of sediment transport pathways and suspended sediment concentrations (SSC). In addition given the high energy nature of the environment ongoing monitoring of sites such as the Casquets Banks may be needed to better understand the baseline geomorphology and natural background fluctuations.

4.1.1.5 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors (e.g. seabed features whose form and function might be altered by the placement of a tidal turbine device). It is therefore recommended that, at a minimum, the near-field study area include all of Alderney's territorial waters and the interconnector cable route, with the far-field incorporating at least one tidal ellipse excursion from these boundaries. Regional scale modelling indicates that mean tidal excursions of greater than 30 km can be expected (ABPmer, 2008). The wider study area shown on Figure 2 encompasses these wider-scale boundaries.

4.1.2 Impact Assessment

The Draft Plan has the potential to affect the marine geomorphology of the study area through the following impact pathway:

- Alteration of Seabed Form and Features (Section 4.1.2.1).

The sensitivity of seabed form and features to change is considered to depend on the recoverability of the feature. Sandbanks are considered to have a greater sensitivity compared to harder substrate, and therefore the sensitivity of features is considered to range between low to moderate depending on substrate type and nature of exposure.

Alderney South Banks Subtidal Sandbank is of nature conservation importance and would meet the criteria for designation as a subtidal sandbank under the EC Habitats Directive (see Section 5.6.1) and therefore the marine geomorphological importance of this feature, in terms of its level of protection, is considered to be moderate. The rest of the marine and coastal environment in the study area is not designated specifically for physical features and is therefore considered to be of negligible to low importance.

4.1.2.1 Alteration of seabed form and features

Alteration of seabed form and features could occur during the construction, operational and decommissioning phases of the Draft Plan. Sandwave and megaripple clearing during construction and/or decommissioning, if required, will alter the seabed characteristics and has the potential to deposit material on the seabed. Once installed, hydrodynamic changes, in particular to the tidal flow, have the potential to alter the location and size of any seabed features, for example the South Banks.

In addition to being dependent upon the phase of the development, the potential to which any features will be impacted will vary for different elements comprising the Draft Plan.

In terms of tidal stream turbines, the potential to which any features will be impacted by the turbines is ultimately dependent upon the level of energy extraction (array size), structure location in relation to the predominant tidal currents and any seabed features whose form and function are controlled by the tidal regime. For example, it has been shown that should a tidal array be placed at the north-eastern extent of South Banks, the potential effects upon the tidal flows and ultimately the sediment transport regime maintaining the feature, will be greater than if placed at other locations within the Project 1 area (Haynes *et al*., 2013). It is assumed that this finding can be transposed to other locations in Alderney's waters where seabed features are located, for example the Casquets SSE bank in the Project 2 area.

During the construction and decommissioning phases of tidal stream turbines, any effects are likely to be temporary and their extent dependent upon the design characteristics of the proposed foundation or anchoring options selected. There may be some seabed disturbance, for example as a result of sandwave clearance or seabed levelling (a potential requirement for gravity base structures), but it is considered that such activity is likely to be localised. Temporary effects may also occur from jack-up barges that have the potential to locally affect the seabed form through the introduction of seabed indentations (assuming a layer of superficial sediments is present). It has been assumed that tidal stream infrastructure will not be directly placed on large-scale morphodynamic features, including sandbanks, given their structural instability and therefore the exposure to change during construction and decommissioning is considered negligible to low, resulting in an insignificant to minor adverse impact.

The potential change to seabed form and features is most likely to occur during the operational phase, which spans the entire lifetime of the development. The magnitude of any change is dependent upon the placement of the device relative to any seabed features, with larger impacts being more likely when the turbines are placed closer to these features, for example sandbanks. It is therefore considered that the exposure to change of a single array during operation is low to medium, resulting in an insignificant to moderate adverse impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is unlikely to be able to avoid sensitive seabed form and features and is therefore considered to result in a high level of exposure to change and an overall moderate to major adverse impact.

In terms of cables, the proposed route for the export cable is through the north-east tip of the South Banks. Given the mobility associated with this feature, and in particular the sand waves/megaripples, an accurate determination of the burial depth will become important in order to ensure retained cable burial through the project lifetime (should burial be chosen).

Effects are most likely to occur during the construction and decommissioning phases and are considered temporary. Cables are likely to be placed directly on the seabed and covered with protection (i.e. rock dumping or mattressing) and as such will cause local changes to the seabed form. Seabed disturbance will occur along the length of cable route and at landfall. However, the majority of route can be considered of low sensitivity as it is mainly within areas of bedrock or high energy which indicate the potential for high recoverability. Any sandwave / megaripple clearance and operations which disturb the seabed have the potential to deposit material on the seabed. There is also the potential for increased SSCs depending upon the preferred installation method. Cable installation at the landfall site has the potential to affect the shoreline morphology; however this assessment considers the cable will be accurately engineered and therefore there is only potentially short-term localised disturbance at landfall during the installation period. Overall, it is considered that the exposure to change during construction and decommissioning is low to medium, resulting in an **insignificant to moderate adverse** impact.

Once the cable has been installed, any alteration to the seabed form will be limited and localised during the operational phase. It is considered that the precise engineering at the landfall will ensure that there will be no effects following construction on the coastal geomorphology. If the cable is laid on the seabed surface and protected by rock dumping or mattressing rather than buried there will be changes to the local flow properties. Over time this may result in localised bed change, depending on the bed properties. Available evidence suggests that bedrock predominates along much of the cable route, but in those locations where softer substrate is present, scour may occur. The development of any scour will be dependent upon the tidal characteristics and the dimensions (height; width) of the protection. Overall, it is considered that the exposure to change during operation is negligible, resulting in an **insignificant** impact.

It is possible that any tidal development in Alderney waters by ARE or another developer would require one or more offshore substations (see Section 1.2). During the construction and decommissioning phases any change to seabed form and features will be temporary. It is assumed that monopile or jacket foundations will be used, and therefore increased SSCs, followed by seabed deposition and an alteration to the seabed form may occur. Temporary effects may also occur from jack-up barges that have the potential to locally affect the seabed form through the introduction of seabed indentations (assuming a layer of superficial sediments is present). It is unlikely that the offshore substations will be placed directly on large-scale features such as sandbanks given their dynamic nature. Overall, therefore, it is considered that the exposure to change during installation and decommissioning is negligible to low, resulting in an **insignificant to minor adverse** impact.

During operation, offshore substations will operate as a stationary structure piled into the seabed. Any effects during this phase will occur as localised and low magnitude changes to the tidal flow properties. EIAs that have been undertaken for offshore wind farm developments have concluded that changes brought about by equivalent structures are insignificant with no impacts upon the seabed anticipated (e.g. East Anglia Offshore Wind Farm ES). Scouring local to the monopile or jacket foundations may also occur; however, this will only occur if the seabed has erosional tendencies and will not occur if the seabed surface is bedrock. Overall, therefore, it is considered that the exposure to change during operation is negligible to low, resulting in an insignificant to minor adverse impact.

4.1.2.2 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) physical process impacts that have been identified in this REA:

- Amendment of site design, including reduction in the number of tidal devices and/or array location to minimise energy extraction at those locations where the tidal regime controls key seabed features (e.g. sandbanks) or where protected features are present (i.e. Alderney South Banks Subtidal Sandbank);
- Optimisation of array design;
- Development of a cable burial / protection plan;
- Minimisation of cable, device and offshore substation footprints; and
- Use of scour protection measures.

4.1.2.3 Residual impact

The mitigation measures identified in Section 4.1.2.2 could reduce the potential impacts of the Draft Plan, thereby resulting in a lower level of residual impact. However, it is not possible with any level of certainty to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on project specific factors. Therefore, the significance of potential residual impacts has been estimated and is summarised in Table 6.

4.1.2.4 Summary

Table 6. Assessment of the potential effects of the Draft Plan on marine geomorphology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Alteration of seabed form and features	N-L	L-M	N-M	Insignificant-Minor	-	-
	Operation	Alteration of seabed form and features	L-H	L-M	N-M	Insignificant -Major	Section 4.1.2.2	Minor / insignificant
	Decommissioning	Alteration of seabed form and features	N-L	L-M	N-M	Insignificant-Minor	-	-
Cable Routing	Construction	Alteration of seabed form and features	L-M	L-M	N-M	Insignificant -Moderate	Section 4.1.2.2	Minor / insignificant
	Operation	Alteration of seabed form and features	N	L-M	N-M	Insignificant	-	-
	Decommissioning	Alteration of seabed form and features	L-M	L-M	N-M	Insignificant -Moderate	Section 4.1.2.2	Minor / insignificant
Offshore Substations	Construction	Alteration of seabed form and features	N-L	L-M	N-M	Insignificant-Minor	-	-
	Operation	Alteration of seabed form and features	N-L	L-M	N-M	Insignificant-Minor	-	-
	Decommissioning	Alteration of seabed form and features	N-L	L-M	N-M	Insignificant-Minor	-	-

N Negligible
L Low
M Medium/moderate
H High

4.2 Physical Processes

This section considers the hydrodynamic (waves and tides) and sediment transport regimes within Alderney's territorial waters and is inherently linked to Marine Geomorphology (Section 4.1).

4.2.1 Baseline Description

This baseline description initially presents the wider regional setting followed by an outline of Alderney's territorial waters and finally, any available local level information.

4.2.1.1 Regional setting

The English Channel is a semi-enclosed sea that narrows towards the east. The hydrodynamic conditions here are predominately controlled by the tidal regime. The maximum tidal range in the English Channel varies from 6 to 10 m and is greatest in the Channel Islands Gulf (Grochowski *et al*., 1993). Influence is also enforced, though to a lesser degree, by wind and pressure gradients.

The main tidal wave that propagates through the Channel approaches from the west to the east. Due to the narrowing in the central and eastern parts of the Channel, regional spatial variations in tidal velocities are observed. To the east of the Cotentin Peninsula, and including the Channel Islands, the maximum annual mean spring and neap current speeds are of the order of 4 m/s to 1.5 m/s respectively.

Waves originating from the North Atlantic enter the English Channel from the west and are able to propagate directly to Alderney. Locally generated waves will also impart some influence. In deep water, it is wind that dominates the character of the waves. However, as waves travel into shallower, nearshore waters they are affected by refraction, shoaling and diffraction due to depth variation with the wave crests tending to realign with the bed contours; refraction by currents; and energy dissipation through friction and breaking.

At a regional scale, Alderney is located to the west of a north - south bedload parting zone, extending from the Isle of Wight, England to the Cotentin Peninsula, northern France (Kenyon and Cooper, 2004). Net sediment transport either side of this zone is directed away from the central axis and thus, with respect to Alderney, any potentially mobile sediment is transported away from the area to the west of the island. Although the presence of a bedload parting zone near this region is not in dispute, Dix *et al*. (2007) notes that:

"*The precise location of the divergence axis in the central English Channel is not the same in all reports and is variously located: in a broad strip at an oblique angle between St Catherine's Point and the west of the Cotentin Peninsula (Kenyon and Stride, 1970); a north to south line between St Catherine's Point and the east of the Cotentin Peninsula (Grochowski et al., 1993); and, in a north to south strip between The Needles and the centre of the Cotentin Peninsula (this study). Although Grochowski et al. (1993) predict a very precise and narrow axis, the present study found the axis region to be much broader; it is unlikely that the results of Kenyon and Stride (based on interpretation of sparse geophysical data) could resolve a clear line* *either. As such, the accuracy of the breadth or location of the reported axis cannot be confirmed in or by any study so far*."

4.2.1.2 Alderney's territorial waters

Tidal Regime

Alderney is located in a macro-tidal setting, with spring tidal ranges in excess of 6 m. Along the interconnector cable route specifically, the tidal ranges increase with distance towards the Cotentin Peninsula, and are of the order of 10 m (spring tide) at landfall (Bois *et al*., 2012).

Figure 8 shows spring and neap tide flow speeds around Alderney. Tidal flows are predominately to the north-east within Alderney's territorial waters until, approximately, half way along the interconnector route when a series of re-circulation patterns occur (Figure 9). Tidal flow speeds remain highest within Alderney's waters, reducing along the cable route towards landfall (Bois *et al*., 2012). Tidal excursion ellipses for a mean tide are shown to exceed 30 km at locations with Alderney's territorial waters (ABPmer, 2008).

A series of Acoustic Dopler Current Profiler (ADCP) measurements have been taken to characterise the hydrodynamic regime on a more local scale, particularly for the Project 1 area. A series of metocean campaigns (Osiris Projects, 2009d) undertaken at three discrete locations within Project 1 (T61, T74, T75; see Figure 6) in *circa* 42 m water depths, allow for a refined description of the tidal conditions. Characteristic tidal properties at these three locations at the seabed are:

- Peak spring currents range from 1.5 m/s to 4.4 m/s;
- Peak neap currents range from 1.0 m/s to 2.5 m/s;
- The regime is ebb dominated;
- Tidal flow is along a NE (flood) to SW (ebb) axis. This tidal direction also occurs on the opposite side of the island, with flow along a NW to SE axis at the north and south of Alderney (ABPmer, 2008);
- Surface current perturbations, for example eddies, are contained within 4 m of the surface; and
- Bed related turbulence is contained within 1 m of the bed.

The interaction of the fast flowing tides with structures, for example headlands and rock pinnacles, are likely to result in eddy formations. Indeed historic literature documents the presence of large scale eddies within the Casquets (White, 1835).

Elsewhere, tidal diamond information provides an indication of the tidal flows within the territorial waters of Alderney:

- In The Swinge, spring and neap peak flows reach 3.5 m/s and 1.4 m/s, respectively;
- Outwith Alderney Harbour, spring and neap peak flows reach 1.7 m/s and 0.8 m/s, respectively; and
- In the Ortac Channel, spring and neap peak flows reach 2.8 m/s and 1.2 m/s, respectively.

Wave Regime

High-level regional data sets show that summer and winter significant wave heights are of the order of 1.25 m and 2.25 m respectively (ABPmer, 2008). Figure 8 shows the annual mean significant wave height in Alderney's territorial waters and the wider area. For this location, the 50-year extreme return significant wave height is given as, approximately, 10 m (HSE, 2002).

Available wave measurements from campaigns undertaken in the Project 1 area during spring and summer 2009 indicate a maximum significant wave height of 3.1 m (block T74), with wave periods ranging between 2.0 and 7.8 secs (Osiris Projects, 2009c). Further details regarding the wave conditions recorded during these campaigns are given in Table 7 below:

Table 7. Wave regime characteristics recorded within Project 1

Block Reference	Wave Height (m) Min / Max	Wave Period (secs) Min / Max
T74	0.25 - 3.1	2.0 - 7.8
T75	0.3 - 2.7	2.5 - 9.3
T61	0.25 - 2.5	1.7 - 7.6

Overall, the highly energetic hydrodynamic regime results in an active sediment transport system, as indicated by the presence of sandwave and megaripple fields (Section 4.1). This system is dependent upon sediment availability. Localised sediment transport patterns have led to the accumulation of finer material (predominately sands) within bays. Offshore, the recirculation of tidal flows around headlands and rocky outcrops has also led to sediment transport pathways supporting the development and maintenance of sandbanks, such as South Banks. Further detail on these features is provided in Section 4.1.

4.2.1.3 Future baseline

With respect to hydrodynamics, there are a number of regime characteristics documented to exhibit change in the future. These are as follows:

- Sea-level Rise: Information on the rate and magnitude of anticipated relative sea level change in the English Channel during the 21st Century is available from the UKCIP (United Kingdom Climate Change Impact Programme, http://www.ukcip.org.uk/). Detailed quantification of this change is currently not specifically available for Alderney; however the information provided by UKCIP indicates that, by 2095, a sea level rise of, approximately, 0.5 m could be expected in the English Channel;
- Storm Surge: The UKCIP also includes projections of changes to storm surge magnitude in the future as a result of climate change (Lowe *et al.*, 2009). There is no detailed quantification of change in this parameter for Alderney, however, evidence from the south coast of England suggests that any storm surge changes are small in comparison to natural variability and as such would not constitute a measurable change;

- **Wave Climate:** There is evidence to suggest that longer-term changes in storminess have taken place across northwest Europe (e.g. Alexandersson *et al*., 2000). These changes may be related to long-term changes in the strength of the North Atlantic Oscillation (NAO), a hemispheric meridional oscillation in atmospheric mass with centres of action near Iceland and over the subtropical Atlantic (Visbeck *et al*., 2001). Longer-term trends in storminess across north and north-western Europe show that storminess was relatively high during the late 19th and early 20th Century, followed by a decrease up until about 1970. A subsequent rise in the late 20th Century can be clearly identified although most recent years have seen a decline in storminess (Matulla *et al*., 2007). These findings are broadly consistent with published investigations into 21st Century wave climate changes which are applicable to the English Channel (HSE, 2001; 2005; McMillan *et al*., 2011b). Modelling as part of UKCIP (Lowe *et al*., 2009) currently gives the most up-to-date projection of the likely future wave climate. Changes in climate over the 21st Century may include changes in mean wind speed and direction which will in turn affect the wave regime. The UKCIP indicates that in the English Channel in the vicinity of the study area, mean annual maxima significant wave heights between 1960 and 1990 and 2070 and 2100 will change by the order of ± 0.25 m; and
- **Sediment Transport Regime:** The predicted rise in sea level described above is unlikely to result in significant modifications to the existing hydrodynamic regime. It is therefore considered that the sediment regime will not be affected.

4.2.1.4 Limitations and data gaps

Detailed descriptions of the tidal regime are currently limited to three specific locations within the Project 1 area and these are of relatively close proximity to each other. It is understood that further ADCP deployments, both within and outwith Project 1, were commissioned for the purposes of the numerical modelling of Alderney waters and sediment transport study that has recently been undertaken by the University of Southampton (Haynes *et al*., 2013). These will assist towards improving the current understanding of the tidal regime within Alderney's territorial waters.

There are several areas of uncertainty associated with defining the present baseline which relate to gaps in primary data. An understanding of the entire hydrodynamic regime would be required at the project-level both for EIA and engineering purposes. It is, therefore, recommended that individual developers undertake a desk based review and fieldwork designed to provide more detail on the following:

- Wave regime (particularly if the project is not within the location where there is existing ADCP data) for approximately 6 months or until representative events have been captured; and
- Tidal regime (particularly if the project is not within the location where there is existing ADCP data) for a minimum of a spring-neap tidal cycle.

These could be collected using either an ADCP and/or wave buoy. An ADCP can also be used to measure the SSC within the water column.

The collection of this information should be used in conjunction with an understanding of the sediment regime to determine the degree to which the different sediments characteristics of the area are mobile and under which conditions they are mobile. For example, certain sediments may only be mobile under infrequent storm events whilst others are mobile under both spring and neap tidal currents.

The coverage of any collected data, in conjunction with the proposed development characteristics, will determine whether there is a requirement for numerical modelling to be undertaken (for both the baseline and impact assessment). It is recommended that developers discuss this with relevant stakeholders and regulators (i.e. the Commission) prior to any works.

4.2.1.5 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors (e.g. sediment transport pathways which may be interrupted by the placement of a tidal turbine device). It is therefore recommended that, at a minimum, the near-field study area includes all of Alderney's territorial waters and the interconnector cable route, with the far-field incorporating at least one tidal ellipse excursion from these boundaries. Regional scale modelling indicates that mean tidal excursions of greater than 30 km can be expected (ABPmer, 2008). The wider study area shown on Figure 2 encompasses these wider-scale boundaries.

4.2.2 Impact Assessment

The Draft Plan has the potential to affect the physical processes of the study area through a number of impact pathways which are assessed in the following sections:

- Alteration to Tidal Regime and Sediment Transport (Section 4.2.2.1); and
- Alteration to Wave Characteristics (Section 4.2.2.2).

The sensitivity of physical processes (tidal regime, sediment transport and waves) to change is related to their recoverability, which will vary depending on the phase of the development. During construction and decommissioning phases, the sensitivity is considered to be negligible and during operation the sensitivity is considered to be low to moderate.

Alderney South Banks Subtidal Sandbank is of nature conservation importance and would meet the criteria for designation as a subtidal sandbank under the EC Habitats Directive (see Section 5.6.1) and therefore the importance of the physical processes (hydrodynamics and sediment regime) that support this feature is considered to be moderate. The rest of the marine and coastal environment in the study area is considered to be of negligible to low importance.

4.2.2.1 Alterations to tidal regime and sediment transport

The potential to which the tidal regime and sediment transport will be impacted by a project is reliant upon the phase of the development, the specific infrastructure type and its specific location. For example, tidal turbines and cabling will have the potential to alter physical processes through different pathways.

Changes to physical processes during construction and decommissioning of tidal stream turbines and offshore substations are likely to be temporary. EIAs for offshore windfarms have shown that these phases of development do not significantly alter the tidal regime and in turn sediment transport (e.g. East Anglia Offshore Wind Farm ES). Temporary effects may also occur from installation equipment, such as jack-up barges, that have the potential to locally affect the sediment transport regime during the short-term period of their operation. Similarly, during the construction and decommissioning phases associated with cable routing, there are unlikely to be any effects upon the tidal regime and sediment transport properties. The overall exposure to change is considered negligible, resulting in an **insignificant** impact.

Negative effects from tidal stream turbines are more likely to occur during the operational phase, with its duration extending over the project's lifetime. Tidal turbine arrays have the potential to cause hydrodynamic changes which can alter tidal flow and the stability, location and size of seabed features such as the South Banks. In addition, alterations to the tidal regime have the potential to affect sediment transport. The magnitude of this effect will be dependent upon the device capacity and its location, with the probability of occurrence high. Available evidence suggests that the sediment transport regime is dependent upon the tidal conditions which are likely to change. Therefore the overall exposure to change of a single array is considered to be medium, resulting in an **insignificant to moderate adverse** impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a high level of exposure to change and an overall **moderate to major adverse** impact.

Cables are likely to be placed directly on the seabed and covered with protection (i.e. rock dumping or mattressing), which has the potential to cause localised impacts on physical processes through changes to the local flow regime. Therefore localised changes to the flow field could be expected during the operational phase, depending upon the dimensions of any cable protection infrastructure used and the exact properties of the tidal regime at the seabed. In turn, changes to the sediment transport regime could be anticipated, however it is expected that these will be localised to the flow disturbance and of a limited magnitude particularly when the seabed is devoid of sediment and not within an active sediment transport pathway. Any impacts are likely to be larger when in areas of mobile sediment, as identified through the presence of sandwaves and megaripples. Therefore it is considered that that the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

During operation, the offshore substation will operate as a stationary structure piled into the seabed. Any effects during this phase will occur as localised low-magnitude changes to the tidal flow properties, with both reductions and increases in current speed occurring. EIAs for equivalent structures within offshore windfarm developments have shown these changes to be localised to the substation with no consequential impacts upon the sediment transport regime identified. It is therefore considered that the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

4.2.2.2 Alterations to wave characteristics

No likely impacts on wave characteristics are anticipated for cables during any phase of the Draft Plan, however offshore structures have the potential to reduce wave characteristics during a development's operational phase, reducing exposure at the seabed and along the coast.

For tidal stream turbines this change is most likely to occur during the operational phase. The device design, in particular the location or depth in the water column where the device is located, will ultimately define the extent to which the wave regime is altered. Tidal turbines may be placed under the water surface and indeed OpenHydro's device, which is proposed for the ARE developments, is bed mounted. However, other developers may propose to use different tidal turbine devices. For those devices that operate on the water surface, wave dampening may occur, however, tidal devices are designed to capture the energy from tides rather than waves. Furthermore, the baseline physical process conditions within Alderney's territorial waters suggest that it is the tidal regime which is the dominant driving force in controlling sediment transport and the seabed form and features, such that changes to the wave regime will have a smaller impact upon physical processes. Overall, it is considered that the exposure to change upon the wave regime is negligible, resulting in an **insignificant** impact.

During operation of offshore substations the infrastructure will operate as a stationary structure piled into the seabed. Any effects during this phase will occur as localised low-magnitude changes to the wave regime, with wave height reductions occurring in the lee of the structure. Changes to the wave period will be dependent upon the pile size whilst directional changes are unlikely to be greater than a few degrees. EIAs for equivalent structures (size and number) within offshore windfarm developments have shown these changes to be localised to the array (e.g. East Anglia Offshore Wind Farm ES). Available evidence indicates that water depths increase rapidly offshore suggesting that wave effects may not reach the seabed at many locations. Therefore, it is likely that any post-installation effects upon the wave regime will also not affect the seabed. The extent to which any effects are experienced along the coast will be dependent upon the structure size and its distance offshore. Of note here is that much of the coastline is sheltered from wave effects by headlands. It is therefore considered that the exposure to change is low, resulting in an **insignificant to minor adverse** impact.

4.2.2.3 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) physical process impacts that have been identified in this REA:

- Amendment of site design, including reduction in the number of tidal arrays and/or change in the location of the array and substation to reduce potential shoreline and seabed effects;
- Optimisation of array design; and
- Development of a cable burial / protection plan.

4.2.2.4 Residual impact

The mitigation measures identified in Section 4.2.2.3 could reduce the potential impacts of the Draft Plan, thereby resulting in a lower level of residual impact. However, it is not possible, with any level of certainty, to determine the exact level of residual impact at the plan level as the extent of mitigation achievable will be heavily dependent on project specific factors. The significance of potential residual impacts has been estimated and is summarised in Table 8.

4.2.2.5 Summary

Table 8. Assessment of the potential effects of the Draft Plan on physical processes

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Alterations to tidal regime and sediment transport	N	N	N-M	Insignificant	-	-
	Operation	Alterations to tidal regime and sediment transport	M-H	L-M	N-M	Insignificant to major	Section 4.2.2.3	Minor / insignificant
		Alterations to wave characteristics	N	L-M	N-M	Insignificant	-	-
Cable Routing	Construction	Alterations to tidal regime and sediment transport	N	N	N-M	Insignificant	-	-
	Operation	Alterations to tidal regime and sediment transport	N-L	L-M	N-M	Minor / Insignificant	-	-
	Decommissioning	Alterations to tidal regime and sediment transport	N	N	N-M	Insignificant	-	-
Offshore Substations	Construction	Alterations to tidal regime and sediment transport	N	N	N-M	Insignificant	-	-
	Operation	Alterations to tidal regime and sediment transport	N-L	L-M	N-M	Insignificant to minor	-	-
		Alterations to wave characteristics	L	L-M	N-M	Insignificant to minor	-	-

N Negligible
L Low
M Medium/moderate
H High

4.3 Water Quality

This section considers the water quality within Alderney's territorial waters and is inherently linked to other receptor topics, in particular those comprising the Biological Environment (Sections 5.1 to 5.6).

4.3.1 Baseline Description

Alderney is located within the English Channel, approximately, 25 km offshore from mainland France. The prevailing water quality conditions reflect open water conditions within the English Channel (i.e. fully saline). Suspended sediment concentrations (SSC) are generally low, as a result of the active hydrodynamic regime coupled with the generally erosive resistant shoreline and predominance of bedrock offshore. Regional scale assessments of SSC have been carried out using satellite remotely sensed images calibrated against six SmartBuoys around the UK. Within Alderney waters, mean surface SSC values do not exceed 2 mg/l (Eggleton *et al*., 2011).

Water quality measurements have been undertaken by Alderney Harbour Master and ARE in respect to radioactivity and bathing water quality, with the latter samples collected at the western end of Longis Bay and Bibette Head (Figure 3). Whilst the former are currently unavailable, the results from the latter are available for the period May to September 2011 (ARE, 2011). When compared against the requirements set out in the EU Bathing Directive relevant at this time (noting that a new Directive was implemented in 2012), which is not a legal requirement in Alderney, only one of the 11 samples failed with nine classified as 'excellent'.

The nearest Water Framework Directive (WFD) (2000/60/EC) waterbody is Cap de Carteret - Cap de la Hague (FRHC04[2]) which has been assessed as being in good condition for the period 2006 to 2011.

4.3.1.1 Future baseline

It is not considered that any environmental factors, as discussed in Section 4.2.1.3, will change significantly enough to induce a future change in suspended sediment concentrations.

Whilst the capacity of Alderney's infrastructure to accommodate increased sewage is not fully understood, it is unlikely that its population will increase to a level which becomes unsustainable in this regard.

4.3.1.2 Limitations and data gaps

There is presently very limited information available regarding SSC, water and sediment quality within Alderney Waters. Monitoring data may be available for the French WFD coastal waterbody Cap de Carteret - Cap de la Hague (FRHC04) which would provide additional

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2 http://envlit.ifremer.fr/var/envlit/storage/documents/atlas_DCE/scripts/site/fiche_etatmequal.php?code=FRHC04&qualite_id=234

baseline information along the interconnector cable route to France. Relevant stakeholders have been consulted on the availability of previous water quality measurements that have been undertaken in Alderney Waters but no further information has been received to date. However, in the absence of significant information from point or diffuse sources into Alderney waters, water quality would generally expected to be high and characteristic of open waters of the western English Channel.

At the EIA project-level, it is recommended that the developers undertake a desk based review and fieldwork designed to provide more detail on the following:

- Suspended sediment concentrations (in parallel with any metocean measurements to determine the controls upon this parameter);
- Water quality measurements; and
- Seabed sediment contamination (as identified within Section 4.1).

These could be collected using a variety of methods, including ADCP (for a determination of suspended sediments), water sample collection (at pertinent tidal states to allow minimum and maximum contamination levels to be measured) and seabed sediment sampling.

SSC information should be used in conjunction with metocean measurements to determine the degree to which the different sediments characteristic of the area are mobile and under which conditions they are mobile (see Section 4.2.1.4). For example, certain sediments may only be mobile under infrequent storm events whilst others mobile under both spring and neap tidal currents.

4.3.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. Regional scale modelling indicates that mean tidal excursions of greater than 30 km can be expected (ABPmer, 2008). It is therefore recommended that, at a minimum, the near-field study area include all of Alderney's territorial waters and the interconnector cable route, with the far-field incorporating at least one tidal ellipse excursion from these boundaries. The wider study area shown on Figure 2 encompasses these wider-scale boundaries.

4.3.2 Impact assessment

The Draft Plan has the potential to affect the water quality of the study area through a number of impact pathways which are assessed in the following sections:

- Toxic Contamination (Spillage) (Section 4.3.2.1);
- Non-Toxic Contamination (Section 4.3.2.2); and
- Toxic Contamination (Sediment Release) (Section 4.3.2.3).

The sensitivity of water quality changes brought about by the Draft Plan is considered to be negligible to low given that the majority of the study area is a highly dynamic environment and existing flushing rates, even in the more sheltered areas around the coast, are likely to be high.

In terms of sediment quality, there is limited sediment coverage within the study area, with many areas characterised by bedrock. The sediment that is present is typically coarse and highly mobile. The release of contaminated sediments is, therefore, considered unlikely to be a significant issue other than local to discharge points or the historical munitions dumping ground.

In Europe water quality is afforded protection through a range of Directives (e.g. Bathing Waters Directive, Water Framework Directive (WFD), Shellfish Waters Directive). However, given that Alderney falls outside of any European Directive, there is no level of protection, and therefore the importance is considered to be negligible.

4.3.2.1 Toxic contamination (spillage)

Toxic contamination could result from the spillage of fluids, fuels and/or construction materials into the marine environment. Spillage has the potential to originate from the survey, construction, decommissioning and maintenance vessels associated with the tidal device, cabling and offshore substation, in addition to the tidal device itself. Furthermore, it is possible that during any of the preceding activities, large vessels may be involved in serious accidents which lead to high volumes of pollutants entering the ecosystem.

Given the highly energetic hydrodynamic regime within Alderney's territorial waters, it is considered that any pollutants will be rapidly dispersed from any release point. However, it should be acknowledged that the possibility exists for the effects of any large-scale spillage(s) to have an impact further afield (e.g. France and the other Channel Islands). Overall, however, taking account of the likely risk of spillage, and the adherence of standard best practice (see Section 4.3.2.4), the exposure to change is negligible to low, resulting in an **insignificant** impact.

4.3.2.2 Non-toxic contamination

Sediment disturbance during the installation and/or removal of tidal devices, offshore substations and export cables may lead to a significant elevation in SSC, and a subsequent increase in water column turbidity. Typically, larger disturbed particles are quickly deposited on the seabed, while finer sediments remain suspended for longer durations and coupled with a highly dispersive environment can be transported over greater distances. Settlement of coarse material is most likely to occur within 20 to 200 m (BERR, 2008). A number of secondary water quality impacts could occur as a result of seabed disturbance. Changes to the seabed structure could modify local geophysical and hydrodynamic processes and lead to further sediment disturbance. Nutrients from the seabed could also be released into the water column and contribute to phytoplankton growth in the water column which would reduce water clarity.

For tidal stream turbines and offshore substations, the design of the structure is an important consideration with regards to potential increases in SSC. For example, a structure which requires drilling or piling in order to be secured to the seabed could induce a sediment plume. In contrast, a structure which is anchored to the seabed would not be expected to result in a sediment plume, apart from any bed levelling required prior to placement of gravity base structures. Any seabed disturbance will result in elevated SSC; however the extent of the increase will also be dependent upon the surface layer of sediments and underlying geological properties. Any SSC increase will be temporary; the time period of which is reliant upon the duration of installation works and the dispersion time for background SSC to be reached. The energetic hydrodynamic regime within the study area means that sediment plumes will be rapidly dispersed. However, it should be acknowledged that the effects of any elevated SSCs may also have an impact further afield (e.g. France and the other Channel Islands). It is therefore considered that the exposure to change is low, resulting in an insignificant impact.

Sediment disturbance as a result of cable routing activities has the potential to become more significant if burial related activities are undertaken. Here the length of the cable corridor to be buried in addition to the depth at which export cables are buried into the seabed needs to be considered, as deeper trenches will lead to a larger sediment volume being disturbed compared to shallower depths. The SSC elevation will also be dependent upon the superficial sediments and underlying geological properties. The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection i.e. rock dumping or mattressing) in areas where the cable cannot be buried. Minimal disturbance to the seabed is anticipated in areas that do not require burial with little opportunity for sediment plumes. Overall, it is considered that the exposure to change is negligible to low, resulting in an insignificant impact.

4.3.2.3 Toxic contamination (sediment release)

The impact pathways for toxic contamination related with sediment release can occur during installation and decommissioning and is associated with activities related to the tidal device, cabling and the offshore substation. Of these, the smallest potential for release of toxic contamination associated with sediments would be related to the installation of the cables, which are likely to be placed directly on the seabed and covered with protection in areas of hard substrate and buried where sediment allows.

The release of contaminated material is most likely to occur where toxic material has previously settled onto the seabed. There remains little information regarding the contamination level of the seabed sediments and underlying geology within Alderney's territorial waters. It is considered that, in offshore waters, any historical contaminated sediment release is likely to have quickly dispersed given the highly energetic hydrodynamic regime. However, in more sheltered areas (such as Longis Bay), dispersal will not have been as rapid and contaminated sediment may have settled on the seabed. Furthermore, sediment contamination is only likely to be evident in areas close to the coastline of industrial locations or in coastal areas where water and sediments have been subject to historical contamination. For example, treated sewage has historically been discharged near to Longis Bay on the southeast coast of Alderney providing a potential source to this more sensitive area. Should any actual developmental activities be proposed at Longis Bay (e.g. trenching of export cables or drilling), it would be necessary to fully characterise the level of sediment contamination that could arise. This includes consideration of the spatiotemporal scale of the contamination. Therefore, it will be necessary to evaluate the potential for sediment contamination at the EIA project-level in more detail.

It has been indicated that settlement of sediment is most likely to occur within 20-200m of a cable for a wind farm (BERR, 2008) but contaminants are almost always associated with fine sediments and could travel further than this in some areas where there is a large tidal excursion and strong tidal flows. Given the energetic hydrodynamic regime within Alderney's territorial waters it is considered that any pollutants will be rapidly dispersed from any release point. However, it should be acknowledged that the effects of any spillage(s) may also have an impact further afield (e.g. France and the other Channel Islands). Furthermore, the majority of seabed sediments in Alderney waters are coarser-grained (sand) or rocky in character (see Section 4.1), and therefore the levels of sediment-bound contaminants associated with these are likely to be negligible. Overall, it is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low. For cable routeing the exposure to change is considered to be low. The impact to water quality is, therefore, considered to be insignificant.

4.3.2.4 Mitigation

Given that water quality is not afforded any formal level of protection in Alderney, the assessment has concluded that no significant water quality effects will result from the Draft Plan (Table 9). However, given that the possibility exists for the effects of any large-scale spillage(s) to have an impact further afield (e.g. France and the other Channel Islands) adherence to standard best practice will be essential at the project level. This will involve establishing and employing environmental management and pollution control strategies, whilst preparing a clear spillage response plan prior to the commencement of any offshore works.

4.3.2.5 Residual impact

Given that no specific mitigation measures are required for water quality, the residual impact has not been assessed.

4.3.2.6 Summary

Table 9. Assessment of the potential effects of the Draft Plan on water quality

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	N-L	N	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	N-L	N	Insignificant	-	-
Cable Routing	Survey	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	N-L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	L	N-L	N	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	N-L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	L	N-L	N	Insignificant	-	-
Offshore Substations	Survey	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	N-L	N	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	N-L	N	Insignificant	-	-
		Non-toxic contamination	L	N-L	N	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	N-L	N	Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

5. Biological Environment

Alderney is exposed to the full force of the sea and weather conditions that prevail in the western approaches. This is reflected in the fauna and flora recorded around Alderney and the associated nature conservation designations. This section provides an assessment of the potential effects of the Draft Plan on benthic and pelagic ecology as well as fish and shellfish, ornithology marine mammals and turtles, nature conservation and terrestrial ecology. Each section contains a baseline description of the biological environment and also identifies data gaps and limitations that will need to be considered further at the EIA project-level by the developer. An assessment of the potential effects that could arise from the various elements and phases of the Draft Plan is included together with any mitigation measures that are required to reduce significant impacts to acceptable levels.

5.1 Benthic Ecology

5.1.1 Baseline Description

The marine life found within the waters around Alderney is typical of that associated with strong tidal streams and high energy environments with a range of encrusting animals (animals fixed on or in the seabed), including soft corals, hydroids (sea firs), bryozoans (sea mats), large sponges and anemones. In shallow water, bedrock and boulders often support kelp and sea oak macroalgae, which grow very long in the tidal currents, and have a variety of animals growing on them (UKBAP, 2008; Wood, 2007; 2008; 2010).

The macrofauna associated with the Alderney South Banks Subtidal Sandbank has low species diversity and abundance and is dominated by tide-swept communities associated with coarse and mobile sand. Rocky reefs are dominated by turf fauna and tide-swept communities, the latter being of some interest due to the relative scarcity of this habitat across the UK and Europe as a whole (Axelsson *et al*., 2011).

5.1.1.1 Subtidal benthic ecology

There is limited survey data of subtidal benthic habitats within Alderney territorial waters and the wider study area. Predicted broadscale benthic habitats within Alderney territorial waters and the wider study area, based on EUSeamap modelling, are shown in Figure 10. Based on this model, the main broad scale habitat around Alderney is likely to comprise moderate energy circalittoral rock (EUNIS Level 3 classification A4.2) in which faunal communities on deep moderate energy circalittoral rock dominate (EUNIS A4.27), and circalittoral coarse sediment (A5.14). An area of deep low energy circalittoral rock, dominated by faunal communities (A4.33) is predicted off the south coast of Alderney. To the south west of Alderney and between Alderney and the French coast, areas of deep circalittoral sand are predicted to occur (A5.27).

A number of species and habitats exist in the waters around Alderney which are listed as having important conservation value under UK and EU directives. Although these do not apply to the Channel Islands, the importance of these species and habitats in terms of their level of protection is worth highlighting. A list of the species and habitats which exist in the waters around Alderney are listed in Table 10.

Table 10. Important habitats and species found in the waters around Alderney

Feature		Description	Protection
Habitats	Tidal Rapids	Strong tidal streams result in characteristic marine communities rich in diversity typically comprising soft corals, hydroids, bryozoans, sponges, anemones, mussels and brittle stars in dense beds. In deeper water, such as between islands, strong tidal streams may be felt down to 30 m. In shallow water, bedrock and boulders often support kelp and sea oak plants, which grow very long in the tidal currents, and have a variety of animals growing on them. Other smaller red and brown seaweeds grow on cobbles and pebbles, many of these being characteristic of tide-swept situations.	BAP
	Sandbanks	Annex I sandbanks slightly covered by seawater all the time occur where areas of sand are predominantly surrounded by deeper water. Animals that live on sandbanks include worms, crabs, starfish, sandeels and flatfish.	EC Habitats Directive Annex I habitat
	Seagrass Beds	Eelgrass beds are important for the stabilisation of the substratum. They are also an important source of organic matter which is a food source for wildfowl, and provide shelter and a surface for attachment for other species.	BAP
Species	Pink Sea-fan (*Eunicella verrucosa*)	The pink sea-fan is a long lived slow growing species which is threatened by entanglement in fishing nets and line which can severely damage or kill colonies (UKBAP, 1995). The pink sea-fan is a host species for another BAP priority species, the sea anemone *Amphianthus dohrnii*.	BAP Schedule 5 of the WACA 1981

(Axelsson *et al*., 2011)

Seasearch has carried out a number of surveys of the subtidal area around Alderney in 2007, 2008 and 2010 (Wood, 2007; 2008; 2010). The sites can be seen on Figure 11 and Table B1 in Appendix B shows the features of interest at each site ('a' sites = 2007, 'b' sites = 2008, and 'c' sites = 2010). Additionally Seastar survey carried out a survey on the sandbank off the southeastern coast of Alderney in 2010 (Table B2 in Appendix B) (Axelsson *et al*., 2011). The results of each of these surveys are described in more detail below.

Seasearch 2007 Survey

A total of 15 sites were originally surveyed in 2007. 276 species were recorded for the survey as a whole comprising 165 animals and 111 plants. The sites with the greatest diversity of plants recorded were Longis Bay (Site 1a), Cats Bay/Les Hommeaux Florains (Site 4a) and The Lugg on Burhou (Site 15a). In the case of all three sites there were a mixture of rocks and boulder/cobbles providing a diversity of habitats. These sites are all relatively sheltered out of main tidal streams. Conversely the sites with the greatest diversity of animal life were the exposed, tide-swept sites of Braye Rock (Site 11a) and Les Étacs (Sites 13a and 14a) (Wood, 2007).

The greatest diversity of sponges was at Braye Rock (Site 11a) with 18 species recorded. Many of these were typical of clean water rocky environments in SW Britain with such conspicuous species as the hedgehog sponge, *Polymastia boletiformis*, elephant-hide sponge, *Pachymatisa johnstonia* and yellow staghorn sponge, *Axinella dissimiis*. A similar variety of sponges was present at the other two deeper circalittoral sites, Les Étacs (Sites 13a and 14a) and The Grois Rocks (Site 7a).

The three most commonly recorded molluscs all had a widespread distribution and are common around much of the British Isles. The grey topshell, *Gibbula cineraria* is commonly found on seaweeds in shallow water, the painted topshell, *Calliostoma zizyphinum* is rarely found on the shore but commonly seen on shallow sublittoral rocks, and the netted dog whelk, *Hinia reticulata* is a scavenger and seen both on rocks and soft sediments. The most significant mollusc recorded was the ormer, *Haliotis tuberculata,* the signature mollusc species of the Channel Islands. This species was recorded at three of the shallow water sites (Sites 4a, 10a and 12a) however it is likely to be much more widespread. The ormer is not found on the northern side of the English Channel and thus the Alderney records are likely to be the most northerly (Wood, 2007).

A wide range of seaweeds were recorded within the shallow coastal sites. The greatest diversity of species was found at Cats Bay/Les Hommeaux Florains (Site 4a), The Lugg at Burhou (Site 15a) and in Longis Bay (Site 1a). The deeper sites had few seaweeds and the diversity was also low in Hannaine Bay (Site 12a) probably due to the exposure and nature of the seabed (Wood, 2007).

The brown seaweeds include most of the large species, including the kelps. In most parts of the British Isles the primary kelp forest species is cuvie, *Laminaria hyperborea.* Whilst this species is commonly recorded on Alderney, particularly deeper down, two other kelps are equally common. Furbelows, *Saccorhiza polyscides*, distinguished by its flat belt-like stalk, typically colonises disturbed areas. Its prevalence on Alderney may well reflect the level of disturbance occurring naturally through winter storms and the strong tidal streams. The densest forests of this species were in shallow water at Bibette Head (Site 8a) and in Hannaine Bay (Site 12a). The third forest kelp is the golden kelp, *Laminaria ochroleuca*. This is a south westerly species only common in England in the Isles of Scilly. In Alderney it is most common at tide-wept sites such as outside Les Hommeaux Florains (Site 4a) and in St Esquere Bay (Site 3a). The peacock's tail, *Padina pavonica,* a leafy brown seaweed, was also recorded in Longis Bay (Site 1a). It has very restricted distribution in the British Isles with relatively few records on the south coast of England (Wood, 2007).

Seasearch 2008 Survey

A further three sites were surveyed by Seasearch in 2008 to include habitats and biotopes which were under-recorded in the 2007 survey. They were all wave and tide exposed sites with rocky surfaces in the lower infralittoral and circalittoral zones (Figure 11). A total of 62 animal species were observed at the three sites, of which six had not been recorded in 2007. Seaweeds were not recorded, except for the large brown kelp characterising species. These were represented by the biotopes IR.HIR.KFaR - Kelp forest on high energy infralittoral rock -

which was present at all three surveyed sites and is likely to be widespread around Alderney, and IR.HIR.KFaR - Kelp park on high energy infralittoral rock and boulders - which was present at both Ortac (Site 2b) and Coque Lihou (Site 3b) and is likely to reflect the strong tidal currents at these sites. CR.HCR.XFa.SpAnVt - Steep or vertical bedrock walls with a fauna turf of sponges and anemones was present on the gulley walls at Renonquet (Site 1b) and had the most diverse fauna of any of the Alderney habitats. It differs a little from the biotope classification because of the presence of the orange sea-squirt, *Stolonica socialis*, in significant numbers, but this variation, which may be a southerly one, is also common in Sark and is found in South Devon. CR.HCR.FaT.CTub - Tide-swept steep or vertical bedrock walls dominated by oaten pipe hydroids, *Tubularia indivisa*, and sponges was present at both Ortac (Site 2b) and Coque Lihou (Site 3b) and was characterised by a less varied sessile fauna than at Renonquet (Site 1b), dominated by oaten pipe hydroids, *Tubularia indivisa*. There were significant numbers of anemones in this habitat - elegant anemones, *Sagartia elegans*, at Coque Lihou and jewel anemones, *Corynactis viridis*, and Devonshire cup-corals, *Caryophyllia smithii*, at both sites.

Seasearch 2010 Survey

A further nine sites were surveyed in more detail by Seasearch in 2010 along the southeastern coastline of Alderney (Figure 11) (Wood, 2010). A total of 212 species were recorded for the survey as a whole comprising 106 animals and 106 plants (Table 11). The total for all the Seasearch surveys to date in Alderney is 194 animals and 150 plants. The sites with the greatest diversity in 2010 overall were Rousset (Site 6c) and La Tchue (Site 7c). The site with the greatest diversity of animal life was La Tchue which was significantly more diverse than any other site. In terms of plants recorded these were more evenly spread across sites with Rousset, La Tchue, Les Boufresses (Site 2c) and Queslingue (Site 4c) all reasonably diverse (Wood, 2010).

Table 11. Groups of flora and fauna identified during all the Seasearch surveys

Flora and Fauna	Taxa	Total Recorded
Sponges	Porifera	35
Jellyfish, hydroids, anemones and corals	Cnidaria	33
Flatworms	Platyhelminthes	1
Segmented worms	Anellida	8
Barnacles, crabs, prawns and lobsters	Crustacea	16
Shells, bivalves and sea slugs	Mollusca	30
Sea mats and sea mosses	Bryozoa	15
Horseshoe worms	Phoronida	1
Starfish, sea urchins and sea cucumbers	Echinodermata	12
Sea squirts	Tunicata	16
Fishes	Pisces	27
Red seaweeds	Rhodophycota	101
Brown seaweeds	Phaeophyceae	35
Green seaweeds	Chlorophyceae	13
Flowering plants	Angiospermae	1

(Wood, 2010)

Twelve different biotopes were identified, the majority of which (8) were infralittoral rock biotopes. This is unsurprising given the preponderance of shallow sites surveyed by Seasearch. Because of the lack of circalittoral habitats surveyed in 2010 the sponge fauna was limited to 25 species. Species newly recorded for Alderney were *Grantia compressa* (Les Boufresses - Site 2c), *Leuconia gossei* (Rousset - Site 6c), *Stelligera stuposa* (Les Boufresses and Queslingue - Site 4c), *Myxilla rosacea* (La Tchue - Site 7c) and *Endectyon delaubenfelsi* (La Tchue). Two nationally scarce species recorded were *Adreus fasicularis* (Les Boufresses, Queslingue and La Tchue) and *Axinella damicornis* (Les Boufresses, Queslingue, Rousset and La Tchue).

The seaweeds encountered during the survey were mostly typical of this biogeographic region, with seaweeds typical of southern Britain together with others which are fairly scarce in Britain but more common on Atlantic coasts of France and the Iberian Peninsula to the south. Examples include *Haliptilon squamatum, Gracilaria bursa-pastoris, Gigartina teedii* and *Codium vermilara*. During the 2010 Seasearch survey the Alderney seaweed flora was considered particularly rich and interesting with a large number of species being recorded from a small number of sites (Wood, 2010).

Only limited numbers of molluscs were recorded. However, they included four new species for Alderney. They are all widespread species and in three cases somewhat seasonal in occurrence. They comprise the moon snail *Euspira catena* (South of Rubbish Tip - Site 8c), sea hare *Aplysia punctata* (Longis Bay - Site 3c), fried egg sea slug *Diaphorodoris luteocincta* (Queslingue, La Tchue and South of Rubbish Tip), and sea slug *Crimora papillata* (Queslingue).

There were relatively few records of hydroids, anemones and corals, partly due to the shallow nature of the sites surveyed. Similarly, no unusual flatworms or segmented worms were observed and crabs, lobsters, shrimps and prawns were notable for their small numbers and low diversity at all sites. As in previous surveys in Alderney, echinoderms were not numerous and no new sea squirts were recorded for the area. As on previous surveys the most common species of sea squirts were the orange sea squirt *Stolonica socialis*, and two club sea squirts *Aplidium punctum* and *Morchellium argus*.

As observed in the 2007 intertidal survey, the entrance to Longis Bay (Site 1a) is home to an extensive eelgrass bed. During the 2007 Seasearch survey this eelgrass bed did not appear to be particularly species rich, though there were burrowing worms and anemones (Wood, 2007). In 2008, a follow up survey was undertaken to attempt to map the extent of the seagrass bed in more detail. The survey showed that there was continuous eelgrass across the whole of the western side of Longis Bay but there is a gap closer to Raz Island (Wood, 2008). This site was further surveyed in 2010 (Site 3c) where there was found to be continuous eelgrass across the whole of the mouth of the bay (Wood, 2010).

Sparse areas of eelgrass were also found in the harbour close to the wall (Site 9a) and Saye Bay (Site 6a) in 2007. Another tide-swept eelgrass bed was also identified in Frying Pan Bay (Site 5c) in 2010. Seagrass beds, including eelgrass (*Zostera marina*) are a threatened habitat in many areas because they occur in shallow, sheltered areas which are also popular with human activities and are a Biodiversity Action Plan habitat in the UK. This particular eelgrass bed is notated on the Admiralty Chart as an anchorage (Wood, 2007).

Seastar 2010 Survey

Seastar Survey Ltd. undertook an acoustic and environmental baseline survey of an area to the south of Alderney encompassing a sandbank area known as the Alderney South Banks (Figure 11) (Axelsson *et al*., 2011). A summary of the habitats and species recorded in the Alderney South Banks survey area are provided in Appendix B, Table B1.

The seabed environment in all the Alderney South Banks survey area was dominated by coarse sand and shell sand material, particularly in the southern and central sections of the survey area. Coarse sand was typically found in gullies and channels as well as in the surrounding seabed environments but also often as a thin layer across the rocky outcrops. Rocky habitats were found in the area to the northeast which is dominated by a mixed rocky seabed environment consisting of predominantly cobbles and boulders with sections of bedrock. There is also a rocky outcrop section centrally along the southern boundary of the survey area.

A total of 16 biotopes / biotope complexes were identified in the Alderney South Banks survey area (see Table B1, Appendix B). The SS.SCS.CCS biotope complex was the most frequently identified habitat in this study, characterised by coarse sand, sand waves and very little visible fauna or flora (Axelsson *et al*., 2011).

The CR.HCR.FaT.CTub biotope, known as tide-swept communities or tidal rapid communities, is of national importance, listed under the UK Biodiversity Action Plan (UKBAP, 2008). During the Alderney South Banks survey this biotope was identified at the edges of the survey area in areas surrounding the main sandbank. The marine life associated with these habitats is abundant in animals fixed on or in the seabed, and typically include soft corals, hydroids (sea firs), bryozoans (sea mats), large sponges, anemones, mussels and brittlestars in dense beds (UKBAP, 2008).

The CR.HCR.XFa.ByErSp biotope is found on wave-exposed circalittoral rock in moderate to strong tidal streams. It is characterised by bryozoan turf and erect sponges but there is some variability within this biotope and a large number of species might be present. In the current survey area this biotope was primarily found along the north-eastern boundary but a few locations were also found centrally along the southern boundary (Axelsson *et al*., 2011).

From a total of 11 grab samples taken within the Alderney South Banks survey area a total of 898 individuals from 17 taxa were identified. Overall, the macrofauna were dominated by Annelida, which represented 98.6% of the total individuals found. Crustaceans and Echinoderms contributed with 1% and 0.4% respectively. In general, the faunal diversity was low at all of the sites. The sites sampled in the south of survey area had highest total number of individuals and different taxa but low diversity and low equitability. These sites were characterised by extremely high numbers of one taxa (*Polygordius* sp.). The sites to the north of the survey area had fewer total individuals and species, but the numbers were more evenly spread across the taxa present, resulting in higher diversity values (Axelsson *et al*., 2011).

5.1.1.2 Intertidal ecology

Alderney's coastline consists of a variety of rocky shores, pebble and sandy shorelines and cliff tops. The high energy marine environment does not favour the deposition of fine-grain sediments and the intertidal substratum recorded comprises of bedrock, cobbles, boulders, pebbles and sand (see also Marine Geomorphology Section 4.1 and Terrestrial Ecology Section 5.7).

A series of intertidal surveys have been conducted around Alderney by Alderney Wildlife Trust Enterprise (AWTE) between 2010 and 2012 (AWTE, 2011; 2012 a,b; 2013 a,b,c,d,e,f). In general these survey areas are focussed on five main locations (see Figure 12); Hanaine Bay, south coast of Alderney, Longis Bay, Brinchetais Ledge and Houmet Herbé. The intertidal ecology of these areas is described in more detail below. A full list of the intertidal biotopes recorded around Alderney is provided in Table B3 in Appendix B and is shown in Figure 12.

Hanaine Bay

Hanaine Bay is located along the west coast of Alderney, adjacent to the Swinge tidal stream and to the south of Fort Clonque and Clonque Bay (Figure 12). The coastline consists of a variety of rocky shore areas, pebbly beaches with small sandy pockets and cliff tops. An intertidal habitat biotope survey (AWTE, 2013a) and intertidal phase II fixed photography monitoring survey (AWTE, 2013f) were undertaken in the summer of 2012. In general, the Hanaine Bay survey area comprised of three substrate types; bedrock, boulders and sands. The upper and mid shoreline height regions comprised of large proportions of bedrock, with the lower shoreline height region consisting of smaller proportions of boulders and sands.

In total 23 intertidal biotopes were recorded during the biotope habitat survey, with the most predominant biotopes recorded identified as stable bedrock with boulders and rocky shorelines. Characterising species within these biotopes were primarily seaweeds or barnacles which can tolerate strong physical factors such as fast flowing tidal conditions, wave action and exposure.

The upper shoreline comprised of biotopes that represented moderate energy types (such as LR.MLR.BF.PelB), lichen types (such as LR.FLR.Lic.YG) and also the ephemeral macroalgae biotope, LR.FLR.Eph.Ent. These biotopes represent low ecological status and are commonly associated with this shoreline height region. In addition, the seaweed biotope LR.MLR.BF.FspiB was recorded within this shoreline height. This biotope is assigned moderate ecological status, which is based on this biotope sustaining high proportions of marine invertebrate species (AWTE, 2012; 2013f).

The mid shoreline height region largely represented high or moderate energy types, such as the high energy barnacle mosaic LR.HLR.MusB.SemSem. This included the moderate ecological status biotope LR.MLR.BF.Fser.R, characterised by *Fucus spiralis*. This biotope is also regarded as moderately important due to this biotope sustaining high proportions of marine invertebrate species (AWTE, 2012). In addition, the invasive macroalgae species *Sargassum muticum* was also recorded as a rock-pool biotope, within this shoreline height (AWTE, 2013f).

The lower shoreline predominately comprised of high and moderate energy biotopes types. This included biotopes such as the red algae biotope LR.HLR.FR.Pal, which is commonly found within intertidal lower shoreline height levels. Two moderately ecologically important biotopes were also identified within this lower shoreline height; LR.MLR.BF.Fser.R and LR.HLR.FR.Coff.Coff. Both biotopes are known to sustain high biodiversity, with LR.HLR.FR.Coff.Coff also providing important food sources (such as amphipods) for intertidal creatures, fish and seabirds (AWTE, 2012; 2013f).

A total of 24 macroalgal species were identified during the Phase II survey throughout the Bay. This included 3 Ascomycota (lichen), 3 Chlorophyta, 8 Phaeophyta and 10 Rhodophyta taxonomic grouped species. Macroalgae species biodiversity and evenness estimates were lowest within the upper and mid shoreline height regions of the Hanaine Bay survey area. This was due to the large proportion of the lichen species *Caloplaca marina*, within the upper shoreline height region. The largest marcroalgal species biodiversity estimates were observed within the lower shoreline height region (AWTE, 2013f).

A total number of 422 faunal individuals were recorded within the Hanaine Bay survey area, including seven molluscan species. Again, the upper shoreline height region consisted of the lowest abundance counts and biodiversity estimates, across the three shoreline height regions of the Hanaine Bay survey area. Faunal species biodiversity estimates were greatest within the mid shoreline height region. Species composition and functional forms showed some differences between the three shoreline height levels. This was due to the dominance of the top shell *Phorcus lineatus* within the upper shoreline height region and the common limpet, *Patella vulgata* within the mid and lower shoreline height regions (AWTE, 2013f).

The South Coast of Alderney

AWTE completed an intertidal biotope survey between August and September 2011 in an area located along the south coast of Alderney, adjacent to the Alderney Race tidal stream (Figure 12). The coastline consists of a variety of rocky shore areas, pebbly and sandy shorelines and also cliff tops.

A total of 28 intertidal biotopes were recorded across the survey area. As observed in Hanaine Bay, the moderately important biotopes characterised by *Fucus serratus*, LR.HLR.FT.FSerTx, LR.MLR.BF.FSerR, LR.MLR.BFFSer.Bo were also observed here. The importance of such biotopes was based on the important role they play on marine invertebrates and in the life of other marine animals.

The common brown seaweed *Himanthalia elongata* biotope (LR.HLR.FR.Him) was identified extending across the lower infra-littoral and sub-littoral environments of the entire survey area. These areas also comprise an element of the locally important Eelgrass biotope (biotope code: SS.SMp.SSgr.Zmar), primarily concentrated between the Frying Pan and Impot areas (AWTE, 2012a). A variety of rockpools, caves and overhangs were also located throughout the survey area, both within the upper and lower shore regions of the intertidal area. These were characterised predominately by opportunistic and invasive seaweed species. This included fresh-water influenced green seaweeds, encrusting algae and the invasive species *Sargassum* *muticum*. Biotopes with moderate importance include those found in the littoral caves or overhangs of the survey area including, LR.FLR.CvOv.AudCla and LR.FLR.CvOv.FaCr. Both biotopes are rare within the British Isles and are under threat from coastal defence building works (AWTE, 2012a). Miscellaneous and unidentified habitats such as artificial sea walls and rock exposures were also identified, predominately around the Cachelier Pier (AWTE, 2012a).

Longis Bay and Associated Areas

Longis Bay is located along the south eastern side of Alderney and is a low lying sheltered bay surrounded by a variety of rocky shore and cliff top areas (Figure 12). An intertidal habitat biotope survey, undertaken in 2010, was completed for Longis Bay and Frying Pan Bay plus the wider coastline from the southern side of the Houmet Herbé fort, extending across all intertidal areas down towards the island's refuse site (known locally as the Impo) (AWTE, 2011). An intertidal Phase II fixed photography monitoring survey, undertaken in 2011, was also completed for Longis Bay and the adjacent Frying Pan Bay only (AWTE, 2012b).

A total number of 49 intertidal biotopes were recorded across the total survey area (AWTE, 2011). The most predominant biotopes recorded within the overall survey area were identified as stable bedrock and rocky shorelines which exhibit high to moderate exposure levels, extending from Houmet Herbé to the start of Longis Bay and also further ranging from Frying Pan Bay to the Impo site area (AWTE, 2011).

Both Longis Bay and Frying Pan Bay survey areas predominately comprised of bedrock and boulder substrates, with Longis Bay also consisting of coarse sand substrates. Within the Longis Bay survey area, a total number of 13 associated biotopes were identified, which consisted of moderately exposed to sheltered biotopes, such as LR.MLR.BF.FspiB and LR.LLR.F.Fserr.X characterised by seaweeds. A locally important eelgrass biotope (biotope code: SS.SMp SSgr.Zmar) was also recorded at the mouth of Longis Bay. The biotope is uncommon within the British Isles and often regarded as being of high or moderately high ecological significance. However, the biotope identified in this survey portrayed some physical damage and sustained smaller proportions of marine life when compared to other known *Z. marina* beds. Therefore the ecological status for this biotope is described as moderate (AWTE, 2011). A total number of 13 biotopes were also identified within the Frying Pan Bay survey area, comprising of more highly exposed biotope types such as LR.HLR.FR.Him and LR.HLR.FR.Mas. Both Bays also consisted of mixed substrate types, lichen types and the cave biotope, LR.FLR.CvOv.AudCla. The cave biotope is regarded as uncommon, with a moderate ecological status across the local, regional and national level (AWTE, 2012b).

A total number of 70 marine algal species and four lichen species were recorded across the full survey site (AWTE, 2011). This included 9 Chlorophyta, 17 Phaeophyta and 44 Rhodophyta algae species respectively. The majority of the algae and lichen identified were either regarded as widespread or common status found throughout the Channel Islands and British Isles. However, a small number of important species were identified within the overall survey area. This included the UK nationally rare red seaweed *Gracilaria bursa-pastoris* and the brown seaweed peacock's tail, *Padina pavonica* (Sanderson, 1996; Wood, 2007).

A total of 16 macroalgal species were identified within Longis Bay with 25 identified within Frying Pan Bay during the 2011 survey. This predominantly included Phaeophyceae and Rhodophyceae taxonomic groups. Overall, the composition of macroalgal species, taxonomic groups and morphological form was similar between both bays, with the opportunistic *Ulva* species and the canopy-forming *Fucus vesiculosus* species common within both Bays. Longis Bay also comprised of species which represent lower shoreline species such as *Mastocarpus stellatus* and *Himanthalia elongate* (AWTE, 2012b). The fucoid biotopes present within the Bays provide vital refuges and 'habitat stepping stones' for local migration and breeding regimes.

A total of 78 marine invertebrate and vertebrate species were recorded across the full survey site (AWTE, 2011). This included 7 sponge, 11 cnidarian, 9 polychaete, 11 crustacean, 20 mollusc, 1 bryozoa, 4 echinoderm and 15 chordate species respectively. The majority of species recorded were either regarded as common or widespread status, located throughout the Channel Islands and British Isles. The rarely recorded yellow sponge *Endectyon delaubenfels*i and the uncommon sea slug *Aplysia depilans* were also recorded within the survey area.

A total of 10 faunal species were recorded across Longis Bay whilst 11 were recorded across Frying Pan Bay, comprising predominantly of molluscan species. Faunal species diversity estimates were also larger in Longis Bay, with both bays comprising of mollusc, barnacle and intertidal worm species. Differences in faunal species composition were found between the two bays, due to the dominance of the common limpet, *Patella vulgata* identified in the Frying Pan Bay whilst Longis Bay also comprised of the topshells; *Osilinus lineatus* and *Gibbula umbilicalis* (AWTE, 2012b).

Commercial fish and shellfish such as the edible crab, *Cancer pagurus*, bass, *Dicentrarchus labrax* and pollack, *Pollachius pollachius* were identified within the survey site. This also included the regionally important green ormer, *Haliotis tuberculata*. Its presence is restricted to the Channel Islands with few recorded in the UK (AWTE, 2011).

Brinchetais Ledge

Brinchetais Ledge is located on the east coast region of Alderney, behind Houmet Herbé fort and adjacent to the Race tidal stream (Figure 12). An intertidal habitat biotope survey (AWTE, 2013c) and an intertidal Phase II fixed photography monitoring survey (AWTE, 2013d) were undertaken in 2012 for the area. The Brinchetais Ledge is a bedrock reef cut through the middle by a strong tidal channel that divides it in two, an inshore section and various offshore rock outcrops.

The Brinchetais Ledge is characterised by a large amount of sediment movement due to the strong scouring processes, limiting the number of species present to those that are sediment tolerant. The ledge provides a vital environment for marine species as well as giving shelter to fish and crustaceans such as lobsters and crabs.

A total of 13 intertidal biotopes were recorded across both the inshore and offshore rock outcrops (AWTE, 2013c). The most predominant biotopes recorded were identified as high energy littoral and infralittoral on stable bedrock and rocky shorelines.

On the inshore reef, the bladder wrack biotope LR.MLR.BF.FvesB dominates higher ground levels. The common brown seaweed *Himanthalia elongata* biotope was identified extending across the most part of the lower infra-littoral and sub-littoral environments. A high density of the seaweed *Bifurcaria bifurcata* was noted on the biotope LR.HLR.FR.Coff.Coff, but not to the extent seen on the offshore reef (AWTE, 2013c). The quadrat survey stations from the fixed photography monitoring survey (AWTE, 2013d) also revealed the presence of the biotope LR.MLR.BF.Fser.R, which is composed of a mixture of the *Phaeophyta* macroalgae species, *Fucus serratus*, and other *Rhodophyta* macroalgae species. Both these biotopes are also regarded as moderately ecologically important as they sustain high biodiversity, and provide important food sources (such as amphipods) for intertidal creatures, fish and seabirds (AWTE, 2012).

The offshore reef was characterised by the presence of large quantities of highly unstable coarse sediment where scour-tolerant species dominate (AWTE, 2013c). The quadrat survey stations within the offshore section predominately comprised of high to moderate energy biotopes and a number of other biotope types (AWTE, 2013d). This included the infralittoral fringe kelp *Saccorhiza polyschides* biotope, IR.HIR.KSed.Sac, which is described as a sand-scoured, kelp dominated environment (AWTE, 2012). This biotope extended across the whole infra-littoral fringe and corresponded to 58% of the overall survey area. This biotope is regarded as uncommon in the UK, mainly due to the physical characteristics associated with it. Although it has not been assigned with an importance status in the British Isles, this biotope is considered of locally moderate importance (AWTE, 2013c).

A total of 21 macroalgal species were identified during the survey of the Brinchetais Ledge survey area, overall (AWTE, 2013d). This included 3 Chlorophyta, 7 Phaeophyta and 11 Rhodophyta taxonomic grouped species. The inshore section consisted of slightly larger estimates of species biodiversity; however macroalgae composition and functional form were generally similar between the inshore and offshore sections of the Brinchetais Ledge survey area due to large proportions of the coralline algae *Lithothamnia* species recorded within both sections. A high density of the seaweed *Bifurcaria bifurcata* was noted on the infra-littoral fringe and infra-littoral zone of the offshore reef characterised by the biotopes *Coralline officinalis* and *Mastocarpus stellatus* on exposed to moderately exposed lower eulittoral rock (LR.HLR.FR.Coff.Coff) on its uppermost level and IR.HIR.KSed.Sac on the lower levels (AWTE, 2013c).

Eight species were recorded within the Brinchetais Ledge survey area, comprising 1 Cnidarian, 1 Crustacean, 1 Poriferan and 5 Molluscan species. The total number of faunal individuals recorded within the inshore and offshore sections was largely comparable. Intertidal faunal species composition differed slightly between the inshore and offshore regions of the Brinchetais Ledge survey area, due to larger proportions of the anemone, *Actinia equina* recorded within the offshore section. The analysis also outlined the overall dominating presence of barnacle species throughout the survey area (AWTE, 2013d).

North of Houmet Herbé

An area north of Houmet Herbé located along the north-east coast of Alderney and extending across all intertidal areas from Fort Houmet Herbé to the bay west of Fort Les was surveyed in 2012 (Figure 12). Both an intertidal habitat biotope survey (AWTE, 2013b) and an intertidal Phase II fixed photography monitoring survey (AWTE, 2013e) were undertaken for the area. This coastline consists of a variety of rocky shores, low cliff tops (lighthouse area), small bays and minor sections of sandy and pebbly shorelines associated with those bays.

In total 29 intertidal biotopes were recorded across the survey area (AWTE, 2013b). The most predominant biotopes recorded were identified as high to moderate energy littoral and infra-littoral on stable bedrock and rocky shorelines. The area also includes two small bays, locally known as St. Esquere Bay and Cats Bay, and a third bay to the west of Fort Les Houmeaux Florains. High to extremely high wave exposure and strong tidal stream conditions were found across some part of the survey area. The three bays show more moderate conditions which allow the appearance of sandy areas within the more sheltered zones.

The quadrat survey stations from the fixed photography monitoring survey (AWTE, 2013e) showed that the upper shoreline comprised of biotopes that represented moderate energy types (such as LR.MLR.BF.PelB), lichen types (such as LR.FLR.Lic.YG) and also sediment biotopes; LS.LCS.Sh.Barsh and LS.LSa.St.Tal. These represent low ecological status and are commonly associated with this shoreline height region. In addition, the *Fucus spiralis* biotope LR.MLR.BF.FspiB was recorded within this shoreline height. This biotope is assigned moderate ecological status, based on this biotope sustaining high proportions of marine invertebrate species (AWTE, 2012).

Quadrat survey stations within the mid shoreline height region represented a wider range of biotopes, including; high to low energy types, rockpools and ephemeral macroalgal dominated habitats (such as LR.FLR.Eph.EphX). This included the moderate ecological status biotopes; LR.MLR.BF.Fser.R, LR.MLR.BF.Fser.Bo and LR.LLR.F.Fserr.X. These biotopes are dominated by the macroalgal *Fucus serratus* and sustain high proportions of marine invertebrate species (AWTE, 2012). In addition, the invasive macroalgae species *Sargassum muticum* was also recorded as a rock-pool biotope, within this shoreline height (AWTE, 2013e).

The lower shoreline predominately comprised of high energy types and other biotopes types. This included biotopes such as LR.HLR.FR.Him (characterised by brown seaweed) and IR.HIR.KSed.Sac (characterised by kelp), which are commonly found within intertidal lower shoreline height levels. Two moderately ecologically important biotopes were also assigned to the quadrat survey stations within this shoreline height; LR.MLR.BF.Fser.R (characterised by *Fucus serratus* seaweed) and LR.HLR.FR.Coff.Coff (characterised by red algae) (AWTE, 2013e). Both biotopes are known to sustain high biodiversity, with LR.HLR.FR.Coff.Coff also providing important food sources (such as amphipods) for intertidal creatures, fish and seabirds (AWTE, 2012).

A total of 33 macroalgal species were identified during the survey. This included 4 Ascomycota (lichen), 4 Chlorophyta, 10 Phaeophyta and 15 Rhodophyta taxonomic grouped species. Macroalgae species biodiversity and evenness estimates across the Houmet Herbé survey area were lowest within the upper shoreline height region, with larger estimates within the mid and lower shoreline heights, respectively (AWTE, 2013e). The composition of the recorded macroalgal species was significantly different between the three shoreline height regions within the Houmet Herbé survey area. This included channelled wrack *Pelvetia canaliculata* recorded within the upper shoreline height region, bladder wrack *Fucus vesiculosus* within the mid shoreline height region and false Irish moss *Mastocarpus stellatus* within the lower shoreline height region. However, comparable estimates of ephemeral green seaweed species such as *Ulva* species were found across all shoreline height regions (AWTE, 2013e).

Sixteen species were recorded across the Houmet Herbé survey area, comprising 1 Chordate, 2 Cnidarian, 1 Crustacean, 11 Molluscan and 1 Poriferan species. The upper shoreline height region comprised of the fewest recorded faunal abundance counts and the lowest biodiversity estimates across the three shoreline height regions overall. The mid shoreline height region showed the largest abundance counts and biodiversity measures across the shoreline height regions. The composition of the recorded faunal species between the shoreline height regions differed within the Houmet Herbé survey area with significant differences between the upper and mid shoreline height regions due to large presence of the top shell *Phorcus lineatus* within the upper shoreline height region, compared to the other shoreline height regions.

Invasive Species

A total of three invasive intertidal and terrestrial species have been outlined for future monitoring practices across Alderney. These include; Slipper limpet (*Crepidula fornicata*), Japanese Seaweed (*Sargassum muticum*) and Hottentot fig (*Carpobrotus edulis*) (AWT, 2012b). *Sargassum muticum* has been recorded within Hanaine Bay, covering an area of 303 m^2, from Fort Houmet Herbe to the rock outcrop west of Fort Hommeaux Florains, covering an area of 53 m^2 and within Longis Bay, covering an area of 1177m^2. During additional observations in 2012, larger estimates of *Sargassum muticum* were noted within Longis Bay, compared to that recorded in the 2010 survey (AWT, 2012b). *Sargassum muticum* was also widely recorded throughout the Seasearch 2007 survey (Wood, 2007). Its fast rate of growth and large size (up to 2m) can cause both clogging of shallow sheltered areas such as harbours as well as outcompeting native seaweeds.

A survey in 2012 also mapped the extent of the invasive species Hottentot fig *Carpobrotus edulis* across Alderney. The survey revealed that a total of 206m^2 of Alderney's coastline is covered in *Carpobrotus edulis*, 2.6% of the island's total area (AWT, 2012b). *Carpobrotus edulis* is an invasive species originating from South Africa; it directly competes with other plants for water, nutrients and light, often outcompeting and smothering surrounding species (Leakhena, 2000). The plant is also very tolerant of salt spray and a high soil salinity (Tanji *et al*., 2007).

Although, it has not yet been recorded, there is also the potential for the slipper limpet (*Crepidula fornicata*) to occur in Alderney and as such it has been included as a target species to monitor in the Alderney West Coast and Burhou Islands Ramsar Site Management Strategy (AWT, 2012a, b).

During the 2007 Seasearch survey a number of introduced seaweed species were also recorded. These included the red seaweed *Asparagopsis armata* which was widely and commonly recorded around Alderney (Wood, 2007). This species has barbed branches and attaches to and becomes entangled with, other seaweeds. Another introduced species, the red algae *Heterosiphonia japonica,* was found in the drift in Braye harbour. It has previously been recorded on Guernsey. Conversely, thriving populations of the small green seaweed *Codium tomentosum* were observed. This is the native species which has been replaced by the invasive green sea finger *C. fragilis* at many sites on the English south coast.

5.1.1.3 Future baseline

Climate change presents various pressures to benthic habitats in terms of the likely increase in sea level rise (see Section 4.2.1.3). Along Alderney's coast, these changes could potentially lead to a reduction in intertidal habitat due to coastal squeeze in areas where hard sea defences and/or military defences back some of the bays (e.g. Longis Beach), which will have implications for associated benthic intertidal communities. In addition, climate change could lead to potential changes in water temperature and an elevated threat from invasive non-native species. The introduction and establishment of non-native species may also have future impacts on the ecology with species competing for food and space with indigenous organisms.

5.1.1.4 Limitations and data gaps

A large number of existing relevant baseline studies of intertidal and subtidal species and habitats exist for the waters around Alderney. The intertidal surveys are concentrated along the southern coast of Alderney where it is presumed any cable landings would interact with this habitat. It is assumed that intertidal habitats and species along the north coast of Alderney would be similar to those observed on the south coast as both sides of the island experience similar physical forcing characteristics. Due to the importance of some of the benthic species recorded at Alderney, additional sampling/survey of both intertidal and subtidal areas may be beneficial to identify and map the distribution of these rare species.

The Agence des Aires Marines Protégées will be publishing the results of a major program to map the marine habitats in French waters, called CARTographie des HAbitats Marins (CARTHAM[3]), in the first half of 2014. This study could provide complementary information on the characterisation and distribution of habitats in the French part of the Race.

The monitoring requirements for benthic marine survey at the EIA project-level will need to be considered by individual developers, particularly in areas where there is a paucity of data. It is important to note that the Alderney Wildlife Trust has recommended that a 3-year programme of ecological baseline information would be required to inform an assessment at the project-level. Examples of the specialist surveys which may be required to support the EIA include:

- Benthic grab samples for faunal and sediment analysis;
- Videos/photography surveys;
- Trawling surveys;

[3] http://cartographie.aires-marines.fr/?q=node/43&page=1

- Acoustic mapping (e.g. multibeam acoustic ground discrimination systems or sidescan data acquisition);
- Diver sampling;
- Intertidal Phase 1 habitat mapping techniques; and
- Intertidal quadrat sampling.

The developer will also need to consider the appropriate spatiotemporal scales of any proposed surveys and the potential difficulties of surveying in strong hydrodynamic environments. It is recommended that any survey methodology is discussed and agreed with relevant stakeholders (e.g. AWT) and regulators (i.e. the Commission) prior to any works.

5.1.1.5 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. It is therefore recommended that, at a minimum, the near-field study area include all of Alderney's territorial waters and the interconnector cable route, with the far-field incorporating at least one tidal ellipse excursion from these boundaries. Regional scale modelling indicates that mean tidal excursions of greater than 30 km can be expected (ABPmer, 2008). The wider study area shown on Figure 2 encompasses these wider-scale boundaries.

5.1.2 Impact Assessment

The Draft Plan has the potential to affect the benthic ecology of the study area through a number of impact pathways which are assessed in the following sections:

- Toxic Contamination (Spillage) (Section 5.1.2.1);
- Direct Loss and/or Damage to Benthic Habitats (Section 5.1.2.2);
- Non-Toxic Contamination (Section 5.1.2.3);
- Toxic Contamination (Sediment Release) (Section 5.1.2.4);
- Potential for Non-Native Species Introductions (Section 5.1.2.5); and
- Introduction of New Structures (Section 5.1.2.6).

A number of species and habitats exist in the waters around Alderney which are listed as having important conservation value under UK and EU Directives (see Table B2 in Appendix B). Although these are not afforded protection in Alderney, given that the Commission is committed to adopting best UK practice, their overall importance in terms of ecological structure and function is considered to be low to moderate.

5.1.2.1 Toxic contamination (spillage)

Benthic habitats are likely to be sensitive to toxic contamination brought about by the release of synthetic contaminants such as fuels, oils, construction material from the survey, construction, decommissioning and maintenance associated with the all marine and intertidal elements of the Draft Plan (see Section 4.3.2.1). The sensitivity to toxic contamination varies between species and the type of spillage. For example, both eelgrass and the common limpet are considered moderately sensitive to synthetic compound contamination. However, for heavy metal contamination eelgrass is considered to have a very low sensitivity whereas the sensitivity of the common limpet is moderate (Tyler-Walters, 2008; Hill, 2008). Across the key species that are found to occur in the study area, the overall sensitivity to any toxic contamination is considered to range from low to moderate.

Renewable energy devices have no planned discharges (DECC, 2009) and the probability of substantial spillage such as large amounts of oil or hydraulic fluids entering the environment as a result of a major structural failure or spill is considered to be low. In the unlikely event of any toxic contamination entering the environment it is considered likely to be dispersed and degraded very quickly by the strong hydrodynamic conditions generally found around Alderney, before reaching the seabed and affecting benthic ecology. Overall, exposure to change is considered to be negligible to low (Section 4.3.2.1), resulting in an **insignificant to minor adverse** impact.

5.1.2.2 Direct loss and/or damage to benthic habitats

Benthic habitats are sensitive to direct physical loss and/or damage where permanent or temporary structures are introduced as part of the Draft Plan, including the bases for tidal stream turbines, cable routeing and offshore substations during construction, operation and decommissioning. Their sensitivity is considered to be higher in areas of seabed that will be permanently lost. In areas that will be temporarily damaged, their sensitivity may be lower given that some species are able to re-colonise the area in the short to medium term, depending on the level of damage and degree of recoverability of specific species. The pink seafan, for example, is considered moderately sensitive to physical disturbance and displacement whereas the yellow staghorn sponge is considered to have a high sensitivity (Hiscock, 2007; Jackson, 2008). Across the key species that are found to occur in the study area, the overall sensitivity is considered to range from low to high.

The level of exposure to this impact pathway is dependent on a range of factors such as the habitat type, the extent of habitat affected, the location and the nature of activities and whether they are temporary or permanent. Given that the marine and intertidal habitats that are found in Alderney's waters are widespread, and the overall footprint of change on the seabed of a single array and associated infrastructure is considered to be relatively minor, the exposure to change is considered to be low to moderate, resulting in an **insignificant to moderate adverse** impact for all stages of development, except decommissioning where exposure to change is considered low and therefore resulting in an **insignificant to minor adverse** impact.

A full build out of the Draft Plan, however, will result in the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2). Given that each licence block can hold a maximum of 207 tidal devices (see Section 1.2.2), and assuming the whole block can be utilised to exploit the tidal resource of Alderney's territorial waters, this would cover a minimum of 20 licence blocks (equivalent to approximately 69km^2). Assuming the OpenHydro turbine is exclusively used (see Section 1.2.2), this would result in approximately 3.1km^2 of seabed habitat being lost under the footprint of all the turbines (representing approximately 4% of the licence blocks). In terms of intra- and inter-array cabling, if cable protection (i.e. concrete mattressing) were required along their entire length, approximately 1.8km^2 of existing seabed habitat would be lost (representing approximately 3% of the licence blocks). The cable protection associated with the export cable between Alderney and France would result in an additional 0.15km^2 of habitat loss per cable that needs to be layed (see Section 2.2.2). Overall, the full build out of the Draft Plan is considered to result in a high level of exposure to change and a **moderate to major adverse** impact.

5.1.2.3 Non-toxic contamination

The increases in suspended sediments from construction and decommissioning activities associated with tidal stream turbines, cable routeing and offshore substations typically result in short-term, localised changes to the marine environment (see Section 4.3.2.2). In the event of substantial resuspension, the potential exists from the settlement of materials to cause a smothering of the seabed. The sensitivity to non-toxic contamination varies between species. For example the pink sea fan is considered to have low sensitivity to an increase in suspended sediment (Hiscock, 2007). Across the key species that are found to occur in the study area, the overall sensitivity is considered to range from low to moderate.

For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low to medium (Section 4.3.2.2). The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection in areas where the cable cannot be buried. Overall, therefore, the level the exposure to change is negligible to low (Section 4.3.2.2). Overall, the impact to benthic ecology is considered to be **insignificant to moderate adverse** depending on the relative sensitivity of species.

5.1.2.4 Toxic contamination (sediment release)

Intertidal and subtidal habitats are likely to be sensitive to any toxic contamination that is released during the disturbance of seabed material during construction and decommissioning activities. As previously discussed, the sensitivity to toxic contamination varies between species and overall sensitivity is considered to be low to moderate (see Section 5.1.2.1). Overall, it is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low (Section 4.3.2.3). For cable routeing the exposure to change is considered to be low (Section 4.3.2.3). The impact to benthic ecology is, therefore, **insignificant to minor adverse**.

5.1.2.5 Potential for non-native species introductions

The introduction of new surfaces in the form of new tidal stream turbines, offshore substation bases and cable armouring (or the clearing of seabed habitats to allow the introduction of these components) has the potential to facilitate the encroachment of invasive non-native species. This is because they will be initially barren with no competition from indigenous species which could allow invasive non-native species to potentially colonise these surfaces. This is based on the assumption that the current spread of such species is limited by the prevailing physical regime and lack of new colonising substrata. The species composition and the rate of colonisation will depend upon the location of the structure, time of year and the availability of larval/juvenile stages. Benthic species are considered to have a low to moderate sensitivity to this impact pathway. Alderney waters are considered highly dynamic and therefore the overall potential exposure to change as a result of a single array and associated infrastructure is considered to be low, resulting in an insignificant to minor adverse impact.

A full build out of the Draft Plan, however, will result in the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2). Assuming the OpenHydro turbine is exclusively used (see Section 1.2.2), this would result in approximately 3.1km^2 of new artificial substrate being introduced into the marine environment with the potential to be colonised by non-native species. In terms of intra- and inter-array cabling, if cable protection (i.e. concrete mattressing) were required along their entire length, approximately 1.8km^2 of new substrate would be introduced to the seabed. The cable protection associated with the export cable between Alderney and France would result in an additional 0.15km^2 of new substrate for each cable that needs to be layed (Section 2.2.2). Overall, the full build out of the Draft Plan is therefore considered to result in a moderate level of exposure to change and an insignificant to moderate adverse impact.

5.1.2.6 Introduction of new structures

In designing the bases for devices and substations, or the armouring for cable, the potential exists for the structures themselves to become suitable surfaces for the settlement of reef forming species and thus there could be impacts during both the initial installation and at the decommissioning phase. In addition, cables may be allowed to 'self-bury' over time in soft sediments, thus changing the amount of available hard substrate through time. Wilson *et al*. (2010) noted in reviewing offshore windfarms that the marine system is able to adjust to new structures in the sea, and that these devices may even have the potential to act as a benefit to their receiving environment. Work has shown how scour protection and towers may create hard substrata and thus act as artificial reefs, thereby increasing primary production and creating organic material and enrichment of the local marine environment. However, this potential benefit will need to be studied in greater detail as part of project-level impact assessments. Overall, the sensitivity of benthic species to this impact pathway is considered to be low to moderate and the level of exposure to change is considered to be low, resulting in an insignificant to minor adverse impact.

5.1.2.7 Mitigation

The following mitigation works should be considered by the developer, as appropriate, to minimise any potentially significant impacts (i.e. moderate or major) on benthic ecology that have been identified in this REA:

- Reduction in the number of tidal devices and associated cables in order to minimise the area of substratum loss and/or damage; and
- Avoid any sensitive habitats (e.g. eelgrass beds) at the project planning and design phase. With a potential full build out of the Draft Plan, there will still be approximately 97% of the seabed across all the licence blocks available for micro-routeing (see Section 5.1.2.2). Such micro-routeing may need to be considered further at the EIA project-level by the developer.

5.1.2.8 Residual impact

The mitigation measures identified in Section 5.1.2.7 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on benthic ecology as the extent of mitigation achievable will be heavily dependent on many project specific factors. The significance of potential residual impacts have been estimated and summarised in Table 12.

5.1.2.9 Summary

Table 12. Assessment of the potential effects of the Draft Plan on benthic ecology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
	Construction	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	L-M	Insignificant to moderate	Section 5.1.2.7	Insignificant to minor
	Operation	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Introduction of new structures	L	L-M	L-M	Minor/ insignificant	-	-
	Decommissioning	Direct loss and/or damage to benthic habitats	L	L-H	L-M	Minor/ insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	N-L	L-M	L-M	Minor/ insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L	L-M	L-M	Minor/ insignificant	-	-
Cable Routeing	Survey	Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
	Construction	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	L	L-H	L-M	Minor/ insignificant	-	-
		Toxic contamination (sediment release)	L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	L-M	Insignificant to moderate	Section 5.1.2.7	Insignificant to minor
	Operation	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Introduction of new structures	L	L-M	L-M	Minor/ insignificant	-	-
	Decommissioning	Direct loss and/or damage to benthic habitats	L	L-H	L-M	Minor/ insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	L	L-H	L-M	Minor/ insignificant	-	-
		Toxic contamination (sediment release)	L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L	L-M	L-M	Minor/ insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Offshore Substations	Survey	Toxic contamination (spillage)	L	L-M	L-M	Minor/ insignificant	-	-
	Construction	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	N-L	L-M	L-M	Minor/ insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	L-M	Insignificant to moderate	Section 5.1.2.7	Insignificant to minor
	Operation	Direct loss and/or damage to benthic habitats	L-H	L-H	L-M	Insignificant to major	Section 5.1.2.7	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Introduction of new structures	L	L-M	L-M	Minor/ insignificant	-	-
	Decommissioning	Direct loss and/or damage to benthic habitats	L	L-H	L-M	Minor/ insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Non-toxic contamination	N-L	L-M	L-M	Minor/ insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	L-M	Minor/ insignificant	-	-
		Potential for non-native species introductions	L	L-M	L-M	Minor/ insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

5.2 Pelagic Ecology

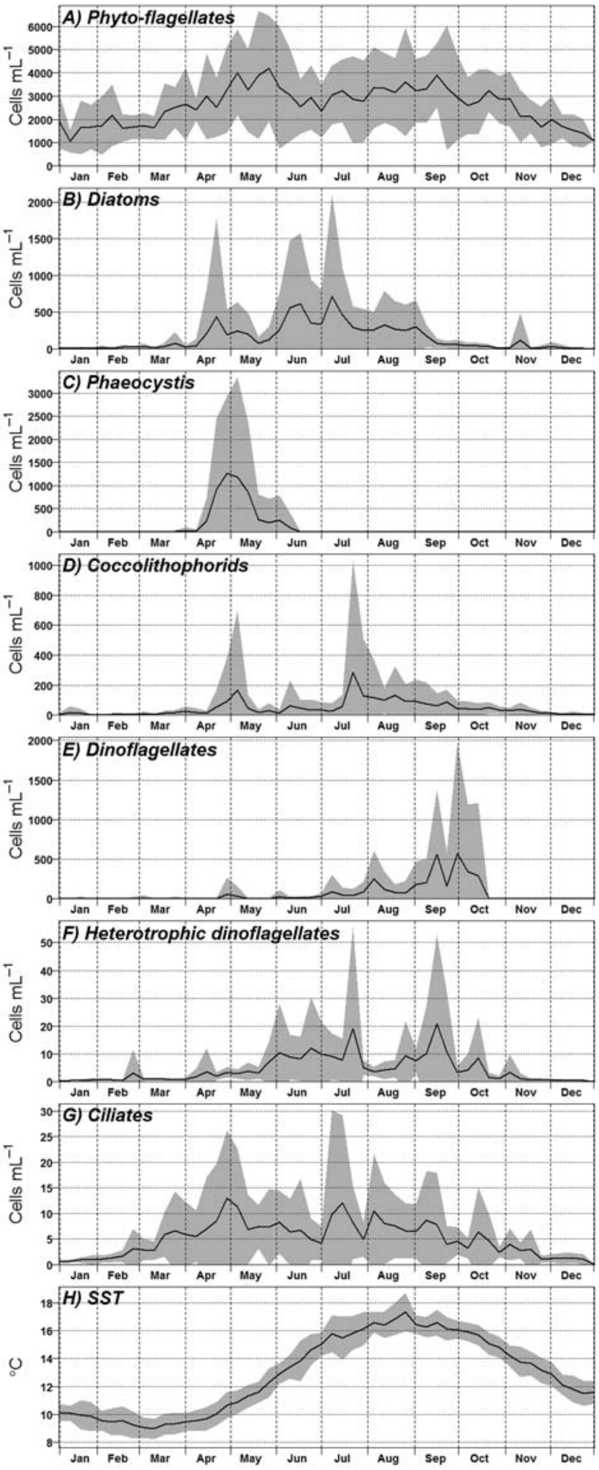
5.2.1 Baseline Description

There is very limited published information relating to the pelagic ecology of Alderney waters; however, the area is likely to be similar to other parts of the south-west approaches which are well documented. Alderney is situated at the boundary of two converging marine biogeographical regions: warmer waters typical of southern Europe and colder waters of the United Kingdom and the North Sea (GREC, 2011). Thus, plankton community dynamics in the western English Channel are likely to be strongly influenced by the resultant water characteristics and other physical parameters of the region.

Plankton data from a long term time-series conducted at the L4 station (50.258N, 04.218W, Figure 13) can be used to broadly characterise the plankton community of the western approaches and Alderney area as it follows the typical pattern of temperate waters. Station L4 is located 10km south of Plymouth on the south coast of the United Kingdom, with a water depth of approximately 50 m. The spring diatom bloom is clearly evident at this site, occurring between April and June (San Martin, 2005). It is closely followed by the development of a prominent summer phytoplankton bloom, including the "red-tide" dinoflagellate *Karenia mikimotoi* (formerly known as *Gyrodinium aureolum*) (Rodriguez *et al*., 2000). In fact, monospecific blooms of *K. mikimotoi* in the western English Channel have been found to represent chlorophyll *a* levels of up to 100 mg m^{-3} and cell numbers in millions L^{-1} (Holligan, 1979; Vanhoutte-Brunier *et al*., 2008).

In terms of overall phytoplankton abundance, an average (mean) of 2,594 phyto-flagellate cells ml^{-1} were recorded at the L4 site using data collected between 1992 and 2007 (Image 3); this accounted for 86.98% of the total phytoplankton pool (Widdicombe *et al*., 2010). Picoplankton and flagellates are thought to show a distinct seasonal pattern at the site, contributing the majority of overall phytoplankton biomass during late autumn and winter. On the other hand, coccolithophores and ciliates showed little seasonality during this period. The coccolithophore *Emiliania huxleyi* bloomed towards the late summer (July/August, ~100 cells ml^{-1}) with low numbers recorded throughout the study period (<10 cells ml^{-1}) (Widdicombe *et al*., 2010).

An investigation at a site off Roscoff in northern France (July 2000 to September 2001), of similar proximity to Alderney as Station L4 (Figure 13), has suggested the chlorophyte (green algae) *Micromonas pusilla* dominates the picoplanktonic (0.2-3 µm) community throughout the year (Not *et al*. 2004). Another study by Masquelier *et al.* (2011) also recorded high numbers of *M. pusilla*, but also suggested that large chain-forming diatoms (*Guinardia flaccida*, *G. delicatula*, and *G. striata*) were the dominant species in the English Channel during June/July 2007, with relatively few dinoflagellates present (e.g. *Prorocentrum* spp.). The report also highlighted that the genera *Chaetoceros* and *Guinardia* were the main microphytoplankton sampled in the rich and well-mixed waters of the English Channel (Masquelier *et al*., 2011), typical of that time of year (Jouenne *et al*., 2007).

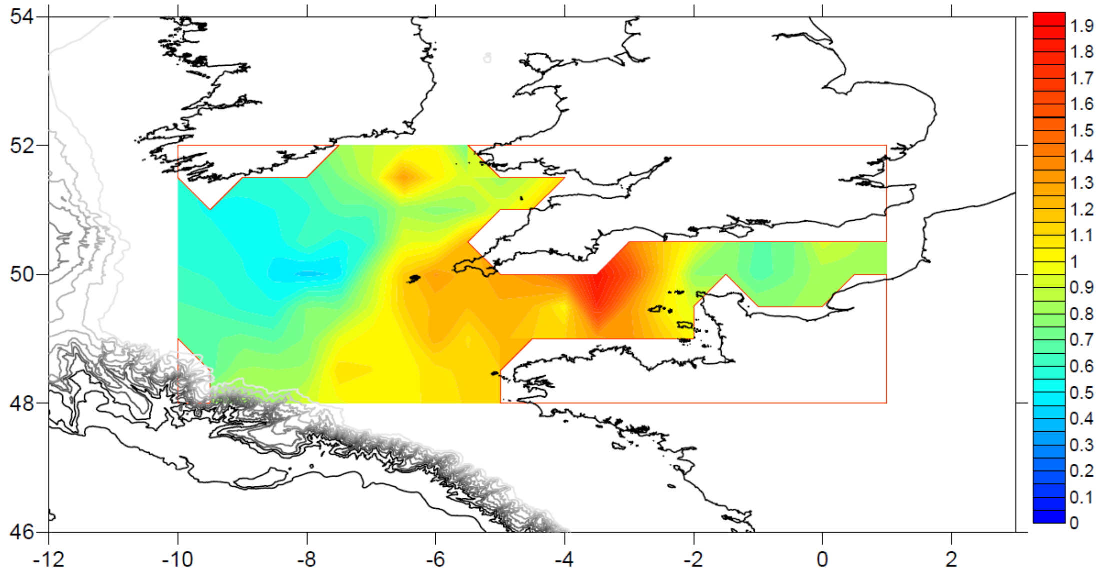


(Figure from Widdicombe *et al*., 2010)

Black line and shaded area represents average and standard deviation in abundance, respectively, over the 15-year time-series (1992-2007).

Image 3. Seasonal patterns in mean monthly abundance (cells ml^{-1}) of (A) phyto-flagellates, (B) diatoms, (C) *Phaeocystis*, (D) coccolithophorids, (E) dinoflagellates, (F) heterotrophic dinoflagellates, (G) ciliates and (H) weekly average of sea surface temperature (SST)

Between 1988 and 2007, copepods (Crustacea) represented 62% of the total zooplankton abundance at Station L4 (Eloire *et al*., 2010). The rest included pelagic larval stages of organisms living mainly on the benthos (i.e. the meroplankton), as well as other predatory zooplankton. The abundance of many species of meroplankton at Station L4 have been found to exhibit annual and seasonal variability, with Cirripedia (barnacles) typically the most abundant group in March and April, Echinodermata (e.g. sea stars, sea urchins, sea cucumbers) in August and Lamellibranchiata (e.g. oysters, mussels, cockles) in September and October (Highfield *et al*., 2010). One direct physical control on planktonic larval abundance is the naturally occurring North Atlantic Oscillation (NAO), which influences wind, sea temperature and other climatic factors (Beaugrand *et al*., 2000; Irigoien *et al*., 2000).



(Figure from Johns, 2008)

Image 4. Contour map of Phytoplankton Colour Index (PCI), showing regional variations in the SEA 8 area

Although no specific local information is currently available, some limited regional information on planktonic communities is provided in the Strategic Environmental Assessment (SEA) 8 area report on plankton (Johns, 2008, and Image 4). Alderney is located on the boundary of a productive frontal area, with relatively lower productivity suggested in the Celtic Sea and towards the eastern English Channel (Image 4). Large scale phytoplankton blooms take place during the summer months (i.e. July to August) in the western English Channel, with chlorophyll concentrations as high as 40 mg m^{-3} (Garcia-Soto and Pingree, 2009). Amongst the most commonly occurring phytoplankton species (i.e. those found in the most number of samples) from the overall SEA 8 area are the following (Johns, 2008):

- *Thalassiosira* spp. (19.44%; diatom);
- *Rhizosolenia alata* (14.84%; diatom);
- *Ceratium fusus* (14.27%; dinoflagellate);
- *Thalassionema nitzschoides* (13.57%; diatom); and
- *Ceratium tripos* (10.49%; dinoflagellate).

In terms of zooplankton, the most common species or genus in the Western section of the English Channel are the following (Johns, 2008):

- *Temora longicornis* (copepod; Crustacea);
- *Calanus helgolandicus* (copepod; Crustacea);
- *Para-pseudocalanus* spp. (copepod; Crustacea);
- Decapoda larvae (e.g. crabs, lobster and shrimps; Crustacea);
- Chaetognatha (phylum, also known as "arrow worms");
- *Acartia* spp. (copepod; Crustacea); and
- Cirripede larvae (e.g. barnacles; Crustacea).

5.2.1.1 Future baseline

Major changes have taken place in plankton of the seas around the British Isles over the last few decades (Edwards *et al*., 2010). They include the important decadal climate indicator for the North Atlantic, the North Atlantic Oscillation (NAO), has been generally rising (with occasional negative NAO years) along with Northern Hemisphere Temperatures over the past 30 years and the surface waters of the European Continental shelf have been warming. This has caused extensive changes in the planktonic ecosystem in terms of plankton production, biodiversity, and species distribution which have had effects on the marine food-web and on other trophic levels (e.g. fish, seabirds) through bottom-up control.

Future warming is likely to alter the geographical distribution of primary and secondary pelagic production, affecting ecosystem services such as oxygen production, carbon sequestration and biogeochemical cycling. These changes may place additional stress on already-depleted fish stocks as well as have consequences for mammal and seabird populations. Ocean acidification may also become a problem in the future and both phytoplankton and zooplankton living in the upper water column may be vulnerable to ocean acidification, although results so far have shown there is high species-specific variability.

5.2.1.2 Limitations and data gaps

There are no existing survey records of the planktonic community around Alderney that may be affected by the Draft Plan. Plankton is considered to be widespread across the wider study area. Additionally, water quality is not considered a significant issue and therefore at the EIA project -level it is likely pelagic ecology can be scoped out.

5.2.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. It is therefore recommended that, at a minimum, the near-field study area includes all of Alderney's territorial waters and the interconnector cable route, with the far-field incorporating at least one tidal ellipse excursion from these boundaries. Regional scale modelling indicates that mean tidal excursions of greater than 30 km can be expected (ABPmer, 2008). The wider study area shown on Figure 2 encompasses these wider-scale boundaries.

5.2.2 Impact Assessment

The Draft Plan has the potential to affect the pelagic ecology of the study area through a number of impact pathways which are assessed in the following sections:

- Toxic Contamination (Spillage) (Section 5.2.2.1);
- Non-Toxic Contamination (Section 5.2.2.2); and
- Toxic Contamination (Sediment Release) (Section 5.2.2.3).

Plankton has a relatively high tolerance to the above impact pathways and, therefore, sensitivity is considered to be low throughout this assessment. Pelagic ecology is considered to be a key component of the marine food web and in turn of importance to higher trophic levels that may be protected (e.g. migratory fish species and marine mammals). Given that plankton are widespread within and outside of the marine study area their overall importance is considered to be low in the assessment.

5.2.2.1 Toxic contamination (spillage)

Pelagic ecology is sensitive to toxic contamination such as any potential oils spills during the construction and decommissioning phases of the tidal stream turbines, cable routeing and the offshore substations, due to any adverse water quality effects. There are a range of contamination sources from marine renewables and associated infrastructure, including anti-fouling paints and sacrificial anodes and the accidental leakage of fluids and/or spillage fuels or cargo from vessels (Scottish Executive, 2007). The quantities and toxicities associated with sacrificial anodes and antifouling coatings are generally expected to be extremely small, and it is therefore considered that the level of exposure will be negligible. It is not possible at the REA plan-level to make any realistic estimate of the geographical extent of this impact due to the large numbers of variables involved. Accidental leakage of hydraulic fluids may be more significant, should they occur through storm damage, device malfunction or collision with navigating vessels. The probability of substantial spillage occurring and the overall level of exposure to change is considered to be negligible too low for all phases and developments, resulting in an **insignificant** impact. In the unlikely event of an incident, best practice measures put in place to manage potential water quality impacts (see Section 4.3.2.1), such as the use of oil spill action plans, would contain the spillage and prevent substantial effects.

5.2.2.2 Non-toxic contamination

The increases in suspended sediments from the construction and decommissioning activities associated with renewable energy devices, cable routeing and offshore substations may result in short-term, localised changes to the marine environment. Substantial increases in turbidity may reduce the level of primary productivity in the waters affected, due to reduced light levels in the water column; with direct effects on pelagic ecology. Given that the waters of Alderney are highly dynamic and the majority of seabed sediments are relatively coarse-grained, the suspended sediments are likely to be rapidly dispersed and reduced to low levels as sediments re-settle on the seabed (see Section 4.3.2.2). For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low resulting in an insignificant impact. The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection in areas where the cable cannot be buried. Overall, therefore, the level the exposure to change is negligible to low, resulting in an insignificant impact.

5.2.2.3 Toxic contamination (sediment release)

In areas being excavated or disturbed for the installation/removal of tidal stream turbines, cables or offshore substations there will be an increase in suspended sediment concentrations during the period of the activity. Where this occurs then the potential also exists for the mobilisation and release of sediment-bound contaminants into the water column. However, as outlined in water quality (Section 4.3.2.3) and sediment contamination is considered only likely to be evident in areas close to the coastline of industrial locations or in coastal areas where water and sediments have been subject to historical contamination. . Furthermore, the majority of seabed sediments in Alderney waters are coarse-grained (see Section 4.1), and the levels of sediment-bound contaminants associated with these are likely to be negligible. Overall, it is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low, resulting in an insignificant impact. For cable routeing the exposure to change is considered to be low, resulting in an insignificant impact.

5.2.2.4 Mitigation

Given that none of the impacts on pelagic ecology are significantly adverse (i.e. moderate or major), no mitigation measures are considered to be necessary.

5.2.2.5 Residual impact

Given that no mitigation measures are required for pelagic ecology, the residual impact has not been assessed. The significance of potential impacts has been estimated and summarised in Table 13.

5.2.2.6 Summary

Table 13. Assessment of the potential effects of the Draft Plan on pelagic ecology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L	L	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L	L	Insignificant	-	-
Cable Routeing	Survey	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	L	L	L	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	L	L	L	Insignificant	-	-
Offshore Substations	Survey	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Construction	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L	L	Insignificant	-	-
	Operation	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
	Decommissioning	Toxic contamination (spillage)	N-L	L	L	Insignificant	-	-
		Non-toxic contamination	N-L	L	L	Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L	L	Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

5.3 Fish and Shellfish

5.3.1 Baseline Description

There is a diverse array of demersal and pelagic fish and crustacean shellfish in Alderney waters. Twenty-seven species of fish have been recorded during Seasearch surveys (Wood, 2010), including: conger eel *Conger conger*, European eel *Anguilla Anguilla*, pollack *Pollachius pollachius*, bib *Trisopterus luscus*, poor cod *Trisopterus minutus*, bass *Dicentrarchus labrax*, red mullet *Mullus surmuletus*, grey mullet *Mullidae*, wrasse (rock cook *Centrolabrus exoletus*, corkwing wrasse *Crenilabrus melops*, goldsinny *Ctenolabrus rupestris*, ballan wrasse *Labrus bergylta*, cuckoo wrasse *Labrus mixtus*), blennies (shanny *Lipophrys pholis*, tompot blenny *Parablennius gattorugine*, black faced blenny *Tripterygion delaisi*), lesser sand eel *Ammodytes tobianus*, dragonet *Callionymus lyra*, gobies (giant goby *Gobius cobitis*, rock goby *Gobius paganellus*, two spot goby *Gobiusculus flavescens*, small gobies *Pomatoschistus* spp., leopard spotted goby *Thorogobius ephippiatus)* and topknot *Zeugopterus punctatus*. Of these species, the red mullet and the black-faced blenny are considered to be rare or scarce in UK waters (Wood, 2007) and the European eel is a UK BAP priority fish species.

Shellfish recorded during Seasearch surveys in Alderney Waters (2007, 2008, 2010) included: shrimps and prawns *Palaemonidae*, lobster *Homarus gammarus*, squat lobsters *Galathea*, edible crab *Cancer pagurus*, spiny spider crab *Maja squinado*, spindly spider crab *Inachus* sp., velvet swimming crab *Necora puber*, shore crab *Carcinus maenas*, king scallop *Pecten maximus*, cuttlefish *Sepia officinalis* and squid *Loliginidae*. However, the Seasearch surveys only recorded these species as a by-product of their primary objective so there is considered to be limited value in these data (Alderney Wildlife Trust pers. comm., June 2013).

Many of the fish and shellfish species noted above are also of commercial importance (also see Section 7.2, Commercial and Recreational Fisheries). Other commercially important fish species present in Alderney waters include black bream *Spondyliosoma cantharus*, gurnard (species not specified), john dory *Zeus faber*, brill *Scophthalmus rhombus*, mackerel *Scomber scombrus*, cod *Gadus morhua*, ling *Molva molva* and plaice *Pleuronectes platessa*. Unusual fish species caught by commercial and recreational anglers in the Bailiwick of Guernsey between 2010 and 2011 include megrim *Lepidorhombus whiffiagonis*, Atlantic saury *Scomberesox saurus*, couch's sea bream *Pagrus pagrus* (now commonly caught in Guernsey waters), Atlantic bonito *Sarda sarda*, Cornish blackfish *Schedophilus medusophagus* (first record of species in Guernsey waters), salmon trout *Salmo trutta*, marbled electric ray *Torpedo marmorata* and an unusual bream which was probably a two-banded bream *Diplodus vulgaris* (Guernsey Sea Fisheries Section, 2010; 2011). In addition the critically endangered common skate *Dipturus batis* and the thornback ray *Raja clavata* are noted to be present within Alderney South Banks Subtidal Sandbank (see Section 5.6.1).

Fifteen species of elasmobranch have been recorded from the English Channel (Ellis *et al*., 2005). Elasmobranch species recorded in Seasearch surveys or caught within Alderney waters by the commercial fishing fleet include: lesser-spotted catshark *Scyliorhinus canicula*, tope *Galeorhinus galeus*, thornback ray *Raja clavata*, porbeagle *Lamna nasus*, smoothound *Mustelus mustelus*, blue shark *Prionace glauca*, and thresher shark *Alopias vulpinus* (Wood, 2010; ACRE supplied data, February 2013).

In the wider study area, four ray species are commonly caught in Jersey waters: blonde ray *Raja brachyura*, small-eyed ray *Raja microocellata*; thornback *Raja clavata* and undulate ray *Raja undulata*. A tag and recapture study of small-eyed, blonde and undulate rays conducted in Jersey showed that the majority of recaptured rays (17% of the total tagged) were caught around Jersey (within 20 km of the original tag and release site), although some were taken from Guernsey and Sark and two were caught along the French coast. The maximum distance travelled by a recaptured skate was 61 km (blonde ray moving from St Aubin's Bay on Jersey's south coast to the Bay of St-Brieuc (France). No recaptures were reported from outside the Normano-Breton Gulf (Ellis *et al.*, 2010). An acoustic tagging study conducted on a small number of small-eyed and blonde rays captured within 500 m of Portelet Bay on the south coast of Jersey suggested that the rays occasionally returned to the bay for short periods during movements over a wider area although the study was not able to determine the range of the rays' movements when not present in the Bay (Morel *et al.*, 2012).

Basking sharks *Cetorhinus maximus* have been recorded around Alderney within the 12 nm limit (Bloomfield and Solandt, 2008), although the total number of sightings (between 1987 and 2006) is relatively low compared to the southwest of England. In the wider area, Brittany has been described as a 'hot-spot' for surface sightings of basking sharks (OSPAR, 2009) and the waters around the Channel Islands could form part of their migratory route as they travel from Plymouth to waters off north-west Brittany (Sims *et al*., 2005 cited in ARE, 2011). The entrance to the Casquets Traffic Separation Scheme in the English Channel (see Section 7.3.1) has been reported to have 'high basking shark activity' (OSPAR, 2009). In 2004, an estimated 70 basking sharks were reported off the Hurd Deep (north of Alderney), 3-4 miles north-west of Les Casquets lighthouse (GREC, 2011 and references therein).

Of the elasmobranch species recorded in the study area, tope, porbeagle, blue shark and basking shark are UK BAP priority species.

Migratory Diadromous Fish

No information was found relating to the movements of migratory diadromous fish species in and through Alderney waters. There are sites in the wider study area, on the French coast, that are designated for such features, including Atlantic salmon, European brook, river and sea lamprey and twaite and allis shad, and these are detailed in the Nature Conservation Section (Section 5.6).

Spawning and Nursery Areas

The wider study area has been identified as a high intensity spawning ground for sole *Solea solea* and plaice, a low intensity spawning ground for sole, sandeel *Ammodytidea* spp., mackerel, cod and horse mackerel *Trachurus trachurus* and a low intensity nursery ground for undulate ray, anglerfish *Lophius piscatorius* and mackerel (Ellis *et al*., 2012). Of these species mackerel, cod, ling, sole, horse mackerel and anglerfish are covered by the UK BAP commercial marine fish grouped plan and undulate ray is a UK BAP priority species.

A tag and recapture study of small-eyed, blonde and undulate rays conducted in Jersey indicated the potential importance of St Aubin's Bay (southern coast of Jersey) for undulate ray and blonde ray and the importance of Jersey's coastal zone for most life stages of blonde rays, including secondary nursery grounds.

Further information on commercially important fish and shellfish spawning and nursery grounds and seasonal migratory movements in Guernsey Waters is provided by the Guernsey Renewable Energy Commission (GREC) Regional Environmental Assessment for Marine Energy (GREC, 2011). The REA states that Guernsey Waters are spawning areas for seabass, sprat, black sea bream and that water to the east of Guernsey are a spawning area for sole. A tagging study indicated that the bass fishery was composed of adults that spent the spring and summer months in the Eastern English Channel and southern North sea, returning to the western English Channel in late autumn and winter to spawn. There is an important pre-spawning/spawning ground for the bass centred around the Boue Blondel and associated reefs off the west coast of Guernsey (within 3 nm of the coast) between November and March, although it is not known whether the fish actually spawn there or use the area as a feeding ground prior to spawning. Spawning takes place in March (GREC, 2011). Guernsey Waters appear to be an important overwintering ground for black bream. This species is predominantly present around the Channel Islands in April and May, with spawning occurring in May (GREC, 2011 and references therein). The Guernsey REA also noted that spider crab migrate from deep water to the South of Guernsey into shallower inshore waters off Guernsey between April-June, while cuttlefish are also known to move between overwintering grounds in the central English Channel and Guernsey waters during spring migrations (GREC, 2011).

5.3.1.1 Future baseline

It is possible that the distribution of fish and shellfish species may change in relation to future rises in sea temperature related to climate change (see Section 4.2.1.3). This could result in changes in the distribution and abundance of species with associated indirect effects to higher trophic levels (see Section 5.4.1.1 for Ornithology and Section 5.5.1.1 for Marine Mammals and Turtles). However, there is a high degree of uncertainty associated with climate change predictions both in terms of the magnitude and the timescales over which they might occur (Pinnegar *et al*., 2012). The effects of climate change on fish are difficult to distinguish from the impacts of fishing (See Section 7.2). However, shifts in species distribution into deeper water and more northerly locations, and an increase in the incidence of southern species in UK waters (and therefore Alderney), have been related to warming. Some species may also show temperature related changes in recruitment and growth (Evans *et al.* 2010).

5.3.1.2 Limitations and data gaps

Monitoring programmes which describe the abundance and distribution of fish and shellfish are considered limited. There is the potential for a shore-based fish tagging scheme, which would use recreational fisheries angling methods, to be established on Alderney at the end of 2013 (Melanie Broadhurst, ACRE, *pers. com*., April 2013). This may provide further information on the movements of specific fish species in Alderney Waters and the wider study area. Examples of the specialist surveys which may be required to support an EIA at the project-level are likely to be similar to those potentially required for benthic ecology (Section 5.1.1.4) including trawling and/or underwater camera or video. The Alderney Wildlife Trust has recommended that a 3-year programme of ecological baseline information would be required to inform an assessment undertaken at the project-level.

5.3.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. Fish are highly mobile species and therefore the study area will need to encompass the full mobile range of species (throughout their life cycle) using Alderney's territorial waters and the interconnector cable route (i.e. migratory routes, spawning/nursery grounds etc.). It is also important that any fish that are a qualifying feature of Natura 2000 sites and that may overlap with the changes brought about by the Draft Plan be considered as part of the assessment (see Section 5.6.1). The mobile Natura 2000 features study area shown on Figure 2, which incorporates the entire English Channel and the coastlines of southern England and Northern France, encompasses these wider-scale boundaries.

5.3.2 Impact Assessment

The Draft Plan has the potential to affect the fish and shellfish in the study area through a number of impact pathways which are assessed in the following sections:

- Collision/ Entrapment Risk (Section 5.3.2.1);
- Visual Disturbance (Section 5.3.2.2);
- Noise/ Vibration Disturbance (Section 5.3.2.3);
- Toxic Contamination (Spillage) (Section 5.3.2.4);
- Changes To/ Loss of Habitat (Section 5.3.2.5);
- Non-Toxic Contamination (Section 5.3.2.6);
- Toxic Contamination (Sediment Release) (Section 5.3.2.7);
- Barrier to Movement (Section 5.3.2.8);
- Introduction of New Structures (Section 5.3.2.9); and
- Electromagnetic Field (EMF) (Section 5.3.2.10).

There is the potential for Natura 2000 fish features to be using areas that overlap with the potential direct and indirect environmental changes brought about by the Draft Plan. A number of species are also considered to be rare or scarce in the UK or a UK BAP priority fish species. In addition, many of the fish and shellfish species noted in the baseline are also of commercial importance (see Section 7.2). Therefore, fish and shellfish are considered to be of low to moderate importance.

5.3.2.1 Collision/entrapment risk

All phases and marine elements of the Draft Plan (tidal stream turbines, cable routeing and offshore substations) are considered to have a potential collision or entrapment risk. Based on the limited information that is currently available on the subject, the operational movement of tidal stream turbines (i.e. the rotation of turbine blades) is considered to pose the greatest risk. For all other phases, the risk is considered to be in association with the temporary movement of vessel propellers.

Visual stimuli could lead to fish avoiding prospective tidal arrays. Increased localised (underwater) noise levels associated with the operation of vessels or machinery, such as the mechanical movement of tidal energy devices, also has the potential to lead to an avoidance response by fish swimming in the area (e.g. through 'startle' responses). The nature of the response will depend on the propagation of noise from the source, the background noise levels and sensitivity of the fish species (see Section 5.3.2.3). The ability for fish to avoid colliding with an object is also dependent on swimming speeds of the species. Other key factors include the number, size and spacing between structures (Gill, 2005). Also, should a structure be located either completely or partially along a migratory route it could form a barrier to movement (also see Section 5.3.2.8), and the risk of a collision will be heightened (Gill, 2005). In this way, the potential for a collision to occur is greater in enclosed areas, such as estuaries (Dadswell and Rulifson, 1994).

Overall, the sensitivity of fish to this impact pathway is considered to be moderate. The exposure to change is considered low for all phases and elements of the Draft Plan resulting in an **insignificant to minor adverse** impact, with the exception of the operation of a single tidal stream array where exposure to change is considered to be medium resulting in a **moderate adverse** impact to protected fish species and **insignificant to minor adverse** impact for all other species. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a high level of exposure to change (due to a much higher chance of collision) and an overall **moderate to major adverse** impact to protected fish species and **minor to moderate adverse** impact for all other species.

5.3.2.2 Visual disturbance

Visual disturbance to fish could arise during all phases and marine elements of the Draft Plan (tidal stream turbines, cable routeing and offshore substations). All marine activities have the potential to cause a disturbance to fish or create a physical barrier to movements (see Section 5.3.2.8) and, in turn, may lead to behavioural effects, such as changes in feeding and breeding. Fish will be particularly sensitive to large permanent structures (e.g. the tidal turbines array and offshore substations), however, their overall sensitivity to this pathway is considered to be low. Given the small footprint of the change within the wider study area, the exposure to change is considered to be low resulting in an **insignificant to minor adverse** impact.

5.3.2.3 Noise/vibration disturbance

Noise and visual disturbance to fish could arise during all phases and marine elements of the Draft Plan (tidal stream turbines, cable routeing and offshore substations). All marine activities have the potential to cause a disturbance; however, the key sources of underwater noise and vibration are considered to relate to construction, decommissioning and device/offshore substation installation, specifically from shipping and machinery, and any dredging, pile driving or drilling requirements. Additionally, cable/pipeline burial requires the use of trenching or jetting machinery in soft sediments, rock cutting machinery in hard seabeds, or rock or concrete mattress laying to protect cables, the latter of which is considered the most likely to be used given the nature of the seabed and existing hydrodynamics of the area. Of all of the sources of noise, the noise emitted during pile driving is understood to have the greatest potential effects on marine wildlife (Thomsen *et al*., 2006). This is due to the fact that pile driving generates very high sound pressure levels over a relatively broad frequency range (20 Hz to >20 kHz).

Fish typically respond strongly to lower frequencies of noise, as opposed to marine mammals that are sensitive to a broader bandwidth of sound (see Section 5.5.2.3). Fish that have specialist structures (e.g. Weberian ossicles, swimbladder diverticulae and gas filled bullae) that enhance hearing have been referred to as hearing 'specialists', whereas fish that do not have such structures are referred to as hearing 'generalists'. Those species that have a low hearing threshold over a wide spectrum of frequencies and are most sensitive to noise are the hearing specialists. The impacts of noise can broadly be split into lethal and physical injury, auditory injury and behavioural response. Richardson *et al*. (1995) defined four zones of noise influences, depending on the distance between the source and receiver. These are as follows:

- Zone of hearing loss, discomfort or injury, the zone within which hearing or other severe damage results;
- Zone of masking, the region within which noise is strong enough to interfere with detection of other sounds, such as communication or echolocation clicks;
- Zone of responsiveness, the region in which the animal reacts; and
- Zone of audibility, the area within which the animal is able to detect the sound.

At very high exposure levels, such as those close to piling operations, fatality may occur in marine species. The likelihood of fatality is also related to the time period of exposure. With respect to auditory injury and particularly where there are repeated high level exposures from activities such as impact pile driving underwater sound has the potential to cause hearing impairment in marine species. This can take the form of a temporary loss in hearing sensitivity, known as Temporary Threshold Shift (TTS), or a permanent loss of hearing sensitivity, known as Permanent Threshold Shift (PTS). TTS occurs more frequently whereby an individual's ability to hear is temporarily decreased. This short-term reduction in hearing ability returns to pre-exposure levels soon after (perhaps a few days), although persistent levels of noise can lead to PTS.

At lower noise levels, it has been reported that behavioural responses may be observed in marine species. Behavioural responses include leaving the source area for a period of time, either temporarily or permanently, or a startle reaction to the noise.

Nedwell *et al*. (2007) have developed a generic decibel (dB) scale, which enables better estimates of the effects of sound on marine species to be made and allows the likelihood of behavioural effects and damage to hearing to be assessed for a wide range of species (Table 14). Of significance for this assessment, is that at 90 dBht (species) and above there will be a strong avoidance reaction by all individuals of that species, and that below 50 dBht (species) there will be a mild reaction by a minority of individuals.

It should be noted that these criteria reflect the initial response and do not reflect the complexity of behavioural, physiological and auditory impacts over the medium and long-term. Furthermore, this criterion has not been validated by experimental study. The potential effects of anthropogenic underwater noise on the behaviour of fish are particularly difficult to determine as they are context dependent, and must be statistically based.

Table 14. Criteria suggested for the effects of underwater noise on marine mammals and fish

Level in dB_{ht} (Species)	Effect
Less than 50	Mild reaction by minority of individuals
50 to 75	Mild reaction by majority of individuals
75 to 90	Stronger reaction by majority of individuals
90 to 130	Strong avoidance reaction by all individuals and increasing risk of physiological injury
Above 130	Possibility of traumatic hearing damage from single event
Above 140	Risk of lethal injury
* In their decibel hearing threshold (dB_{ht}, species) scale a frequency dependent filter is used to weight the sound. The suffix 'ht' relates to the fact that the sound is weighted by the hearing threshold of the species.	

(Source: Nedwell *et al*., 2007)

In terms of vibration, many fish utilise a lateral line sensory system to detect subtle movements (prey and predators) in the surrounding area through vibrations. Similar to the effects of noise, large-scale vibrations could mask other signals used by fish to detect prey and evade predators, whilst also leading to behavioural responses (e.g. avoiding the area). Furthermore, high level vibrations in close proximity to fish could lead to physical injury (e.g. internal organ rupture) or even death.

Based on the precautionary assumption that piling may be required as part of the Draft Plan, the sensitivity of fish and shellfish to noise and vibration is considered to be moderate during the construction phase of the tidal turbine devices and offshore substations and low during all other phases/elements of the Draft Plan.

Noise and vibration disturbance during construction of the tidal turbine devices and offshore substations will generally only be short-term. Given the unconfined nature of the area, any fish that do pass through areas of disturbance are considered to be able to easily move away from any temporary noise disturbance and return once the disturbance has ceased. However, given the relatively large distances that behavioural changes can occur over, exposure to change from a single tidal array and associated infrastructure (i.e. substation) is considered to be negligible to medium (assuming piling is required), resulting in an **insignificant to moderate adverse** impact. In all other phases, levels of exposure are expected to be low, resulting in an **insignificant to minor adverse** impact. The potential concurrent installation of tidal arrays in Alderney's territorial waters (see Section 2.2.2) as a result of the Draft Plan is considered to result in a high level of exposure to change from cumulative noise sources (assuming piling is required) and an overall **moderate to major adverse** impact to fish.

5.3.2.4 Toxic contamination (spillage)

There is potential for the spillage of fluids, fuels and/or construction materials into the marine environment, originating from the survey, construction, decommissioning and maintenance vessels associated with the tidal device, cabling and offshore substation, in addition to the tidal device itself. Toxic contaminants may be consumed by the biotic community and result in the bioaccumulation, particularly in shellfish and the prey of various fish species. The sensitivity of shellfish and fish species to this impact pathway is species dependent and overall is considered to be low to moderate. The probability of substantial spillage occurring and the overall level of exposure to change is considered to be negligible to low for all phases and developments, resulting in an **insignificant to minor adverse** impact. In the unlikely event of an incident, best practice measures put in place to manage potential water quality impacts (see Section 4.3.2.1), such as the use of oil spill action plans, would contain the spillage and prevent substantial effects.

5.3.2.5 Changes to/loss of habitat

As discussed in benthic ecology (Section 5.1.2.2) habitats are sensitive to a direct physical loss and/or damage where permanent or temporary structures are introduced within the development footprint. Any effect could indirectly affect fish and shellfish such as through loss of feeding and nursery areas. However, fish species are typically highly mobile and it is considered they can utilise alternative food sources or sheltered areas should they need to move to new foraging/nursery grounds and, therefore, the sensitivity of fish to a change in habitat is considered to be low. In general, the mobility of shellfish species is reduced compared to fish and, therefore, they are considered to have a moderate sensitivity.

The effects arising are dependent on a range of factors such as the habitat type, the extent of habitat affected, the location and the nature of activities and whether they are temporary or permanent. Given that the marine and intertidal habitats that are found in Alderney's waters are widespread, and the overall footprint of change on the seabed is considered to be relatively minor, the exposure to change is considered to be low, resulting in an **insignificant to minor adverse** impact.

5.3.2.6 Non-toxic contamination

As outlined in Section 4.3.2.2, in areas being excavated or disturbed for the installation/removal of tidal stream turbines, cables or offshore substations there will be an increase in SSC. Increased SSC has the potential to affect fish behaviour species. The increased SSC may also impact shellfish through smothering or a reduction in food availability in the water column. Conversely, disturbance of the seabed may increase ambient nutrient levels which, in turn, could lead to an elevated food supply. The sensitivity of fish to this impact pathway is considered to be low given their high mobility whereas the sensitivity of shellfish is considered to be moderate.

For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low, resulting in an **insignificant to minor adverse** impact. The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection in areas where the cable cannot be buried. Overall, therefore, the level the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

5.3.2.7 Toxic contamination (sediment release)

There is potential for toxic contaminants to be released into the marine environment as a result of the disturbance of contaminated sediments during construction and decommissioning of all elements of the Draft Plan. As previously discussed, the sensitivity to toxic contamination varies between species and the mobility of shellfish species is reduced compared to fish and, therefore, overall the sensitivity is considered to range between low to moderate.

It is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low (Section 4.3.2.3). For cable routeing the exposure to change is considered to be low. Overall, this will result in an **insignificant to minor adverse** impact.

5.3.2.8 Barrier to movement

The presence of sub-surface tidal structures may present a barrier to movement and migratory pathways depending on array design. Fish are considered particularly vulnerable to any structures which could act as a barrier that may prevent movement to key foraging or nursery grounds and therefore their sensitivity to this impact pathway is considered to be moderate. The significance of any obstruction is also dependent on the spatial confines and size of the array (e.g. whether it spans across the entire mouth of an estuary). Given the unconfined nature of the study area, the turbines are not considered likely to act as a barrier to movement. Therefore, the exposure to change is considered to be low, resulting in an **insignificant to minor adverse** impact.

5.3.2.9 Introduction of new structures

The construction and decommissioning activities of the tidal turbine devices and offshore substations may provide new habitat and suitable conditions for wildlife to flourish. In time, the structures may be colonised and used as artificial reefs by the marine community and much research has been conducted on fish aggregating devices (FADs); floating or moored structures which attract fish and provide new habitat. A number of reasons why fish are attracted to FADs have been hypothesised by Freon and Dagorn (2000); these include shelter from predators, concentration of food supply, spatial reference in otherwise featureless environments, resting opportunities, indicators of other characteristics, such as productive areas and meeting points.

The introduction of new structures can lead to the modification of the benthic environment by providing hard substrate upon which sessile organisms can attach (e.g. mussels). In turn, this could provide an additional food source to other species and lead to increased biodiversity compared to previous levels due to the artificial reef effects (Wilhelmsson *et al*., 2006; Linley *et al*., 2007). It is therefore possible that the introduction of tidal devices and/or offshore substations around Alderney will actually increase benthic fish and shellfish stocks, perhaps even on a commercial scale. In such cases, it would be potentially feasible to leave such structures on the seabed after the operational period has ceased. This would provide a further benefit in that no decommissioning activities would be required and, consequently, the development would have a lesser impact on the surrounding environment. Overall, sensitivity of fish and shellfish species to change is considered to range from low to moderate, and the exposure to change is considered to be low given the relatively small footprint of the change in the context of the study area, resulting in an overall **insignificant to minor beneficial** impact.

5.3.2.10 Electromagnetic field

Electromagnetic fields (EMF) arise from the power cables associated with tidal energy power cabling as a result of the current passing along the conductor and the voltage differential between the conductor and earth ground, which is nominally at zero volts. The nature and strength of the fields produced, depends on the system voltage and the current passing through. The effects on the surrounding environment depend on the cable construction, configuration and orientation in space.

Export cables from tidal devices transmitting high voltage alternating current (AC) and direct current (DC) generate an EMF comprising two components: firstly, an electric field contained within the cable by armouring and, secondly, a magnetic field that can be detected outside of the cable (Gill, 2005). The EMF levels generated are typically well below those detectable by humans, but many species of fish are electrosensitive and rely upon subtle bioelectrical emissions in the marine environment in order to catch prey and avoid predators. Research by COWRIE and Scottish Natural Heritage indicates that electro-sensitive species of fish, particularly elasmobranches, can detect the levels of induced electric field generated by a cable. Other fish species such as salmon, eels and sea trout may also be able to detect the magnetic fields associated with cables, depending on cable design. The overall impact on fish populations associated with EMF from cables is uncertain (Gill, 2005). The resulting behavioural responses could include avoidance of the area, attraction towards the export cable or disruption of migratory patterns.

Based on the limited information available, sensitivity is considered to be at worst moderate and due to the limited area potentially affected, as a result of the cabling required for a single tidal array, exposure is considered to be low resulting in an **insignificant to minor adverse** impact. A minimum of approximately 367km of cable length will be required for the full build out of the Draft Plan (see Section 2.2.2). Overall, this is considered to result in a moderate level of exposure to change and an **insignificant to moderate adverse** impact.

5.3.2.11 Mitigation

The following mitigation works will need be applied, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on fish and shellfish:

Collision/Entrapment Risk:

- Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices.

Noise/Vibration Disturbance:

- Avoid construction during sensitive seasons, e.g. breeding/peak egg laying/spawning seasons, in feeding grounds and during migration times of migratory fish;
- Good construction practice to minimising noise and vibration; and
- Minimise use of high noise emission activities such as piling.

Electromagnetic Field (EMF):

- Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).

5.3.2.12 Residual impact

The mitigation measures identified in Section 5.3.2.11 could reduce the potential impacts of the Draft Plan, thereby resulting in a lower level of residual impact. However, it is not possible, with any level of certainty, to determine the exact level of residual impact at the plan level as the extent of mitigation achievable will be heavily dependent on project specific factors. The significance of potential residual impacts has been estimated and are summarised in Table 15.

5.3.2.13 Summary

Table 15. Assessment of the potential effects of the Draft Plan on fish and shellfish

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Collision/entrapment risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
	Construction	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision/entrapment risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	N-H	M	L-M	Insignificant to major	Section 5.3.2.11	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	N-L	L-M	L-M	Insignificant to minor	-	-
	Operation	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision/entrapment risk	M-H	M	L-M	Insignificant to major	Section 5.3.2.11	Insignificant to minor
		Barrier to movement	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Introduction of new structures	L	L-M	L-M	Insignificant to minor	-	-
	Decommissioning	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision/entrapment risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	N-L	N/L	L-M	Insignificant to minor	-	-
Cable Routeing	Survey	Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Construction	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision/entrapment risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	L	L	L-M	Insignificant to minor	-	-
	Operation	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Electromagnetic field (EMF)	L-M	M	L-M	Insignificant to moderate	Section 5.3.2.11	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
	Decommissioning	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	L	N/L	L-M	Insignificant to minor	-	-
Offshore Substations	Survey	Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
	Construction	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	N-H	M	L-M	Insignificant to major	Section 5.3.2.11	Insignificant to minor
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	N-L	N/L	L-M	Insignificant to minor	-	-
	Operation	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Introduction of new structure	L	L-M	L-M	Insignificant to minor	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Changes to/ loss of habitat	L	L-M	L-M	Insignificant to minor	-	-
		Collision risk	L	M	L-M	Insignificant to minor	-	-
		Visual disturbance	L	L	L-M	Insignificant to minor	-	-
		Noise/ vibration disturbance	L	L	L-M	Insignificant to minor	-	-
		Toxic contamination (spillage)	N-L	L-M	L-M	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L-M	L-M	Insignificant to minor	-	-
		Toxic contamination (sediment release)	N-L	N/L	L-M	Insignificant to minor	-	-

N Negligible
L Low
M Medium/moderate
H High

5.4 Ornithology

5.4.1 Baseline Description

The baseline review has been split into the following discrete sections:

- Marine and coastal waterbirds: This section focuses on those species that forage wholly or mainly in the marine environment. In the UK these species consist of seabirds (within the families Procellariidae, petrels and shearwaters; Hydrobatidae, storm-petrels; Phalacrocoracidae, cormorants and shags; Stercoraridae, skuas; Laridae, gulls and terns; and Alcidae, auks); divers (within the family Gaviidae); grebes (within the family Podicepididae) and sea ducks. This section also includes coastal birds focusing on those species that primarily forage around the coastline within the intertidal zone (such as on mudflats, or coastal lagoons) including waders (Rallidae, Haematopodidae, Recurvirostridae, Burhinidae, Charadriidae and Scolopacidae), herons and egrets (Ardeidae) as well as some species of duck, geese and swan (Anatidae); and
- Terrestrial birds: This section will focus on those species that primarily forage on land.

Counts of seabirds breeding at colonies on the Channel Islands have been primarily derived from the JNCC Seabird Monitoring Programme Online Database. This database comprises counts from the mid-1980s to the present and incorporates the results from the two most recent complete censuses that have so far been undertaken in the UK and Republic of Ireland: 'Seabird Colony Register' (1985-88) and 'Seabird 2000' (1998-2002).

The most comprehensive information on seabird distributions at sea comes from the European Seabirds at Sea (ESAS) database. This is a collaborative dataset with inputs from the JNCC, and other north western European organisations. The dataset was established in 1991 with the aim of collating data on the distribution of seabirds in north-west European offshore areas. Much of the information for this database comes from a series of boat and aerial surveys carried out from 1979 to 2002 in the marine environment in the north-east Atlantic by the JNCC Seabirds at Sea Team (SAST). This data is available via the OBIS (Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations) Seamap website (www.seamap.env.duke.edu).

Relevant supplementary information on seabird ecology and behaviour from the Birdlife International seabird database (BirdLife International, 2012) was also reviewed along with information on the foraging ranges of 25 species of UK seabirds, prepared jointly by BTO, RSPB and Birdlife International (Thaxter *et al*., 2012).

Of particular relevance are a number of recent monitoring and survey projects which have been undertaken specifically around the Channel Islands. These data sources include the following:

- Seabird and marine mammal baseline survey within the south east region of Alderney: Alderney Wildlife Trust Enterprises Ltd was commissioned in 2010 by Alderney Commission for Renewable Energy to undertake a seabird and marine mammal survey located within Longis Bay and associated areas (Alderney Wildlife Enterprise, 2011).

The surveys involved four two hour observational surveys at a designated land-based observation point on a monthly basis.

- OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring: Marine mammal and seabird monitoring undertaken as part of the OpenHydro Subsea Tidal Array Installation between March 2006 and February 2008. Over the survey period a total of 44 boat-based and 44 land based surveys were undertaken. The land based surveys were at four fixed points (ARE, 2009; Entec UK Limited, 2007).
- A Working List of the Birds of the Channel Islands: The working list includes information on the status of all bird species recorded in the Channel Islands of Jersey (including Les Écréhous and LesMinquiers), Guernsey (including Herm, Jethou and Lihou), Alderney (including Burhou and the Casquets) and Sark (Young *et al*., 2012). The report used the criteria in Table 16 to describe the status of birds species.

Table 16. Criteria used by Young *et al*. (2012) to assess the status of birds around the Channel Islands

Breeding Species		Migrants and Non-breeding Visitors	
Criteria	Number	Criteria	Number
Very rare (occasional)	Species has bred in most years	Very rare (occasional)	10< records
Rare	1-10 pairs breed in most years	Rare	10-20 records
Scarce	11-50 pairs breed in most years	Scarce	21-50 individuals
Common	51-500 pairs breed in most years	Common	51-100 individuals
Very common	500+ pairs breed in most years	Very common	101-1,000 individuals
Abundant	More than 1,000 pairs breed in most years	Abundant	More than 1,000 individuals

Marine and Coastal Waterbirds

The Channel Islands are a breeding and foraging area for a variety of seabird species. A summary of seabird ecology and distribution within the English Channel and Channel Islands is included in Table 17. In addition, recent counts of birds at the main colonies in the Channel Islands are included in Table 18.

The Northern Gannet (*Morus bassanus*) breeds at Les Etacs and Ortac rocks near Alderney, and approximately 7000 breeding pairs are recorded at the sites each year which constitutes 2% of the world population (Veron and Lawlor, 2009; Alderney Wildlife Trust, 2012). Gannets first colonised Ortac in 1940 and have steadily increased since then. Gannets breeding at sites in Alderney are near the most Southerly extent of their breeding range with the most Southerly colony on the French islet of Le Rouzic (home to approximately 11,500 pairs of Northern Gannet). Soanes *et al* (2013) investigated the foraging ranges of breeding Northern Gannets at Les Etacs. The research tracked 17 Northern Gannets and found foraging trips lasted an average of 18 hours with a mean total foraging trip distance of 289 km.

Table 17. Summary of seabird ecology and distribution within the English Channel and Channel Islands

Species	Max. Foraging Range From Colony[1, 2]	Foraging Habitat[1]	Diet[1]	Foraging Behaviour, Dive Depth[1]	Distribution Within English Channel[3, 4, 5]	Summary of the Channel Islands Population Status[6]
Arctic Skua	75-100, 75	Primarily coastal	Small fish derived from host and also seabirds	Kleptoparasitism and feeding on other seabirds	Passage migrant	Jersey: Rare spring and scarce autumn migrant. Guernsey: Scarce autumn migrant. Alderney: Scarce, mainly autumn, migrant. Sark: Very rare
Arctic Tern	20.6, 30	Coastal and offshore	Sandeel, sprat, herring, small gadoids, prawns and small crustacea	Plunge diver and surface dipper.	Scarce passage migrant	Jersey: Rare, mainly autumn, migrant, probably overlooked. Guernsey: Scarce but probably overlooked autumn migrant. Alderney: Scarce, mainly autumn migrant, probably overlooked. Sark: Very rare
Atlantic Puffin	200, 200	Coastal and offshore	Sandeel, sprat, herring, rockling and small gadoids.	Pursuit diver Max 70 m, mean 37.03 m.	Scarce breeder. Passage migrant and winter visitor.	Jersey: Rare and declining breeding species and rare migrant. Rare in winter. Guernsey: Scarce breeding visitor. Rare in winter. Alderney: Common breeding species, formerly very common but now declining. Sark: Rare breeding species, decreasing.
Black Guillemot	55, -	Coastal and offshore	Benthic fish, invertebrates (including crustacea, annelids, and molluscs)	Pursuit diver. Max 50 m, mean 30.22 m.	Very rare	Very rare
Black-headed Gull	-, 40	Coastal and offshore	Worms, insects, small fish, crustacea and carrion	Surface feeder	Breeds at a number of colonies in low to high numbers. Common resident, winter visitor and passage migrant.	Jersey: Abundant winter visitor, spring and autumn migrant. Scarce in summer. Guernsey: Common winter visitor and migrant. Scarce in summer. Alderney: Common winter visitor and autumn migrant. Sark: Rare winter visitor.
Black-legged Kittiwake	200, 120	Coastal and offshore	Sandeel and clupeids	Surface feeder using dipping or shallow plunge diving.	Breeds at a small number of colonies in low to moderate numbers. Passage migrant and winter visitor.	Jersey; Common spring and autumn migrant, present offshore nearly throughout year. Guernsey: Fairly common winter visitor and migrant. Alderney: Scarce breeding species and fairly common migrant and visitor. Sark: Scarce migrant. Former breeder
Common Guillemot	200, 135	Coastal and offshore	Sandeel, sprats herring and small gadoids	Pursuit diver. Max 200 m, mean 90.06 m	Breeds at a small number of colonies in low to moderate numbers. Passage migrant and winter visitor.	Jersey: Scarce winter visitor and migrant. Occasional in summer. Formerly bred. Guernsey: Scarce breeding visitor. Scarce in winter. Alderney: Fairly common breeding species. Sark: Fairly common breeding species.
Common Gull	-, 50	Coastal and offshore	Worms, insects, carrion, fish, small birds, small mammals, eggs, berries.	Surface feeder	Passage migrant and winter visitor.	Jersey: Scarce winter visitor and migrant. Guernsey: Scarce winter visitor and migrant. Alderney: Scarce visitor. Sark: Occasional winter visitor.
Common Tern	37, 30	Coastal	Small marine and freshwater fish and aquatic invertebrates	Shallow plunge diver	Breeds at a small number of colonies in low numbers. Summer visitor and	Jersey: Common breeding species and very common migrant. Occasional in winter. Has shown poor breeding in recent years. Guernsey: Common summer visitor and migrant - small numbers breed.

Species	Max. Foraging Range From Colony[1, 2]	Foraging Habitat[1]	Diet[1]	Foraging Behaviour, Dive Depth[1]	Distribution Within English Channel[3,, 4 , 5]	Summary of the Channel Islands Population Status[6]
					passage migrant.	Alderney: Scarce breeding species and fairly common migrant. Sark; Scarce breeding visitor and migrant.
European Shag	20, 17	Coastal	Sandeel as well as gadoids, gobies, flatfish, clupeids and sea scorpions	Pursuit diver. Max 80 m, mean 33.43 m	Breeds at a number of colonies, generally in low numbers. Year round resident.	Jersey: Common, declining, resident and migrant. Has shown very poor breeding in recent years. Guernsey: Common resident and migrant. Has shown very poor breeding in recent years. Alderney: Common resident, poor breeding success lately. Sark: Fairly common resident.
European Storm Petrel	-, >65	Coastal and offshore	Krill and microzooplankton	Feeds on the surface by hovering and dipping.	Breeds at several colonies in low to moderate numbers. Fairly common passage migrant and winter visitor.	Jersey: Scarce summer visitor and autumn migrant. Guernsey: Scarce in summer, seen in suitable weather conditions. Formerly bred north of Herm (last, 1946). Alderney: Breeds on Burhou. Sark: Former breeder, status uncertain - may still breed on Bec du Nez.
Great Black-backed Gull	-, -	Coastal and offshore	Carrion, seabirds, small mammals, fish and shellfish.	Surface feeder, kleptoparasitism and also feeds on other seabirds.	Breeds at a small number of colonies in low numbers. Passage migrant and winter visitor.	Jersey: Common breeding species, very common winter visitor and migrant. Guernsey: Common resident and migrant. Alderney: Common resident. Sark: Fairly common resident.
Great Cormorant	50, 35	Coastal	Feeds on fish such as flatfish, blennies gadoids, sandeel, salmonid and eels.	Pursuit diver. Max 35 m, mean 12.07 m.	Breeds at a number of colonies in low numbers. Resident, passage migrant and winter visitor.	Jersey: Common resident and migrant. Guernsey: Common resident and migrant. Alderney: Scarce resident, breeds in small numbers. Sark: Scarce resident, breeds in small numbers.
Great Skua	100, 219	Coastal and offshore	Various fish (such as gadoids, sandeel and clupeids) and also seabirds.	Splash diver or kleptoparasitism (also efficient predators on other seabirds)	Fairly common passage migrant and winter visitor.	Jersey: Rare winter visitor and autumn migrant. Guernsey: Scarce winter visitor and scarce, mainly autumn, migrant. Alderney: Scarce, mainly autumn, migrant. Sark: Very rare.
Herring Gull	-, 92	Coastal and offshore	Omnivorous-fish, discards, offal	Splash diver, kleptoparasitism (will also prey on other seabirds and small mammals)	Common breeder. Common resident, winter visitor and passage migrant.	Jersey: Very common resident. Declining, has shown poor breeding in recent years. Guernsey: Common resident. Alderney: Common resident and migrant. Sark: Very common resident.
Leach's Storm Petrel	-, <120	Coastal and offshore	Krill and microzooplank-ton	Feeds on the surface by hovering and dipping.	Passage migrant	Rare
Lesser Black-backed Gull	-, 181	Coastal and offshore	Omnivorous- fish, discards, offal	Feeds on the surface or shallow plunge dives. Mainly coastal foraging range in summer	Breeds at a number of colonies in low to high numbers. Common summer and winter visitor and passage migrant.	Jersey: Common breeding species and migrant, scarce winter visitor. Guernsey: Common breeding species and migrant, scarce winter visitor. Alderney: Common breeding species and migrant, scarce winter visitor. Sark: Fairly common summer visitor.
Little Tern	11, 11	Coastal	Small fish such as clupeids and sandeel. Small invertebrates	Shallow plunge diver and dipper	Breeds at a small number of colonies in low numbers. Summer visitor and passage migrant.	Jersey: Rare spring and scarce autumn migrant. Guernsey: Scarce migrant. Alderney: Scarce autumn migrant.

Species	Max. Foraging Range From Colony[1, 2]	Foraging Habitat[1]	Diet[1]	Foraging Behaviour, Dive Depth[1]	Distribution Within English Channel[3, 4, 5]	Summary of the Channel Islands Population Status[6]
Manx Shearwater	400, >330	Coastal and offshore	Clupeids as well as cephalopods, small crustacea and occasionally offal	Surface feeder and shallow plunge diver	Breeds at several colonies in low numbers. Fairly common passage migrant and winter visitor.	Jersey: Common, mainly spring and autumn migrant and summer visitor. Guernsey: Scarce migrant, recorded also in summer and winter. Alderney: Regular autumn migrant and summer visitor. Possibly breeds on Burhou in small numbers. Sark: Summer visitor, has bred occasionally since 1977.
Mediterranean Gull	75[5]	Terrestrial and marine	During breeding season; insects, gastropods, small numbers of fish and rodents. When not breeding feeds on: Marine fish, molluscs, insects, berries, seeds and offal.	Surface feeder	Scarce breeder. Fairly common passage migrant and winter visitor.	Jersey: Scarce, mainly spring and autumn, migrant, seen in most months. Guernsey: Scarce migrant and winter visitor. Alderney: Scarce migrant and winter visitor. Sark: Very rare
Northern Fulmar	664, 580	Coastal and offshore	Sandeel, sprat, zooplankton, squid, fish discards and offal	Surface feeder. Also splash dives	Breeds at a number of colonies in low numbers. Common passage migrant, winter visitor and summer visitor.	Jersey: Common resident and migrant. Guernsey: Fairly common resident and scarce migrant - first recorded breeding 1985. Alderney: Common resident and migrant - first recorded breeding 1975. Sark: Common resident - first recorded breeding, 1986.
Northern Gannet	640, 590	Coastal and offshore	Mackerel, herring, sandeel, gadoids fish discards	Plunge diver. Max 34 m, mean 8.8 m.	Breeds at a small number of colonies in high numbers. Common passage migrant, winter visitor and summer visitor.	Jersey: Common, particularly in summer. Guernsey: Common, particularly in summer. Alderney: Two colonies developed 1940-45. Now common throughout the year. Sark: Common, particularly in summer.
Razorbill	51, 95	Coastal and offshore	Sandeel, sprat, herring and rockling	Max 140 m, mean 41.09 m.	Breeds at a small number of colonies in low numbers. Passage migrant and winter visitor.	Jersey: Rare breeding species. Common winter visitor and common, occasionally abundant, autumn migrant. Guernsey: Scarce breeding visitor. Scarce in winter. Alderney: Scarce breeding species and scarce winter visitor. Sark: Well established breeding species and winter visitor.
Roseate Tern	30, 30	Coastal	Clupeids, gadoids and sandeel	Plunge diver. Max 7 m, mean 6.75 m.	Scarce breeder. Very scarce summer visitor and passage migrant.	Rare
Sandwich Tern	70, 54	Coastal	Clupeids, gadoids and sandeel	Plunge diver. Max 20 m, mean 20 m	Scarce breeder. Summer visitor and passage migrant.	Jersey: Common in summer, rare in winter and very common spring and autumn migrant. Seen in every month. Guernsey: Common migrant, rare in winter. Formerly bred. Alderney: Passage migrant, recorded annually. Sark: Regular passage spring and autumn migrant.

Derived from:
[1] BirdLife International (2012) ; [2] Thaxter *et al* (2012);
[3] ESAS data, [4] DECC, 2009
[5] Marinelife, 2010 [6] Young *et al.* 2012

Table 18. Recent counts (since 2000) of seabirds breeding at the main breeding colonies in the Channel Islands

Site	Species	Count Type	Number*	Year Surveyed
Les Etacs (near Alderney)	Northern Gannet	Occupied nests	4862	2005
Ortac rocks (near Alderney)	Northern Gannet	Occupied nests	2547	2005
Burhou (near Alderney)	Atlantic Puffin	Occupied burrows	176	2012
	Lesser Black-Backed Gull	Occupied nests	1236	2011
	European Storm Petrel	Occupied nests	60	2002
Alderney	Shag	Occupied nests	160	2000
Brecqhou (near Sark)	Herring Gull	Occupied sites	90	1999 - 2000
	Lesser Black-Backed Gull	Occupied sites	360	1999 - 2000
	Shag	Occupied nests	54	1999 - 2000
Guernsey	Herring Gull	Occupied sites	1150	1999 - 2000
	Lesser Black-Backed Gull	Occupied sites	123	1999 - 2000
	Shag	Occupied nests	96	1999 - 2000
Herm	Herring Gull	Occupied sites	140	1999 - 2000
Jethou (near Guernsey)	Herring Gull	Occupied sites	220	1999 - 2000
	Lesser Black-Backed Gull	Occupied sites	60	1999 - 2000
	Shag	Occupied sites	250	1999 - 2000
Les Amfroques	Common Guillemot	Individuals on land	105	1999 - 2000
	Herring Gull	Occupied sites	60	1999 - 2000
	Shag	Occupied nests	130	1999 - 2000
Sark	Common Guillemot	Individuals on land	298	1999 - 2000
	Herring Gull	Occupied sites	440	1999 - 2000
	Lesser Black-Backed Gull	Occupied sites	555	1999 - 2000
	Shag	Occupied nests	69	1999 - 2000
Les Écréhous (near Jersey)	Common Tern	Occupied nests	84	2000
	Shag	Occupied nests	108	2000
	Herring Gull	Occupied nests	200	2000
Devil's Hole (Jersey)	Herring Gull	Occupied nests	93	2000
La Chretienne (Jersey)	Herring Gull	Occupied nests	203	2000
Sorel Point (Jersey)	Herring Gull	Occupied nests	92	2000
Wolf's Caves (Jersey)	Shag	Occupied nests	90	2000
St. Helier (Jersey)	Herring Gull	Occupied nests	190	2001

* This figure is thought to be an under-estimate. The Guernsey Ringing Group, who use mark recapture methods for work on Burhou, give population figures close to 1000 (Alderney Wildlife Trust, 2012).

(Source: Seabird Monitoring Programme Online Database; Alderney Wildlife Trust, 2012; States of Jersey, 2012)

The nearby island of Burhou is home to the largest Atlantic Puffin *Fratercula arctica* colony found in the Channel Islands and one of the few breeding colonies at the southern edge of this species breeding range. The breeding colony has seen a slight increase in Puffin numbers from 127 Apparently Occupied Burrows (AOB) in 2007 to 176 AOB in 2012. The only European storm-petrel *Hydrobates pelagicus* colony in the Channel Islands is also found on Burhou Island (also close to the southern edge of its breeding range). A small breeding population of 60 Apparently Occupied Nests (AON) were recorded during Seabird 2000. However, this figure is thought to be an under-estimate. The Guernsey Ringing Group, who use mark and recapture methods for work on Burhou, give population estimates close to 1000.

In addition, nationally important numbers of the graellsii sub species of Lesser Black-backed Gull *Larus fuscus* occur on Burhou Island. Between 2000 and 2005, the Lesser Black-backed Gull population increased sharply to 1085 pairs on Burhou, indicating Burhou alone now supports a nationally important population of Lesser Black-backed Gulls (Soanes and Michel, 2005). In 2011, the figure was higher with 1236 AON recorded on Burhou, although it is important to note that the figures vary depending on survey methodology (Alderney Wildlife Trust pers. comm., June 2013). The productivity of Lesser Black-backed Gulls on Burhou was very low for three years during the period of ARS1; 2007, 2008 and 2011 (Alderney Wildlife Trust, 2012). The importance of this area for these bird species is reflected in the international designation of the Alderney West Coast and the Burhou Islands Ramsar site (Alderney Wildlife Trust, 2012; Durrel Wildlife Conservation Trust, 2008).

Small colonies of other nesting cliff seabirds, including the Guillemot *Uria algae*, Razorbill *Alca torda*, Fulmar *Fulmarus glacialis* and European Shag *Phalacrocorax aristotelis*, also occur around the Channel Islands (Durrel Wildife Conservation Trust, 2008; ARE, 2011). Seabird at sea data indicates that the area is regularly used by a range of foraging seabirds including Northern Gannet, Razorbill, European Shag and Fulmar (Alderney Wildlife Enterprise, 2011).

The largest Common Tern Sterna hirundo colony can be found on the island of Les Écréhous. The population fluctuated through the 1970s to 1990s (between 36 and 90 pairs, averaging at about 60). In 2007 and 2008 the breeding colony failed. Whilst it was not possible to ascertain a definitive reason for this, several causes including avian predators and human disturbance were proposed as contributory factors (States of Jersey, 2012; Société Jersiaise, 2008). The Common Tern is a qualifying species of the Les Écréhous & Les Dirouilles Ramsar site.

Seabird monitoring undertaken as part of the OpenHydro Subsea Tidal Array Installation recorded a total of 26 seabird species, with Gannets, Shags and large Gull species the most numerous. Regular records of Auks and occasional Kittiwakes and Terns were also recorded. The distribution and abundance of bird species was similar in both years of the survey (ARE, 2009; Entec UK Limited, 2007). ESAS data also regularly recorded Auk species and Gull species in the Channel Islands area.

The seabird and marine mammal baseline survey of the southeast region of Alderney, commissioned in 2010 by Alderney Commission for Renewable Energy recorded seven species of seabird regularly occurring in the area (Gannet, Shag, Razorbill, Fulmar, Herring Gull *Larus argentatus*, Lesser Black-backed Gull and Great Black-backed Gull *Larus marinus*) (Alderney Wildlife Enterprise, 2011) (Figure 14). Gannets were the most commonly observed species, (primarily between the months April to September). Shags were the second most abundant species recorded. The surveys identified similar Shag presence across the survey period, with a slight decline between September and November. Razorbill and Fulmar were recorded in low numbers during all the survey months. Very low numbers of Puffin were also recorded. Herring Gull was the most abundant gull species recorded. Great Black-backed gulls were recorded in low numbers until September, with a marked increase in observations also from October to December. Lesser Black-backed gull abundance was particularly low throughout the survey months, with slight increases in the summer months overall. The spatial distribution of four of the key seabird species (Shag, Herring Gull, Gannet and Great Black-backed Gull) observed around Alderney between 2006 and 2008 has been mapped (Figure 15).

Inshore UK waters host large numbers of wintering seaduck, divers (*Gaviidae*) and grebes (*Podicepididae*). Seaducks undertake surface diving to capture molluscs such as mussels and clams as well as crustacea. Divers and grebes are piscivores, preying on a variety of small fish such as clupeids, sandeel and small gadoids by undertaking pursuit diving (BirdLife International, 2012). Around the Channel Islands seaducks such as Common Eider *Somateria mollissima,* Long-tailed Duck *Clangula hyemalis,* Common Scoter *Melanitta nigra* and Greater Scaup *Aythya marila* are considered rare or scarce winter visitors and migrants. Divers such as the Red-throated Diver *Gavia stellata* and Grebes such as the Great Crested Grebe *Podiceps cristatus* are also considered scarce (Young *et al.*, 2012).

The Channel Islands are also used by a range of overwintering and passage waterbirds and shorebirds which utilise coastal habitats such as estuaries, beaches and mudflats. Commonly occurring wading bird species include Eurasian Oystercatcher *Haematopus ostralegus*, Eurasian Curlew *Numenius arquata* and Dunlin *Calidris alpina.* Wildfowl species which are regularly observed include Mallard *Anas platyrhynchos,* Eurasian Teal *Anas crecca* and Dark-bellied Brent Goose *Branta bernicla bernicla*. A summary of the ecology and status of the most commonly recorded coastal waterbird species is provided in Table 19. Other species such as Common Shelduck *Tadorna tadorna*, Knot *Calidris canutus* and Black-tailed Godwit *Limosa limosa* are recorded more rarely during migratory periods (Young *et al*., 2012).

The seabird and marine mammal baseline survey within the south east region of Alderney recorded several species of waterbird. In particular, Oystercatcher was regularly observed throughout the survey period, with increased abundances during the autumn passage period. Mallard and Eurasian Curlew were also recorded (Alderney Wildlife Enterprise, 2011).

Table 19. Summary of the ecology and status of commonly occurring waterbirds

Species	Diet	European Population Structure (Source: Holt *et al.,* 2011)	Summary of the Channel Islands Population Status
Eurasian Oystercatcher	Cockles *Cerastoderma edule* and mussels *Mytilus edulis* between 15mm and 35mm in length as well as lugworms, *Arenicola marina.*	Oystercatchers in the UK are from the ostralegus population, which breeds in north and west Europe and winters in west Europe and south to west Africa.	Jersey: Common resident and very common, occasionally abundant, winter visitor and migrant. Guernsey: Common resident, common winter visitor and migrant. Alderney: Common resident and common winter visitor. Sark: Fairly common resident, winter visitor and migrant.
Eurasian Curlew	The shore crab *Carcinus maenas* and polychaete worms such as the ragworm *H. diversicolor.*	The wintering population of Curlews in UK comprises both British and Scandinavian breeding birds.	Jersey: Very common winter visitor and migrant. Some birds present in summer. Guernsey: Common winter visitor and migrant. Some birds present in summer.

Species	Diet	European Population Structure (Source: Holt *et al.*, 2011)	Summary of the Channel Islands Population Status
			Alderney: Common winter visitor and migrant. Some birds present in summer. Sark: Fairly common winter visitor and migrant. Occasional in summer.
Redshank	Amphipod crustaceans *Corophium* spp., mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor.*	Predominantly found on the coast in the UK, the non-breeding population of Redshanks is considered to comprise local breeders and birds from Iceland and nearby European populations.	Jersey: Very common winter visitor and migrant. Some birds present in summer. Guernsey: Common winter visitor and migrant. Alderney: Fairly common winter visitor and migrant. Some birds present in summer. Sark: Accidental.
Eurasian Teal	Sed-bearing saltmarsh plants including glasswort *Salicornia* spp. and oraches *Atriplex* spp.	Most Teal that spend the winter in Great Britain breed either on the near continent, in Iceland, or in Scandinavia	Jersey: Common winter visitor and migrant. Guernsey: Fairly common winter visitor and migrant. Alderney: Common winter visitor. Sark: Rare winter visitor.
Mallard	Plant material, algae, insects, larvae and small fish	Mallards in Britain may be resident or migrant. Many that breed in Iceland and northern Europe spend the winter in Britain and Ireland. Other populations from eastern Europe and Russia migrate in Autumn.	Jersey: Common resident and migrant. Many birds showing characteristics of domestic varieties living wild. Guernsey: Common resident, fairly common winter visitor and migrant. Alderney: Common resident and winter visitor. Sark: Common resident
Grey Plover	Polychaete worms *H. diversicolor, Nephtys hombergii, Lanice* spp *and A. marina.* Bivalves *C. edule, M. balthica* and crab *C. maenas*	Grey Plovers breed in the tundra zones of Eurasia and North America, with the most important wintering areas in Europe being the southern North Sea coasts, other British estuaries, and the Atlantic coast of France.	Jersey: Very common winter visitor and migrant - occasionally recorded in summer. Guernsey: Common winter visitor and migrant - occasionally recorded in summer. Alderney: Regular winter visitor.
Dunlin	Smaller size class of polychaete worms, particularly *H. diversicolor*, the bivalve *M. balthica* and the gastropod mollusc *H. ulvae,* brown shrimp *Crangon crangon*, and small shore crabs *C. maenas*	British breeding birds migrate south for winter. Dunlins from Greenland pass through on migration. Others from Iceland, northern Europe and Russia arrive in autumn to the winter on British and Irish estuaries.	Jersey: Abundant winter visitor and migrant. Guernsey: Common winter visitor and migrant. Alderney: Fairly common winter visitor, spring and autumn migrant.

Species	Diet	European Population Structure (Source: Holt *et al.*, 2011)	Summary of the Channel Islands Population Status
Bar-tailed Godwit	Polychaete worms such as *H.diversicolor* as well as bivalves and shrimps	Bar-tailed Godwits seen in Britain during winter are of the nominate race lapponica whose breeding range extends from northeast Europe to western Siberia. Many passage birds (at least in spring) are of the central Siberian race taymyrensis; regularly seen passing the south coast of England in April and May.	Jersey: Very common winter visitor and migrant. Guernsey: Common winter visitor and migrant. Alderney: Scarce winter visitor, spring and autumn migrant. Sark: Accidental.
Northern Lapwing	Eats a variety of invertebrates including worms, beetles, flies and ants. Also spiders, small frogs, snails and some plant material.	The Lapwing population wintering in the UK comprises the part of the breeding population that does not move southwards to continental Europe, supplemented by birds from Scandinavia, Eastern Europe and Russia. Numbers wintering in the UK are known to vary in response to temperatures, both here and particularly in continental Europe.	Jersey: Rare resident and common migrant, sometimes abundant in winter. Guernsey: Common winter visitor and migrant. Alderney: Fairly common winter visitor and migrant. Sark: Scarce and decreasing migrant and winter visitor.
Sanderling	Amphipods, shrimps, small crabs and marine worms	Sanderling breed in the high Arctic and birds from both the Siberian and Greenland populations migrate south from northwest Europe.	Jersey: Very common winter visitor and migrant. Guernsey: Common winter visitor and migrant. Alderney: Scarce spring and autumn migrant. Sark: 1 record, 2/9/1973.
Ringed Plover	Feeds on a variety of small insects, worms, crustaceans and other creature, including shrimps. Marine snails, beetles and small fish.	Many birds resident all year round, but birds from Europe winter in Britain and birds from Greenland and Canada pass through on migration.	Jersey: Rare resident, may attempt to breed annually, common winter visitor and migrant. Guernsey: Rare resident, breeds annually, common winter visitor and migrant. Alderney: Rare resident, attempts to breed annually, common winter visitor and autumn migrant. Sark: Rare visitor.
European Golden Plover	Eats a variety of invertebrates, especially beetles and worms. Also moths, larvae, ants, spiders, snails, plant material and berries.	Most British breeding birds remain in Britain. Majority of migratory birds are from Iceland, others from northern Europe.	Jersey: Common winter visitor and migrant. Guernsey: Scarce winter visitor and migrant. Alderney: Fairly common winter visitor. Sark: Scarce winter visitor and migrant.

Species	Diet	European Population Structure (Source: Holt *et al.,* 2011)	Summary of the Channel Islands Population Status
Whimbrel	On the coast it feeds on periwinkles, whelks, crabs, shrimps and amphipods. Inland feeds on beetles, worms, snails, slugs and flies.	The majority of Whimbrels seen in Britain are en route to and from breeding sites in Iceland, Scandinavia and western Siberia, and the main wintering areas in west Africa.	Jersey: Common spring and scarce autumn migrant. Guernsey: Common migrant and occasional winter visitor. Alderney: Fairly common spring and autumn migrant and non-breeding summer visitor. Sark: Scarce spring and autumn migrant. Occasional in winter.
Dark-bellied Brent Goose	Algae, eelgrass, saltmarsh plants. Birds visiting agricultural land graze the shoots of winter cereals, grass and oilseed rape.	Dark-bellied Brent Geese winter along the coasts of western Europe, the majority at sites on the Atlantic west coast of France, the south and east coasts of England, southwest Netherlands and the Wadden Sea.	Jersey: Very common autumn migrant and winter visitor. Guernsey: Common winter visitor. Alderney: Rare but annual winter visitor. Sark: Rare winter visitor.
Turnstone	Opportunist feeder on a wide variety of food including mussels, molluscs, crabs, insects and carrion.	Turnstones from two distinct breeding populations occur in the UK. The majority of those which winter in the UK originate from Greenland and east Canada, while Siberian and Scandinavian breeders pass through in spring and autumn en route to and from wintering sites in western Africa.	Jersey: Very common winter visitor and migrant. Some birds present in summer. Guernsey: Common winter visitor and migrant. Alderney: Common winter visitor and migrant. Some birds present in summer. Sark: Scarce winter visitor and migrant.

(Data Sources: Holt *et al*., 2011; Holden and Cleeves, 2002; Young *et al*., 2012)

Terrestrial Birds

A wide range of terrestrial bird species (both migratory and resident) are also recorded on the Channel Islands, including commonly occurring species such as the Wren *Troglodytes troglodytes*, Dunnock *Prunella modularis*, Stonechat *Saxicola torquata*, Linnet *Carduelis cannabina*, Blackbird *Turdus merula*, Songthrush *Turdus philomelos*, Skylark *Alauda arvensis* and Meadow Pipit *Anthus pratensis* (Young *et al.,* 2012). There are also rarities such as Dartford Warbler *Sylvia undata* and the Serin *Serinus serinus Certhia brachydactyla* and many continental overshoots in the spring including Golden Orioles *Oriolus oriolus* and Hoopoes *Upupa epops* (La Societe Guernesiaise website; Young *et al*., 2011).

Alderney is an important staging post during spring and autumn migration periods. From March until early June the Channel Islands become resting and refuelling stops for large numbers of passerines, including Wheatears *Oenanthe oenanthe,* (La Societe Guernesiaise website). The autumn migration is less predictable but includes bird species such as Swallow *Hirundo rustica*, Swift *Apus apus* and Sand Martin *Riparia riparia.* A number of rarities have also been observed, including Rose-breasted Grosbeak *Pheucticus ludovicianus* from North America and Yellow-Browed Warbler *Phylloscopus inornatus* from the east (Young *et al*., 2012).

Birds of prey also occur throughout the islands, including Kestrels *Falco tinnunculus,* Peregrines *Falco peregrinus*, Sparrowhawks *Accipiter nisus* and Buzzards *Buteo buteo* (Wildlife Extra website). The area of Giffoine, which lies near the high rocky cliffs of Alderney's west coast, is best for spotting kestrels and peregrines, and the eastern end of the island is good for seeing buzzards. Other birds of prey including Osprey *Pandion haliaetus,* Hen Harrier *Circus cyaneus* and Merlin *Falco columbarius* are typically seen during spring and summer migration periods (Young *et al*., 2012).

5.4.1.1 Future baseline

Birds could be impacted in the future by a range of human pressures including fisheries (changing prey stock levels and causing by-catch), marine developments and pollution. Future climate change has the potential to have a particularly large impact on the abundance and distribution of different bird species. JNCC and the Centre for Ecology and Hydrology (CEH) undertook a scientific review of the potential future impacts associated with climate change as part of the Marine Climate Change Impact Partnership (MCCIP) Annual Report Card (Mitchell and Daunt, 2010). The main findings from this report are summarised below:

- Range shifts: Most seabird species in the UK are at the southern limit of their range in the North-east Atlantic - this may be because they are adapted to living in a particular climate. If this is the case, as the climate in the UK changes, there may be a shift in range that may or not cause a decrease in breeding numbers, depending on the availability of nesting sites and food elsewhere.
- Changes to physical habitat: Future climate change is also likely to have direct impacts on breeding seabirds. Rising sea levels, particularly in the southern North Sea may wash away coastal nesting habitat of ground-nesting seabirds such as terns. Increases in storminess may lead to nests being washed away during the summer or to large scale mortality during the winter. However, storminess is not predicted to change markedly in the future in the study area (see Section 4.2.1.3).
- Changes to the food web: Climate change is considered to impact on seabirds primarily by reducing the number, quality or availability of prey fish, in particular sandeels, and this process is expected to intensify in the future. The continued warming of waters around much of the UK has led to changes in species competition and abundance at lower trophic levels, with detrimental effects on sandeels. If sea temperatures continue to rise as predicted, it is likely that kittiwakes and other seabirds that feed on small shoaling fish will continue to experience poor breeding seasons with increasing frequency. The combination of reduced recruitment and lower adult survival associated with high sea temperatures will lead to further large declines in population size.

The Terrestrial Biodiversity Climate Change Impacts Report Card (LWEC, 2013) indicates a number of potential changes to terrestrial birds, including the following:

- Changes in the timing of life cycle events (phenology): Spring events will advance, such as the egg laying in birds. The extent of this effects is species-specific. Phenological changes are also affecting the synchrony between bird predators and prey;

- Range shifts: Changes in the range margins of many bird species are consistent with recorded increases in temperature and this is set to continue;
- Community composition: There have been some shifts in community composition among birds, consistent with the effects of recent warming and this is anticipated to continue. Warming has generally been associated with an increase in species diversity, which reflects the importance of southern species and their preference to higher temperatures;
- Changes in population: Climate change may contribute to bird population declines by increasing the effects of diseases and parasites; and
- Reproductive processes: Many bird species have better breeding performance during a mild spring.

5.4.1.2 Limitations and data gaps

Breeding seabirds nesting on the Channel Islands are regularly monitored as part of established colony counts. Dedicated monitoring programmes which describe the abundance and density of other foraging seabirds at sea, as well as passage and overwintering waterbirds utilising coastal habitat, is more limited. The use of established seabird at sea and coastal waterbird monitoring techniques around Alderney would therefore be recommended. Examples of the specialist assessments which may be required to support the EIA project-level include:

- Power analysis of the boat-based seabird survey data;
- Collision risk modelling;
- OWF collision models and population models;
- Impacts of noise on prey species of birds; and
- Habitat modelling.

A pilot programme that is being led by the Agence des Aires Marines Protégées and a number of scientific partners, called Programme d'acquisition de connaissances sur les oiseaux et les mammifères marins en France métropolitaine (PACOMM[4]) has involved the collection of data on birds and marine mammals in French waters between 2010 and 2014. This study which is due to be published later in 2014 evaluates the distribution of seabirds and marine mammals, as well as human activities, boats, waste and their spatial and temporal variability. This will therefore complement the existing baseline characterisation of birds undertaken as part of this REA and should be considered by individual developers at the project-level as necessary.

5.4.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. Seabirds can undertake long distance foraging excursions away from nesting colonies with some species such as Northern Gannet and Fulmar recorded travelling over 600km during the course of two foraging trips (Thaxter *et al*., 2012; BirdLife International, 2012). Given the potential for transboundary effects, particularly for species moving to and from French waters, but also possibly to and from English waters, it is also important that any

4 http://www.aires-marines.fr/Connaitre/Habitats-et-especes-pelagiques/Oiseaux-et-mammiferes-marins-en-metropole

birds that are a qualifying feature of Natura 2000 sites and that may overlap with the changes brought about by the Draft Plan be considered as part of the assessment (see Section 5.6.1). The mobile Natura 2000 features study area shown on Figure 2, which incorporates the entire English Channel and the coastlines of southern England and Northern France, encompasses these wider-scale boundaries.

5.4.2 Impact Assessment

The Draft Plan has the potential to affect the ornithology in the study area through a number of impact pathways, which are assessed in the following sections:

- Collision Risk (Section 5.4.2.1);
- Visual Disturbance (Section 5.4.2.2);
- Noise/ Vibration Disturbance (Section 5.4.2.3);
- Toxic Contamination (Spillage) (Section 5.4.2.4);
- Changes To Foraging Habitat Availability (Section 5.4.2.5);
- Non-Toxic Contamination (Section 5.4.2.6);
- Toxic Contamination (Sediment Release) (Section 5.4.2.7);
- Barrier to Movement (Section 5.4.2.8);

Throughout the impact assessment all bird features are considered to be of moderate to high importance given that all birds are protected under both Channel Island and UK law and many species are also protected under European Law (e.g. EU Habitats Directive).

5.4.2.1 Collision risk

Seabirds could potentially collide with structures both above and below the sea-surface during surveying, construction, operation and decommissioning of any tidal infrastructure and the operation of onshore wind turbines. Collision risk and mortality will depend on a range of factors related to bird species, abundance, foraging modes (e.g. locations and methods), foraging timings (e.g. day or night), topography, weather conditions the value of the area as a feeding ground, the consistency with which it is used for foraging and the nature (especially the underwater mobility) of the structures themselves including the use of lighting for above-surface components (DECC, 2009). This section starts by assessing the sensitivity of bird receptors followed by consideration of potential impact pathways, including collision with vessel propellers underwater, collision with tidal turbine blade and other moving parts underwater and finally collision with onshore windfarm blades and other structures above the water.

Species sensitivity to collision risk varies depending on species foraging modes and ecology. Terrestrial birds and those diving bird species which forage on coastal and offshore waters, whether at the surface or through diving and pursuit, are considered to be at the greatest risk of colliding with surface and sub-surface tidal structures.

Some species such as shag forage only during daylight, whereas a proportion of foraging activity of guillemots and razorbills occurs around dawn and dusk (Daunt *et al*., 2006; Thaxter *et al*., 2009) possibly increasing the risk of effects. Moreover, Manx shearwaters and both petrel species arrive at breeding burrows overnight (thus, travelling at sea overnight), rendering these species more at risk from surface collisions. This may be exacerbated by their low flight trajectory.

During survey, construction and decommissioning, those seabirds that fly and forage during the night are considered to be of low sensitivity from collision with structures, e.g. due to activities of cable/pipeline and device installation. During operation the same species are considered to have a moderate sensitivity to collision mortality due to the presence of above sea-surface surface structures and vessels. Diurnally foraging species can be considered at lower risk of collision mortality in all phases.

During turbine operation, collision risk will particularly depend on the size and positioning of devices in the water column. Species that dive underwater, and hence spend time travelling through or foraging within the water column, will be at the greatest overall risk of collision with below sea-surface structures. Hence, these species are considered to be of medium sensitivity; surface feeders will be least at risk (classed as low), as they are not likely to interact with underwater turbine blades. Individual species that may be considered to be of medium sensitivity include plunge divers such as the Gannet, together with species that dive from the surface but use the whole water column including common guillemot, razorbill, puffin, shag and cormorant. Surface feeders such as gulls, skuas and terns are only likely to be of low sensitivity to collision and only at risk from floating devices and above surface structures.

Based on a precautionary approach, birds are considered to have a moderate sensitivity to collision risk both in the air and underwater. Sensitivities at a population-level are also likely to be inherently lower than for individuals, particularly where populations are geographically dispersed.

Collision with Vessel Propellers Underwater

Collision risk with vessels throughout all stages would be expected to be low given the highly mobile nature of such bird species. It is also likely that any visual and noise disturbance caused by the vessel movements themselves would limit the potential for collision incidents. The short temporal scale and slow speeds of vessels associated with all phases of development, in addition to the small number of installation vessels involved relative to existing vessel activity in the area, indicates that the risk of collision with vessels is considered to be low, leading to an **insignificant to minor adverse** impact.

Collision with Tidal Turbine Blade and Other Moving Parts Underwater

During operation, collision with turbine blades underwater may potentially pose the highest risk to diving foraging seabirds, though the significance of this will depend on whether birds will be able to detect and avoid the blades. The design of devices and use of features such as cowling around rotors will also affect collision risk. As with above surface structures, the risk posed may be greater in sounds and channels where topography restricts avoidance. The risk of collision in such sites will also depend on topography and whether birds will be able to detect and avoid the blades, and also the orientation of any scheme. The risk of collision will also be increased if schemes alter flow characteristics; birds are attracted to flow gradients due to prey association, and any alteration could present a higher risk for diving species.

Underwater collision risk will also be greater in areas with moderate to high turbidity where visibility for birds is reduced. For instance, a very small increase in turbidity can negatively affect the vision of cormorants (Strod *et al*., 2004). In comparison to turbine blades, fixed moorings (i.e. anchor blacks and plinths) should present no greater risk to diving seabirds than natural barriers, and cables, chains, and considering the small cross-sectional area, power lines extending through the water column should not provide a major threat of entanglement.

Frid *et al*. (2012) stated that the risk of collision is expected to be minimal for most seabirds, with the predicted slow turbine speeds relative to the agility of diving bird species making the risk of mortality very low. Ultimately, the level of risk will be dependent upon exposure and that will only be fully understood at a project level.

Given that diving birds species such as seabirds are regularly recorded around Alderney and in the absence of further information on specific device characteristics (such as blade speed) and operational noise levels (which might provide early acoustic warning avoidance behaviour), exposure to change has been assessed as medium. On this basis the risk of collision impact with a single tidal array has been assessed as minor to moderate adverse. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a high level of exposure to change (due to a much higher probability of collision) and an overall moderate to major adverse impact.

Collision with Onshore Windfarm Blades and Other Structures Above the Water

It is recognised that it is difficult to assess the airborne collision risk of birds as species may make random migration and forage flights or may repeatedly fly over the same routes. Identifying distinct flyway routes is complex both because of the nature and limitations of available information on the subject and because these movements are likely to occur across broad fronts rather than along clearly definable routes.

There are also a number of variables involved in flight direction including:

- Spatial variation in food abundance (including anthropogenic factors such as fishing vessels);
- The risk of predation/kleptoparasitism by other bird species;
- The importance of nest attending to incubate eggs and protect nest from predators; and
- Weather and climatological factors (ABPmer, 2010a).

For instance, waterfowl may relocate to other sites during periods of adverse weather during the winter months, outside of the main migratory periods. Therefore, it is likely that few if any birds are likely to be excluded solely on the basis that their main foraging habitats are not directly or indirectly affected by the Draft Plan.

Hamer *et al*. (2007) suggested that birds remember directions to feeding sites and use this knowledge on subsequent foraging trips. However this foraging behaviour has not been observed in all studies and is considered to be linked to the spatial and temporal predictability of prey resources.

Flight heights have also been observed to be highly variable between species. Birds tend to fly at the altitude that maximises flight efficiency, whether this is at high elevations, well above turbine height, when unimpeded or at low elevations over the water when making short sea crossings or during bad weather or strong headwinds (Langston, 2010). However birds have been observed apparently increasing flight height to avoid offshore wind farm areas (Griffin *et al*., 2010).

A further consideration in respect of the impacts from collision, is the lighting of wind farms offshore and on land. A lot of work has been done to investigate the collision risk posed by very high towers (>200m) on land to flying birds and such towers have been shown to cause large numbers of collisions. Therefore, wind turbines could, when lit at night, pose a risk that is similar to communication towers (Ecology Consulting 2001). This study also highlighted evidence that altering the type of lighting (e.g. flashing/strobing) and/or the light's colour spectrum can reduce the risk of attracting birds and therefore reduce such collision risks.

Collision rates are variable with average collision rates per turbine ranging from 0.01 to 23 bird collisions annually (Drewitt and Langston, 2006; Everaert *et al*., 2001; Pettersson; 2005). Collision Risk Modelling (CRM) has been extensively used for both onshore and offshore sites globally, including a range of UK offshore developments. This CRM modelling tool has predicted collision rates for the UK Round 1 and Round 2 developments and for a range of different species on an annual basis. The maximum predicted collision rates for most species were in the order of a few tens (per year, per development) (DECC, 2009) but they are dependent on the parameters and avoidance rate for individual species and so will be specific to individual developments. It should also be noted that such numerical predictions are highly sensitive to assumptions on avoidance rates.

Given that large numbers of passage and migratory birds species are recorded around Alderney and in the absence of further information on the number of turbines and specific device characteristics (such as blade speed), exposure to change has been assessed as medium. On this basis the exposure to collision risk as a result of the onshore wind turbine is considered to be medium and has been assessed as **minor to moderate adverse**. The exposure to change as a result of the offshore and onshore substations is considered to be negligible to low given that there are no rotating/moving elements to the structures and, therefore, the impact is considered to be **insignificant to minor adverse**.

5.4.2.2 Visual disturbance

Visual disturbance may occur during the pre-construction survey work (seismic exploration, geophysical surveys), construction/decommissioning (installation/removal of cable, pipelines and turbines or vessel movements) and the operation (mainly maintenance vessels or vehicles) phases of any work undertaken as part of the Draft Plan. Visual disturbance can interrupt feeding and breeding behaviour of birds, with possible long-term effects of repeated disturbance including habitat displacement, loss of weight, condition and a reduction in reproductive success. Birds typically show a dispersive response to disturbance with prolonged disturbance causing displacement. The effect of such disturbance is linked to the amount of times it occurs and the status of the conditions that are prevalent (Liley and Fearnley, 2011; Coleman *et al*., 2003; Ruddock & Whitfield, 2007). Overall, sensitivities are considered to be moderate.

Visual disturbance in the different phases of developments will generally only be short term. However, the level of impact will be dependent on the distance vessels, vehicles and other visual disturbance sources are from key foraging and breeding areas for birds. Monitoring on the SeaGen Strangford Lough project showed that while some fine scale displacement of birds had been recorded in the immediate vicinity of a tidal device, the overall numbers in the Narrows at the mouth of the Lough remained stable (Royal Haskoning, 2011). Nevertheless, there is potential for displacement of birds particularly for developments with significant surface infrastructure (Grecian *et al*., 2010). The greatest disturbance is likely to be caused by human presence and work on the foreshore, however, all effects are anticipated to be temporary. For all phases and elements of the Draft Plan, exposure to change is considered to be low and the potential impacts of **insignificant to minor adverse**.

5.4.2.3 Noise/vibration disturbance

Noise disturbance may occur during the pre-construction survey work (seismic exploration, geophysical surveys), construction/decommissioning (installation/removal of cable, and turbines or vessel movements) and the operation (mainly maintenance vessel and vehicles) phases of any element of the Draft Plan. The extent to which birds are affected by sources of noise and visual disturbance has been the subject of a lot of previous research and monitoring work. Disturbance can result in birds flying away or ceasing to feed which could in turn cause an increase in their energy requirements or result in them moving to alternative, less suitable feeding or roosting sites. Such a response would affect energy budgets and food intake rates, and possibly survival (Kaiser, 2002).

Studies generally show that birds are disturbed by a sudden large noise but have the ability to habituate to regular noises. For instance, with respect to piling specifically, it has been concluded that although piling has the potential to create most noise during construction, it often consists of rhythmic “bangs”, which, after a short period, birds are likely to become accustomed to (ABP Research & Consultancy Ltd, 2001). Other research has also indicated that, in general, birds appear to habituate to continual noises as long as there is no large amplitude ‘startling’ component (Hockin *et al*., 1992). For example as part of the construction work for ABB Power Generation Ltd (Pyewipe), winter bird monitoring showed that there was no large-scale disturbance due to construction work on the site. Although some localised disturbance was recorded in response to two sudden events, this was not considered to have a major effect on surrounding bird populations and was found to be no greater than the effect arising from third party disturbance, including walkers and stopped cyclists, which were unrelated to the work carried out by ABB (ERM, 1996). Observations suggested that it was the initial sudden bang during piling activities, which caused the disturbance, and that subsequent bangs typically resulted in reduced disturbance, demonstrating habituation.

These findings were supported by the studies carried out for the Humber International Terminal development, which indicated that the key factor in triggering disturbance was human presence

(ABP Research & Consultancy Ltd, 2000). Over 12 separate visits, disturbance by construction activities (which involved piling and reclamation of part of the foreshore) was observed on 3 occasions and in each case birds were disturbed over a small area and then rapidly resettled within the zone of disturbance (i.e. they did not leave the area). More recently, surveys of the birds around the Immingham Outer Harbour in the Humber (using the same methods) have also indicated that such disturbance events are limited and are often attributable to non-Port related activities such as the presence of Peregrine Falcons or walkers on the mudflat (ABPmer, 2010b).

The ABP Teignmouth Quay Development also estimated an approximate zone within which birds may be affected by disturbance from construction works (piling and dredging) to be typically about 200m (ABPmer, 2002). The startling effects of sudden noise were quantified, based on published research, by the Environment Agency for the Humber Estuary Tidal Defences scheme. It was concluded that a sudden noise in the region of 80 dB appears to elicit a flight response in waders up to 250m from the source, with levels below this of approximately 70 dB causing flight or anxiety behaviour in some species.

Drilling/piling activity during construction of the tidal turbine devices and offshore substations could disrupt seabird foraging and directly affect the senses of species diving underwater for prey. Seabirds hunt visually underwater, but evidence on land suggests they may also have acute hearing, and thus marine noise could disorientate and upset foraging rhythms, and potentially cause permanent damage to hearing.

With respect to vessel movements, the presence of boats may cause an increase in noise and vibration levels which could result in disturbance to / displacement of seabirds. Species such as Red-throated Divers and Sandwich Terns are considered particularly sensitive to shipping noise, although it is important to recognise the noise source levels of shipping is considerably smaller than for piling.

The sensitivity of birds to airborne noise during all phases is considered to be low given their ability to habituate to continual noises (e.g. piling). The sensitivity of species to underwater marine noise is considered to be moderate for diving species and low for surface-feeding species. There is limited data on this issue, however, as described under visual disturbance, survey work on the SeaGen Strangford Lough project has shown that while some fine scale displacement of birds in the immediate vicinity of the device occurred, the overall numbers in the area have remained stable (Royal Haskoning, 2011).

Noise disturbance during construction will generally only be short-term. Given the unconfined nature of the area, any birds that do pass through the area will be able to easily move away from any temporary noise disturbance and return once the disturbance has ceased. Exposure to change is considered to be medium during construction elements of the Draft Plan if percussive piling is required, resulting in an insignificant to minor adverse impact for terrestrial and surface-feeding birds, and insignificant to moderate adverse for diving birds. Exposure to change is considered to be low for all other phases and elements of the Draft Plan, resulting in an insignificant to minor adverse impact.

5.4.2.4 Toxic contamination (spillage)

There is potential for the spillage of fluids, fuels and/or construction materials into the marine environment, originating from the survey, construction, decommissioning and maintenance vessels associated with the tidal device, cabling and offshore substation, in addition to the tidal device itself. Marine birds are particularly sensitive to contamination by oil (Votier *et al*., 2008), as the oil can cause considerable damage to waterproofing and flight (Wernham *et al*., 1997), as well as additional physiological damage of birds ingesting oil. Species are therefore considered to have moderate sensitivity to oil but exposure is dependent on general behaviour and distribution of species (e.g. the proportion of time spent on the sea surface relative to flying or feeding locations). Auks, in particular, may spend a considerable amount of time on the sea surface or foraging (Thaxter *et al*., 2010), and thus have a higher risk of being adversely affected by 'at sea' spillages of contamination events (e.g. Votier *et al*., 2008). By contrast waders would only be affected by contamination events that affect their intertidal foraging zones. The probability of substantial spillage occurring and the overall level of exposure to change is considered to be negligible to low for all phases and developments, resulting in an **insignificant to minor adverse** impact. In the unlikely event of an incident, best practice measures put in place to manage potential water quality impacts (see Section 4.3.2.1), such as the use of oil spill action plans, would contain the spillage and prevent substantial effects.

5.4.2.5 Changes to foraging habitat availability

As a result of disturbance, avoidance of areas of habitat by birds may occur during the pre-construction survey, construction, operation and decommissioning phases of tidal energy development. Exclusion from habitats essentially prevents access to prey sources. Such exclusion could reduce other effects, notably collision mortality. However, reductions in the availability of habitat and access to prey could lead to many changes in the way individuals forage, including increased individual stress levels and alterations to individual time budgets owing to travelling further to find food (Scottish Executive, 2007).

Although alternative foraging areas may exist, the quality of the foraging habitat that species are forced to use may be lower, as well as more distant, thus increasing searching and foraging time needed to meet energetic needs. Species may have little flexibility to alter their time budgets to encompass extra foraging/travel to destinations. Species may also be reliant on a particular prey source at a location and may have less ability to switch to a different prey source. Effects at the colony and nest sites would be experienced through a reduced attendance time (due to lower feeding rates of chicks and longer foraging trips), possibly with increased neglect of chicks increasing predation risk or attacks from conspecifics. Furthermore, reduction in available habitat can generate increased competition to find food with knock-on implications for neighbouring areas (i.e. not included in the assessment). These disturbances may, therefore, cause a reduction in foraging success, decreases in breeding success, and effects on individual fitness.

The breeding success of some surface-feeding species, such as terns and kittiwakes, is negatively affected by changes in food availability due to reliance on prey brought to the sea surface (Furness & Tasker, 2000). However, those species with higher burdens to energy costs of flight and foraging (such as auks) may find it harder to increase foraging ranges to more distant prey resources (if such a change were to occur), than for instance gannets that are generally less sensitive to natural changes in the availability of food, and can forage over a much wider area. Diving species with high wing loading have high energetic cost during flight, thought to be linked with adaptation of wings for underwater locomotion (Gaston and Jones 1998; Thaxter *et al*., 2010). Thus, while they have the potential to forage far from colonies, their typical ranges may be smaller than those of other species, i.e. 20-40km (Thaxter *et al*., 2009; 2010), and may be less flexible in making changes in the event of reduced prey availability (Enstipp *et al*., 2006). In summary, diving species are considered to have a moderate sensitivity to this effect, and surface-feeding species have a low sensitivity.

All birds are at some risk of disturbance from the indirect loss of foraging habitat although it is clearly the case that this is dependent upon foraging locations used by different species (i.e. whether they feed on intertidal or offshore locations) and the area of development activity. In general, the effects will be temporary during initial survey phases, causing minimal disruption. However, more significant effects may occur in the construction, operation and decommissioning phases. For instance, Garthe and Hüppop (2004) evaluated the sensitivity of species to offshore wind farms, and their score for flexibility in habitat use provides a useful measure to the sensitivity of species to this effect. As suggested by evidence from offshore wind farms, red-throated divers and common scoters (both diving species) may be particularly sensitive to disturbance and thus the effects of indirect habitat loss. Displacement studies around turbines and boat related activity reported in NE and JNCC (2010) showed that up to 80 to 100% of red-throated divers were displaced from the development footprint and surrounding area. The effect of disturbance and habitat exclusion will depend on the extent of construction and operational activities, as well as the time of year; a potential mitigation is to avoid construction at vital times (i.e. before and during breeding) when prey is needed by adult birds and for provisioning to offspring.

In the absence of further information on specific location of elements of the Draft Plan (and therefore the degree of overlap with potentially sensitive areas), exposure to change is considered to be medium if percussive piling is required for construction of tidal stream turbines, offshore substations, onshore substations and onshore wind turbine resulting in an **insignificant to minor adverse** impact for terrestrial and surface-feeding foraging birds, and **minor to moderate adverse** for diving birds. For all other elements and phases of the Draft Plan, exposure to change is considered low and the potential impacts **insignificant to minor adverse**.

5.4.2.6 Non-toxic contamination

As outlined in Section 4.3.2.2, in areas being excavated or disturbed for the installation/removal of tidal stream turbines, cables or offshore substations there will be a temporary increase in SSC and turbidity, potentially leading to effects on (diving) seabird foraging success and predator-prey interactions. Species diving underwater are at greatest risk of having foraging activity disrupted by sediment mobilisation and suspension, and this is most likely to occur during the construction and decommissioning phases. Diving species such as Auks, Shags and Cormorants use much of the water column and thus are considered to have a moderate sensitivity to this effect, whereas surface-feeding seabirds are considered to have a low sensitivity. However, all species are at risk of disruption due to likely prey avoidance of areas that have been disturbed. All species are also at moderate risk from changes to prey distribution areas associated with changes in hydrodynamics. Nevertheless, given the high energy of the environment, the sensitivities of species to this effect are considered to be low.

For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low, resulting in an **insignificant to minor adverse** impact. The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection in areas where the cable cannot be buried. Overall, therefore, the level the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

5.4.2.7 Toxic contamination (sediment release)

There is potential for toxic contaminants to be released into the marine environment as a result of the disturbance of contaminated sediments during construction and decommissioning of all elements of the Draft Plan. Seabirds are at risk either through direct poisoning or bio-magnification of pollutants through ingestion of contaminated prey would increase the probability of mortality of all species being considered. Although data on the sensitivity of birds to toxic contamination through sediment release is limited, the Alderney Wildlife Trust has advised that they are very sensitive to this impact (Alderney Wildlife Trust pers. comm., June 2013). This assessment has, therefore, considered the overall sensitivity to be moderate.

The magnitude of the effect is dependent upon the level of contamination; the proximity of the activity to a designated site and species foraging areas; the type of activity occurring; the manner in which that activity is pursued (including the extent and duration); the particle size of the disturbed sediments and the hydrodynamic conditions. The precise risk would depend on the use of the area by foraging seabirds.

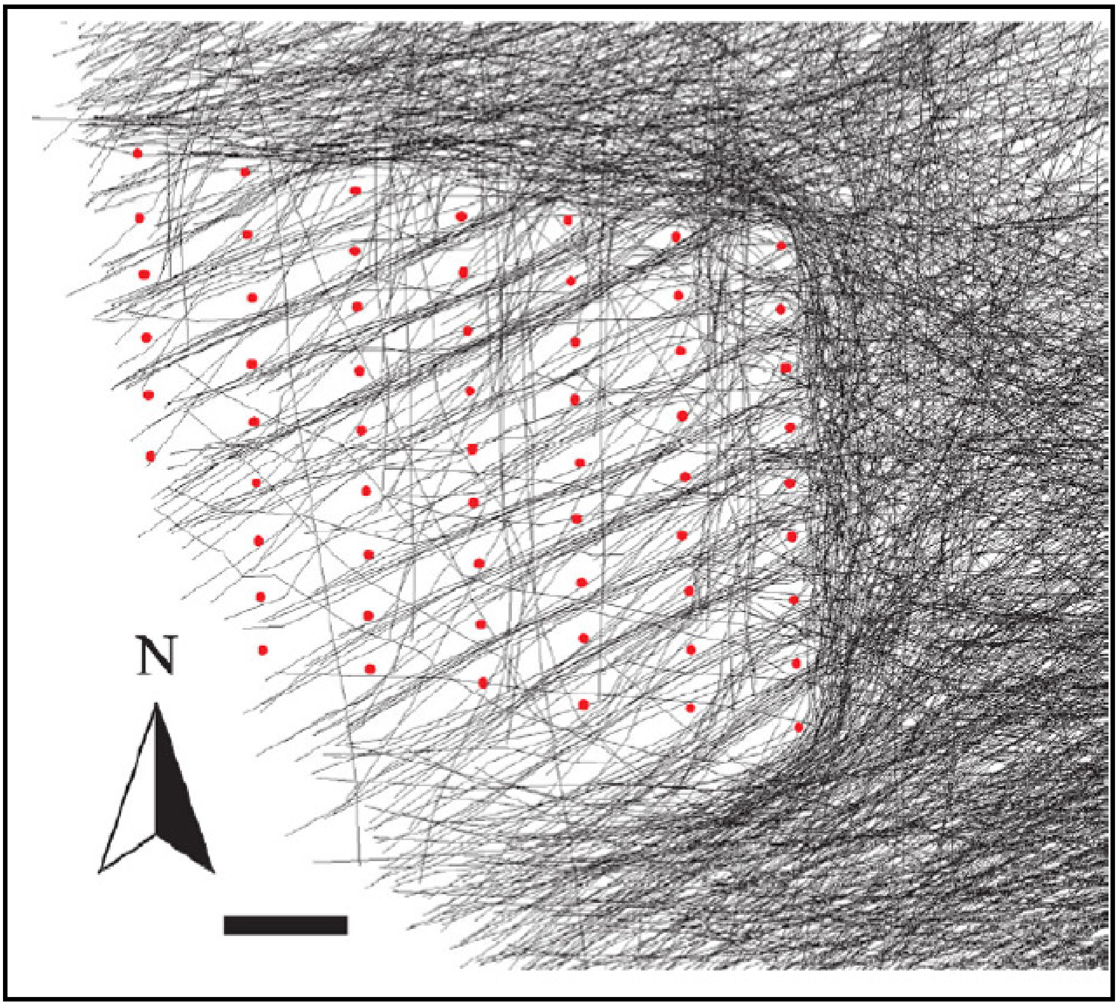
It is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low (Section 4.3.2.3), resulting in an **insignificant to minor adverse** impact. For cable routeing the exposure to change is considered to be low (Section 4.3.2.3). Overall, this will result in an **insignificant to minor adverse** impact.

5.4.2.8 Barrier to movement

Wind turbines visible from above the surface could create a barrier effect and thus birds in flight will probably deviate their flight route to avoid the structures (Desholm and Kahlert 2005). Griffin *et al.* (2010) observed birds apparently exhibiting avoidance behaviour near operational wind farms at Robin Rigg and Barrow by increasing flight height.

At Nysted offshore wind farm in the western Baltic, radar studies have indicated a high degree of avoidance by Eider and other large waterbirds during migration (DECC, 2009). An output from this work is shown in Image 5 where the black lines indicate migrating waterbird flocks and the red dots indicate the wind turbines (the scale bar that is shown represents a distance of 1000m). There was a significant reduction in migration tracking densities within the wind farm area post-construction (Desholm and Kahlert, 2005). During this study avoidance response differences were also observed during daylight and at night. Nocturnally migrating waterfowl over Denmark and the Netherlands were also able to detect and avoid turbines, with avoidance distances greater during darker nights (Dirksen *et al*. 1998; 2000).

Following construction of an offshore wind farm site at Tunø Knob in the Danish Kattegat, the number of Common Scoters and Eiders decreased in the two years following construction. However Eider numbers subsequently increased, possibly due to birds habituating to the wind farm or as a result of the increased abundance of mussels (Drewitt and Langston, 2006). Later work also concluded that Eider reacted strongly to the presence of wind turbines, interpreted to be a consequence of this species' high speed and low manoeuvrability (Larsen and Guillemette, 2007).



(Desholm and Kahlert, 2005)

Image 5. Westerly oriented flight trajectories during the initial operation of the wind turbines at Nysted Offshore Wind Farm

Following construction of Horns Rev Offshore Wind Farm, aerial surveys found that divers, Guillemots, Gannets, Razorbills and Common Scoters all occurred in lower numbers than expected in the wind farm area following construction. Conversely, gulls and terns showed a preference for the wind farm area following construction (Petersen *et al*., 2004). Again it is recognised that these changes may reflect habituation to wind turbine presence or may be as a result of changes in food availability rather than displacement by disturbance (Petersen *et al*., 2003).

Little is known about the sensitivity of bird species to barrier effects and their ability to alter flight heights. However, avoidance behaviour may lead to the possibility of increased energy expenditure when birds fly further or higher to avoid large turbines, and may potentially lead to the disruption of linkages between distant feeding, breeding, moulting and roosting areas which otherwise would be unaffected. Studies have found migrating birds to generally avoid offshore wind farms by flying further or higher, with avoidance distances increasing at night. However, some species have found to be attracted to wind farm areas due to increased prey availability.

Given the level of uncertainty associated with this impact pathway, the sensitivity of bird species to barrier effects is considered to be medium. However, as any onshore wind development on Alderney is likely to consist of only very low numbers of turbines unlike large offshore arrays, the creation of a barrier to movement is considered unlikely and exposure is considered to be low. On this basis the impact from the onshore wind turbine acting as a barrier to movement has been assessed as being **insignificant to minor adverse**.

5.4.2.9 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on ornithology:

Collision Risk:

- Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices.
- Mitigation that is likely to be required to protect marine mammals from collision risk will also protect diving birds (see Section 5.5.2.11). These include:
    - Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure;
    - Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically.

Noise/Vibration Disturbance and Changes to Foraging Habitat Availability:

- Restrict piling (if required) to periods of low species activity periods within annual and diurnal cycles as appropriate to avoid excessive displacement of species by underwater noise caused by infrastructure installation (piling); and
- Where appropriate to the local species ensuring that piling (if required) commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors.

5.4.2.10 Residual impact

The mitigation measures identified in Section 5.4.2.9 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on birds as the extent of mitigation achievable will be heavily dependent on many project specific factors. The significance of potential residual impacts have been estimated and summarised in Table 20 below.

5.4.2.11 Summary

Table 20. Assessment of the potential effects of the Draft Plan on ornithology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Construction	Changes to foraging habitat availability	M	L-M	M-H	Insignificant to moderate	Section 5.4.2.9	Minor/Insignificant
		Collision risk	L	M	M-H	Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	M	L-M	M-H	Insignificant to moderate	Section 5.4.2.9	Minor/Insignificant
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Non-toxic contamination	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	N-L	M	M-H	Minor/ Insignificant	-	-
	Operation	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision risk	M-H	M	M-H	Minor to major	Section 5.4.2.9	Minor/Insignificant
		Barrier to movement	L	M	M-H	Insignificant -minor	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Decommissioning	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Non-toxic contamination	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	N-L	M	M-H	Minor/ Insignificant	-	-
Cable Routing	Survey	Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Construction	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
		Non-toxic contamination	N-L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	L	M	M-H	Minor/ Insignificant	-	-
	Operation	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Decommissioning	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Non-toxic contamination	N-L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	L	M	M-H	Minor/ Insignificant	-	-
Offshore Substations	Survey	Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Construction	Changes to foraging habitat availability	M	L-M	M-H	Insignificant to moderate	Section 5.4.2.9	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	M	L-M	M-H	Insignificant to moderate	Section 5.4.2.9	Minor/ Insignificant
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Non-toxic contamination	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	N-L	M	M-H	Minor/ Insignificant	-	-
	Operation	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision risk	N-L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Introduction of new structure	L	M	M-H	Minor/ Insignificant	-	-
	Decommissioning	Changes to foraging habitat availability	L	L-M	M-H	Minor/ Insignificant	-	-
		Collision risk	L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L-M	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Non-toxic contamination	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (sediment release)	N-L	M	M-H	Minor/ Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Onshore Substation	Survey	Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Construction	Changes to foraging habitat availability	M	L	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	M	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Operation	Changes to foraging habitat availability	L	L	M-H	Minor/ Insignificant	-	-
		Collision risk	N-L	M	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Decommissioning	Changes to foraging habitat availability	L	L	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
Onshore Wind Turbine	Survey	Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Construction	Changes to foraging habitat availability	M	L	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	M	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
	Operation	Changes to foraging habitat availability	L	L	M-H	Minor/ Insignificant	-	-
		Collision risk	M	M	M-H	Minor to Moderate	Section 5.4.2.9	Minor/Insignificant
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-
		Barrier to movement	L	M	M-H	Minor/ Insignificant	-	-
	Decommissioning	Changes to foraging habitat availability	L	L	M-H	Minor/ Insignificant	-	-
		Visual disturbance	L	M	M-H	Minor/ Insignificant	-	-
		Noise/ vibration disturbance	L	L	M-H	Minor/ Insignificant	-	-
		Toxic contamination (spillage)	N-L	M	M-H	Minor/ Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

5.5 Marine Mammals and Turtles

5.5.1 Baseline Description

The waters of the Western Approaches of the English Channel have a relatively high density and moderate diversity of cetaceans. However, diversity and abundance declines further eastwards in the English Channel (DECC, 2009). While over seventeen species of cetacean have been recorded in the Western Approaches of the English Channel since 1980, only harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncates* are regularly recorded through much of the year around the Channel Islands and Cotentin coast (GECC, 2011; GECC, 2010; Seawatch Foundation, 2006). Minke whale *Balaenoptera acutorostrata*, Risso's dolphin *Grampus griseus*, short-beaked common dolphin *Delphinus delphis* are also recorded annually. However, these species are typically seasonal visitors in this area and are more commonly distributed further offshore. Other species such as striped dolphin *Stenella coeruleoalba*, fin whale *Balaenoptera physalus* and sperm whale *Physeter macrocephalus* are also recorded further offshore in the Bay of Biscay and outer Western Approaches of the English Channel (Reid *et al*. 2003).

Two pinniped (seal) species regularly occur around the Channel Islands with the grey seal *Halichoerus grypus* typically sighted more often than the common (harbour) seal *Phoca vitulina* (GECC, 2011; GECC, 2010). Grey seals are on the southernmost limit of their range in the Northern France area. Small numbers of grey seals haul-out at sites on the Channel Islands including the Nannels and Renonquet rocks to the west of Burhou Island near Alderney (Alderney Wildlife Trust, 2012; Open Hydro, 2008). The total size of the Alderney grey seal population is estimated at between 15 and 20 individuals (Open Hydro, 2008). In addition, a small colony is also situated on the Humps off the north coast of Herm which comprises approximately 3-8 individuals (GREC, 2011). Colonies of grey seals are also located along the coast of Brittany and Normandy (Molène archipelago, Sept Îles archipelago and in the Baie du Mont Saint Michel) with a combined population of approximately 105 grey seals (Härkönen *et al*. 2007). Seals from these sites have shown evidence of visiting other colonies in the Channel Islands, Southwest England and Wales indicating that grey seals in France do not constitute a separate population (Härkönen *et al*. 2007; Vincent *et al*. 2005). The most southern European colonies of harbour seals are located in France in the Baie du Mont Saint Michel, Baie des Veys and Baie de Somme with a total count of 295 seals hauled out at these sites recorded in 2008 (Hassani *et al*, 2010). Common seals from these colonies are regularly observed foraging around the Channel Islands (GECC, 2011; GECC, 2010).

Leatherback turtle *Dermochelys coriacea* is the only cheloniid species that is believed to undertake deliberate, seasonal migratory movement to UK waters to feed on gelatinous zooplankton prey (such as the jellyfish *Rhizostoma octopus*). The species is most commonly recorded in the UK in the Celtic Sea and Irish Sea although sightings are generally rare (with an average of around 33 leatherback turtle records each year around the UK). Leatherback turtles are occasionally recorded around the Channel Islands. All other turtle species are believed to reach UK waters only when displaced from their normal range by adverse currents and so UK waters are not considered part of their functional range (Marubini, 2010; Witt *et al*., 2007a, b).

The baseline review has therefore focused on grey and common seal along with the five most commonly occurring cetaceans recorded around the Channel Islands (harbour porpoise, common dolphin, bottlenose dolphin, Risso's dolphin and minke whale). Information on the protected status of these species is summarised in Table 21 with subsequent sections detailing information on the distribution, abundance and ecology of each of these species.

Table 21. Protected status of cetaceans, seals and turtles

Taxonomic Group	Status
Seals (Pinnipeds)	Seals are protected under the Conservation of Seals Act 1970 (England, Scotland, Wales). Grey and common seals are also listed in Annex II of the EU Habitats Directive and protected from disturbance both inside and outside the designated sites. The grey seal is also listed as an Appendix III species under the Bern Convention (1979), which prohibits the deliberate disturbance/capture/killing of species and disturbance of their breeding grounds.
Whales, Dolphins, Porpoises (Cetaceans)	All cetaceans are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (and amendments), under which it is an offence to take, injure or kill these species. Disturbance in their place of rest, shelter or protection is also prohibited. All species of cetacean are also protected under the EU Habitats Directive, in Annex II and IV and the Bern Convention. Harbour porpoise are also listed as an OSPAR threatened species and also listed in Appendix II of the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals).
Cheloniids (turtles)	Turtles are protected under the Wildlife and Countryside Act 1981 (and amendments), under which it is an offence to take, injure or kill these species. Species of turtle are also protected under the EU Habitats Directive (1992) in Annex II and IV and the Bern Convention, 1979.

Some populations of marine mammal undertake large seasonal movements across wide ranges while others occur in relatively discrete areas or habitats. In order to highlight and compare different populations and habitats which might be impacted by the Draft Plan, data has been analysed at three different spatial scales in an iterative manner for each species. Firstly, information on the distribution in the wider English Channel is summarised. This is followed by a summary of abundance levels and distribution around the Channel Islands and Cotentin coast. Finally, data on mammal numbers and distributions specifically around Alderney is presented. The approximate extent of these areas can be seen in Figure 2.

Numerous sources of information were reviewed to inform the marine mammal baseline description. These include a number of national and regional studies to provide information on marine mammal distribution and ecology. This data was used to inform the understanding of the relative importance and functionality of the Channel Islands in the context of the wider English Channel and Western Approaches area. These main data sources include:

- *Small Cetacean Abundance in the European Atlantic and North Sea programmes (SCANS and SCANS-II)*: The surveys undertook widespread ship based and aerial surveys of cetaceans in UK and adjacent waters in the summers of 1994 and 2005 (SCANS-II, 2008). The programme provides detailed wide-scale survey data on cetacean abundance, distribution and density in North West European waters.
- *Ferry-based cetacean surveys in the English Channel and Bay of Biscay:* Data collected during ferry-based cetacean surveys in the English Channel and Bay of Biscay between 1998 and 2002. In all, 17 873 nautical miles were surveyed, and 1008 encounters of 13 identified species, including delphinids, ziphiids, harbour porpoise,

and sperm whale, were recorded. The amount of survey effort varied between sub-regions; 15.9% of effort was in the western English Channel and western approaches, 54.6% in the northern Bay, and 29.5% in the southern Bay (Kiszka *et al*. 2007).

- *Survey of harbour Porpoise in the English Channel:* Marine Conservation Research International (MCRI) and International Fund for Animal Welfare (IFAW) carried out a visual and acoustic survey for harbour porpoises between May and June 2011 from IFAW's research vessel, Song of the Whale. A total of 4243 km track line was completed, with 2749 km "on track" with at least acoustic effort (Marine Conservation Research International, 2011).
- *Atlas of Cetacean Distribution in North West European Waters*: Comprehensive information on cetacean distribution in North West European waters is presented in Reid *et al*. (2003). This report provides a compilation of cetacean sighting records from a variety of systematic surveys and opportunistic sightings amounting to over 2,500 days of observation carried out since 1973.
- *Offshore Energy Strategic Environmental Assessment (SEA):* Detailed reviews of marine mammal distribution and ecology in UK waters have also been carried out by the Sea Mammal Research Unit (SMRU), University of St. Andrews, as a contribution to the UK Department of Energy and Climate Change (DECC) Offshore Energy Strategic Environmental Assessment (SEA) (DECC, 2009).
- *Towards Marine Protected Areas for Cetaceans in Scotland, England and Wales*: The WDCS (Whale and Dolphin Conservation Society) additionally undertook a review identifying critical habitat for cetaceans to help highlight potential Marine Protected Areas (MPAs) for cetacean species (Clark *et al.* 2010).
- *Special Committee on Seals Annual Report*: Information on the status of seals around the UK coast is reported annually by the SMRU-advised Special Committee on Seals (SCOS) (SCOS, 2012).
- *Status of grey seals along mainland Europe from the Southwestern Baltic to France*: A review on the status of grey seals in terms of distribution, population sizes and growth rates from the Baltic to France (Härkönen *et al*. 2007).
- *Harbour seals distribution and abundance in France and Belgium*: A review of the known geographical distribution and abundance in France and Belgium (Hassani *et al*, 2010)

Of particular relevance are a number of recent monitoring and survey projects which have been undertaken specifically in the Channel Islands and Gulf of St Malo area. These data sources include the following:

- OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring: Marine mammal and seabird monitoring undertaken as part of the OpenHydro Subsea Tidal Array Installation (ARE, 2009; Entec UK Limited, 2007).
- Seabird and marine mammal baseline survey within the south east region of Alderney: Alderney Wildlife Trust Enterprises Ltd was commissioned in 2010 by Alderney Commission for Renewable Energy to undertake a seabird and marine mammal survey located within Longis Bay and associated areas (Alderney Wildlife Enterprise, 2011).
- Channel Sea Marine Mammal Sighting Network: Sightings network created by the Cotentin Cetacean Study Group (GECC) to better understand marine mammal

distribution in the English Channel, particularly around Normandy and the Gulf of St Malo (GECC, 2010; GECC, 2011).

- Bottlenose dolphin population study in the Normandy region of the English Channel: Study of demographic parameters and social structure of the bottlenose dolphin in Normandy (Lous *et al*. 2011).

Further details of each of these surveys are summarised in Table 22.

Table 22. Summary of recent monitoring in Alderney and the western English Channel

Data Source	Survey Techniques	Survey Location	Years Surveyed
OpenHydro Subsea Tidal Array Installation baseline monitoring (ARE, 2009; Entec UK Limited, 2007).	A total of 44 boat-based and 44 land based surveys were undertaken. The land based surveys were at four fixed points.	Alderney	March 2006 to February 2008
Channel Sea Marine Mammal Sighting Network (GECC, 2010; GECC, 2011).	The Channel Sea Marine Mammal Sighting Network was created in 1995 by the Cotentin Cetacean Study Group, GECC. More than 4000 observations of 12 different species have been transmitted to the Sighting Network since its creation (GECC, 2010; GECC, 2011).	Normandy and the Gulf of St Malo	1995 to 2011
Demography and social structure of a bottlenose dolphin population in the English Channel (Louis *et al.* 2011)	Study of demographic parameters and social structure based on photographic identification research. A total of 49000 photos have been analysed and more than 600 individuals were identified between 2004 and 2010 including sedentary and migrant animals.	Normandy region of the English Channel	2004 to 2011
Seabird and marine mammal survey of Longis Bay and associated areas (Alderney Wildlife Enterprise, 2011)	Four two hour observational surveys were completed at a designated land-based observation point on a monthly basis.	South eastern side of Alderney,	April 2010 to December 2010

A number of other surveys and scientific studies on marine mammals have also been included where appropriate.

Bottlenose Dolphin (*Tursiops truncatus*)

The bottlenose dolphin in the North Atlantic appears to consist of two forms, coastal and offshore. The better known coastal form is locally common in the Irish Sea (particularly Cardigan Bay), English Channel and off North East Scotland (particularly the inner Moray Firth), and in smaller numbers in the Hebrides (West Scotland). Little is known about the offshore form of bottlenose dolphin, including the relationship between the offshore and coastal forms (Clark *et al*. 2010). More detailed studies in the North West Atlantic suggest that inshore and offshore populations are ecologically and genetically discrete (Hoelzel *et al.* 1998).

Based on the current understanding of near-shore bottlenose dolphin population and community structure the ASCOBANS / HELCOM small cetacean population structure workshop advised that the following populations are each proposed as separate management units (although it is quite possible that some areas have overlapping communities with different movement patterns) (Evans and Teilmann, 2009):

- NS-North Sea (Eastern Scotland from Caithness to the borders with England);
- OH-Outer Hebrides (Island of Barra);
- IH-Inner Hebrides;
- IS-Irish Sea;
- SHE-Shannon Estuary;
- WEI-Western Ireland;
- SE-Southern England;
- NF- North France (Channel Islands and Normandy coast);
- BR-Brittany coast and islands (West France);
- SGA-Southern Galicia; and
- SAE-Sado Estuary (Portugal).

Distribution and Abundance in the English Channel

Inshore populations of bottlenose dolphins are found along the French coast in the English Channel (Reid *et al.* 2003; Kiszka *et al.* 2004). The largest population is found in the Gulf of St. Malo and Cotentin coast. Small numbers are also recorded further East along the Normandy coast (Kiszka *et al.* 2004).

Further west, about 35 individuals inhabit the area around the island of Ouessant and the Archipelago of Molène, with a further 25 individuals around the island of Sein and Cape of Sizun (Liret *et al*., 2006; Evans and Teilmann, 2009). These two groups appear to be relatively isolated with the resident population of bottlenose dolphins around Ile de Sein staying within an area not larger than 5 km^2 and the population around the nearby Molene archipelago using a range of about 70 km^2 (Liret *et al*. 1996; Liret *et al.* 2001). Scattered sightings occur south to the Bay of Biscay, with regular groups along the coasts of Cantabria and Asturias, but no population estimates are available (Evans and Teilmann, 2009).

A small population of bottlenose dolphin has also been documented to be wide-ranging but resident to the coast of South West England since the early 1990 (Clark *et al*. 2010; Marine Connection & The Wildlife Trusts, 2007).

Comparisons of images of recognisable individuals have shown no evidence for interchange between bottlenose dolphins between the southern coasts (Normandy and the Channel Islands) and the northern coasts of the English Channel (South coast of England) (Liret *et al*., 1998; Evans and Teilmann, 2009).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

The bottlenose dolphin population found along the Cotentin coast and Channel Islands is thought to number approximately 387 (95% CI 304-480). The population is considered to be one of the largest in Europe consisting of a demographically healthy single population with sightings concentrated on three main areas: The Baie du Mont Saint-Michel, the Minquiers archipelago and the northern part of the Gulf of St. Malo (Louis *et al*. 2010). These sighting areas are shown in Figure 16.

Bottlenose dolphin were the most commonly observed cetacean species in both 2011 and 2010 recorded by The Channel Sea Marine Mammal Sighting Network (representing 62% and 70% of observations respectively) (Figure 17). In 2011, 280 observations of bottlenose dolphin were recorded with 173 sightings recorded in 2010. In both years the highest density of sightings were in the Baie du Mont Saint-Michel and the northern part of the Gulf of St. Malo Photographic identification also suggested a movement of bottlenose dolphins between Baie du Mont Saint-Michel during summer and sights further west during spring (GECC, 2010; GECC, 2011).

Distribution and Abundance Around Alderney

Bottlenose dolphin were recorded feeding within the waters around Alderney during the OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring including seven pods, ranging from 2-12 individuals in the near shore environment of Longis Bay during the survey period (Figure 18). Bottlenose dolphins were the most frequently encountered marine mammal throughout the survey period, with an encounter rate of 0.1 individual per hour (ARE, 2009; Entec UK Limited, 2007). No bottlenose dolphin were recorded in the seabird and marine mammal baseline survey within the south east region of Alderney commissioned in 2010 by Alderney Commission for Renewable Energy (Alderney Wildlife Enterprise, 2011).

Harbour Porpoise (*Phocoena phocoena*)

Harbour porpoise distribution is restricted to temperate and sub-arctic (primarily 5-14ºC) seas of the Northern Hemisphere. The harbour porpoise is the most commonly recorded cetacean in UK waters, primarily occurring on the continental shelf (DECC, 2009; Reid *et al.* 2003). In coastal waters, they are often encountered close to islands and headlands with strong tidal currents (Evans *et al*. 2003; and DECC, 2009). Porpoise mating occurs around October with births (usually a single calf) from March to August. Harbour porpoise have a varied diet, exploiting seasonally abundant prey from both pelagic and demersal habitats. Small schooling fish including herring and sprat (Clupeidae), sandeel (Ammodytidae) and members of the cod family (Gadidae) are important food sources in UK and Irish waters (Pierpoint, 2008).

The identification of different stocks or subpopulations for harbour porpoise was undertaken by ASCOBANS Population Structure Workshop based on genetic studies and the combining of information from other approaches (e.g. telemetry). The workshop identified 14 distinct stocks for the North Atlantic. The stocks relevant to UK waters are the North Eastern North Sea & Skagerrak (NENS), South Western North Sea & Eastern Channel (SWNS), Celtic Sea (plus South West Ireland, Irish Sea & Western Channel) (CES) and North West Ireland & West Scotland (NWIS) (Evans and Teilmann, 2009).

Distribution and Abundance in the English Channel

Harbour porpoise are recorded in low numbers in the English Channel with sightings typically more abundant in the western part than the eastern part (Marine Conservation Research International, 2011; Reid *et al*. 2003). The 1994 SCANS surveys reported no harbour porpoise sightings in the English Channel in 1994 and only a few isolated sightings of harbour porpoises in the 2005 SCANS-II survey (SCANS-II, 2008). Marine Conservation Research International (2011) conducted a visual and acoustic survey to investigate the presence and distribution of harbour porpoises in the Channel during 2011. The survey which covered a distance of over 4243 km recorded a total of 34 detections of harbour porpoise (13 visual and 21 acoustic).

Ferry-based cetacean surveys undertaken in the English Channel and Bay of Biscay (17 873 miles of survey effort of which 15.9% of effort was in the western English Channel and western approaches) recorded a total of 114 sightings of harbour porpoise of which 113 were in the English Channel and western approaches (Kiszka *et al*. 2007)

Following a serious decline in the presence of porpoises in European coastal waters in the first half of the 20th Century, sightings and stranding reports increased in the 1990's. In the last few years, some observations and studies indicate a shift of harbour porpoise distribution in European waters, from northern regions of the North Sea to the southern North Sea, English Channel and Celtic Sea (Evans and Prior, 2012).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

A total of 53 harbour porpoise sightings were recorded by The Channel Sea Marine Mammal Sighting Network in 2011 (GECC, 2011). The number of observations of porpoises recorded by The Channel Sea Marine Mammal Sighting Network along the Normandy coast and Gulf of Saint Malo has risen sharply over the past three years which is consistent with an increase observed across the wider English Channel (Evans and Prior, 2012).

Distribution and Abundance Around Alderney

Harbour porpoise were recorded infrequently within the waters around Alderney during the OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring (ARE, 2009; Entec UK Limited, 2007). No harbour porpoise were recorded in the seabird and marine mammal baseline survey within the south east region of Alderney commissioned in 2010 by Alderney Commission for Renewable Energy (Alderney Wildlife Enterprise, 2011).

Short-beaked Common Dolphin (*Delphinus delphis*)

The common dolphin is widely distributed in tropical, subtropical and temperate seas of the Atlantic and Pacific Oceans both in oceanic and shelf waters. Within the Northeast Atlantic most sightings have been reported in waters South of 60°N. Analysis of summer sightings on shelf waters around the UK from 1983-1998 showed the vast majority of common dolphin sightings to occur in waters above 14°C in temperature. The mating period occurs from May to September with a high density of sightings recorded along and off the continental shelf slope to the South West of the UK during this period (DECC, 2009; Reid *et al*. 2003).

Distribution and Abundance in the English Channel

High densities of common dolphin have been recorded in the western English Channel in winter with the area appearing to be important for foraging seasonally (Clarke *et al*., 2010; WDCS, 2005; Kiszka *et al*. 2007; DECC, 2009). Relatively few sightings have been reported in the eastern English Channel and the North Sea. An estimated abundance of 14,349 common dolphin were recorded in the Southern North Sea and Channel in 2005 (SCANS-II, 2008).

Based on observations of seasonal patterns in sightings data, common dolphins are thought to show a general movement into offshore waters beyond the shelf zone (Clarke *et al*., 2010; DECC, 2009). The apparent movement into offshore waters during the summer is likely to be prey-driven. While a large proportion of the population are thought to move into offshore waters, not all do. Encounter rates during the summer are still quite high off south west England and parts of the western English Channel. Dietary differences between the population that remains in on-shelf waters over the summer and the one that moves offshore suggest that two ecological stocks within the north east Atlantic might occur, a coastal and a neritic stock (Clarke *et al*., 2010).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

The Channel Sea Marine Mammal Sighting Network recorded 12 sightings of bottlenose dolphin in 2010 and 14 sightings in 2011 in the Gulf of St Malo and Normandy coast. Sightings in both years were widely distributed (GECC, 2011; GECC, 2010).

While common dolphin has sometimes been recorded around the Channel Islands, the species has a largely offshore distribution, typically where water depths range from 50-150 metres (Seawatch Foundation, 2007; Baines and Evans, 2012).

Distribution and Abundance Around Alderney

Common dolphin were recorded to the north of Alderney but not further inshore during the OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring (ARE, 2009; Entec UK Limited, 2007). No common dolphin were recorded in the seabird and marine mammal baseline survey within the south east region of Alderney commissioned in 2010 by Alderney Commission for Renewable Energy (Alderney Wildlife Enterprise, 2011).

Risso's Dolphin (*Grampus griseus*)

The Risso's dolphin is widely distributed in tropical and temperate seas of both hemispheres, occurring in small numbers along the Atlantic European seaboard from the Northern Isles, South to North West France, the Southern Bay of Biscay, around the Iberian Peninsula and East into the Mediterranean Sea. Risso's dolphins generally prefer continental slope regions. In North West Europe however, Risso's dolphin appear to be a continental shelf species (Reid *et al*. 2003).

Distribution and Abundance in the English Channel

Generally few sightings of Risso's dolphins are made in the English Channel with the majority of Risso's dolphin sightings in UK waters around the Hebrides, the Irish Sea (particularly West Pembrokeshire, the Lleyn Peninsula, Anglesey in Wales and the South East coast of Ireland (Baines and Evans, 2012 Clarke *et al*. 2010; Reid *et al*. 2003).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

Risso's dolphin sightings compiled by The Channel Sea Marine Mammal Sighting Network were distributed around the coasts of Ille-et-Vilaine and Côtes d'Armor in both 2010 and 2011 (four sightings and six sightings respectively). Although this species remains uncommon, this species does appear to be recorded close to the coast in this area seasonally (GECC, 2011; GECC, 2010).

Distribution and Abundance Around Alderney

No Risso's dolphin sightings were recorded in any of the recent monitoring surveys around Alderney (ARE, 2009; Entec UK Limited, 2007; Alderney Wildlife Enterprise, 2011). The species is therefore only likely to occur rarely in the Alderney area.

Minke Whale (*Balaenoptera acutorostrata*)

Minke whales are the smallest and most abundant of the baleen whales encountered around the UK coast. They appear to favour areas of upwelling or strong tidal currents and are usually seen singly or in pairs but sometimes aggregate in greater numbers in areas of rich feeding (Reid *et al.* 2003). Within UK waters, minke whales are most frequently sighted in the North Sea and West of Scotland around the Hebrides.

Distribution and Abundance in the English Channel

Both SCANS and SCANS II recorded low densities Minke whale in the English Channel with modelling of the SCANS II data predicted an area of higher density off south west England, in the western part of the Channel (SCANS II, 2008). Sightings from ferries travelling from the south coast of England to Bilbao have tended to record minke whales in the western section of the Channel, and mainly from July to September. Minke whales are thought to be uncommon in the eastern English Channel (Clarke *et al*. 2010)

Distribution and Abundance Around the Channel Islands and Cotentin Coast

Only a few minke whale sightings are typically recorded by The Channel Sea Marine Mammal Sighting Network in the Gulf of St Malo and Normandy coast annually (GECC, 2011; GECC, 2010).

Distribution and Abundance Around Alderney

No minke whale sightings were recorded in any of the recent monitoring surveys around Alderney (ARE, 2009; Entec UK Limited, 2007; Alderney Wildlife Enterprise, 2011). The species is therefore only likely to occur rarely in the Alderney area.

Grey Seal (*Halichoerus grypus*)

The grey seal is the larger of the two seal species found in British waters, with males reaching a length of 2.45m and weigh over 300kg (SCOS, 2012). Grey seals predominantly inhabit remote islands and coastline, breeding on undisturbed beaches of cobble and boulders or within sea-caves along the coast. Pupping time occurs primarily from August through to December with September generally being the busiest month. About 38% of the world population of grey seals is found in Britain and over 88% of British grey seals breed in Scotland, the majority in the Hebrides and in Orkney (SCOS, 2012).

Distribution and Abundance in the English Channel

Grey seals are on the southernmost limit of their range in the Northern France area. Colonies of grey seals are also located along the coast of Brittany and Normandy (Molène archipelago, Sept Îles archipelago, the Baie du Mont Saint Michel and the Baie de Somme) with a combined population of approximately 105 grey seals (Härkönen *et al*. 2007).

In the Baie du Mont Saint Michel and the Baie de Somme, haul-out site numbers are small with a maximum of about ten individuals typically recorded in each bay seasonally. In the Sept Îles archipelago, numbers varied between 10 and 20 in the period 1997 to 2000 with data suggesting numbers have increased since then. During the same period, the number of seals hauling out in the Molène archipelago varied between 30 and 65 individuals (Härkönen *et al.* 2007.

Seals from these sites have shown evidence of regularly visiting other colonies in the Channel Islands, Southwest England and Wales indicating that grey seals in France do not constitute a separate population (Härkönen *et al*. 2007; Vincent *et al*. 2005). For example, individual movements from the main colony of the Molène archipelago were assessed by using Satellite Relay Data Loggers (SRDLs). Sixteen wild seals were tracked from 1999 to 2003. Fourteen seals left the archipelago, of which 9 crossed the English Channel to Southwest England, Wales, or the Channel Islands (Vincent *et al.* 2005). Two out of 4 rehabilitated juvenile grey seals released in the vicinity of the Molène archipelago in 1997 also crossed the Channel, with 1 seal visiting a grey seal colony in South-east Ireland (Vincent *et al.* 2002). Overall, more than half of the 20 seals tracked from western Brittany visited other grey seal colonies overseas (Härkönen *et al*. 2007).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

Small numbers of grey seals haul-out at sites on the Channel Islands. For example, a small colony is also situated on the Humps off the north coast of Herm which comprises approximately 3-8 individuals (GREC, 2011).

Distribution and Abundance Around Alderney

The distribution of seals is shown in Figure 19. Grey seals haul-out on the Nannels and Renonquet rocks to the west of Burhou Island near Alderney (Alderney Wildlife Trust, 2012; Open Hydro, 2008). The total size of the Alderney grey seal population is estimated at between 15 and 20 individuals (Open Hydro, 2008). In 2012, there was the repeat presence of grey seal pups in the late summer and early autumn on the Burhou reefs and, therefore, the Alderney Wildlife Trust is starting to consider this as a potential breeding site (Alderney Wildlife Trust pers. comm., June 2013).

Grey seal were only recorded within the inshore waters of the north coast of Alderney during the OpenHydro Subsea Tidal Array Installation Seabird and Marine Mammal Monitoring (ARE, 2009; Entec UK Limited, 2007). No grey seals were recorded in the seabird and marine mammal baseline survey within the south east region of Alderney commissioned in 2010 by Alderney Commission for Renewable Energy (Alderney Wildlife Enterprise, 2011).

Harbour seal (*Phoca vitulina*)

The common seal (also known as harbour seal) is the smaller of the two native UK seals measuring up to approximately 1.85m in length and typically weigh 80-100 kgs. Britain is home to approximately 30% of the population of the European sub-species of common seal (having declined from approximately 40% in 2002). Scotland holds approximately 85% of the UK harbour seal population. Common seals are found in a wide variety of coastal habitats and come ashore in sheltered waters, including on sandbanks, in estuaries and along rocky areas (SCOS, 2012).

Distribution and Abundance in the English Channel

The most southern European colonies of harbour seals are located in France in the Baie du Mont Saint Michel, Baie des Veys and Baie de Somme with a total count of 295 seals hauled out at these sites recorded in 2008 (Hassani *et al*, 2010).

Distribution and Abundance Around the Channel Islands and Cotentin Coast

Common seal do not regularly haul-out on islands in the Channel Islands. However, common seals from colonies along the French coast are observed foraging around the Channel Islands (GECC, 2011; GECC, 2010).

Distribution and Abundance Around Alderney

No common seal sightings were recorded in any of the recent monitoring surveys around Alderney (ARE, 2009; Entec UK Limited, 2007; Alderney Wildlife Enterprise, 2011). The species is therefore only likely to occur rarely in the Alderney area.

5.5.1.1 Future Baseline

Marine mammals and turtles could be impacted in the future by a range of sources including fisheries (changing prey stock levels and through by-catch), marine developments and pollution. Future climate change has the potential to have a particularly large impact on the abundance and distribution of different marine mammal species. However, there is a high degree of uncertainty associated with climate change predictions both in terms of the magnitude and the timescales over which they might occur (Pinnegar *et al.* 2012). The Sea Watch Foundation, SMRU and University of Aberdeen undertook a scientific review of the potential future impacts associated with climate change as part of the Marine Climate Change Impact Partnership (MCCIP) Annual Report Card (Evans *et al.* 2010). The main findings from this report are summarised below:

- Range shifts: As a result of increased sea temperatures, it is thought that some species will shift their ranges latitudinally to remain within their preferred thermal habitats. In the UK, species like the short-beaked common and striped dolphin might occur more regularly in northern Britain and within the North Sea, displacing the white-beaked and Atlantic white-sided dolphin. Likewise, other shelf species, the harbour porpoise and minke whale, could move northwards.
- Changes to physical habitat: In the UK it is considered unlikely that changes to physical habitat will affect cetaceans, although some seal haul-out / breeding locations in caves or on low-lying coasts may be lost or modified. Increases in storm frequency and associated wave surges could exacerbate effects, although these are unlikely to be significantly in Alderney (see Section 4.2.1.3). Alternatively, seals may adapt to these changes and new habitats may be created.
- Changes to the food web: Effects of changes to community structure are probably the most difficult to predict. Changes in ocean currents and the positions of associated fronts as well as in ocean mixing, deep water production and coastal upwellings could have profound effects on biological productivity which in turn is likely to affect top predators such as marine mammals. Mismatches in synchrony between predator and prey could occur, either in time or location. There has been some speculation that the recent shift in abundance of harbour porpoises from the northern to southern North Sea may be due to a shortage of sandeels, a known prey item, and this has led to suggestions of food starvation amongst stranded porpoises. A number of findings indicating potential effects on other marine taxa could also impact upon marine mammals through the food chain. Examples include reductions in salinity, increases in CO_2 and consequent decreases in pH particularly affecting cephalopods. Several marine mammal species feed either exclusively or to a large extent upon cephalopods.
- Susceptibility to disease and contaminants: Global warming has been implicated in the worldwide increase in reports of diseases affecting marine organisms, including marine mammals. Climate change has the potential to increase pathogen development and survival rates, disease transmission, and host susceptibility whilst higher temperatures may stress organisms, increasing their susceptibility to some diseases.

5.5.1.2 Limitations and data gaps

A wide range of marine mammal monitoring and research programmes have been undertaken in the Western Approaches to the English Channel and along the French coast which broadly overlap with the Channel Islands, and have fed into the Sea Watch Foundation database.

There is also a pilot programme that is being led by the Agence des Aires Marines Protégées and a number of scientific partners, called Programme d'acquisition de connaissances sur les oiseaux et les mammifères marins en France métropolitaine (PACOMM[5]) which has involved the collection of data on birds and marine mammals in French waters between 2010 and 2014. This study which is anticipated to be published later in 2014 evaluates the distribution of seabirds and marine mammals, as well as human activities, boats, waste and their spatial and temporal variability. This will therefore complement the existing baseline characterisation of marine mammals undertaken as part of this REA and should be considered by individual developers at the project-level as necessary.

Although this is considered to be an adequate source of baseline information for the region, a monitoring programme will need to be established at the EIA project-level to understand the possible impacts particularly of tidal stream turbines. Examples of the specialist surveys which may be required to support the EIA include:

- Aerial surveys;
- Land or boat based counts at haul-out sites;
- Vantage point surveys;
- Boat based surveys;
- Photo ID;
- Telemetry;
- Stranding and carcass ID;
- Towed Hydrophone array protocol; and
- Autonomous Acoustic Monitoring (e.g. cetacean pods (C-PODs)).

5.5.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. Marine mammals and turtles are highly mobile and can forage and move over long distances. Evidence suggests that seals recorded around the Channel Islands are part of a larger population with regular movement between haul-out sites in the Channel Islands, France and England (Härkönen *et al*. 2007; Hassani *et al*, 2010; GECC, 2011). Harbour porpoise have also been recorded undertaking large movements of up to 1000km (Teilmann *et al*. 2008). Inshore bottlenose dolphin populations are generally more discrete with more localised distributions although some connectivity with other populations has been recorded (Robinson *et al*. 2012). With the exception of the resident dolphin population found along the Cotentin coast and Channel Islands other bottlenose dolphin populations are unlikely to be recorded in this area.

5 http://www.aires-marines.fr/Connaitre/Habitats-et-especes-pelagiques/Oiseaux-et-mammiferes-marins-en-metropole

Given the potential for transboundary effects for mammal species moving to and from French waters, but also possibly to English waters, it is also important that any marine mammals that are a qualifying feature of Natura 2000 sites and that may overlap with the changes brought about by the Draft Plan be considered as part of the assessment (see Section 5.6.1). The mobile Natura 2000 features study area shown on Figure 2, which incorporates the entire English Channel and the coastlines of southern England and Northern France, encompasses these wider-scale boundaries.

5.5.2 Impact Assessment

The Draft Plan has the potential to affect the marine mammals and turtles in the study area through a number of impact pathways which are assessed in the following sections:

- Collision Risk (Section 5.5.2.1);
- Visual Disturbance (Section 5.5.2.2);
- Noise/ Vibration Disturbance (Section 5.5.2.3);
- Toxic Contamination (Spillage) (Section 5.5.2.4);
- Loss or Changes To Foraging Habitat (Section 5.5.2.5);
- Non-Toxic Contamination (Section 5.5.2.6);
- Toxic Contamination (Sediment Release) (Section 5.5.2.7);
- Barrier to Movement (Section 5.5.2.8);
- Electromagnetic Field (EMF) (Section 5.5.2.9); and
- Seal Haul-Out Damage (Section 5.5.2.10).

Throughout the impact assessment all marine mammal features (including turtles) are considered to be of high importance given that all marine mammals are highly protected under a range of Channel Island, UK and European Law. Given that only leatherback turtles are occasionally recorded around the Channel Islands, turtles are not specifically focused on as part of this assessment.

5.5.2.1 Collision risk

The main collision risks to marine mammals are posed by the moving turbines on tidal energy generation devices and the propellers (especially ducted) of vessels used for all sectoral activities. Marine mammals have quick reflexes, good sensory capabilities and fast swimming speeds (over 6m/s for harbour porpoise). These species can also be very agile (Carter, 2007; Hoelzel, 2002). These are all attributes which increase the chance of close range evasion with an object that could cause a collision risk. It is well documented, however, that marine mammals have collided with anthropogenic structures such as fishing gear and ships (Pace *et al*., 2006; Zollett & Rosenberg, 2005). Reduced perception levels of a collision threat through distraction, whilst undertaking other activities such as foraging and social interactions, are possible reasons why collisions are recorded in marine mammals (Wilson *et al*., 2007).

Young grey seal pups, which are inexperienced at sea, could be particularly vulnerable to collision risk. Marine mammals can also be very curious of new foreign objects placed in their environment and so curiosity around an object could also increase the risk of collision. Marine mammals are relatively robust to potential strikes as they have a thick sub-dermal layer of blubber which would defend their vital organs from the worst of any blows (Wilson *et al*., 2007). Nevertheless, a direct collision with a sharp object such as a moving blade still has the potential to cause injury to marine mammals. Marine mammals are therefore considered to have moderate sensitivity to collision risk.

Seals and cetaceans can potentially collide with vessel propellers and machinery, possibly leading to physical injury (such as propeller wounds) and, in worst case scenarios, fatality (ASCOBANS, 2003; Pace *et al*., 2006). There have been a number of reported incidents of mortality or injury of cetaceans caused by vessels in UK waters, particularly with inquisitive bottlenose dolphins (WDCS, 2009). In addition, several cases of seal injury, thought to be caused by ducted propellers and azimuth thrusters (used for the dynamic positioning of vessels) have also been reported in recent years (SMRU, 2010). However, in general, incidents of mortality or injury of marine mammals caused by vessels remain a very rare occurrence in UK waters. Although all types of vessels may collide with marine mammals, the most lethal and serious injuries are caused by large ships (e.g. 80 m or longer) and vessels travelling at speeds faster than 14 knots (Laist *et al*. 2001).

Juvenile grey seal pups, which are inexperienced in the water, are likely to be most vulnerable to collision risk. Unlike some other cetacean species, harbour porpoise rarely approach boats, usually actively moving away from vessels and are therefore not considered sensitive to collision with vessels (Dunn *et al*, 2012). In addition, Alderney is a busy area for recreational boating and so marine mammals in the area are likely to be familiar and accustomed to vessel traffic.

The short temporal scale and slow speeds of vessels associated with all phases of development, in addition to the small number of installation vessels involved relative to existing vessel activity in the area, indicates that the risk of collision with vessels is considered to be low, leading to a low exposure to change and consequently a minor adverse impact.

In terms of collision with tidal turbine blade and other moving parts underwater, the understanding of 'near field' interactions of wet renewable devices with marine mammals is limited as such technology is in its infancy. Their behaviour in response to moving parts on tidal devices is less certain and a key area for further research (Scottish Executive, 2007). Carter (2007) investigated the collision risk to marine mammals from marine renewable tidal devices. The research focused on creating an acoustic device detection model to explore how much warning and avoidance time marine mammals swimming underwater would get of a device ahead of them. The study concluded that tidal stream devices are most likely to be first detected acoustically rather than visually by marine mammals. Therefore, it is possible that these species could show some long range avoidance of the device.

Behavioural responses of marine mammals to perceived threats can be broadly categorized in two ways: avoidance and evasion. Hence, with respect to marine renewable devices, marine mammals may demonstrate two types of response: long range avoidance (i.e. avoiding the area within the vicinity of the device) or close range evasion (i.e. during a close encounter with a turbine blade), depending upon the distance at which the device is perceived and the subsequent behavioural response. Some devices will have features which have the potential to cause severe damage or mortality to a marine mammal, whereas other devices could be considered as having characteristics which are unlikely to cause harm to a marine mammals. Thus, collision risk can be seen as a function of the extent of exposure, avoidance response (both long range avoidance and close range evasion) and the potential physiological damage caused by a wet renewable device. The extent of any risk will also be dependent on device characteristics, and modified by various environmental factors. The good sensory capabilities and fast swimming speeds of marine mammals should help increase the chance of close range evasion with tidal stream devices. However, marine mammals do regularly collide with other anthropogenic structures (particularly when they have reduced perception levels while feeding or undertaking social interactions).

The most comprehensive field based monitoring of marine mammals currently available is from the SeaGen tidal turbine device located in the Narrows of Strangford Lough, Northern Ireland from 2005 to 2010 (Royal Haskoning, 2011). This work has concluded that no major impacts on marine mammals had occurred across the 3 years of post-installation monitoring. While porpoises were recorded less frequently during installation, no long-term changes in abundance of either seals or porpoises were attributed to the presence or operation of the device. Observations found that seals and porpoises regularly transit past the operating turbine, demonstrating a lack of any barrier effect from this turbine. The seals which regularly transit the Narrows appeared to transit less frequently when the turbine was operating relative to when it was not operating. Small scale changes in the behaviour and distribution of seals and harbour porpoises were observed during operation. Seals generally transited at a relatively higher rate during periods of slack water, indicating avoidance. The report suggested that this avoidance reduces the risk of any direct interactions with the moving rotors and that both seals and porpoises have the capacity to adjust their distributions at local scales in response to a potential hazard. Monitoring of harbour porpoise has also been undertaken around the NSPI (OpenHydro) tidal turbine device deployed in the Minas Passage, Bay of Fundy (Nova Scotia) from August to November 2010. The monitoring used passive acoustic techniques and found that harbour porpoise were detected regularly through late summer and autumn, but did not appear to spend significant time periods around either the turbine or the control site (suggesting transit through Minas Passage or local foraging in areas out of detectable range). The study found no statistical evidence of the presence of the turbine attracting or repulsing porpoises, but when porpoises were present, behaviour appeared to differ between the two sites (Tollit *et al*., 2011).

Given that marine mammals (particularly bottlenose dolphins) are regularly recorded around Alderney and in the absence of further information on specific device characteristics (such as blade speed) and operational noise levels (which might provide early acoustic warning avoidance behaviour), exposure to change is considered to be medium. On this basis the risk of collision impact of a single tidal turbine array has been assessed as moderate adverse. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a high level of exposure to change (due to a much higher chance of collision) and an overall major adverse impact.

5.5.2.2 Visual disturbance

Disturbance caused by an external visual influence can cause marine mammals to stop feeding, resting, travelling and/or socialising, with possible long term effects of repeated disturbance including loss of weight, condition and a reduction in reproductive success (ABPmer, 2009; JNCC, 2008). The group which are most at risk from visual disturbance are seals (when they are on land resting or breeding). In general, ships more than 1,500m away from grey seal haul-out areas are unlikely to evoke any reactions from grey seals. Between 900m and 1,500m, grey seals could be expected to detect the presence of vessels and at closer than 900m a flight reaction could be expected (Scottish Executive, 2007). Overall, sensitivities are considered to be moderate.

In the UK, there are currently no good-practice guidelines for minimisation of disturbance by shipping or commercial vessels (JNCC, 2008). However, the Scottish Marine Wildlife Watching Code that was designed for recreational water users advises that the minimum approach distance for vessels to avoid visual and noise disturbance to dolphins and porpoises is 50m (200-400m for mothers and calves, or for animals that are clearly actively feeding or in transit).

Visual disturbance from vessels in the different phases of developments will generally only be short term. However, the level of impact will be dependent on the distance vessels are from major seal haul-out sites and key foraging areas for marine mammals. No evidence of disturbance was evident during installation, or a change in underlying relative grey seal abundance in the area was recorded in a shore based marine mammal survey undertaken for the SeaGen tidal energy device located in Strangford Lough (Royal Haskoning, 2011). Exposure to change is therefore considered to be low leading to a minor adverse impact.

5.5.2.3 Noise/vibration disturbance

Marine mammals (particularly cetaceans) are considered to be the most sensitive receptors in relation to acoustic disturbance in the marine environment, due to their use of echolocation and vocal communication (DECC, 2009). In comparison to fish, marine mammal species are sensitive to a very broad bandwidth of sound.

Similar to fish (Section 5.3.2.3), the impacts of noise on marine mammals can broadly be split into lethal and physical injury, auditory injury and behavioural response. The received levels around which lethality, physical damage and disturbance occurs are not well understood (Sarah Dolman, Whale and Dolphin Conservation Society (WDCS) Pers. Comm.).

Reference should be made to Section 5.3.2.3 for the criteria suggested for considering the effects of underwater noise on marine mammals and fish (Table 14). In addition, geophysical surveys carried out for installations of marine renewable devices often involve side scan sonar that may cause acoustic disturbance of marine mammals. Available information on the magnitude impact from side scan sonar indicates that disturbance (for single or multiple devices) of marine mammals is low (ABPmer, 2007) in contrast to seismic surveys employed for oil and gas exploration which generate much greater source noise levels (JNCC, 2008). However, the effect on marine mammals from vessel noise is not clear, with both attraction and avoidance reactions having been observed (Nedwell & Howell, 2004). Noise levels from the ship's echo-sounder or acoustic emissions from a dynamic positioning system would not be expected to cause widespread disturbance to marine mammals (Scottish Executive, 2007). For harbour porpoises, the zone of audibility of shipping noise ranges from 1-3km depending on the frequency of noise emitted by the ship (Thomsen *et al*., 2006). The Scottish Marine Wildlife Watching Code advises that the minimum approach distance for vessels to avoid visual and noise disturbance to dolphins and porpoises is 50m (200-400m for mothers and calves, or for animals that are clearly actively feeding or in transit). As with fish (Section 5.3.2.3), the key sources of noise related to construction and device installation are:

- Shipping and machinery;
- Dredging; and
- Pile driving or drilling.

Additionally, cable/pipeline burial requires the use of trenching or jetting machinery in soft sediments, rock cutting machinery in hard sea-beds, or rock or concrete mattress laying may be used to protect cables in areas where they cannot be buried.

Of all of the sources of noise noted above, the noise emitted during pile driving is understood to have the greatest potential effects on marine wildlife (Thomsen *et al*., 2006). This is due to the fact that pile driving generates very high sound pressure levels over a relatively broad frequency range (20Hz to >20kHz). A number of studies have investigated the distances at which marine mammals may be disturbed as a result of piling particularly associated with offshore wind farms (Table 23). Based on the findings from these studies it is apparent that, although hearing injuries from construction are only likely to occur within several hundred metres of pile driving activity, strong avoidance responses could occur several kilometres from the piling with masking of vocalization and mild behavioural changes (e.g. change in swimming direction) occurring as far away as 50km or more from a wind farm development. However, the levels of noise relates to pile size and most piles used for tidal work will be smaller than those used for windfarms.

Table 23. Summary of research on the spatial extent of piling noise impacts on marine mammals

Activity	Study	Background Information	Reference
Pile driving	Empirical study on underwater noise levels during pile-driving at turbines in NE Scotland and potential effects on marine mammals.	Pile-driving noise was measured at distances of 0.1 to 80km (when background noise was no longer distinguishable above ambient). The study concluded that for bottlenose dolphins auditory injury would only have occurred within 100m of the pile-driving and behavioural disturbance (defined as modifications in behaviour) could have occurred up to 50km away.	Bailey *et al*. (2010)
	Empirical studies of porpoise behaviour during construction of offshore wind farms at Horns Rev (North Sea) and Nysted (Baltic).	At the wind farms, acoustic activity of porpoises decreased shortly after each pile-driving event and returned to baseline conditions after 3-4h. This effect was not only observed in the direct vicinity of the construction site but also at monitoring stations approximately 15km away. Behavioural observations showed that during	Tougaard *et al*. (2003a; 2003b)

Activity	Study	Background Information	Reference
		pile-driving, porpoises exhibited relatively more directional swimming patterns. This effect was found at distances of more than 11km, and possibly also up to 15km from the construction site.	
	Assessment of the likely sensitivity of bottlenose dolphins to pile-driving noise.	Research concluded that at 9kHz, masking of strong vocalisations could potentially occur within 10 to 15km. The potential masking radius was predicted to reduce with increasing frequency to 6km at 50kHz and 1.2km at 115kHz.	David (2006)
	Attenuation of modelled pile-driving noise at different distances from the source levels.	Study concluded that pile-driving noise, under realistic North Sea conditions, would be audible to harbour porpoises and seals over distances of at least 80km. Thomsen *et al*. (2006) also applied the dBht metric which indicated that mild behavioural reactions (e.g. subtle change in swimming direction) in harbour porpoises might occur between 7 and 20km distance from the pile-driving source.	Thomsen *et al*. (2006)
	A two-zone model of effect from pile-driving noise based on measurements from North Hoyle, Scroby Sands, Kentish Flats, Barrow and Burbo Bank.	A Noise Injury Zone, bounded by the 130dBht contour, defines the area in which hearing injury can occur, and, in addition, the areas in which lethal and physical injury could occur, since the ranges at which these will occur are much less than those for hearing injury. This area typically extends to a few hundred metres from pile driving. The Behavioural Effect Zone is bounded by the 90dBht level contour. Within this area, the modelling suggested that harbour porpoise show strong avoidance within ranges of a few kilometres. Milder behavioural effects could occur at ranges of the order of 10 kilometres or more. Noise from pile driving operations can remain above the background underwater noise to ranges of 25km or more.	Nedwell *et al*. (2003; 2007a)
	Assessment of lethal and physical injury of marine mammals and requirements for Passive Acoustic Monitoring.	The estimated likely impact ranges from a 4.7m diameter pile (252 dB re: 1 µPa source level) were predicted to be 4m for lethal range and 81m for injury range. A 6m diameter pile (260dB re: 1 µPa source level) had a lethal range of 65m and an injury range of 530m.	Parvin *et al*. (2007)

Studies undertaken as part of the Scottish Marine Renewables SEA (Scottish Executive, 2007) included undertaking a quantitative analysis of the PTS and TTS ranges of marine mammals for the operation of tidal current turbines. The PTS assessment revealed that if the most sensitive receptor were to spend 30 minutes within a distance of 16m[6] of the device, it might suffer permanent hearing. Evidence suggests that it is unlikely that an animal would choose to

6 The 16m distance relates to a frequency of 19,953 Hz and source levels of 157.6 dB re 1µPa-1m, and is estimated to be the maximum distance over which PTS could occur for the most sensitive species.

stay in close proximity to the source of a loud noise. The assessment of TTS revealed that if the most sensitive receptor were to spend 8 hours within 934m[7] of the device, it might suffer temporary, recoverable hearing damage (Scottish Executive, 2007).

The same assumptions and methodology were used to assess the impacts of the wave device as the tidal device[8]. The estimated noise spectrum was shown to not exceed the 30 minute PTS threshold at any frequency. Therefore, based on the limited data available, it is not expected that a wave energy device of this type would present any potential for causing PTS. The maximum predicted TTS range for an exposure of 8 hours is only 6m, so the risk of an animal experiencing TTS from a single 1 MW device of this type is insignificant.

The sensitivity of marine mammals is considered to be high during the construction phases of tidal works (based on the precautionary assumption that piling may be required), but medium during other periods.

Noise disturbance during construction will generally only be short-term. While marine mammals are recorded relatively frequently around Alderney, given the unconfined nature of the area, any mammals that do pass through the area will be able to easily move away from any temporary noise disturbance and return once the disturbance has ceased. However, given the relatively large distances that behavioural changes due to piling can occur over, exposure to change is considered to be negligible to medium (assuming piling is required), leading to an **insignificant to major adverse** impact during construction. The potential concurrent installation of tidal arrays in Alderney's territorial waters (see Section 2.2.2) as a result of the Draft Plan is considered to result in a high level of exposure to change from cumulative noise sources (assuming piling is required) and an overall **major adverse** impact to marine mammals.

In all other phases, noise levels are expected to be low and of a similar order to existing background levels. Therefore, the exposure to change is assessed as low and consequently the potential impacts are considered **minor adverse**.

5.5.2.4 Toxic contamination (spillage)

As discussed in the water quality assessment (Section 4.3.2.1), there is a risk of contamination and spillages across all phases of development (especially from vessel movements/accidents).

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7 The 934m distance relates to a frequency of 15,849 Hz and source levels of 157.2 dB re 1μPa-1m, and is estimated to be a maximum distance over which TTS could occur for the most sensitive species. The assessment was based on the assumption that the devices radiate omnidirectionally. A number of precautionary assumptions were also assumed to provide a worst-case scenario of potential effects to marine mammal species. For example, the seabed type that was applied to these calculations was a hard reflective seabed and the water depth was assumed to be relatively shallow. In deeper water, with a less reflective seabed (e.g. a muddy seabed), the range of TTS impact would be reduced (Scottish Executive, 2007).

8 It should be noted that there was no measurement data to base the noise emissions of the wave device on and, therefore, the sound levels had to be estimated based on available data for similar machinery types. The tonals due to the hydraulic power packs were scaled up to a 1 MW generator, again assuming that acoustic power scales linearly with generator power. However, the third octave levels representing the broadband wave noise spectrum have not been scaled up. Although it may be expected that a physically larger device might generate somewhat higher levels of wave noise, this is not expected to scale linearly with generator power.

Marine mammals are also exposed to a variety of anthropogenic contaminants, through the consumption of prey. As top predators, they are at particular risk from contaminants which biomagnify through the food chain (i.e. are found at increasing concentrations at higher trophic levels). Most research has focused on two main groups of contaminants: the persistent organic pollutants (POPs) and the heavy metals. However, there is some information on other contaminants including polyaromatic hydrocarbons (PAHs), butyl tins and perfluorinated chemicals (DECC, 2009). POPs accumulate in fatty tissues, are persistent and commonly resistant to metabolic degradation; they are often found in high concentrations in marine mammal blubber. They may affect the reproductive, immune and hormonal systems.

Cadmium, lead, zinc and mercury are the heavy metals of greatest importance in marine mammals. They are frequently present in the highest concentrations in the liver, kidney and bone, with levels varying considerably with the geographic location of the species. Marine mammals are able to produce certain proteins (metallothioneins) which can sequester certain metal ions into less toxic complexes; this enables many species to cope with relatively high dietary exposures to certain metals. Whilst there are few studies that show major impacts of heavy metals, it is possible that they may have combined effects as they often co-occur with the persistent organic contaminants (DECC, 2009).

Sensitivity of mammals to contaminants is highly variable depending on which specific chemicals are released and has therefore been assessed as moderate. The probability of large amounts oil or hydraulic fluids entering the environment as a result of a major structural failure or spill and the overall level of exposure to change is considered to be negligible to low for all phases and developments, resulting in an insignificant to minor adverse impact. In the unlikely event of an incident, best practice measures put in place to manage potential water quality impacts (see Section 4.3.2.1), such as the use of oil spill action plans, would contain the spillage and prevent substantial effects.

5.5.2.5 Loss or changes to foraging habitat

While mammals are highly mobile species with large foraging ranges they often aggregate in areas of high prey resource (Clark *et al*. 2010). They can therefore be particularly vulnerable to any structures which impact on these key foraging grounds and prey species, namely fish (see Fish and Shellfish Section 5.3), and are therefore considered to have an overall moderate sensitivity to these changes.

While marine mammals (particularly bottlenose dolphins and grey seal) are frequently recorded around Alderney any loss of habitat from individual developments is likely to only constitute a very small fraction of the total area used by a species for foraging as they are recorded widely around the islands and the wider area. For example, Diederichs *et al*. (2008) found no significant influence of wind farms on the occurrence of harbour porpoises which were found to be recorded moving through and foraging in two wind farm areas (Horns Rev-North Sea and Nysted-Baltic Sea) almost daily. Exposure to change is therefore considered to be low and consequently the potential impacts are considered to be minor adverse.

5.5.2.6 Non-toxic contamination

As discussed under water quality (Section 4.3.2.2) SSC could increase such as a result of drilling of the seabed for the installation of the piles, excavation of the seabed for installation of gravity base structures or during the burial of the power cables. Increased turbidity could affect foraging, social and predator/prey interactions of marine mammals. However, marine mammals are known to have acute hearing capabilities which allow them to function as predators in low visibility, turbid conditions. Seals just use passive listening while Odontocetes are known to use both passive and active listening when navigating and foraging (echolocation). Marine mammals also have well developed vision which also helps them operate in low light levels (Scottish Executive, 2007). Seals hunting in poor visibility waters also use fish-generated water movements for locating prey, which they can detect using their highly sensitive mystacial vibrissae (Schulte-Pelkum *et al*., 2007). Marine mammals are therefore well adapted to living in areas with a high suspended sediment load and are regularly recorded in such environments in the UK e.g. estuaries and tidal steams. Therefore, sensitivity is considered low.

For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low, resulting in a **minor adverse** impact. The cables are likely to be buried in soft sediment areas and placed directly on the seabed and covered with protection in areas where the cable cannot be buried. Overall, therefore, the level the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

5.5.2.7 Toxic contamination (sediment release)

The sensitivity of mammals to contaminants is highly variable depending on which specific chemicals are released and has therefore been assessed as moderate.

Sediments are considered likely to be low in contaminant levels within tidal areas, given the distance away from major coastal development and the inherently dispersive and often dynamic nature of the environment. The characteristically high-energy environments in which the devices will be located will also assist in the dispersion of any localised contamination, thus, minimising any impacts on water quality (as discussed in water quality Section 4.3.2.3). It is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact. For cable routeing the exposure to change is considered to be low. Overall, this will result in a **minor adverse** impact.

5.5.2.8 Barrier to movement

The presence of sub-surface tidal structures may present a barrier to movement and migratory pathways depending on array design. Cetaceans and seals are highly mobile, pelagic species which can undergo large seasonal movements and migrations (Reid *et al*., 2003; Learmonth *et al*., 2006). They can therefore be particularly vulnerable to any structures which could act as a barrier, preventing movement to these key foraging or nursery grounds and are therefore considered to have medium sensitivity to changes in habitat.

The potential for tidal energy devices/arrays to act as a barrier to movement will be dependent on the extent that noise and visual cues from the device(s) causes an avoidance response. It is also dependent on the ability of marine mammals to navigate around the devices and associated turbulence. The significance of any obstruction is also dependent on the spatial confines and size of the array (e.g. whether it spans across the entire mouth of an estuary).

While marine mammals are recorded relatively frequently around Alderney, given the unconfined nature of the area, the turbines should not act as a barrier to movement with mammals easily able to pass through the area. Exposure to change is therefore considered low, and the overall impact minor adverse.

5.5.2.9 Electromagnetic field

Electromagnetic fields (EMF) arise from power cables transmitting electricity (associated with tidal energy power cabling) as a result of the current passing along the conductor and the voltage differential between the conductor and earth ground, which is nominally at zero volts. The nature and strength of the fields produced, depends on the system voltage and the current passing through. The effects on the surrounding environment depend on the cable construction, configuration and orientation in space.

In order to standardise terminology, Gill *et al*. (2005) proposed the term EMF should be used to describe the direct electromagnetic field. The two constituent fields of the EMF should be clearly defined as the E (Electric) field and the B (Magnetic Field) field, whilst the induced electric field should be labelled the iE field.

Magnetic fields are produced from alternating current (AC) or direct current (DC) passing through the conductor and these emanate outwards from the cable in a circular plane, perpendicular to its longitudinal axis. The field strength produced as a result of the operation of electricity transmission (AC or DC) decreases rapidly with distance away from the source (the decay curve follows the inverse square law). The magnetic field around an AC cable is constantly changing at the same frequency as the AC that is producing it, which means that the modulation it produces in the Earth's field will also be constantly variable.

Marine mammals are not considered to be electrosensitive species (Gill *et al*., 2005) and there is an apparently low risk of cetacean species being affected. For magnetosensitive species, sensitivity to the geomagnetic field is associated with a direction finding ability e.g. migration. Gill *et al*. (2005) listed cetaceans including the harbour porpoise as magnetosensitive; no evidence was found to suggest that pinnipeds (e.g. Grey seals) are magnetoreceptive. The underlying assumption that cetaceans have ferromagnetic organelles capable of determining small differences in relative magnetic field strength remains, however, unproven and is based on circumstantial information. There is also no apparent evidence that existing cables have influenced migration of cetaceans. Migration of the harbour porpoise in and out of the Baltic Sea necessitates several crossings over operating subsea HVDC cables in the Skagerrak and western Baltic Sea without any apparent effect on their migration pattern (Scottish Executive, 2007). Sensitivity of mammals is therefore considered to be low.

The generated magnetic fields that can be expected by tidal energy developments are expected to be perceived by cetaceans as a new localised addition to the heterogeneous pattern of geomagnetic anomalies already occurring naturally and anthropogenically in the sea. The expected magnetic field from cables (up to a few micro Tesla (μT)) is also very small, particularly relative to the Earth's own magnetic field (approximately 50 μT) (PMSS Ltd, 2007). The exposure of cetaceans to electromagnetic fields from cables associated with a single tidal array is considered to be low and consequently the potential impacts are considered **minor adverse**. A minimum of approximately 367km of cable length will be required for the full build out of the Draft Plan (see Section 2.2.2). Overall, this is considered to result in a moderate level of exposure to change and a **minor to moderate adverse** impact.

5.5.2.10 Seal haul-out damage

Damage to seal haul-out sites could potentially is considered to potentially occur as a result of the construction, operation and decommissioning of cable routeing. Reference should also be also made to visual disturbance effects in relation to seals (see Section 5.5.2.2). As discussed in the baseline marine mammals section, there is a known seal colony to the north of Burhou Island within the designated Ramsar site, and other seal colonies that qualify for designation under Natura 2000 sites in the wider study area. Small numbers of grey seals haul-out at sites on the Channel Islands including the Nannels and Renonquet rocks to the west of Burhou Island near Alderney (Alderney Wildlife Trust, 2012; Open Hydro, 2008). Additionally the most southern European colonies of harbour seals are located in France in the Baie du Mont Saint Michel, Baie des Veys and Baie de Somme with a total count of 295 seals hauled out at these sites recorded in 2008 (Hassani *et al*, 2010).This assessment considers that in general, ships more than 1,500m away from grey seal haul-out areas are unlikely to evoke any reactions from grey seals and therefore exposure to change is considered to be low. Between 900m and 1,500m, grey seals could be expected to detect the presence of vessels and at closer than 900m a flight reaction could be expected (Scottish Executive, 2007). Overall, sensitivities are therefore considered to be moderate resulting in a **minor adverse** impact.

5.5.2.11 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on marine mammals:

Collision Risk :

- Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure;
- Marine mammal monitoring (visual and using PAM techniques) undertaken for a defined period of time during initial operation with potential turbine shutdown when a mammal is within 50m of turbine rotors;
- Regular surveillance for carcasses and post mortem evaluation of carcass stranding and assessment of cause of death;
- Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically; and

- Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices.

Noise/Vibration Disturbance:

- Restrict any piling to periods of low species activity within annual and diurnal cycles as appropriate to avoid displacement of species by underwater noise caused by infrastructure installation (piling);
- Where appropriate to the local species, ensure that piling commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors; and
- Ensuring that piling activities do not commence until half an hour has elapsed during which marine mammals have not been detected in or around the site. The detection should be undertaken both visually (by Marine Mammal Observer) and acoustically using appropriate Passive Acoustic Monitoring equipment. Both the observers and equipment must be deployed at a reasonable time before piling is due to commence. This should include ensuring that at times of poor visibility e.g. night-time, foggy conditions and sea state greater than that associated with force 2 winds, enhanced acoustic monitoring of the zone is carried out prior to commencement of relevant construction activity.

Electromagnetic Field (EMF):

- Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).

5.5.2.12 Residual impact

The mitigation measures identified in Section 5.5.2.11 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on marine mammals as the extent of mitigation achievable will be heavily dependent on many project specific factors. Therefore, the significance of potential residual impacts have been estimated and are summarised in Table 24.

5.5.2.13 Summary

Table 24. Assessment of the potential effects of the Draft Plan on marine mammals and turtles

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
	Construction	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	N-H	H	H	Insignificant to major	Section 5.5.2.11	Minor/Insignificant
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
		Non-toxic contamination	L	L	H	Minor	-	-
		Toxic contamination (sediment release)	N-L	M	H	Insignificant to minor	-	-
	Operation	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	M-H	M	H	Moderate to major	Section 5.5.2.11	Minor/Insignificant
		Barrier to movement	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
	Decommissioning	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
		Non-toxic contamination	L	L	H	Minor	-	-
		Toxic contamination (sediment release)	N-L	M	H	Insignificant to minor	-	-
Cable Routeing	Survey	Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor		
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
	Construction	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
		Non-toxic contamination	N-L	L	H	Insignificant to minor	-	-
		Toxic contamination (sediment release)	L	M	H	Minor	-	-
		Seal haul-out damage	L	M	H	Minor	-	-
	Operation	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Electromagnetic Field (EMF)	L-M	M	H	Minor to moderate	Section 5.5.2.11	Minor/Insignificant
		Seal haul-out damage	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
	Decommissioning	Seal haul-out damage	L	M	H	Minor	-	-
		Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Seal haul-out damage	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
		Non-toxic contamination	N-L	L	H	Insignificant to minor	-	-
		Toxic contamination (sediment release)	L	M	H	Minor	-	-
		Seal haul-out damage	L	M	H	Minor	-	-
Offshore Substations	Survey	Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
	Construction	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	N-H	H	H	Insignificant to major	Section 5.5.2.11	Minor/ Insignificant
		Toxic contamination (spillage)	N-L	M	H	Insignificant to minor	-	-
		Non-toxic contamination	L	L	H	Minor	-	-
		Toxic contamination (sediment release)	N-L	M	H	Insignificant to minor	-	-
	Operation	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	L	M	H	Minor	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Loss or changes to foraging habitat	L	M	H	Minor	-	-
		Collision risk	L	M	H	Minor	-	-
		Visual disturbance	L	M	H	Minor	-	-
		Noise/vibration disturbance	L	M	H	Minor	-	-
		Toxic contamination (spillage)	L	M	H	Minor	-	-
		Non-toxic contamination	L	L	H	Minor	-	-
		Toxic contamination (sediment release)	N-L	M	H	Insignificant to minor	-	-

N Negligible
L Low
M Medium/moderate
H High

5.6 Nature Conservation

5.6.1 Baseline Description

Designated Sites: There are three designated sites for nature conservation within Alderney and its territorial waters as well as a site that is nationally recognised as important and would meet the criteria for designation under the EC Habitats Directive. These are shown in Figure 20 and detailed below.

1) Alderney West Coast and the Burhou Islands Ramsar Site: The site covers 15,629 hectares and comprises the western coast of Alderney and adjacent shallow waters and the islets of Burhou, Les Etacs and Ortac, including the tidal stream body known as The Swinge (ARE, 2011).

The site qualifies under Ramsar Criterion 1, 3, 4, 6 and 7 (JNCC, 2005), and comprises a mixture of habitats including the following wetland types:

- Permanent shallow marine waters (20% of site);
- Marine subtidal aquatic beds (45% of marine area);
- Rocky marine shores (30% of site);
- Maritime cliff and slopes; and
- Sand, shingle and pebble shores (5% of site).

The rocky islets and cliff faces are highly important breeding areas for Northern gannet *Morus bassanus.* This qualifying species regularly supports during breeding season, 5950 pairs based on two islets, representing 1.5% of the breeding population. Based on recent photographic survey counts, this figure is closer to 7,800 pairs and 2.3% of the world population (Alderney Wildlife Trust pers. comm., June 2013). Other qualifying bird species include Atlantic puffin *Fratercula arctica*, Fulmar *Fulmarus glacialus*, Herring Gull *Larus argentatus* and European storm-petrel *Hydrobates pelagicus*. The breeding colonies of gannet and storm petrel on Alderney are the only ones in the Channel Islands (see Section 5.4.1). There is a seal colony to the north of Burhou Island (see Section 5.5.1) and many rare species are found in the marine area of the site. Green ormers *Haliotis tuberculata* are present within the Ramsar site and are of particular significance as part of the heritage of the Channel Islands, as they are found nowhere else in the British Isles (JNCC, 2005). The sand, shingle and pebble shores within the Ramsar site also support a number of bird species, particularly overwintering populations of Oystercatcher *Haemoptus ostrlegus*, Curlew *Numenius arquata*, Little Egret *Egretta garzetta*, Turnstone *Arenaria interpres* and other wading birds. One beach, Platte Saline, supports Alderney's only breeding population of Ringed Plover *Charadrius hiaticula* (Alderney Wildlife Trust, 2012).

Seagrass beds of *Zostera* also occur within the Ramsar site that are of considerable ecological importance, supporting a high density and diversity of associated flora and fauna. Seagrass beds provide important nursery grounds for fishes and birds, and the binding effect of seagrass roots acts to stabilise sediment and prevent erosion (Alderney Wildlife Trust, 2012).

Seaweeds have been studied at the site for numerous years, with around 100 species recorded and the potential for many more to be identified. Of particular importance is knotted wrack *Ascophyllum nodosum*, due to its specific habitat requirements and the fact that up to 75% of the world's population is found in the UK. The red seaweed *Halymenia latifolia* is also considered to be of conservation importance following a 25-49% decline in Great Britain over the last 25 years. The diversity of seaweeds around Alderney and within the Ramsar site plays an important role in supporting the marine fauna and nesting bird populations in the area (Alderney Wildlife Trust, 2012).

2) Longis Nature Reserve: This reserve contains a number of UK BAP species and habitats. The site was designated under a memorandum of understanding in 2003 between the Alderney Wildlife Trust, the States of Alderney and local land owners. Situated on the east of the island, Longis reserve is the largest terrestrial reserve on Alderney, covering 105 hectares, and contains 18 recorded biotopes including marine, intertidal, coastal heathland, grassland, scrub woodland habitats and both natural and man-made freshwater ponds. The reserve contains a high diversity of plant species, and provides an important site for migratory birds, mammals and insect species. Nearly 100 insects of national importance are present within the Longis Nature Reserve, many of which have not yet occurred in the UK (Alderney Wildlife Trust website).

3) Val du Saou Nature Reserve: This reserve is the smallest on the island and was designated under a memorandum of understanding in 2004 between the Alderney Wildlife Trust, the States of Alderney and two private landowners. The reserve is on the southern coast of Alderney and comprises coastal cliff top woodland valley habitats and covers 7 hectares. The site supports a variety of migratory birds, the island's only reptile, the slow worm *Anguis fragilis* and many important insect species (Alderney Wildlife Trust website).

4) Alderney South Banks Subtidal Sandbank: Alderney's South Banks is of nature conservation importance and would meet the criteria for designation as a subtidal sandbank under the EC Habitats Directive. As Alderney is not a member of the EU full designation may not occur, however, the Commission is committed to adopting best practice and has therefore recommended that the site receive the same consideration as a fully designated SAC. Shallow sandy sediments such as the South Banks typically support burrowing fauna, crustaceans, bivalve molluscs and echinoderms. Mobile epifauna at the sand surface usually include shrimps, gastropod molluscs, crabs and fish. Notable fish species found on sand banks include sandeels *Ammodytes spp.*, an important food source for seabirds, the critically endangered common skate *Dipturus batis* and the thornback ray *Raja clavata*. Communities of foliose seaweeds, hydroids, bryozoans and ascidians may form on more stable stones and shells on the sediment (Axelsson *et al*., 2011).

Designated Sites Within the Wider Study Area: There are a number of Natura 2000 and Ramsar sites in the wider study area that are designated for a range of mobile interest features (i.e. marine mammals, birds and migratory fish). These mobile features could be using Alderney and its surrounding waters and, therefore, could potentially overlap with the impacts brought about by the Draft Plan. The nearest Natura 2000 sites and Ramsar sites on the adjacent French Cotentin Peninsula and within the other Channel Islands are shown on Figure 20 and include the following, which are designated for mobile interest features:

- Anse de Vauville SAC - bottlenose dolphin, harbour porpoise and grey seals;
- Récifs et landes de la Hague SAC - bottlenose dolphin, harbour porpoise, harbour and grey seals;
- Banc et Recifs de Surtainville SAC - bottlenose dolphin, harbour porpoise, harbour and grey seals;
- Recifs et marais arrier-littoraux du Cap Levi a la Pointe de Saire SAC - bottlenose dolphin, harbour porpoise, harbour and grey seals;
- Havre de Saint-Germain-sur-ay et Landesde Lessay SAC - Atlantic salmon, European brook, river and sea lamprey species;
- Marais du Cotentin et du Bessin - Baie des Veys SAC- harbour seal, Atlantic salmon, twaite and allis shad, river and sea lamprey;
- The Baie de Seine Occidentale SAC - bottlenose dolphin and harbour seal, Twaite and Allis Shad, Sea Lamprey, Atlantic Salmon;
- A Landes et dunes de la Hague SPA - a number of breeding, overwintering and migratory bird species;
- The Baie de Seine Occidentale SPA - a number of breeding, overwintering and migratory bird species;
- Basses Vallées du Cotentin et Baie des Veys SPA - a number of breeding, overwintering and migratory bird species;
- Site ornithologique des falaises de Jobourg - a number of breeding, overwintering and migratory bird species;
- Lihou Island and L`Erée Headland Ramsar site - a number of breeding, overwintering and migratory bird species;
- Les Écrehous & Les Dirouilles Ramsar site - grey seal, bottlenose dolphin, common dolphin, white beaked dolphin, Risso's dolphin, Striped dolphin, harbour porpoise, pilot whale, basking shark, Atlantic salmon, Twaite shad;
- Les Pierres de Lecq (the Paternosters) Ramsar site - grey seal, bottlenose dophin, common dolphin, white beaked dolphin, Risso's dolphin, Striped dolphin, harbour porpoise, pilot whale, basking shark, Atlantic salmon, Twaite shad; and
- South East Coast of Jersey Ramsar site - bottlenose dolphin; and
- Les Minquiers Ramsar site - grey seal, bottlenose dophin, common dolphin, white beaked dolphin, Risso's dolphin, Striped dolphin, harbour porpoise, pilot whale, basking shark, Atlantic salmon, Twaite shad.

5.6.1.1 Future baseline

As part of the strategy plan for the Alderney West Coast and the Burhou Islands Ramsar Site, Alderney Wildlife Trust (2012) hope to focus on "developing a stakeholder advisory group and developing and enacting policy and legislation protecting the natural environment of Alderney as a whole, including the Ramsar site". There have been two Management Strategies published for the Ramsar site on Alderney: ARS1 and ARS2.

The ARS1 outlined a main objective that aimed to develop an Alderney Environmental Protection Act. This Act would allow for the designation of marine and terrestrial protected areas and specific protection awarded to threatened or endangered species, in line with legislation in the UK and EU (Alderney Wildlife Trust, 2012).

A Stakeholder Steering Group (SSG) is to be set up by 2016 that will review ARS2 for the site, in order to advise on their areas of interest, such as fishing, recreational use or botany. Such stakeholder participation may alter the focus of management of the Alderney West Coast and the Burhou Islands Ramsar Site in the future.

The ARS2 also suggests the development of networks of designated sites throughout the Channel Islands and with similar organisations in France. Due to the fluid nature of the seas and migratory patterns of many species, ARS2 suggests that the establishment and management of such networks will allow management organisations to liaise on common problems and produce more coherent records of sightings of migratory species. Specifically, ARS2 suggests that:

- Strong links between Alderney and the French Normand-Breton Marine Natural Park programme should be developed; and
- The potential for a cooperative network of Ramsar sites throughout the Channel Islands should be investigated, specifically utilising a shared website.

It is therefore considered that the natural environment in Alderney is likely to receive further protection in the future such as further designated sites or more protection to specific features. Furthermore, the potential exists for international nature conservation sites to be designated within the study area, such as the designation of Marine Protected Areas (MPAs) within the Gulf of Normandy and Brittany by the Agence des Aires marines Protegees (http://www.aires-marines.fr/L-Agence/Organisation/Missions-d-etude-de-parc/Golfe-normand-breton) or the potential designation of new Ramsar sites. It is therefore recommended that at the EIA project level, the developer confirm the status of existing designated sites and whether any new sites have been proposed or designated.

5.6.1.2 Limitations and data gaps

Data on the ranges of mobile designated features within nature conservation sites in the wider study area is currently limited. Reference should be made to specific nature conservation feature topics (including Fish and Shellfish 5.3.1.2, Ornithology 5.4.1.4, and Marine Mammals 5.5.1.9) for specific limitations and data gaps, as well as specialist surveys potentially required.

5.6.1.3 Study area

The study area will need to encompass any pathways which connect the Draft Plan with receptors. Given the potential for transboundary effects for qualifying features of Natura 2000 sites moving to and from French waters, but also possibly to English waters, it is important that any mobile interest features (i.e. marine mammals, birds and migratory fish) that may overlap with the changes brought about by the Draft Plan be considered as part of the assessment. The mobile Natura 2000 features study area shown on Figure 2, which incorporates the entire English Channel and the coastlines of southern England and Northern France, encompasses these wider-scale boundaries.

5.6.2 Impact Assessment

A range of sensitivities relevant to statutory designations and wider conservation resources are considered in the REA. Specific sensitivities that need to be considered are listed below.

The Draft Plan has the potential to affect nature conservation features in the study area through a number of impact pathways which are assessed in the following sections:

- Collision Risk (Section 5.6.2.1);
- Visual Disturbance (Section 5.6.2.2);
- Noise/ Vibration Disturbance (Section 5.6.2.3);
- Toxic Contamination (Spillage) (Section 5.6.2.4);
- Loss/Damage and/or Disturbance (Section 5.6.2.5);
- Loss or Changes To Foraging Grounds (Section 5.6.2.6);
- Non-Toxic Contamination (Section 5.6.2.7);
- Toxic Contamination (Sediment Release) (Section 5.6.2.8);
- Potential for Non-Native Species Introductions (Section 5.6.2.9);
- Barrier to Movement (Section 5.6.2.10);
- Introduction of New Structures (Section 5.6.2.11);
- Seal Haul-Out Damage (Section 5.6.2.12); and
- Electromagnetic Field (EMF) (Section 5.6.2.13).

In general reference should be also made to specific receptor topics including Fish and Shellfish (Section 5.3), Ornithology (Section 5.4), Marine Mammals (Section 5.5) and Terrestrial Ecology (Section 5.7) for further information. This section focuses on potential effects on the integrity of designated sites and its supporting features.

One of the possible cable routes is anticipated to come ashore on the south-east coast of Alderney and potentially through the Longis Bay Nature Reserve, however in general the precise location of other elements of the Draft Plan are currently unknown. The importance of a feature is based on its value and rarity and considering Alderney includes designated nature reserves, and an internationally important Ramsar, importance is considered to range between moderate to high depending on the level of protection of the feature. Sensitivity is considered to be the intolerance of a habitat, community or individual species designated and the variation between the impact pathways are discussed in the individual assessments below.

5.6.2.1 Collision risk

There is a potential collision risk on mobile species particularly from moving turbine blades during the operation of tidal stream turbines and onshore wind turbine (specifically for birds). Temporary effects may also occur from vessel propellers used during the survey, construction and decommissioning stage associated with tidal stream turbines, cable routeing and offshore substation as well as any maintenance vessels during operation of cable routeing and offshore substations. The potential for effects is discussed further in each of the specific receptor topic assessments: Fish and Shellfish (Section 5.3.2.1), Ornithology (Section 5.4.2.1) and Marine Mammals (Section 5.5.2.1). In addition these sections reference species that are features of designated site and therefore an effect on these species is considered to a related effect on this assessment.

The nature conservation sites around Alderney include designations for breeding seabird colonies. A number of sites within the wider study area have also received designation due to the importance of their mobile features (marine mammals, fish and birds). In particular SPAs and Ramsar Sites require a wider area of consideration as any effect on birds from the Draft Plan have the potential to effect interest features of other nearby SPAs that could be using areas directly or indirectly. Therefore whilst the location of renewable devices is currently unknown, the range of mobile features and associated spatial overlap of the Draft Plan with the designated sites potentially affected is likely to be very large.

The exposure to change is dependent on numerous factors. As discussed in previous receptor specific topics this includes the location, number, size and spacing between structures and the location in relation to migratory routes. Additionally, associated (underwater) noise levels are considered to have the potential to lead to an avoidance response.

This assessment considers sensitivity to be moderate due to the potential for a direct collision with a sharp object such as a moving blade to cause injury. This also reflects the assessments undertaken for receptor specific topics which reference species that are designated for mobile interest and also considers sensitivity to be moderate.

In terms of exposure to change for all phases excluding the operation of tidal stream turbines and onshore wind turbine, exposure to change is considered to be low, resulting in an insignificant/minor adverse impact. For the operation of a single tidal stream array and onshore wind turbine, in the absence of further information on specific device characteristics (such as blade speed) and operational noise levels (which might provide early acoustic warning avoidance behaviour), exposure to change has been assessed as medium resulting in a minor/moderate adverse impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a high level of exposure to change (due to an increased chance of collision) and an overall moderate to major adverse impact to protected species.

5.6.2.2 Visual disturbance

Visual disturbance such as the presence of vessels or a new structure as part of the all marine and terrestrial related phases and developments of the Draft Plan (the survey, construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore wind turbine and onshore substations) may cause disturbance to designated features. Mobile species are considered most at risk. The potential for effects is discussed further in each of the specific receptor topic assessments: Fish and Shellfish (Section 5.3.2.2), Ornithology (Section 5.4.2.2), Marine Mammals (Section 5.5.2.2) and the Terrestrial Ecology section below (Section 5.7.2.2). In addition these sections reference species that are features of designated sites and therefore an effect on these species is considered to a related effect on this assessment.

Sensitivity is considered to be low to moderate with large permanent structures (e.g. numerous tidal turbines and offshore substations) having the potential to create the most effect as well as disturbance caused by human presence and work on the foreshore. Exposure to change is therefore considered to be medium for onshore substation and windfarms during construction resulting in a minor/moderate adverse impact. In all other phases and developments, exposure to change is considered low resulting in a minor adverse/insignificant impact.

5.6.2.3 Noise/vibration disturbance

Noise/vibration disturbance may cause disturbance to designated features during all marine and terrestrial related phases and developments of the Draft Plan (the survey, construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore wind turbine and onshore substations). The potential for effects is discussed further in each of the specific receptor topic assessments: Fish and Shellfish (Section 5.3.2.3), Ornithology (Section 5.4.2.3), Marine Mammals (Section 5.5.2.3) and the terrestrial ecology section below (Section 5.7.2.3). Underwater noise is considered to potentially be greatest during construction and device installation such as from specifically from shipping and machinery, dredging; and pile driving or drilling (if required). Of all of the sources of noise, the noise emitted during pile driving is understood to have the greatest potential effects on marine wildlife (Thomsen *et al*., 2006). For birds it is considered they are likely to become accustomed to the rhythmic “bangs” (ABP Research & Consultancy Ltd, 2001) and birds appear to habituate to continual noises as long as there is no large amplitude ‘startling’ component (Hockin *et al*., 1992). Given the limited data on diving birds, they are considered to be more sensitive to changes in underwater noise than terrestrial or surface-feeding birds. Marine mammals (particularly cetaceans) are considered to be the most sensitive receptors in relation to acoustic disturbance in the marine environment, due to their use of echolocation and vocal communication (DECC, 2009). In comparison to fish, marine mammal species are sensitive to a very broad bandwidth of sound Noise disturbance during construction will generally only be short-term. The majority of species are considered likely to exhibit avoidance behaviour in response to increased noise levels, although noise disturbance may cause exclusion of species from areas, such as seal species abandoning local haul-out sites.

This assessment considers sensitivity to be low to high for marine construction elements accounting for the potentially varying sensitivities between fish and shellfish, marine mammals and birds particularly due to piling and the potential for behavioural changes to occur over large distance resulting in the potential for an insignificant to major adverse impact. The potential concurrent installation of tidal arrays in Alderney’s territorial waters (see Section 2.2.2) as a result of the Draft Plan is considered to result in a high level of exposure to change from cumulative noise sources (assuming piling is required) and an overall major adverse impact to protected species. During all other phases and elements of the Draft Plan sensitivity is considered to be low to moderate given the likely avoidance behaviour in response to temporary increased noise levels, and exposure to change is considered to be low, resulting in an insignificant to minor adverse impact. This also reflects the assessments in each of the specific receptor topic assessments.

5.6.2.4 Toxic contamination (spillage)

Toxic contamination (spillage) can affect ecological features associated with designated sites during all marine and terrestrial related elements and phases of the Draft Plan. The potential for effects is discussed further in each of the specific receptor topic assessments: Water

Quality (Section 4.3.2.1), Benthic Ecology (Section 5.1.2.1) Fish and Shellfish (Section 5.3.2.3), Ornithology (Section 5.4.2.4), Marine Mammals (Section 5.5.2.4) and the Terrestrial Ecology section below (Section 5.7.2.4). Bioaccumulation of toxins may occur and contamination of species can cause harmful effects to apex predators such as mammals and seabirds. Sea birds, in particular, are susceptible to a build-up of heavy metals which can affect many aspects of their life history; mercury notably causes egg shell thinning. All such effects have the potential to directly or indirectly effect designated sites. The sensitivity to toxic contamination has been shown to vary between species and the type of spillage and is assessed as low to moderate. Exposure to change is considered to be negligible to low for all phases and developments, resulting in an **insignificant to minor adverse** impact. In the unlikely event of an incident, best practice measures put in place to manage potential water quality impacts (see Section 4.3.2.1), such as the use of oil spill action plans, would contain the spillage and prevent substantial effects.

5.6.2.5 Loss/damage and/or disturbance

Loss or damage to qualifying habitats within designated nature conservation areas may occur in the footprint of the development work. Onshore or coastal and offshore habitats may be damaged or lost due to associated scour during the construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substations and onshore wind turbine. The potential for effects is discussed further in each of the specific receptor topic assessments: Benthic Ecology (Section 5.1.2.2) Fish and Shellfish (Section 5.3.2.5) and the Terrestrial Ecology section below (Section 5.7.2.1). Loss or changes to foraging grounds are discussed in Section 5.6.2.6 below. This assessment considers sensitivity to be low to high due to the potential for permanent loss of species from the footprint of the Draft Plan. This is also reflected in the individual assessments highlighted above.

In terms of exposure to change, the proposed cable route is anticipated to come ashore on the south-east coast of Alderney and potentially through the Longis Bay Nature Reserve. The cable is expected to be trenched and buried from the shallow subtidal zone, along the beach and will exit in the bunker within the anti-tank wall before being buried along the road. Terrestrial habitats in the area include scrubland and sand dune grassland, which is of conservation importance under the EU Habitats Directive and in within the local nature reserve (ARE, 2008). Increased movement of workmen and vehicles may increase erosion rates and indirectly affect species assemblages.

Additionally, a number of licensed blocks in the Draft Plan are situated within the Alderney West Coast and the Burhou Islands Ramsar Site and offshore of the Longis Nature Reserve (Figures 1 and 8), and all licensed blocks and planned cable routes lie within the wider study area and study area for mobile marine mammal Natura 2000 features. Whilst the location of renewable devices is currently unknown the range features potentially affected by such devices is potentially very large. Therefore taking a precautionary approach the exposure to change is considered to be moderate for a single tidal array and all other development comprising the Draft Plan resulting in an **insignificant to moderate adverse** impact. A full build out of the Draft Plan, however, will result in the potential installation and operation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2), which is considered to result in a high level of exposure to change and an overall **moderate to major adverse** impact.

5.6.2.6 Loss or changes to foraging grounds

A loss or change in foraging ground such as a reduction in the area or quality for seabirds and marine mammals has the potential for an associated effect on designated features. Potential effects are discussed further in each of the specific receptor topic assessments: Ornithology (specifically Section 5.4.2.5) and Marine Mammals (Section 5.5.2.5). As discussed in these assessments sensitivity is considered to vary between species. Due to the potential loss of key foraging grounds sensitivity is considered low to moderate. However any loss of habitat from individual developments may only constitute a very small fraction of the total area used by a species for foraging however in the absence of detail on the footprint of the development and the associated habitat potentially affected and exposure to change is considered to be low to medium resulting in an **insignificant to moderate adverse** impact.

5.6.2.7 Non-toxic contamination

Local suspended sediment concentrations (SSC) have the potential to increase during the construction and decommissioning phases associated with tidal stream turbines, cable routeing and offshore substations. Such non-toxic contamination has the potential to increase turbidity and may reduce the foraging ability of marine mammals and seabirds resulting in an associated effect on a designated feature. Subsequent re-deposition of disturbed sediments may also result in the smothering of features qualifying for designation, to which benthic species are considered particularly susceptible. Reference should be made to each of the specific receptor topic assessments: Water Quality (Section 4.3.2.2), Benthic Ecology (Section 5.1.2.3), Fish and Shellfish (Section 5.3.2.6), Ornithology (Section 5.4.2.6) and Marine Mammals (Section 5.5.2.6) for more detail. This assessment considers sensitivity to be low to moderate based on the varying sensitivity of designated features. Whilst any seabed disturbance will result in temporary elevated SSC, the extent of the increase is considered to be dependent upon the superficial sediments and underlying geological properties. The energetic hydrodynamic regime within the study area means that sediment plumes will be rapidly dispersed. However, it should be acknowledged that the effects of any elevated SSCs may also have an impact further afield (e.g. France and the other Channel Islands).

For tidal stream turbines and offshore substations, the overall level of exposure to change is considered to be low, resulting in an **insignificant to minor adverse** impact. Minimal disturbance to the seabed is anticipated for cable routeing activities given that it is considered likely that they will be placed directly on the seabed and covered with protection, and therefore the overall level the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact.

5.6.2.8 Toxic contamination (sediment release)

Contaminants within seabed sediments may be released during the construction and decommissioning associated with tidal stream turbines, cable routeing and offshore substations. Any effects could have an associated impact on designated features. Reference should be made to each of the specific receptor topic assessments: Water Quality (Section 4.3.2.3), Benthic Ecology (Section 5.1.2.4), Fish and Shellfish (Section 5.3.2.7), Ornithology

(Section 5.4.2.7) and Marine Mammals (Section 5.5.2.7). The level of effect is considered to vary depending on factors such as the chemical released and the proximity to designated features. For example treated sewage has historically been discharged near to Longis Bay on the southeast coast of Alderney which is considered to have the potential to affect designated features such as through dispersion into designated sites such as Alderney South Banks Subtidal Sandbank or mobile features in close proximity. However given the energetic hydrodynamic regime within Alderney's Territorial Waters it is considered that pollutants will generally be rapidly dispersed from any release point. Overall, it is considered that for the installation and decommissioning of the tidal stream turbines and offshore substation the exposure to change is negligible to low, resulting in an **insignificant to minor adverse** impact. For cable routeing the exposure to change is considered to be low. Overall, this will result in a **minor adverse** impact.

5.6.2.9 Potential for non-native species introductions

The introduction of invasive non-native species may occur during the construction and decommissioning of tidal stream turbines, cable routeing and offshore substations. New substratum on the seabed provided by such structures may facilitate the colonisation of invasive species that may out-compete or smother native species. Such species may also be introduced to designated areas via vessels. Reference should be made to the Benthic Ecology (Section 5.1.2.5) for further details. Alderney waters are considered highly dynamic and therefore the overall potential exposure to change as a result of a single array and associated infrastructure is considered to be low, resulting in an **insignificant to minor adverse** impact.

A full build out of the Draft Plan, however, will result in the potential installation of up to 4000 tidal devices in Alderney's territorial waters (see Section 2.2.2). Assuming the OpenHydro turbine is exclusively used (see Section 1.2.2), this would result in approximately 3.1km^2 of new artificial substrate being introduced into the marine environment with the potential to be colonised by non-native species. In terms of intra- and inter-array cabling, if cable protection (i.e. concrete mattressing) were required along their entire length, approximately 1.8km^2 of new substrate would be introduced to the seabed. The cable protection associated with the export cable between Alderney and France would result in an additional 0.15km^2 of new substrate for each cable that needs to be layed (Section 2.2.2). Overall, the full build out of the Draft Plan is therefore considered to result in a moderate level of exposure to change and an **insignificant to moderate adverse** impact.

5.6.2.10 Barrier to movement

The operation of tidal stream turbines and cable routeing has the potential to act as a barrier presenting a barrier to the movement of mobile designated features. Reference should be made to each of the specific receptor topic assessments: Fish and Shellfish (Section 5.3.2.8), Ornithology (Section 5.4.2.8) and Marine Mammals (Section 5.5.2.8). Little is known about the sensitivity of bird species to barrier effects and their ability to alter flight heights. Fish and mammals are considered particularly vulnerable to any structures which could act as a barrier that may prevent movement to key foraging or nursery grounds and are therefore considered to have medium sensitivity. The significance of any obstruction is also dependent on the spatial confines and size of the array (e.g. whether it spans across the entire mouth of an estuary) and considering the unconfined nature of the area, the turbines are not considered likely to act as a barrier to movement. Exposure to change is therefore considered low, and the overall impact is **insignificant to minor adverse** impact.

5.6.2.11 Introduction of new structures

The operation of tidal stream turbines and offshore substations has the potential to introduce new structures that could become surfaces for the settlement of designated features and may even have the potential to act as a benefit to their receiving environment. Reference should be made to Fish and Shellfish (Section 5.3.2.9) for further details. However, this potential benefit needs to be studied in greater detail, allowing it to be taken into consideration when undertaking project-level impact assessments on the benthic community. Overall, sensitivity to change is considered low to moderate and exposure to change is low resulting in a potential **insignificant to minor beneficial** impact.

5.6.2.12 Seal haul-out damage

Damage to seal haul-out sites could potentially occur as a result of the construction, operation and decommissioning of cable routeing. Reference should also be also made to Marine Mammals (see Sections 5.5.2.2 and 5.5.2.10). There is a known seal colony to the north of Burhou Island within the designated Ramsar site, and other seal colonies that qualify for designation under Natura 2000 sites in the wider study area. Small numbers of grey seals haul-out at sites on the Channel Islands including the Nannels and Renonquet rocks to the west of Burhou Island near Alderney (Alderney Wildlife Trust, 2012; Open Hydro, 2008). Additionally the most southern European colonies of harbour seals are located in France in the Baie du Mont Saint Michel, Baie des Veys and Baie de Somme with a total count of 295 seals hauled out at these sites recorded in 2008 (Hassani *et al*, 2010).This assessment considers that in general, ships more than 1,500m away from grey seal haul-out areas are unlikely to evoke any reactions from grey seals and therefore exposure to change is considered to be low. Between 900m and 1,500m, grey seals could be expected to detect the presence of vessels and at closer than 900m a flight reaction could be expected (Scottish Executive, 2007). Overall, sensitivities are considered to be moderate and importance of marine mammals features are high resulting in a **minor adverse** impact.

5.6.2.13 Electromagnetic field

The operation of cable routeing has potential to create Electromagnetic fields (EMFs) and have associated effects on Fish and Shellfish (See 5.3.2.10) and Marine Mammals (see Section 5.5.2.9). This assessment considers that designated features may be affected by the production of EMF such as altering migration patterns. Whilst sensitivity of mammals is considered to be low fish species such as salmon are designated features and have been identified as electro sensitive and potentially effected by EMF and sensitivity is therefore considered to be moderate. Due to limited area potentially affected by EMF exposure as a result of a single turbine is considered low resulting in a **minor adverse/insignificant** impact. However, the level of exposure associated with the potential full build out of the Draft Plan is considered to be moderate resulting in an **insignificant to moderate adverse** impact.

5.6.2.14 Mitigation

The following general mitigation works should be considered at the EIA project-level by the developer, as appropriate, to minimise any potentially significant impacts identified at the plan-level. Reference should also be made to mitigation recommended for other specific receptor topics including Fish and Shellfish (Section 5.3.2.11) Ornithology (Section 5.4.2.9), Marine Mammals (Section 5.5.2.11 and Terrestrial Ecology (Section 5.7.2.5):

- Consider a zone of avoidance around designated sites (this will vary depending on the sensitivity of qualifying interest features and the spatiotemporal scale of pressures brought about by activities associated with specific projects);
- Minimisation of survey / construction / decommissioning works in designated sites;
- Consider alternative installation methods (including non-invasive measures such as Horizontal Directional Drilling (HDD)) to avoid an adverse effect on site integrity;
- Careful consideration of the design and placement of structures to minimise effects, e.g. for tidal turbines the number, size and spacing between and avoiding key migratory routes;
- Selection of device type to minimise effects such as collision/entrapment risk or visual;
- Avoid sensitive sites /species e.g. seabed habitats such as maerl beds, seagrass beds which have a particularly strong ecosystem function in supporting different life stages for fish and shellfish;
- Avoid siting devices in or near particularly sensitive areas e.g. seal haul out sites, seabed fish spawning/nursery grounds, key bird foraging/breeding sites;
- Avoid construction work during sensitive time periods for fish, e.g. breeding, migration and spawning events;
- Avoid cable-laying through sensitive areas, e.g. spawning and feeding grounds;
- Creation of new habitat creation e.g. where rock armouring has been used;
- Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; and
- Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).

5.6.2.15 Residual impact

The mitigation measures identified in Section 5.6.2.14 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on many project specific factors. The significance of potential residual impacts have been estimated and summarised in Table 25.

5.6.2.16 Summary

Table 25. Assessment of the potential effects of the Draft Plan on nature conservation

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Construction	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	M	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
	Operation	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	M-H	M	M-H	Minor to major	Section 5.6.2.14	Minor/ Insignificant
		Barrier to movement	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Introduction of new structures	L	L-M	M-H	Minor/Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L	L-M	M-H	Minor/Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Cable Routeing	Survey	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Construction	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/Insignificant
		Seal haul-out damage	L	M	H	Minor	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	N-L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
	Operation	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Electromagnetic Field (EMF)	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Seal haul-out damage	L	M	H	Minor	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Barrier to movement	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Seal haul-out damage	L	M	H	Minor	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	N-L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L	L-M	M-H	Minor/Insignificant	-	-
Offshore Substations	Survey	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Construction	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	M	L-H	M-H	Minor to major	Section 5.6.2.14	Minor /Insignificant
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
	Operation	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Introduction of new structures	L	L-M	M-H	Minor Benefit/ Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	M-H	L-H	M-H	Insignificant to major	Section 5.6.2.14	Minor/ Insignificant
		Loss or changes to foraging grounds	L-M	L-M	M-H	Insignificant to moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Non-toxic contamination	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (sediment release)	N-L	L-M	M-H	Minor/Insignificant	-	-
		Potential for non-native species introductions	L	L-M	M-H	Minor/Insignificant	-	-
Onshore Substation	Survey	Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Construction	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Visual disturbance	M	L-M	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Operation	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
Onshore Wind Turbine	Survey	Visual disturbance	L	M-H	M-H	Moderate/Major	Section 5.6.2.14	Minor/ Insignificant
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Construction	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Visual disturbance	M	L-M	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Operation	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/ Insignificant
		Collision risk	M	M	M-H	Minor/Moderate	Section 5.6.2.14	Minor/ Insignificant
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	M	L-H	M-H	Insignificant to Moderate	Section 5.6.2.14	Minor/Insignificant
		Visual disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-M	M-H	Minor/Insignificant	-	-
		Toxic contamination (spillage)	N-L	L-M	M-H	Minor/Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

5.7 Terrestrial Ecology

5.7.1 Baseline Description

A Phase I habitat survey of a 'terrestrial zone' within Longis Bay was undertaken by Alderney Wildlife Trust in 2008. Another Phase 1 Habitat Survey of Alderney's terrestrial land was undertaken by ARE in July 2010. Although the source data for these surveys is unavailable, a description of the significant habitats and species identified is provided in ARE (2008; 2011). This information is included where relevant within the sub-sections below.

Habitats

Terrestrial habitats on Alderney include species rich calcareous coastal (vegetated) grasslands, coastal heathland and agricultural habitats, sand dune, scrubland and woodland. There are also several fresh water habitats including natural quarry ponds (Alderney Wildlife Trust website). Fifteen terrestrial habitats were recorded in the 2008 Phase 1 habitat survey, including mixed woodland (semi natural), scrub, tall herb and fern, strandline vegetation, sand dune grassland, maritime hard cliff/slope, coastal grassland/heathland and cultivated disturbed land. Of these habitats the mixed woodland, strandline vegetation, sand dune grassland and maritime cliff/slope were considered to be of moderate to high ecological importance (ARE, 2008).

Coastal habitats

Alderney's coastal habitats can be divided into two groups; coastal cliffs and dune systems. . Sand dune habitat is classified as a priority habitat under Annex I habitat of the European Habitats Directive due to their limited range and is a priority habitat under the UKBAP because it is considered extremely fragile and is also species rich in invertebrates (UKBAP, 2008a). Mobile dune systems are found at Longis Bay, Braye Bay and Platte Saline, which succeed into fixed dune grassland habitats. Dune grasslands are one of the most diverse habitats found on Alderney and support a variety of rare and delicate flora and fauna such as dodder *Cuscuta*, wild thyme *Thymus serpyllum* and sky larks *Alauda arvensis*. Longis reserve's coastal grasslands also include rare species such as small hare's-ear, scrambled egg lichen, autumn lady's tresses, bastard toadflax and green winged orchids. The marine and freshwater wetlands within the reserve provide an important site for migratory birds with other habitats also hosting many of the island's best mammal habitats.

Over the past century the quality and expanse of dune grassland on Alderney has decreased due to a lack of management and following the construction of sea defences (ARE, 2011). At Longis Bay, the dune system is threatened by both of these factors. Coastal heathland and grassland require disturbance in order to prevent their succession to scrub, such as grazing, exposure to strong winds or clearing and cutting. The common at Longis Bay was grazed up until the 1950s, after which the grassland was left to succeed to dune scrub. The construction of an anti-tank wall during the Second World War also removed the mobile aspect of the dunes and led to the establishment of bracken and bramble scrub. Other dune systems are threatened by erosion, both natural and anthropogenic (trampling, sand extraction) (ARE, 2011).

The southern and western cliffs of Alderney comprise exposed hard and soft cliffs, coastal grasslands and heathlands and dense gorse *Ulex europeaus*, blackthorn *Prunus spinosa* and bracken scrub. Maritime cliffs and slopes are a UK BAP priority habitat and are classified due to the diversity of plants, seabirds and invertebrates they support. The cliffs around Alderney, for example, are important breeding habitats for a number of seabird species (see also Section 5.4). This UK BAP priority habitat is under increasing pressure from impacts such as erosion and coastal development (UKBAP, 2008b).

Inland habitats

Alderney has very little woodland cover, although there are small patches of planted deciduous woodland throughout the valleys. Those woodlands that are semi-natural are dominated by sycamore. Due to the scarcity of natural woodland, fungi associated with this habitat are rare. Lowland mixed deciduous woodland has been formally adopted as a UK BAP priority habitat (UKBAP, 2008c).

There are few wet meadows on Alderney and those present are of poor quality, with the exception of the Bonne Terre Valley bottom, dominated by *Carex paniculata* (ARE, 2011). There are also few freshwater bodies on Alderney. A notable example is La Mare du Roe, or Longis Pond; a natural flush within Longis Nature Reserve that supports an extensive reed bed. Many quarry ponds also exist as a result of Alderney's quarrying heritage, notably Mannez Quarry, a mosaic of open water, *Eleocharis palustris* swamp, *Salix cinerea* scrub and *Crassula helmsii* communities (ARE, 2011). Biologically important freshwater habitats include:

Ponds:

- Platte Saline Pond;
- La Mare du Roe (Longis Pond); and
- Mannez Pond.

Streams:

- Bonne Terre;
- Barrackmaster's Lane;
- Trois Vaux;
- Val du Saou;
- Vau du Fret; and
- Vau Pommier.

Flora

During the 2008 Phase I habitat survey, 156 species of flora were recorded within the Longis Bay terrestrial environment alone, although around 1030 species of flowering plants and ferns have been recorded throughout the island[9]. The majority recorded were not of any local or national importance and considered common around Alderney, however, two species,

[9] http://www.islandlife.org/natural_history_of_alderney.htm

Hypochoeris glabra (smooth cat's ear) and *Crambe maritima* (sea kale) are classified as uncommon or rare within Alderney and the British Isles. Seven species (names not provided in the text) were non-native species generally uncommon in the UK (ARE, 2008).

Common Alder *Alnus glutinosa*, Horse-radish plant *Armoracia rusticana*, Black poplar *Populus nigra* subsp. *Betulifolia*, Rough clover *Trifolium scabrum*, Gorse *Ulex europaeus*, Water speedwell *Veronica anagallis-aquatica* and eelgrass *Zostera marina* are classed as Least Concern on the latest International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN Red List website) given that they are widely distributed, the overall populations are stable to increasing and face no major threats. Thrift *Armeria maritima* is classed as Vulnerable given that is endemic to northeast and central Portugal where not more than 500 mature individuals have been recorded. It furthermore suffers from the affects of recreational activities and infrastructure development on its sites. Lance leaf plantain *Plantago lanceolata* is also classed as Vulnerable because the area of occupancy as well as the quality and extent of its habitat are declining due to agricultural activities. Sea Beet *Beta patula* subsp. *maritima* is Critically Endangered because its distribution is severely fragmented and there is continuing decline in the extent and quality of its habitat. It is also threatened by invasive alien species, grazing pressure and an increase in the seagull population. Kidney Vetch *Anthyllis vulneraria* and wild carrot *Daucus carota* subsp. *gummiferis* are classed as Data Deficient as there is currently not sufficient information on the population size, their trend and potential threats available. The other species identified during the survey have not yet been assessed for the IUCN Red List.

Alderney has a rich diversity of terrestrial flora and there are many species of plants that are 'rare' or not found on mainland Britain due to the island's unique and isolated geography, including the endemic Alderney Sea-lavender *Limonium normannicum* and the Alderney geranium, *Geranium sub-molle* (Alderney Wildlife Trust website). Other notable plant species on Alderney include:

- Greater broomrape *Orobanche rapum-geniste;*
- Yarrow broomrape *Orobanche purpurea;*
- Spotted rock-rose *Tuberaria guttata;*
- Sand crocus *Romulea columnae;*
- Small rest harrow *Ononis reclinata* (now reduced to a single colony);
- Bastard Toadflax *Thesium humifusum;*
- Fumitory *Fumaria muralis;*
- Flax-leaved St. John's-wort *Hypericum linariifolium;*
- Four-leaved Allseed *Polycarpon tetraphyllum;*
- Orange bird's foot *Ornithopus perpusillus;*
- Bithynian Vetch *Vicia bithynica ;*
- Western Clover *Trifolium occidentale;*
- Cape Cudweed *Gnaphalium undulatum;*
- Jersey Cudweed *Gnaphalium luteoalbum;*
- Dwarf Rush *Juncus capitatus;*
- New Zealand Cabbage Palm *Cordyline australis;*
- Royal Fern *Osmunda regalis;*

- House Holly Fern *Cyrtomium falcatum;*
- Lanceolate Spleenwort *Asplenium billotii;*
- Rust back-fern *Asplenium ceterach; and*
- Great Horsetail *Equisetum telmateia.*

Mammals

There are few mammal species on Alderney, although most are common due to a lack of natural predators. Those present include two species of *pipistrelle* bat: the Soprano and Nathusius, Grey Long Eared bats, mice, rabbits, moles the greater white-toothed shrew *Crocidura russula* and hedgehogs, including the rare blonde hedgehog *Erinaceus europaeus*. Alderney is also one of the few places in the British Isles that the Black Rat still survives[10].

In the UK it is illegal to intentionally kill bats, disturb them, or damage their roost sites. Several European wildlife treaties give additional protection to important bat feeding areas. In addition, specific action plans have been prepared for some bats by the UK Biodiversity Group e.g. the Soprano pipistrelle, *Pipistrellus pygmaeus* which is a priority UK BAP species (JNCC, 2010a).

Reptiles and amphibians

The only reptile present on Alderney is the slow worm *Anguis fragilis,* which is included on the UK BAP Priority Species List (JNCC, 2010b). Amphibians on Alderney include Palmate newts *Lissotriton helveticus* and introduced common frogs and toads (ARE, 2011).

Invertebrates

Terrestrial invertebrates on Alderney include butterflies, dragonflies and moths that are unknown in the UK[11]. There are nearly 100 insect species of national importance, many of which have not yet occurred in the UK and moth trap surveys that are conducted on a regular basis. Numerous butterfly species occur on Alderney despite increases in the use of herbicides, pesticides and the clearance of scrubland. Nine species of dragonfly are present, the largest of which is the Emperor.

The stretch of Clonque Bay between Fort Tourgis and the Clonque causeway is the island's only known breeding-site of *Polyphaenis sericata*, the Guernsey Underwing moth, which is found in Guernsey and Jersey but has never been seen in the UK. The larva feeds on honeysuckle, where this grows through clumps of bramble surrounded by bracken, apparently always within 100 metres of the shoreline. Clonque Bay is an ideal site for this extremely rare species (Alderney Wildlife Trust, 2012a).

Other insects of interest include the Great Green Bush-Cricket and eight species of ground-burrowing bumble bee.

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10 http://www.islandlife.org/natural_history_of_alderney.htm
11 http://www.alderneywildlife.org/pages/wildlife.php?pg=insects

Invasive species

Non-native species on Alderney include the Spanish bluebell *Hyacinthoides hispanica* which has become very prolific. Within the Ramsar site, the invasive Hottentot fig *Carpobrotus edulis* is also present (Alderney Wildlife Trust, 2012a). The Hottentot fig originates from South Africa and directly competes with other plants for nutrients, light and water. It is tolerant of high salinities and smothers Alderney's more delicate indigenous flora and supports only a limited assemblage of associated species as it alters soil nitrogen and salt levels. All of Alderney's coastal regions are currently threatened by the spread of the Hottentot fig (ARE, 2011). The white poplar *Populus alba* was introduced to Britain in the fourteenth century and has established itself at Longis Common, although efforts have been made for its removal. (Alderney Wildlife Trust, 2008).

There have been two Management Strategies published for the Ramsar site on Alderney. The designation of the Alderney Ramsar site is in large part for the protection of the numerous bird species present, and these bird populations and their eggs are currently vulnerable to predation by rats. As a result, Alderney Wildlife Trust has suggested the continued monitoring of the island for the presence of invasive rats that are believed to originate from Houment des Pies or Hannaine Bay, where rat populations have been confirmed (Alderney Wildlife Trust, 2012a).

The ARS2 aims to establish an ecological baseline of flora present on Burhou and associated islets in conjunction with another list established for the South Cliffs of Alderney. Monitoring, mapping and removal of invasive species is also identified as necessary, notably for Hottentot fig. Spanish bluebells are considered too widespread to effectively map and monitor their distribution.

Planning

Under the 'Alderney Land Use Plan' (see Section 7.8 for further details) Zone C is put in place to protect the island's natural heritage (see Figure 21). Areas within Zone C will not be developed unless it aims to restore or protect a feature or aspect of that zone. Any developments must be accompanied by an EIA, and special consideration is given to 'Biologically Important Terrestrial Habitats' which are listed under the Land Use Plan as:

- British Red Data Lists (JNCC);
- Biodiversity Action Plans; and
- That which might be designated under any future wildlife legislation during the term of the current Land Use Plan.

5.7.1.1 Future Baseline

There is no known significant land or marine development that is proposed in Alderney and its territorial waters (apart from tidal energy development). It is therefore considered that there is unlikely to be any substantial change to the current baseline for terrestrial ecology in the absence of implementation of the Draft Plan. Potential changes to terrestrial birds as a result of climate change are considered in Section 5.4.1.1. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

5.7.1.2 Limitations and data gaps

Limited data is available describing Alderney's terrestrial ecology. Data on the presence and location of Alderney's flora will need to be obtained from the Alderney Wildlife Trust Records Centre by developers once the study areas of individual developments are known at the project level. Examples of additional specialist surveys which may be required to support the EIA include:

- Phase 1 habitat surveys covering the terrestrial footprint of proposed works;
- Phase 2 survey or key species listing may be adequate depending on area of effect
- Bat potential and bat activity surveys;
- Protected species surveys; and
- Invasive species surveys.

5.7.1.3 Study area

Given the uncertainties in the Draft Plan regarding the exact location of onshore cables or substations, the full extent of the study area will need to take account of the entire island, although it is expected that the export power cable associated with Project 1 (The Race) will run ashore on the south-east coast of Alderney.

5.7.2 Impact Assessment

Impacts to terrestrial ecology may arise at all stages of development. The impacts of the construction phase of development are likely to be of most significance, although effects on terrestrial ecology may persist due to the presence of infrastructure and ongoing maintenance.

The Draft Plan has the potential to affect terrestrial ecology of the study area through a number of impact pathways which are assessed in the following sections:

- Loss/Damage and/or Disturbance (Section 5.7.2.1);
- Visual Disturbance (Section 5.7.2.2);
- Noise/ Vibration Disturbance (Section 5.7.2.3); and
- Toxic Contamination (Spillage) (Section 5.7.2.4).

Due to the presence of a range of species including a range of designated species such as habitats of high ecological importance; priority habitats under Annex I of the EU Habitats Directive and UK BAP priority habitats, importance is considered to be low to high.

5.7.2.1 Loss/ damage and/or disturbance

The construction footprint of cable routeing as well as the construction, operation and decommissioning of and onshore substation and onshore wind turbine have the potential to result in the direct loss or damage and disturbance to terrestrial habitats.

Details of potential footprints of any onshore turbines are unknown, however an onshore substation might be expected to cover an area 200 x 120m based on the London Array offshore windfarm for AC cables. It has also been proposed that cables will be installed in trenches around 0.45m wide and 1m deep, and will be routed so much as possible to run alongside existing roads and cable infrastructure from the landfall site to the location of the substation. It is expected that the export power cable associated with Project 1 (The Race) will run ashore on the south-east coast of Alderney, potentially through Longis Bay Nature Reserve, an area of designated conservation importance (see Section 5.6).

Due to the high number of ecologically significant species present on Alderney, it is considered activities may cause physical loss or removal of important species during the digging of trenches. Species of flora that have slow growth rates such as lichen and moss are considered likely to be particularly sensitive. Disturbance and removal of habitat also has the potential to affect the fauna on Alderney. For example slow worm populations on Alderney are already declining due to a loss of habitat and the development of the Draft Plan may further reduce the area of suitable habitat. The removal of larger structures, if necessary, could remove important roosting sites for bat species. Other species are expected to be less sensitive to the habitat loss associated with infrastructure construction. Therefore sensitivity is considered to range from low to high.

This assessment considers the footprint effect of the Draft Plan to be small and therefore exposure to change is considered to be low resulting in an **insignificant/moderate adverse** impact.

5.7.2.2 Visual disturbance

Visual disturbance to terrestrial ecology has the potential to occur during the construction of cable routeing as well as the survey, construction, operation and decommissioning and of onshore substations and onshore wind turbine. Visual stimuli during these phases of development have the potential to affect terrestrial fauna, particularly birds, such as through the presence of human's and machine and increased traffic movements (Gill *et al*., 1996; Percival, 2000; Langston & Pullan, 2003). Prolonged disturbance may displace mobile fauna into sub-optimal habitat due to a perceived predation risk and reduce their ability to successfully mate, forage or carry out other aspects of their life history, affecting survival and reproductive success. Other, species are expected to be less sensitive to visual disturbance. Therefore sensitivity is considered to range from low to medium.

Terrestrial power cable routeing is expected to follow existing road routes and cable infrastructure, and visual disturbance is expected to increase only marginally above baseline levels. While terrestrial species may be displaced by such activities, effects will be temporary while work is undertaken, after which it is considered visual disturbance will return to baseline levels. Exposure to change is therefore considered low resulting in a **minor adverse/insignificant** impact.

Visual disturbance associated with the operation of an onshore substation and wind turbine will be greater and more prolonged; requiring more traffic, human presence and machinery over a longer time period. Visual disturbance will also remain on the site during the operational phase after construction is completed and exposure to change is therefore considered medium resulting in a **moderate adverse/insignificant** impact.

5.7.2.3 Noise/vibration disturbance

Noise or vibration during the construction of cable routeing as well as surveying, construction, operation and decommissioning phases of the onshore substation and onshore wind turbines may cause disturbance to species as a result of increased traffic levels and other construction activities, such as the use of heavy machinery and construction vehicles. Noise and vibration disturbance during these phases of development may affect species similarly to visual disturbance, causing them to disperse due to a perceived predation risk. Species sensitive to such disturbance, if prolonged, may become permanently displaced to sub-optimal habitats where successful foraging, mating and other aspects of their life history are affected. Any pile-driving of the wind turbine is expected to cause greatest noise disturbance during construction.

Studies generally show that birds are disturbed by a sudden large noise but have the ability to habituate (become accustomed to) to regular noises. Many other terrestrial animals depend on noise as a means of communication. Noise disturbance associated with construction activities may therefore disrupt communication in many species and affect aspects of life history. Bats, in particular, of which there are three important species on Alderney, utilise echolocation to hunt, and construction noise may discourage foraging behaviour if they coincide with optimal hunting times (Barber *et al*., 2009). Amphibian species may also suppress call behaviour due to external noise disturbance (Sun & Narins, 2005). Sensitivity is therefore considered to be low to high. However considering effects are likely to be temporary and relatively localised exposure to change is considered to be low for all phases and developments except the construction associated with the onshore wind turbines where due to the potential for increased effects associated within piling exposure to change is considered to be medium resulting in a **moderate adverse/insignificant** impact and **minor/moderate adverse** for construction of the onshore wind turbine.

5.7.2.4 Toxic contamination (spillage)

There is a risk of contamination and spillages across all phases of development (especially from vehicle movements/accidents). In addition there is the potential for leaching of toxic compounds from sacrificial anodes, antifouling paints or leakage of hydraulic fluids (if present) from wind turbine devices.

Heavy metals are highly toxic in animal tissues at low concentrations, potentially inhibiting DNA synthesis, altering heart function, disrupting sperm production and changing blood composition (ARE, 2011). However in comparison, some species of flora are likely to be highly tolerant. Sensitivity is considered to vary between low to moderate. However, probability of spillages is considered small and therefore exposure to change is low resulting in a **minor adverse/insignificant** impact.

5.7.2.5 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on terrestrial ecology:

- Re-routeing of cables and relocating development to less sensitive areas;
- Habitat creation schemes to compensate for the loss of terrestrial habitat with ecological value; and
- Relocation of sensitive faunal species.

5.7.2.6 Residual impact

The mitigation measures identified in Section 5.7.2.5 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 26 below.

5.7.2.7 Summary

Table 26. Assessment of the potential effects of the Draft Plan on terrestrial ecology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Cable Routeing	Construction	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor /Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
Onshore Substation	Survey	Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
	Construction	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
	Operation	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	M	L-M	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
	Decommissioning	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
Onshore Wind Turbine	Survey	Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
	Construction	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	M	M-H	L-H	Moderate/Minor	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-
	Operation	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	M	L-M	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Loss/damage and/or disturbance	L	L-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Visual disturbance	L	L-M	L-H	Minor/Insignificant	-	-
		Noise/vibration disturbance	L	M-H	L-H	Moderate to Insignificant	Section 5.7.2.5	Minor/Insignificant
		Toxic contamination (spillage)	L	L-M	L-H	Minor/Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

6. Historic Environment

The area of the Bailiwick of Guernsey (which comprises Guernsey, Alderney and Sark) has a rich historic and archaeological record. This includes hundreds of sites and findspots, both on land and in the marine environment, which form part of a finite and non-renewable resource.

This section first reviews the characteristics of the historic environment, before considering the likely impacts of the Draft Plan. It focuses on the marine and terrestrial archaeological properties independently, as the potential impacts vary and need to be accounted for as such.

6.1 Marine Archaeology

6.1.1 Baseline Description

Marine archaeology is assessed in relation to prehistoric archaeology and maritime archaeology. The prehistoric theme comprises of land surfaces with evidence of human activity, including now submerged landscape features, artefacts, sites, and find-spots that date from the earliest occupation of Britain. The maritime archaeological resource consists broadly of vessel remains, wreckage and submerged vessel/cargo debris. The timeline for this covers sites from all periods dating from the Mesolithic to the modern day.

Prehistoric Archaeology: Until at least the late Mesolithic period the Channel Islands would have been connected to continental Europe, until the land-bridge was breached. Prior to this time, people and animals would have lived on and moved across the landscape, potentially leaving evidence of such activity. There is the potential for the preservation of such landscapes with the submergence and burial below the seabed.

From the Guernsey REA (Guernsey Renewable Energy Team, 2011) it is clear that there is very little evidence available for such landscapes. Evidence of late Palaeolithic flint scatters were identified on the seabed between the islands of Crevichon and Jethou, off Guernsey. The scatter was however an isolated occurrence although there is the possibility of similar exposures elsewhere around the Channel Islands (Guernsey Renewable Energy Team, 2011), including Alderney.

In the Alderney study area, no evidence of prehistoric activity has been identified in the marine environment, although such evidence has been identified in coastal areas around the island. On the island, there is evidence of land surfaces which could have been utilised in prehistory. This is in the form of peat deposits, which were identified at several locations across the island, some of which were also identified to contain a number of worked flints considered to date between the Palaeolithic and Neolithic. Further to the peat deposits, finds of flint material considered to date from the Mesolithic to the Bronze Age were identified on raised beaches across the island, with examples at Catt's Bay (MGU4262) and Berry's Quarry (MGU4282). A Mesolithic flint assemblage indicative of a settlement was identified north of Val L'Emauve, while the remains of a submerged forest considered to date to the Bronze Age was identified within Longis Bay.

The presence of all the above finds on the island indicates the potential for prehistoric finds in the marine environment. This includes the peat horizons which occur on land, which may survive and contain evidence of archaeological significance.

Maritime Archaeology: The study area would have seen active maritime traffic since the Mesolithic period, both in relation to national and international maritime trade routes and warfare. Shipwrecks on the seabed can be used to inform the varying properties of vessels and shipping through different periods as well as the changing usage of the marine environment.

The waters around the Bailiwick of Guernsey (which comprises Guernsey, Alderney and Sark) contain several hundred historical wrecks. Within the archaeological search area applied for this assessment, there are 102 identified wrecks and 32 obstructions around Alderney. The positions for about a third of these wrecks are known with reasonable accuracy. The remaining wrecks have either unreliable or doubtful positions, associated with particular rocks or reefs; or have been approximately located from recorded losses in medieval or post-medieval literature or remain unlocated (GREC, 2011).

Of the 102 wrecks and 32 obstructions located within the archaeological search area, 58 wrecks and 27 obstructions are located within the territorial limits for Alderney. From the above, only 22 wrecks and 9 obstructions are located within the within the tidal development blocks Figure 22. It is not known if any designated wrecks are located within the study area. There are however wrecks that can be considered to be scheduled historic wrecks on the basis that they have been lain wrecked for 50 years, under the *Wreck and Salvage (Vessels and Aircraft) (Bailiwick of Guernsey) Law* (1986 amended 1991) (ARE, 2008). Of the dated wrecks, 35 within the archaeological search area, 30 within the territorial limits and 10 within the tidal development blocks can be considered to be scheduled historic wrecks.

One of the best known wrecks located outside the outside of the tidal development blocks but within the territorial water is an Elizabethan wreck (un-named) situated in water approximately 26-30m deep 900m to the north of Alderney lighthouse and 300m west by north of the Ledge reef. The wreck is estimated to have sunk in 1592 and is crucial evidence of maritime activity during the Elizabethan war in Spain. Therefore, although the wreck does not have a designated status, it does have a half mile exclusion zone, for which any unauthorised activity including fishing, diving and anchoring is strictly prohibited. There is another exclusion zone cantered on the Casquets islands west of Alderney, for which there is believed to be up to 300 wrecks within the larger exclusion zone (AEA, 2007).

The wrecks located within the tidal development blocks which will form the basis of the discussion below are set out in Table 27. Three wrecks are located within “The Race” development block, nine within “The Casquets” block and ten wrecks within “The Ortac Channel” block. In terms of the obstructions, five are located within “The Race”, while two are located in each of the other two development blocks Figure 22. Only four of the above wrecks are positioned accurately with their locations precisely known, while the positions of the remainder are approximate, unreliable or unknown. Sixteen of the 22 wrecks located within the blocks have a ‘Live’, status thereby indicating the presence of extant remains on the seabed. The remaining six, have no specific status indicating these are either ‘Dead’ (indicating no remains are present on the seabed) or their location is unknown. Four obstructions are noted as being 'Live', although there is no further information associated with the record.

The known dates for the wrecks present in the tidal development blocks range between 1792 and 1986. However the descriptions of the wrecks and the circumstances which led up to their foundering and sinking is not available. Neither is an assessment on the condition of the wreck and the characteristic of the present remains.

The island was heavily fortified as part of the World War II (WWII), which would suggest the potential for maritime remains from this period. However the available dates of the recorded wrecks do not show any around this period. Instead, there are a number of examples that precede the First World War (WWI).

Geophysical surveys completed within the Alderney Race in 2009 identified the presence of a wreck that had not been previously identified in the SeaZone dataset (Figure 22). This therefore suggests there is the potential for previously unidentified remains within the study area.

The identified obstructions within the study area most likely relate to debris fields and extant remains of wrecks. Although a Live status is given to a number of these, they have not been sighted beyond the initial report. There is also a disused explosives and ammunition dumping ground to the north of Burhou Island. It is thought to contain numerous unexploded munitions from the German occupation of the island during World War II (WWII).

Table 27. Maritime archaeology within the tidal development blocks

Area	Development Block	ID (SeaZone)	Name	Year Sank	Status
The Race	1	637000001095243	*Belle Colombe*	20/04/1986	Live
	1	637000001095130	*Carrouest One (Possibly)*		Live
	1	2084300020325045			
The Casquets	2	637000001095248	*HMS Dragon*	16/03/1712	Live
	2	2084300020324435			
	2	637000001095131			Live
	2	637000001095167	*Rabbi*	21/10/1916	Live
	2	637000001095236	*Stella (Probably)*	30/03/1899	Live
	2	2087300022618682			
	2	2087300022618686			
	2	637000001095169			Live
	2	2084300020323584			
Ortac Channel	3	637000001095163	*Peras*	29/05/1906	Live
	3	637000001095156	*Linn O Dee (Or Linn O Dec)*	18/06/1910	Live
	3	637000001095164	*Cid*	24/06/1891	Live
	3	637000001095161	*Ville De Malaga*	14/08/1897	Live
	3	637000001095145	*Rhenania*	07/04/1912	Live
	3	637000001095153	*Le Nord*	25/09/1904	Live
	3	637000001095154	*Buchanness*	12/04/1924	Live
	3	637000001095134	*Agrion*	09/02/1975	Live
	3	637000001095133	*Point Law*	15/07/1975	Live
	3	2084300020323963			

6.1.1.1 Future baseline

In the absence of any other known significant marine development that is proposed in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the marine archaeological resource. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

6.1.1.2 Limitations and data gaps

Existing data gaps principally relate to the availability of information to best characterise the marine archaeological heritage and especially the maritime archaeology, as the locations of protected wrecks are presently unknown. Examples of the specialist surveys which may be required to support the EIA of individual developments at the project-level include:

- Videoing of the seabed;
- Multi-beam eco sounder survey (surface) ;
- Side-scan sonar survey (surface) ;
- Seismic profiling (sub-surface);
- Sediment coring (boreholes and vibrocores);
- Diver surveys/investigations; or
- Radiocarbon dating.

6.1.1.3 Study area

The full extent of the study area associated with the marine archaeology resource will need to account for the island, its territorial waters and the archaeological search area which is based on a single tidal excursion extent from the tidal development blocks. This is due to the uncertainties regarding the Draft Plan in terms of the exact location of offshore tidal devices and cable routes and the spatial extent of indirect impacts on the resource.

6.1.2 Impact Assessment

The Draft Plan has the potential to affect marine archaeology of the study area through a number of impact pathways which are assessed in the following sections:

- Direct Damage (Section 6.1.2.1);
- Indirect Damage (Section 6.1.2.2); and
- Exclusion Areas (Section 6.1.2.3).

6.1.2.1 Direct damage

Direct damage to the marine archaeological resource is a physical impact on the resource and involves the destruction of the resource within the construction footprint. This could be in terms of the direct removal or disturbance/destruction of the seabed with archaeological material within it or the removal of the overburden of more recent marine sediment thereby destabilising the archaeological resource beneath. This impact has the potential to occur during the survey, construction, maintenance and decommissioning activities of the offshore tidal array, through setting up of the tidal stream turbines, cable routeing and the offshore substations. It also includes secondary effects from activities associated with the development including bed preparation over a wider area, trenching and damage through anchoring by construction, maintenance and decommissioning vessels.

The direct damage associated with developing the tidal stream turbine array, offshore substations and cable routeing are effectively the same and will therefore be assessed in combination. As the activities all involve seabed preparation over the development footprint and may lead to the removal or destruction of archaeological material in the process. The damage associated with the onshore substations and wind turbine is assessed in Terrestrial Archaeology (Section 6.2.2).

Any direct damage at locations with archaeological material would result in a permanent and irreversible change to the archaeological feature, meaning there is a large magnitude of change. This is likely to still occur through all phases of the development from survey through to decommissioning. In terms of the prehistoric archaeology, no remains have been identified in the offshore environment despite their presence on land. The potential for such remains therefore exists, although the probability of occurrence is low given the low occurrence on land. For the maritime heritage, the exact locations of wrecks on the seabed are not always known, although the available data does highlight the propensity for such remains. There is therefore a medium probability of occurrence for maritime wrecks and maritime related debris in the offshore environment. As a result the exposure to change for the marine archaeology is low to medium.

The sensitivity of the archaeological resource is assessed to be high in the worst case that the seabed removal and disturbance occurs directly over the archaeological resource. On this basis the vulnerability of the resource is assessed to be moderate for the prehistoric features and high for maritime archaeology.

The importance of the marine archaeology would vary in relation to the period it dates from, the number of examples available and the condition or state of the resource. There are numerous examples of modern wrecks within the marine environment, but very few examples from earlier periods and of prehistoric land surfaces and finds. As such the importance of the resource would vary accordingly. On this basis the prehistoric finds are considered to be of low to moderate importance, ranging from Neolithic to Mesolithic activity respectively. Maritime archaeology would range from low to high importance on the basis that there are numerous examples of modern wrecks which can be considered to be of low importance. At the same time there are also highly important wrecks such as the protected Elizabethan wreck which sunk in 1592, which currently has an exclusion zone. Furthermore, in the absence of information on statutorily protected wrecks, the presence of such heritage would be of great importance. For the prehistoric resource an overall significance of insignificant to moderate adverse is assessed. For the maritime archaeology the significance is assessed to be minor to major adverse. Such large ranges apply in the assessment due to the uncertainties associated with the locations and extents of the Draft Plan.

6.1.2.2 Indirect damage

Indirect damage results in the change of environment away from the area of development. This can be through changes in the hydrodynamic and sedimentary regime that ultimately leads to the sedimentation or erosion of seabed material some distance away from the site. Examples include the increase of sediment overburden or development of scour around the archaeological material. The potential effects of indirect damage would principally occur during the operational phase. There is however also the potential for occurrence during the construction and decommissioning phases, although such occurrence would be temporary and transient in nature.

The indirect damage associated with tidal stream turbine array, offshore substations and cable routeing are again the same and will therefore be assessed in combination. Indirect damage associated with the onshore substations is not applicable and therefore not assessed here.

Changes to the seabed around the archaeological material could potentially result in a permanent and irreversible change to the archaeological feature, meaning there is a large magnitude of change. This change can however be beneficial to the archaeological resource, in terms of increased sedimentation which would lead to the further burial and protection of the archaeological remains. Conversely increased scour around archaeological remains would lead to similar impacts as defined for direct damage (Section 6.1.2.1).

The magnitude of change assessed for the archaeological resource in relation to this impact is assessed to range from at best negligible for no impact, through to a large magnitude for the worst case. The latter would involve the development of scour much further afield from the development, where the level of impact would vary in relation to size and extent of the tidal stream array.

The probability of occurrence is as assessed for the direct damage in that a low and medium probability of occurrence is likely for prehistoric remains and maritime archaeology respectively. As a result the exposure to change for the marine archaeology is assessed to range from negligible to low for prehistoric remains and negligible to medium for maritime archaeology.

The sensitivity of the archaeological resource is again assessed to be high in the worst case should the impact extend further afield beyond the development. On this basis the vulnerability of the resource is assessed to range between none to moderate for prehistoric features and non to high for maritime archaeology.

The importance of the marine archaeology resource would vary as described for the direct damage impact (Section 6.1.2.1). Therefore the overall significance of this impact is assessed to range from **insignificant to moderate/minor adverse** for the prehistoric resource and **insignificant to major adverse** for the maritime archaeology.

Due to the uncertainties associated with the spatial location and scale of the marine elements of the Draft Plan, there is the potential for a wider zone of magnitude and effect in relation to the worst case development scenario. As such the range of potential significance that has been assessed is large for any potential indirect impacts to the prehistoric resource and maritime archaeology. In addition, as highlighted above there are both beneficial and negative effects of this impact. The beneficial effect is the burial and further protection of the resource, whereas the negative effect would be similar to that generated by direct impact, ultimately leading to the loss of the archaeological resource. It is however noteworthy that negative effect can easily be mitigated in relation to the array layout and cable routeing characteristics. In addition, indirect impacts are most likely to occur during the operational phase of the development. Although such impacts are also likely to occur during the construction and decommissioning phases, these would only be temporary and transient in nature, in relation the time period involved.

6.1.2.3 Exclusion areas

During the construction, operation and decommissioning activities of the offshore tidal energy array, it is possible that exclusion zones will be put in place around the development.

The implementation of exclusion zones during the construction and decommissioning phases would most likely only be temporary. The implementation of exclusion zones during the operational phase would however limit future archaeological investigations, particularly during the operational life of the development.

It is however most likely that a detailed assessment of the archaeological characteristics in proximity to a selected area for development would be completed, thereby limiting the effect of the exclusion zone. On this basis the overall significance of this impact is assessed to be negligible despite the same importance assessed for both the direct and indirect impacts.

6.1.2.4 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on marine archaeology heritage:

- Careful consideration of the extent, number and layout of tidal devices and offshore substations to minimise both the direct and indirect impacts on receptors identified to be sensitive to the development;
- On selection of the development area, undertaking a geophysical survey of the seabed surface and subsurface with associated archaeological interpretation to identify potential maritime archaeology;
- On selection of the development area, undertaking a geotechnical survey with associated archaeological interpretation to investigate the potential for prehistoric land surfaces and characteristics;
- Locating tidal devices and offshore substations to minimise direct damage to identified archaeological sites;
- Cable export design to minimise direct damage to identified archaeological sites; and
- Undertaking more detailed assessments to investigate the extents of indirect impacts.

6.1.2.5 Residual impact

The mitigation measures identified in Section 6.1.2.4 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on the marine archaeology, as the extent of mitigation achievable will be heavily dependent on many project specific factors. The estimated significance associated with the potential residual impacts are summarised in Table 28.

6.1.2.6 Summary

Table 28. Assessment of the potential effects of the Draft Plan on marine archaeology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Construction	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Operation	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Exclusion areas	N	L	L - H	Insignificant	-	-
	Decommissioning	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
Cable Routeing	Survey	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Construction	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Operation	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Exclusion areas	N	L	L - H	Insignificant	-	-
	Decommissioning	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
Offshore Substations	Survey	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Construction	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
	Operation	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Exclusion areas	N	L	L - H	Insignificant	-	-
	Decommissioning	Direct damage	L - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant
		Indirect damage	N - M	N - H	L - H	Insignificant to Major	Section 6.1.24	Minor/insignificant

N Negligible
L Low
M Medium/moderate
H High

6.2 Terrestrial Archaeology

The Alderney Sites and Monuments Record identify 462 listed sites, which comprise monuments (including structures and natural features), archaeological finds (pottery, furniture, weapons, tools) and fortifications (Napoleonic, Victorian, WWII). The maritime related wreck sites (of which there are 80 records) have been included in the discussion of the marine archaeological resource in Section 6.1.

6.2.1 Baseline Description

Statutory and Local Heritage Designations: There are no known Scheduled Monuments (SM) or Listed Buildings (LB) on Alderney and its surrounding islands. There are also no Registered Historic Parks and Gardens (RP&G) or Registered Battlefields within the same area.

Due to the location of the island in the Channel and use during WWII, there are number of fortifications around the coast of the island, which have a local heritage designation. These form part of a 'Protected Area Zone' defined by The Alderney Land Use Plan (States of Alderney, 2011a), and designed to preserve and protect the Island's natural and archaeological heritage. The area which covers the majority of the Alderney coastline (Figure 21) is said to cover important archaeological areas and sites, some of which include:

- Longis Common Conservation Area. This area contains the greatest concentration of archaeological finds, including an iron-age pottery sited in the Recreational Zone;
- Coastguards Cottage & Red Tiles. Beneath these properties and gardens is an iron-age collective burial site;
- Neolithic/ early Bronze Age grave south of Fort Tourgis;
- Bronze Age enclosure north of Mannez House. This wall was constructed with sandstone blocks stood on end with a turf wall infill;
- The Nunnery. Roman walls within the structure have courses of Roman tile, and medieval walls are also present. About 50 metres to the northeast, there is evidence of a Roman wall running perpendicular to the anti-tank wall;
- Le Petit Blaye. Terraces and walls of archaeological interest are present, also prehistoric structures;
- Mesolithic settlement north of Val L'Emauve; and
- A number of fortifications including Forts Albert, Houmet Herbe, Tourgis, Doyle, Clonque, Grosnez, Cornlets, Quesnard, Hommeaux Florains, Platte Saline, Ile de Raz and Essex. Other fortifications also include The Arsenal, Chateau a L'Etoc and the Mount Hale Battery.

Terrestrial Sites and Find Spots: This section provides an overview of the known and potential terrestrial archaeological resource for Alderney and its surrounding islands. This is based on information available from the Alderney Sites and Monuments Record (SMR) for the island. Although information from the SMR have been grouped into eight "Monument Types" (monument, findspot, building. Land, WWII, hedge, place and destroyed), the properties of the terrestrial archaeology are assessed chronologically. This is because sites and finds relating to each "Monument Types" can span a range of dates and encompass both archaeological and natural material. To therefore carry out an assessment of the impact to the resource, the period from which it is derived, as well as the number of similar examples, all influence the significance of the resource. The associated difficulty is that the information relating to the archaeological record is not always dated, in these instances therefore a best estimate of the period which the records relate to will be applied.

Palaeolithic (circa 900,000 BP - 8,500 BC): There is no evidence for Palaeolithic activity on the island and its environs.

Mesolithic (circa 8,500 - 4,000BC): There are seven records that relate to Mesolithic material (Figure 23). These have principally been dated based on conjectural evidence to be between the Early Mesolithic and Late Bronze Age, roughly spanning an 8,000 year period. Four of the records relate to find spots of worked flints, including flakes, chippings and tools, some of which were located in the context of peat deposits. The density of the identified flint material varied across the different sites around the island. Two of the records were considered to relate to an occupation site (MGU3533 & MGU4326), located north of Val L'Emauve between the runway and road, while one record related to a Mesolithic grave structure.

Site MGU3533 was a lithic working site with a high concentration of flint finds. In proximity to this was site MGU4326, which was considered to be a potential Mesolithic settlement, as additional flints were discovered. At the same time, a peat core from the site indicated there would have been shelter and tree cover during the Mesolithic period, as well as a water supply. The Mesolithic occupation site in addition to the lithic scatter site provides the earliest evidence for settlement in the landscape and is therefore of importance.

Neolithic & Bronze Age (4,000 - 700 BC): A large number of records are associated with this period extending from the Early Neolithic up to the Late Bronze Age (Figure 23). These records which occur all over the island, principally relate to prehistoric monuments such as barrows, chambered tombs, human graves and standing stones, in addition to find spots of human remains, pottery, flint tools and flakes and shell. From the Bronze Age up to the Iron Age and Medieval period, there is further evidence of the landscape being divided up and utilised through the presence of field systems and boundary markers. Examples of which occur at Cotil du Val (MGU4214) and Allee es Fees (MGU4228) respectively.

Evidence of the Neolithic prehistoric monuments in the present landscape are through mounds, standing stones or burial cists. In a number of examples the megalithic structure or barrow form once associated with these prehistoric monuments are long gone with only evidence of burial cists and smaller standing stones. For example a megalithic monument was historically recorded near 'Peter Fourneau's Cottage' at Longis Bay, which was made up of a series of stone cists, with evidence of polished axes, pots, human bones, pottery and shell (MGU3540), the monument has since been destroyed, although the cottage is identifiable. Further examples include (MGU3502 and MGU3506), which were made up of a concentrations of large stones incorporated into an earth bank, which were interpreted to potential be the remains of a prehistoric megalithic setting.

There are also a larger number of Bronze Age records. Aside from the landscape divisions, the available records principally relate to find spots. Most notable is the Bronze Age hoard found on Longis Common in 1832 (MGU5665), which contained about 200 objects that included axes, swords, blades, spearhead, bracelets, knives, rings, pins and slag material. Also identified on the island and dated to the Bronze Age are numerous cemeteries consisting of stone cists which contain human remains with and without associated grave goods (examples include MGU5670 - MGU5673).

It is not apparent if any of the identified Neolithic monuments directly relate to a particular settlement or occupation of the island during this period. However given that Alderney was already an island by the Neolithic and the island had been settled in the Mesolithic, the presence of the prehistoric monuments does strongly suggest that parts of the island were used for settlement. On this basis prehistoric occupation of Alderney is likely to have continued from the Neolithic to the Bronze Age. This is evidenced by the development of field systems into the Bronze Age and also the occurrence of multiple cemeteries across the island.

Iron Age (700 BC - AD 43): Evidence of Iron Age activity on the island is principally indicative of occupation or settlement. This includes evidence of field systems (MGU3545), settlement and industry (MGU3515, MG5685) earthworks as part of a promontory fort for defence (MGU4345 & MGU4369) and cemeteries (MG4233, MGU5673, MGU5686). These sites produce a range of artefacts including worked flint material, pottery, coins, weapons, jewellery and human animal remains. Excavated material at sites considered to relate to settlements (MGU5673) and industry (MGU3515) were found in relation to hearths, where production of pottery was considered to occur in the latter.

The Longis Bay area in particular is identified to provide considerable evidence for Iron Age industry (MGU3515). During excavations, an oval enclosure was identified surrounded by a low drystone wall. Within the enclosure was evidence of a hearth that suggested a bonfire firing site in relation to the manufacturing of Iron Age pottery. Associated finds discovered in relation to the site included pottery vessels, spindle-whorls, loom weights, a bronze razor. Human and animal bones from several individuals with calcined or charred bones also suggested the site may have had other functions. Further Iron Age rotary querns (MGU4340) found on Longis Beach which were made of local stone from Couriaux Quarry (MGU4367) also indicate another possible industry during this period.

Romano-British Period (AD 43 - 410): There are a large number of records which relate to the Romano-British period on the island. Evidence of activity from this period is from fortifications (MGU3539), structures (MGU3510, 3528) and cemeteries (MGU5686, 5687). During the Late Iron Age and Roman periods Alderney appears to have been part of a trading network with Britain and northern Gaul. Due to the numerous finds of Roman material including a scatter of building tile, pottery and glass identified on the beach at Longis Bay, it was likely that the bay was used as the harbour during this period (ARE, 2008).

Other significant Roman sites include The Nunnery at Longis Bay. Although the present fort is from the medieval period, it is also considered to have been constructed on the footprint of an earlier Roman shore fort (MGU3539). Evidence within the fort includes Roman walls with courses of Roman tile, as well as medieval constructed walls.

There are also a number of records that highlight the presence of structures and buildings within the Roman period. Although the functions of the buildings are not necessarily clear, it is likely that some of these would have formed Roman habitation farmsteads. As findspots of burials, brick and tile, pottery, coins, and domestic items including glass and bronze vessels have all been recovered on Alderney and its surrounding islands.

Saxon to Post-Medieval (AD 410 - 1899): Medieval settlement on Alderney was focussed at St Anne, while Longis Bay appears to have been the main harbour in the medieval to early post-medieval period. It remained so up until the construction of Braye Harbour in the mid-18th Century (ARE, 2008).

During the late medieval to post-medieval periods the strategic importance of Alderney and periodic threats of invasion resulted in the construction of fortifications and other defensive structures. As a result, a number of fortifications were built around the island during this period, including new batteries built in the mid-18th Century and further fortifications constructed in the early to mid-19th Century. Examples include Essex Hill (MGU4279), which was fortified in the late 16th Century to protect the harbour at Longis Bay. A chain of 18 forts and batteries were constructed around Alderney between 1850 and 1859 in order to defend the island and Braye Harbour during the French Revolutionary and Napoleonic Wars (ARE, 2008). The earliest was Fort Grosnez (MGU4269) built in 1853 to protect the inner harbour at Braye during the construction of Alderney Breakwater. Fort Tourgis (MGU4266) on the northwest coast is the second largest fort on the island and was completed in 1855. Fortifications were also built on nearby islands to afford defence of Alderney, such as Fort Hommeaux Florains (MGU4275) off the northeast coast and Fort Ile de Raz (MGU4275) off the southeast coast.

Other evidence of Medieval and Post-Medieval activity on the island is from buildings and structures many of which have been demolished or are in a ruinous state. A number of hedges (MGU3538) were also constructed during this period as a basis for land divisions.

Modern Period (1899 - present): Modern activity on the island primarily relates to evidence from World War II in relation to the German occupation of the island between 1940 and 1945. A significant number of records relate to this period of activity on the island. The extent of military activity is demonstrated by the presence of WWII coastal military structures and anti-invasion defences. In 1942 and 1943 further forts were built and earlier forts and batteries were reconstructed with additional defence features as part of the construction of Hitler's *Atlantikwall* (Atlantic Wall) (ARE, 2008). Other military structures constructed along the coast during the occupation include air raid shelters, the establishment of several bunkers and pillboxes with associated gun emplacements some of which served as anti-aircraft guns. In the intertidal and shallow coastal areas anti-tank and underwater obstacles were also built.

Many of the bunkers, pillboxes, gun emplacements and shallow water defences were removed after the war, leaving evidence of extant structures.

6.2.1.1 Future baseline

In the absence of any other known significant land or marine development that is proposed in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the terrestrial archaeological resource of the area. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

6.2.1.2 Limitations and data gaps

Data from the SMR is incomplete as there is an ongoing process of updating the record. In addition, there is currently no information on the presence of protected heritage on the island which includes Scheduled Monuments and Listed Buildings.

6.2.1.3 Study area

Given the uncertainties regarding the Draft Plan, including the location of onshore cables or wind turbine, the full extent of the study area will need to encompass the entire island.

6.2.2 Impact Assessment

The Draft Plan has the potential to affect terrestrial archaeology of the study area through a number of impact pathways which are assessed in the following sections:

- Direct Damage (Section 6.2.2.1);
- Visual Impact (Section 6.2.2.2); and
- Exclusion Areas (Section 6.2.2.3).

The baseline characteristics of the terrestrial archaeology have been assessed chronologically, which forms the basis for the impact assessment. Within each period however, there are a range of archaeological features. The features vary from out of context finds or extant evidence of the archaeology through to large structures and monuments that provide an indication of the structure of society and people groups during that period.

As such, the archaeological characteristics within each period vary in sensitivity and importance, based on the available information in the SMR records. The sensitivity of the terrestrial archaeological resource would vary in relation to the type and extent of the potential disturbance. Also the importance of the resource would vary in relation to the period it dates from, the number of examples available and the condition or state of the resource. The variance in the archaeological properties combined with the uncertainties associated with the locations and extents of the Draft Plan, means that the assessment of impact naturally requires a range that allows for the varied scope of the development. This would also account for the presence of as of yet unknown Scheduled Monuments or sites with nation or international designations and protected status.

Across all periods, the sensitivity and importance of the archaeological resource ranges from none through to high. No sensitivity can be expected for features and sites which are based on extant evidence, with no physical remains. These sites can also be considered to be of no importance. At the other end of the scale and allowing for the worst case, were the archaeological feature be located within the construction footprint and the site have a designated status, both the sensitivity and importance of the feature would be high resulting in an insignificant to major adverse impact.

The sensitivity and importance characteristics of the terrestrial archaeological resource described above apply to all development activities and the construction and operations phases.

6.2.2.1 Direct damage

Direct damage to the terrestrial archaeology is a physical impact that involves the destruction of the resource within the construction footprint. This could be in terms of the removal, disturbance or destruction of the archaeological material in its natural or original setting. The direct damage has the potential to occur during the construction and operational phases of the development activities. This can occur through the bed preparation, foundation construction and cable trenching for the onshore substation and onshore wind turbine.

The direct damage that could occur to the terrestrial archaeology in relation to the construction and operation of the onshore substation and wind turbine, are effectively the same and will therefore be assessed accordingly. Due to the finite nature of the archaeological resource any direct damage would change would result in a permanent and irreversible change to the archaeological feature. This means in the worst case there is the potential for a large magnitude of change to the terrestrial archaeology during all phases of the development. At the best case were the development to be sited away from the archaeology the magnitude of change would be negligible.

A large number of archaeological features have been identified and recorded in the SMR database from all the evaluated periods. In a number of instances the SMR record is based on documentary or extant evidence, meaning no physical evidence is present. At the same time however there are also a large number of records that have a physical occurrence. On this basis the probability of occurrence is determined to range from low to high for evidence from the different periods. Due to the potential range in the magnitude of change in relation to the locations of the development and archaeological resource, the exposure to change is assessed to range from negligible to high.

The sensitivity as stated in Section 6.2.2, ranges from none to high, this range combined with the assessed exposure, a none to high vulnerability is therefore assessed. The assessment of the vulnerability in combination with the importance of the characteristics provides an overall significance assessment of insignificant to major adverse. Such a large range is assessed principally due to the uncertainties in the Draft Plan.

6.2.2.2 Visual impacts

This impact involves impacts to the setting of archaeological resources. It would principally affect structures and the built heritage, but is also relevant to isolated finds spots or buried archaeological material. The impact may be temporary associated with the construction of the development; it may also be permanent in relation to the setting of the new development itself.

As highlighted previously a number of the SMR records relate to extant evidence which would not be affected by this impact. There are also a number of finds spots which relate to isolated occurrences of small archaeological artefacts. These would not necessarily be affected by impacts to the visual setting. This impact is therefore more likely to affect the structural and built archaeology, as well as landscape features such as field systems and earthworks. The features that would be impacted occur across all periods, although there are fewer representative examples from earlier periods (i.e. from the Palaeolithic up to the Roman period). Therefore features from these periods have a probability of occurrence of low to medium. The magnitude to change would then be small to medium in relation to the size and scale of the archaeology. A larger number of examples of built heritage and structures occur from the Medieval up to modern times. As a result, the probability of occurrence for features from these periods would range from medium to high, with a subsequent magnitude of change of small to large in relation to the location of the development. Therefore the exposure to change ranges from negligible to medium/low for early periods and low/negligible to high for later periods.

The sensitivity ranges from none to high across all periods should the development be located in proximity to the archaeological resource (Section 6.2.2). The sensitivity range combined with the assessed exposure, means a none to high vulnerability is assessed. The assessment of the vulnerability in combination with the importance of the characteristics provides an overall significance assessment of **insignificant to major adverse**. The large range is again assessed principally due to the uncertainties in the Draft Plan.

6.2.2.3 Exclusion areas

During the development activities for the onshore substation and onshore wind turbine, it is possible that exclusion zones will be put in place around the development.

The implementation of exclusion zones during the construction phases would most likely only be temporary. The implementation of exclusion zones during the operational life of the development would limit future archaeological use of the site. This includes use of the site for archaeological investigations and heritage tourism.

It is most likely that a detailed assessment of the archaeological characteristics in proximity to a selected area for development would be completed, thereby limiting the effect of the exclusion zone. On this basis the overall significance of this impact is assessed to be **negligible** despite the same importance assessed for both the direct and indirect impacts.

6.2.2.4 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on terrestrial archaeology heritage:

- Careful consideration of the location of the onshore development to minimise both the direct and visual impacts on the receptors identified to be sensitive to the development;
- Siting of the onshore development to minimise effects on the built heritage and character, as well as on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible;
- On site selection, complete a more detailed archaeological assessment identifying the archaeological sites in proximity to the development area; and
- Locate the onshore substation and wind turbine to minimise direct damage to identified archaeological sites.

6.2.2.5 Residual impact

The mitigation measures identified in Section 6.2.2.4 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on the terrestrial archaeology, as the extent of mitigation achievable will be heavily dependent on many project specific factors. The estimated significance associated with the potential residual impacts are summarised in Table 29.

6.2.2.6 Summary

Table 29. Assessment of the potential effects of the Draft Plan on terrestrial archaeology

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Onshore Substation	Construction	Direct damage	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Visual impacts	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
	Operation	Direct damage	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Visual impacts	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Exclusion Areas	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
Onshore Wind Turbine	Construction	Direct damage	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Visual impacts	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
	Operation	Direct damage	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Visual impacts	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant
		Exclusion Areas	N - H	N - H	N - H	Insignificant to Major	Section 6.2.4	Minor/insignificant

N Negligible
L Low
M Medium/moderate
H High

7. Human Environment

This section provides an assessment of the potential effects of the Draft Plan on the human environment including cables, pipelines and grid connectivity, commercial and recreational fisheries, commercial and recreational shipping, infrastructure, recreation and tourism, noise, air quality, landscape and seascape and finally traffic and transport. Each section contains a baseline description of distribution and offers an assessment of the potential effects that could arise from the various elements and phases of the Draft Plan.

7.1 Cables, Pipelines and Grid Connectivity

7.1.1 Baseline Description

Alderney is not connected to either the Channel Island Electricity Grid (CIEG) or France via subsea power interconnectors (Redman *et al*., 2011). Electricity is provided by the power company Alderney Electricity Ltd (AEL); the power station is located at Braye Harbour and burns diesel to power its generators. The diesel is delivered by ship into Braye Harbour and is then pumped via a pipeline to the nearby power station (Caldwell, 2011). Electricity is distributed across the island via an 11kV grid. Most transmission cables are buried with the exception of a short section in the north-east of the Island (Figure 24). Beyond the 11kV system, electricity is transmitted mainly by overhead lines (Caldwell, 2011).

Subsea telecommunication and power cables in the vicinity of Alderney are shown in Figure 25. The nearest active telecommunications cables are 39km to the north (Sea-Me We 3 Seg. 10.2) and 42km to the south west (Liberty) of Alderney whilst the nearest subsea power cable (Ingrid, between Guernsey and Jersey) is 53km to the south of Alderney. Telecommunication services on Alderney are operated commercially by Cable and Wireless and Wave Telecom (part of Jersey Telecom) (Island Analysis, undated).

There are no terrestrial or subsea oil and gas pipelines on and around Alderney. Diesel fuel that currently fuels the island's power station is brought to the island by tanker five times a year (Wilson, 2005).

7.1.1.1 Future baseline

ARE has partnered with Transmission Investment LLP to develop its existing connection agreements into a single interconnector. This interconnector will be a single multi-directional cable to allow electricity trading and export between France and Britain via Alderney (FAB Link project) (see Section 1.2.3).

Given the uncertainties relating to the cable connection to Britain, the Draft Plan comprises only the potential export cable that interconnects the south-east of Alderney and the Cotentin Peninsula in France, including any associated infrastructure on Alderney (Figure 1). The developer will need to confirm the status of FAB Link and whether there are any other development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.1.1.2 Limitations and data gaps

There is currently a lack of information on the proposed landfall sites of the tidal device export cables in Alderney and France. There is also no available information on the likely inter-array cable configuration and the existing terrestrial cable infrastructure associated with the Draft Plan.

7.1.1.3 Study area

Given that there is no offshore marine cable or pipeline infrastructure that may be affected by the development of the Draft Plan, the assessment on impacts will need to focus on Alderney only.

7.1.2 Impact Assessment

There is a risk that the development, operation and maintenance of tidal energy devices and associated cables could cause interference or damage to existing cable or pipeline infrastructure. Further risks of interaction with existing infrastructure exist when cables make landfall and are linked to terrestrial infrastructure.

The Draft Plan has the potential to affect cables, pipelines and grid connectivity in the study area through a number of impact pathways which are assessed in the following section:

- Impact to Existing Grid (Section 7.1.2.1).

The importance of cable, pipelines and grid connectivity is considered low to moderate due to the dependence of power supply to the small population of Alderney.

7.1.2.1 Impact to existing grid

There is a risk that the construction of onshore wind turbine and onshore substation installation, may interfere with or damage the cable pipeline and grid connectivity on Alderney.

Alderney has an onshore network of buried electricity cables (some sections above ground) (Figure 24) that may intersect with the offshore power cable once it makes landfall or with power cables associated with onshore wind turbine. Crossover of infrastructure is also a possibility. In addition, the existing terrestrial grid will need to be assessed for its suitability for the level of power to be generated, which may significantly exceed capacity of the current network. Suitability depends upon the amplitude of injection. The maximum injection limit would be the sum of the maximum transfer capability of the submarine cable and the minimum island demand (ARE, 2011). There is a risk that the existing terrestrial cable grid could be overloaded, although the construction of the proposed FAB Link grid would reduce this risk.

The Mannez Quarry substation (and any other onshore substation required as part of the full build out of the Draft Plan, Section 2.2.2) and any onshore wind turbine would require an extension of the existing grid which would need to be negotiated with the current operator, AEL

(ARE, 2011). Extensions to the terrestrial grid are recommended to follow existing road and cable networks to minimise impacts.

Sensitivity is considered moderate based on the standard protection given to cables and pipelines. Prior to any mitigation, exposure to change is considered low to moderate resulting in an insignificant to moderate adverse impact.

7.1.2.2 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan to the existing grid:

- Follow best practice measures, including the mapping of known infrastructure and the use of cable awareness technology (CAT) scans, and
- Consultation with AEL in order to identify existing infrastructure at the project planning and design phase and requirements for replacing where necessary.

7.1.2.3 Residual impact

The mitigation measures identified in Section 7.1.2.2 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 30 below.

7.1.2.4 Summary

Table 30. Assessment of the potential effects of the Draft Plan on cables, pipelines and grid connectivity

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Onshore Substation	Construction	Impact to existing grid	L-M	M	L-M	Insignificant to Moderate	Section 7.1.2.2	Insignificant/Minor
Onshore Wind Turbine	Construction	Impact to existing grid	L-M	M	L-M	Insignificant to Moderate	Section 7.1.2.2	Insignificant/Minor
N Negligible L Low M Medium/moderate H High								

7.2 Commercial and Recreational Fishing

7.2.1 Baseline Description

Alderney is part of the Bailiwick of Guernsey (States of Alderney, 2011b) and the fishing fleet based in Alderney falls under the jurisdiction of the States of Guernsey Commerce and Employment Department Sea Fisheries Section. Administration of vessels, licensing and registration occurs through the Sea Fisheries Section and management of fisheries is applied though licence conditions. The States of Alderney can also legislate for fisheries management within the 3nm limit and, hence, there is a dual system of fisheries control within Alderney Waters (David Wilkinson, Sea Fisheries Officer, States of Guernsey Commerce and Employment Dept. Sea Fisheries Section pers. com., February 2013).

In August 2012, there were 158 under 10m fishing vessels and eight over 10m vessels in the Bailiwick of Guernsey licensed fleet (Guernsey Sea Fisheries Section, 2011). Of these, currently twelve under 10m licensed vessels are based in Alderney, although these may not all necessarily be active (David Wilkinson, pers. com. February 2013). Alderney's commercial fisherman purchase fishing licences which give unrestricted access to Bailiwick waters under the terms of that licence (Raymond Gaudion, Chairman of Alderney Licensed Fishing Vessel Owners Organisation pers. com., May 2013). In general, the Alderney based vessels fish within 6nm. One or two vessels fish further out into the Channel (i.e. beyond 12nm), although rarely in Guernsey or Sark Waters. Many of the larger Guernsey vessels fish in Alderney waters, particularly on the large sand banks to the south and west of Alderney, which are prolific areas for most types of flatfish (ACRE, 2012). The Alderney based fleet land catches into Braye Harbour on Alderney, Cherbourg in France and Brixham in the UK. Some landings into Alderney are then shipped to France, Guernsey and the UK including Billingsgate market (David Wilkinson, pers. com. February 2013).

Key species targeted within the Bailiwick of Guernsey include seabass, edible crab, black bream, conger, lobster, ray, pollack, spider crab, mackerel, red mullet, turbot, common sole, brill, pouting, cod, ling, plaice and various species of shark (e.g. dogfish, smoothound). Atlantic Crayfish are also noted to be caught in Alderney Territorial waters (Raymond Gaudion, pers. com. May 2013). The abundance of stocks of target species on local fishing grounds fluctuate and the flexibility to be able to target available fisheries is important to the success of the Bailiwick of Guernsey fleet (Guernsey Sea Fisheries Section, 2011).

Fishing methods used by the Bailiwick of Guernsey fleet, include (source: Guernsey Sea Fisheries Section, 2011):

- Potting: using inkwell, creel and parlour pots - for crab and lobster;
- Netting: gill, trammel and tangle nets - set for ray, bass, sole and red mullet depending on season. Bycatches of pout, dogfish and wrasse are landed for use as bait by crab fishermen;
- Trawling: pelagic, pair pelagic (not permitted within 6nm in the Bailiwick of Guernsey) and demersal (otter and beam trawl);
- Angling: handlines, jigging, rod and line, trolling;

- Longlining: inshore targeting bass, ray and pollack and offshore operations targeting dogfish, smoothound and conger; and
- Scallop dredging.

Most of these methods are employed by the Alderney based fleet except scallop dredging.

Potting occurs within the majority of Alderney's 3nm limit, with the exception of areas to the south west of Alderney, where relatively discrete areas spanning the 3nm boundary are fished. This activity is undertaken between March/April and October. Nets are used around the whole of Alderney's coastline and in an area to the west of the island within the 3nm limit; some of these areas are fished all year round. Line fishing occurs in various locations around the island within and just beyond the 3nm limit. Rod and line fishing for bass takes place between May and November, while long lining occurs between March and October Trawling occurs predominantly to the south and south west of the island within and just beyond the 3nm boundary but also occurs to the north of the island. Trawling predominantly takes place between July and April (ACRE supplied data, February 2013).

Alderney is located within ICES rectangle 28E7 which extends 50-60 miles west of Alderney. Consideration of the total volume and value of landings from this ICES rectangle would incorporate landings data from larger vessels than are found in the Alderney fleet and many foreign vessels. As such, the baseline description of the volume and value of landings below describes data for the registered fishing vessels of the Bailiwick of Guernsey and, where available, specifically the Alderney based commercial fishing fleet.

The volume and value of landings for commercial species landed by the Bailiwick of Guernsey fleet between 2005 and 2011 are shown in Table 31.

Table 31. Sea Fisheries statistics for the Bailiwick of Guernsey fleet between 2005-2011

	2005	2006	2007	2008	2009	2010	2011
No. registered <10m vessels	No data	164	175	175	175	171	160
No. registered >10m vessels	No data	13*	13*	12*	11*	8	8
Total volume landings (kg)	1819	1728	1851	1636	1403	1494	1426
Total value landings (£000's)	4033	3825	3877	3534	4014	4395	4214

* Includes one non-active registered vessel

(Source: States of Guernsey Sea Fisheries Section, 2011)

The total volume of fish and shellfish landed by Bailiwick of Guernsey registered fishing vessels in 2011 was 1,426 tonnes, with a market value of £4.2million (States of Guernsey Sea Fisheries Section, 2011). Although the total volume landed in 2011 is lower compared to the volume landed in 2005, the total value is slightly higher. The States of Guernsey 2011 Sea Fisheries Statistics Report stated that while prices for shellfish have remained relatively stable over the timescale shown, the price of wetfish has tended to increase since 2004, reflecting increased exports to auction markets in the UK and France.

Fisheries statistics relating specifically to the Alderney based fleet (a subset of the Bailiwick of Guernsey registered fleet) were only available between 2004 and 2009. The number of active fishing vessels, days at sea (fishing effort) and the total volume and value of the principle commercial species[12] landed by the Alderney fleet (i.e. the volume landed onto Alderney based boats and its estimated market value) between these dates are shown in Table 32. The total value of landings for each of the principal commercial species, and the mean annual value of the landings between 2004-2009, are shown in Table 33.

Table 32. Sea Fisheries statistics for the Alderney based fleet between 2004-2009

	2004	2005	2006	2007	2008	2009
Active boats	12	11	12	11	9	9
Sea days	1525	1176	1043	1146	No data provided	615
Total volume landed (kg)	288,799	210,273	104,332	153,849	98,853	99,307
Total value landed (£)	567,073	421,923	274,464	368,039	237,759	300,823

(Source: ACRE supplied data, February 2013)

Table 33. Value of fish species landed by the Alderney based fleet for the period 2004-2009

Annual Landed Value of Alderney Fleet							
Species	2004	2005	2006	2007	2008	2009	Mean Annual Value (2004-2009)
Lobster	186,960	116,330	97,770	115,440	61,780	67,370	107,608
Edible crab	260,923	129,679	60,018	78,930	24,582	21,059	95,865
Seabass	26,411	27,203	47,322	45,315	54,258	139,684	56,699
Tope	26,908	56,948	11,580	41,770	28,120	10,768	29,349
Conger	3,942	24,571	13,593	13,618	20,202	11,282	14,534
Ray	12,458	11,950	9,898	20,498	8,693	8,668	12,027
Smoothound	130	10,406	304	17,080	26,280	13,158	11,226
Red mullet	6,700	8,230	12,680	7,240	525	2,600	6,329
Turbot	13,352	11,520	1,560	2,128	552	1,576	5,115
Common Sole	5,628	5,978	7,357	5,012	784	1,008	4,295
Pollack	4,137	5,138	4,286	2,300	4,004	4,647	4,085
Black bream	1,196	905	1,448	4,883	1,462	12,660	3,759
Spider	8,235	4,853	1,813	2,905	2,019	2,520	3,724
Dogfish	4,039	5,270	1,420	2,361	2,723	2,434	3,041
Brill	5,130	1,794	2,430	6,450	582	738	2,854
Plaice	309	438	300	933	12	9	334
Cod	88	58	362	836	274	128	291
Ling	155	362	200	113	321	62	202
Porbeagle	150	210	60	20	305	100	141
Mackerel	160	16	66	91	143	269	124
Pouting	62	66	0	119	141	86	79

(Source: ACRE supplied data, February 2013)

12 Principal commercial species comprise: black bream, brill, cod, common sole, conger, dogfish, edible crab, ling, lobster, mackerel, plaice, pollack, porbeagle, pouting, ray, red mullet, seabass, smoothhound, spider crab, tope and turbot (ACRE supplied data, February 2013).

Overall, the total volume and value of landings by the Alderney based fleet has decreased between 2004 and 2009. The data shows that lobster and edible crab provided the highest annual landing values for all years except 2009, and have the highest mean annual value. In 2009, landings from potting (for lobster, edible crab and spider crab) comprised 27% of the total volume of landings (26,851kg) representing 30% of the total value (values not shown in Tables). The value of landings from other gear types was not available for analysis. In 2009, the top five species with respect to volumes landed were seabass (25,397kg), edible crab (17,549kg), black bream (11,509kg), conger (10,256kg) and lobster (6,737kg). The five highest value species in the same year were seabass (£139,684), lobster (£67,370), edible crab (£21,059), smoothound (£13,158) and black bream (£12,660) (Source: ACRE supplied data, February 2013; volume data not shown in Tables).

7.2.1.1 Aquaculture

There are currently no registered aquaculture sites on Alderney and hence no relaying or on-growing of shellfish currently occurs within Alderney waters (David Wilkinson, pers. com. February 2013). As such, no further consideration of aquaculture is made in this assessment.

7.2.1.2 Recreational fisheries

Recreational fishing (sea and shore angling) is an important tourist industry for Alderney contributing up to 5% of the island's tourist income. Chartered sea angling, including reef and bank, shark and fly fishing, take place around Alderney (ARE, 2009) and is carried out using local offshore charter vessels. The main fishing season lasts from March to October, although some fishing continues during the winter. Five to six chartered vessels regularly cross the English Channel from Weymouth for recreational fishing between April and October (AEA, 2007 and references therein).

Recreational sea fishing areas generally coincide with large sand banks south of Alderney and the Casquets (AEA, 2007). Other areas include the Swinge, two locations just north of Burhou and the Race (ARE, 2009). Longis Bay is also used for bait collection (ARE, 2009). Large areas of coastline are used by recreational anglers (Alderney Wildlife Trust pers. comm., June 2013).

7.2.1.3 Future baseline

The Bailiwick of Guernsey fishing fleet continues to face the challenge of maintaining profitable operations against a background of finite markets and the high cost of fuel, the latter of which particularly affects Alderney as excise duty is applied to all hydrocarbons on the island, irrespective of whether it is used for industry. To help maintain profitability, old and new landing opportunities have been secured in the port of Dielette and Cherbourg, ensuring that trade links with France are secure in the future (States of Guernsey Sea Fisheries Section, 2011).

A Fisheries Management White Paper has proposed a number of changes to fisheries management within Alderney's territorial waters (within 3nm), which would include bans on certain types of fishing gears (pair and beam trawling) and restricting the power and size of commercial vessels to 250 brake horse power (bhp) and 10m length respectively. The White paper also proposes restrictions on the number of fish that can be landed by anglers on chartered fishing vessels (States of Alderney, 2011).

In the absence of any other known significant marine development that is proposed in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the commercial fishing activity of the area in the short to medium term. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

Indirect effects may also occur in relation to changes in the future baseline of fish and shellfish (Section 5.3.1.1). For example, the commercially important species sandeel is negatively affected by sea temperature. This key prey species has declined in abundance in UK waters since about 2000, to the point where fisheries have been closed. The decline in species could also be a consequence of the combination of fishing and climate change (Evans *et al.* 2010).

7.2.1.4 Limitations and data gaps

Although sea fisheries statistics for the Bailiwick of Guernsey are available for 2011 (States of Guernsey Sea Fisheries Section, 2011), the fisheries statistics available which were specific to the Alderney Fleet, were from 2004-2009. Detailed information showing areas fished using different gear types within Alderney's Waters were not reproduced within the REA due to commercial sensitivity and the value of landings attributable to fishing gears, other than potting, were not publicly available.

At the project-level, it is recommended that developers consult with the States of Guernsey Commerce and Employment Department Sea Fisheries Section to obtain the most recent sea fisheries statistics relating to the Bailiwick of Guernsey registered fleet, and specifically the Alderney based fleet, and should include any available information on the following:

- Fish landings data;
- Fishing effort data;
- Fishing vessel movements; and
- Value of the fishing industry to the local economy.

7.2.1.5 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of tidal turbine arrays, cable route and landfall sites of cable), the full extent of the study area for commercial and recreational fishing will need to take account of Alderney's entire territorial waters.

7.2.2 Impact Assessment

The Draft Plan has the potential to affect commercial and recreational fishing in the study area through a number of impact pathways which are assessed in the following sections:

- Temporary and Long Term Displacement (Section 7.2.2.1);
- Collision Risk (Section 7.2.2.2);
- Damage to Fishing Gear (Section 7.2.2.3); and
- Increased Congestion (Section 7.2.2.4).

Based on the contribution of commercial and recreational fishing to the local economy this assessment considers the importance of commercial and recreational to be moderate to high.

7.2.2.1 Temporary and long term displacement

The Draft Plan has the potential to disrupt existing fishing activities through obstruction to, and the temporary or long term displacement from, fishing grounds. The presence of vessels during the construction, maintenance and decommissioning phase may temporarily exclude access to fishing grounds and the presence of tidal turbine arrays and export cables during the operational phase will likely present a physical obstruction that will impact on fishing activities and potentially displace fishing activity from these areas. Increased steaming distances to and from fishing grounds will also be involved in detouring around the arrays.

Temporary displacement during the construction, maintenance and decommissioning phases may result in fishing vessels being temporarily displaced onto different fishing grounds, potentially concentrating fishing effort in these areas/fishing grounds where economic returns are lower for a given unit of fishing effort. This temporary displacement may indirectly lead to gear conflict (e.g. between static and mobile gears) or force affected vessels to tie up for the duration of the installation.

Long term displacement of fishing activity may lead to localised depletions in stocks, particularly shellfish, due to the higher fishing effort in other fishing areas and may also impact on other fishing communities (e.g. increased competition for space and catch in Guernsey or Sark Waters) or other marine users. Given that the Bailiwick fleet is dominated by under ten metre vessels, displacement may cause vessels having to fish further offshore or in unfamiliar areas. Given that grounds outside the REA study area are also fished by vessels from the UK, Guernsey and Jersey (3-12 mile limit) and France (6-12 mile limit) options for displaced vessels may be limited. Permanent displacement may ultimately lead to a reduction in fishing opportunities to the extent that the commercial fleet may be permanently reduced. Furthermore, commercial and recreational fisheries not only directly support the employees within those businesses, but also a number of upstream businesses such as vessel and gear supplies, and downstream activities such as retail and distribution.

The magnitude of these effects depends on the location and scale of the renewable developments, the duration and timing of the construction and decommissioning phases, the level of fishing activity that exists within the immediate and wider area and the scale and extent of any restrictions, such as exclusion zones imposed on the fishing industry.

The licence blocks associated with the three project areas currently proposed by ARE are located within the Alderney 3nm limit where the majority of fishing activity by the Alderney based fleet occurs. There is a high degree of overlap between areas utilised for potting activity and all three project areas including the currently proposed cable route (see Figure 1; fishing areas not shown due to commercial sensitivity). There is a smaller degree of overlap between licence block areas and areas fished using nets, lines and trawls. For example, there is only a small degree of overlap between areas utilised for netting activity with licence blocks in Project 2 area (The Casquets; overlap with one licence block) and Project 1 area (The Race; partial overlap with four licence blocks to the east/south east of the island and the proposed cable route), although there is a greater degree of overlap in Project 3 area (The Ortac Channel; partial or complete overlap with 9 of the 14 licence blocks). There is a relatively small degree of overlap between areas utilised for line fishing and the licence blocks, although partial overlap with licence blocks do occur in all three project areas. There is also relatively little overlap between areas utilised for trawling and the project areas, with trawling activity partially overlapping with four licence blocks in the south west corner of Project 2 (The Casquets), one block along the southern edge of Project 3 (The Ortac Channel) and four blocks on the western edge of Project 1 (ACRE supplied data, February 2013). Given the concentration of fishing activity within the 3nm limit, renewable developments in any other licence block areas leased to other developers will also have the potential to impact on commercial or recreational fisheries.

Commercial and recreational fisheries are considered highly sensitive to long term displacement from the operation of tidal stream turbines, offshore substations and cable routeing (where cable burial is not possible and rock dumping or mattressing is required). The sensitivity of the fishing industry to the marine construction elements of the Draft Plan is considered to be moderate given that the effects are temporary. Whilst the location of developments comprising the Draft Plan are unknown, the majority of the Alderney based fleet fish is within 3nm, and therefore there is likely to be a degree of overlap with fishing areas used for potting, and also with fishing areas used for other fishing activity (netting, lining and trawling). Exposure to change is low for the construction phases of all the marine development components the Draft Plan were temporary effects are anticipated, resulting in impacts that are minor adverse/insignificant. The exposure to change is considered to be medium for the operation of a single tidal stream array and associated infrastructure, resulting in a moderate to major adverse impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters and associated cable routeing (see Section 2.2.2) is considered to result in an even higher level of exposure to change associated with the tidal array development.

7.2.2.2 Collision risk

The Draft Plan will result in increased boat traffic in areas utilised by the Bailiwick of Guernsey fishing fleet and recreational anglers, increasing the risk of collision between vessels. This change is most likely to be temporary, occurring mainly during construction and decommissioning, with boat traffic decreasing during the operational phase although still above baseline levels due to any maintenance requirements. In addition, there is also an increased marine collision risk in vicinity of the arrays. A detailed analysis of the vessel collision risk is provided in the commercial and recreational shipping and navigation section (Section 7.3.2.1). Sensitivity of the fishing fleet is considered moderate and exposure to change is considered low based on the use of standard best practice measures resulting in a minor adverse/insignificant impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters and associated cable routeing (see

Section 2.2.2) is considered to result in a higher exposure to collision risk during operation and potentially moderate to major adverse impact.

7.2.2.3 Damage to fishing gear

The presence of tidal turbines, mooring equipment, cabling and offshore substation infrastructure represent snagging/entanglement hazards for both static and mobile fishing gears, potentially resulting in damage to, and possibly loss of, fishing gear. The magnitude of these effect depends on the location and scale of the renewable developments, the level of fishing activity that occurs within these areas and on the scale and the extent of any restrictions, such as exclusion zones, imposed on the fishing industry.

The probability of exposure to this impact will depend upon the degree of overlap between the areas fished and the renewable developments. The probability of exposure to this impact will likely be highest for potting activity, which is undertaken within most of the 3nm mile limit. The probability of exposure may be lowest for trawling activity, as tidal turbines are likely to be placed in higher energy areas with scoured rock, which is unsuitable for trawling. Sensitivity is considered moderate with the majority of change considered temporary. Exposure to change is considered low resulting in a minor adverse/insignificant impact. A full build out of the Draft Plan and the potential installation of up to 4000 tidal devices in Alderney's territorial waters and associated cable routeing (see Section 2.2.2) is considered to result in a moderate exposure to change during operation and minor to moderate adverse impact.

7.2.2.4 Increased congestion

The Draft Plan may result in increased boat traffic at piers and pontoons used by local fishermen during all phases of the development. Sensitivity of the fishing industry to change is considered moderate. This change is likely to be mostly temporary, occurring mainly during construction and decommissioning, with boat traffic decreasing during operation although still above baseline levels due to any maintenance requirements. The magnitude of these effects depend on the seasonal level of fishing activity occurring during the different phases of the Draft Plan. Exposure to change is therefore considered low to moderate resulting in an insignificant to moderate adverse impact.

7.2.2.5 Potential positive effects

The Draft Plan may provide an opportunity for the local fishing industry to utilise their vessels in the conveyance of persons and equipment during construction and decommissioning phases and in the maintenance of devices during their operational life. There are also the potential positive effects associated with the introduction of tidal turbines, mooring equipment and offshore substation infrastructure on fish and shellfish species are described in the Fish and Shellfish (Section 5.3.2.9). Overall sensitivity to change is considered low to moderate and exposure to change is low resulting in the potential for an insignificant to minor beneficial impact.

7.2.2.6 Mitigation

The following mitigation works will need to be considered at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on commercial fisheries:

- Reduction in the number of tidal devices and associated cables in order to minimise the displacement of fishing activities;
- Avoid sensitive sites/species/periods e.g. arrays and cable routes should where possible avoid identified fishing grounds; and
- Cable and device design should reduce snagging risks.

Best practice mitigation should include consultation with the local fishing community and careful planning and notification of construction work to minimise effects. In addition, a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. Note, mitigation measures to minimise impacts on fish and shellfish species are described in Section 5.3.2.11.

7.2.2.7 Residual impact

The mitigation measures identified in Section 7.2.2.6 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on many project specific factors. The significance of potential residual impacts have been estimated and summarised in Table 34.

7.2.2.8 Summary

Table 34. Assessment of the potential effects of the Draft Plan on commercial and recreational fisheries

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Temporary and long term displacement	L	M	M-H	Minor/Insignificant	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Damage to fishing gear	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Operation	Temporary and long term displacement	M-H	H	M-H	Moderate to Major	Section 7.2.2.6	Minor/Insignificant
		Collision risk	L-H	M	M-H	Insignificant to Major	Section 7.2.2.6	Minor/Insignificant
		Damage to fishing gear	L-M	M	M-H	Insignificant to Moderate	Section 7.2.2.6	Minor/Insignificant
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Decommissioning	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
Cable Routeing	Construction	Temporary and long term displacement	L	M	M-H	Minor/Insignificant	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Damage to fishing gear	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Operation	Temporary and long term displacement	M-H	H	M-H	Moderate to Major	Section 7.2.2.6	Minor/Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Damage to fishing gear	L-M	M	M-H	Insignificant to Moderate	Section 7.2.2.6	Minor
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Decommissioning	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
Offshore Substations	Construction	Temporary and long term displacement	L	M	M-H	Minor/Insignificant	-	-
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Damage to fishing gear	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Operation	Temporary and long term displacement	M-H	H	M-H	Moderate to Major	Section 7.2.2.6	Minor/Insignificant
		Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Damage to fishing gear	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Decommissioning	Collision risk	L	M	M-H	Minor/Insignificant	-	-
		Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
Onshore Substation	Construction	Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Operation	Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant
	Decommissioning	Increased congestion	L-M	M	M-H	Moderate to Insignificant	Section 7.2.2.6	Minor/Insignificant

N Negligible L Low M Medium/moderate H High

7.3 Commercial and Recreational Shipping and Navigation

7.3.1 Baseline Description

The baseline descriptions have been split into two sections dealing with commercial shipping and recreational navigation respectively. Where possible, types of vessels using the study area and the adjacent English Channel traffic have been identified and commented upon.

7.3.1.1 Commercial shipping

Commercial shipping is a key activity in Alderney and its territorial waters. Shipping traffic management is split into International Maritime Organization (IMO) routeing instructions and local shipping traffic. Figure 26 provides a view on the key navigational areas including the 3nm study area around Alderney, the Inshore Traffic Zone (ITZ) and IMO traffic separation scheme.

The Casquets Traffic Separation Scheme (TSS) and ITZ were established by the IMO following a number high profile shipping accidents, they are controlled by the French Authorities (Jobourg Traffic) based at Cross Jobourg. The TSS organises the flow of vessels travelling along the south side of the English Channel, keeping them some 7nm North West of the Casquets Rocks. An ITZ has been established through which the transit of vessels over 20m is prohibited unless bound for ports within the ITZ. The ITZ joins the sea area from the Western end of the Casquets TSS to the island of Guernsey/Sark in the South, to Alderney and back to the Eastern end of the Casquets TSS. These traffic schemes have improved the safety of the vessels navigating along the Southern side of the English Channel and within the waters around the Channel Islands.

The density of maritime traffic in the English Channel is amongst the highest in the world equating to nearly 20% of all traffic. Table 35 was taken from the Affaires Maritime survey of vessels passing through the Casquets TSS in 2006, which total 70,975 ships.

Table 35. Vessels passing through the Casquets TSS in 2006

Types Of Ship	Number Of Ships
Oil Tankers	2,844
Gas Tankers	2,593
Chemical Tankers	7,680
Cargo Ships	28,944
Bulk Carriers	9,444
Container Ships	14,291
Passenger Ferries	3,811
Fishing Boats	396
Beacon, Rescue and Police Ships	64
Scientific Ships	157
Tugs	424
Other	327
Total	70,975

(Source: Affaires Maritimes, Traffic 2006 database)

Locally, the Alderney Harbour Master controls vessels in Alderney waters and monitors vessels approaching Braye Harbour using port radar. Braye Harbour accommodates passenger ferries and freight vessels from Guernsey, France and the UK, small tankers (transporting hydrocarbons) relatively small 'adventure' cruise ships (approx. 3-5 liner visits per year), fishing vessels and recreational vessels. The Guernsey Coastguard control vessels entering the area en route to the harbours of St Peter Port and St Sampson (Guernsey) or to anchorages within the Little Russel (a channel between Herm and Guernsey) (ACRE, 2012). The main ferry routes through Alderney waters are those from Poole, Portsmouth, Southampton, Cherbourg, Diellette, Guernsey and Jersey.

The pattern of commercial vessel operations is well established, Figure 27 provides an overview of vessels transits within the study area. The view is broken down into classes of vessel identified by AIS-A 'ship type' classifications contained within the AIS signal. These include the following types:

- Non-Port service craft;
- Port service craft;
- Vessels engaged in dredging or underwater operations;
- High Speed Craft (HSC);
- Military or law enforcement vessels;
- Passenger vessels;
- Cargo vessels;
- Tankers; and
- Fishing vessels/Pleasure/Sailing (carrying AIS-A).

The transit routes shown in Figure 27 are taken from a 28 day period, made up of four (7 day) weeks from the months of April, July and October 2010, plus January 2011 and is designed to remove the seasonal effects. The information presented in Figures 27 and 28 has been translated from the Marine Management Organisation (MMO) 'Spatial Trends in Shipping Activity' (MMO, 2013) prepared to inform English South Coast Marine planning. It is worth noting that these Figures 27 and 28 show commercial vessels above 300 Gross Tonnes (GT) and passenger vessels required to carry AIS-A. In addition, a small percentage of fishing vessels, recreational vessels and sailing vessels use AIS-A and these are also represented within the dataset.

Figure 27 identifies the types of vessels passing into and through the Bailiwick waters, identify clear routes used by different types of vessels. Cargo vessel transits show clear routes that run from the South side of the English Channel, around Cap de la Hague through the Alderney Race, bound for Guernsey and outlying islands and anchorages. A larger percentage of this traffic traverses between Guernsey and Jersey on a Southerly passage. Cargo vessels also follow routes from the North Coast of France and the Channel into Braye Harbour, then onwards between Alderney and the island of Burhou through The Swinge Channel. A small number of cargo transits are seen passing to the west of the Casquets Rocks. Tanker traffic is known to follow similar patterns, however within the dataset depicted, vessels of this type are not evident Bailiwick waters.

HSC routes are very evident from the AIS transits shown on Figure 27. Clear routes are seen from Weymouth and Poole which follow distinct patterns, passing either to the west of the Casquet Rocks, or between the Casquet Rocks and Burhou through the Ortac Channel. These vessels are travelling to and from Guernsey, berthing at St Peter Port. Passenger and cruise vessels use the Alderney Race route whilst transiting from Portsmouth and Southampton, with a small percentage of cruise vessels calling at, or moving through Bailiwick waters. A passenger service runs between Braye Harbour and Guernsey, this routes passes between Alderney and the island of Burhou. The remainder of vessel types classified in the AIS transit information (port and non-port service craft, dredgers, underwater operations, military and law enforcement vessels) present a very small percentage of traffic with occasional vessels calls at Braye Harbour or Alderney anchorages, or on passage through Bailiwick waters.

Figure 28 shows a view of all vessel transits in the 28 day AIS-A information. The transits which intersect with the 3nm study area around Alderney have been highlighted to show both the indicative route, and their possible port of origin and destination. To quantify this information, Table 36 provides a view of the 28 day period, up-scaled to provide a measure of yearly activity.

Table 36. Vessel transits which intersect a 3nm buffer around Alderney

Type	Transit Count (28 day Total)	Uplifted (Yearly) Transits	Yearly Transit %
Unknown (vessels using incorrect identification codes)	59	769	26.2
Non-Port service craft	0	0	0.0
Port service craft	1	13	0.4
Vessels engaged in dredging or underwater operations	0	0	0.0
High Speed Craft (HSC)	57	743	25.3
Military or law enforcement vessels	0	0	0.0
Passenger vessels	19	248	8.4
Cargo vessels	86	1,121	38.2
Tankers	0	0	0.0
Fishing vessels/Pleasure/Sailing (carrying AIS-A)	3	39	1.3
Total	225	2,933	100

The information shown in Table 36 must be used with caution and as indicative transit volumes only. The transit information was obtained from receivers on the English South Coast, which do not provide continuous and detailed coverage of the Channel Islands. Distance to the receiver, power of the transmitted signal and atmospheric conditions affect reception quality. The information available to this study must therefore be interpreted with caution and provides indicative routeing and sea area use by commercial vessels. The collection of a more detailed data set, from AIS receivers located on the Channel Islands must be considered as a priority for individual renewable site specific assessments.

It is worth noting that in addition to the commercial traffic identified as transits from the AIS information, many routes between Alderney and the other Channel Islands are essential for smaller vessels providing inter-island trade and fishing. Less than 12 fishing vessels are registered as commercial fishing vessels with a permanent berth in Alderney (ACRE supplied data, February 2013, see Section 7.2.1). The Coastguards identified that the Guernsey fleet is larger with 195 registered commercial fishing vessels mainly operating out of St Peter Port and St Sampson. All of these vessels have the potential to use Bailiwick waters. In addition, the whole of the Bailiwick waters are used by the emergency services for search and rescue practices, plus occasional 'live' operations to assist vessels in distress.

In terms of accident and incident information for the Bailiwick waters, there have been two cargo ship incidents since 2009. These are namely the 'Huelin Dispatch' which grounded on an isolated rock South West of Alderney on 21 Sept 2012 and the vessel 'Bodyer' which had an onboard equipment breakdown North of Sark on 9 December 2009. Anecdotal information from the Guernsey Coastguard suggests that a number of incidents have occurred within the Casquets TSS, however these records are not formally held by Guernsey Coastguard.

7.3.1.2 Recreational navigation

The Channel Islands are one of busiest areas for recreational boating in Northern Europe with approximately 12,000 visiting pleasure craft each year and more transiting within the ITZ or entering Alderney waters (ACRE, 2012). The most heavily used routes are through the Alderney Race and The Swinge with many vessels stopping to visit Alderney (see Figure 26 for locations). Small numbers of yachts visit the bays and anchorages but most prefer the safety of Braye Harbour (ACRE, 2012) which also has a commercial quay for the berthing of larger vessels such as cargo and cruise vessels. The following Table 37 details the number of recreational vessels calling at Braye Harbour during April to September 2010, and it is estimated that in total *circa* 10,000 yachts visited Bailiwick waters in 2010.

Table 37. Braye Harbour yacht visits - 2010

Month	Yacht Nights Total	British	French	Other	Crew (People) Count
Apr	137	91	33	13	685
May	467	303	139	25	2,335
Jun	1,157	889	149	119	5,785
Jul	2,033	1,297	354	382	10,165
Aug	1,743	1,222	359	162	8,715
Sep	339	236	73	30	1,695
Total (half year)	5,876	4,038	1,107	731	29,380

(Source: http://www.alderney.gov.gg/article/4155/Harbour)

In addition to Braye Harbour, there are a number of other anchorages around Alderney which include Saye and Longis Bay, Telegraph Bay (located on the South-West point of island), Hannaine Bay (located South of Fort Clonque) and Burhou Island where landing is prohibited between 15 March and 27 July each year due to the island's conservation status (AEA, 2007). The anchorage at Longis is visited by tens, if not hundreds of boats per year, and large vessels regularly shelter outside of Longis and drop anchor (Alderney Wildlife Trust pers. comm., June 2013).

Alderney sailing club holds races every year during the holiday periods. The annual races are Cherbourg to Alderney, Alderney to Diellete, Alderney to Guernsey, Round Alderney Race, Casquets Race and other local races. Sailing activities mostly take place from April to

September (Nguyen, 2011). The RYA provides indicative routes which are shown in Figure 29. The RYA heavy use cruising routes are defined as those where six or more recreational craft use the route during summer/daylight hours. RYA moderate use cruising routes are defined as those that recreational craft are seen at most times during summer daylight hours; while light use cruising routes are known to be commonly used, but are not supported by observational data (RYA, 2008). From the information shown in Figure 29, medium routes connect English South coast ports and anchorages to Alderney. It should be noted that this information is indicative only and do not identify routes used between the Channel Islands.

7.3.1.3 Future baseline

Generally, the level of shipping and smaller craft is not expected to increase significantly. It is speculated that in common with background shipping levels, a two-per cent increase in shipping traffic is considered realistic. Any renewable energy developments in the Channel Islands, such as around Guernsey, have the potential to increase commercial vessel movements in respect of survey activities, construction and installation, cable laying and associated maintenance. These vessels will require a base, or bases of operation, and therefore will lead to increases in vessel transits within the Bailiwick waters.

Guernsey has plans to increase the number of visiting cruise liners and leisure craft as detailed in the contingency plans to expand the Port of St Sampson to provide deep water berths for use by tankers and cargo vessels. This will potentially provide limited increases in vessel transits, mainly through the Alderney Race, and will therefore affect the sea area use to the East of Alderney. However, it may also increase recreational vessel use of ports and anchorages en route to St Sampson, such as Braye Harbour and anchorages around Alderney. The developer will need to confirm the status of this plan and whether there are any other proposed projects or plans that would need to be taken into account as part of the EIA at the project level.

7.3.1.4 Limitations and data gaps

The following data gaps have been identified in relation to commercial and recreational navigation:

- Information on Marine Environmental High Risk Areas (MEHRAS);
- Potential search and rescue activity within the study area and the types of aircraft and vessels which may be used;
- AIS data for Alderney has not been made available for this REA, information used has been cited from English studies to inform marine planning. The coverage of AIS-A (commercial vessels 300 GT and larger, plus passenger carrying vessels) is not fully described within the REA due to limitations of reception range;
- Military activity within the area by UK and European countries (whilst on deployment, military vessels are permitted to turn off their AIS transmitter); and
- Information on racing areas in Alderney Waters and the wider study area to inform the understanding of recreational use.

At a project level, the following survey activities may be required:

- AIS data - further work will involve obtaining and processing readily available AIS-A data from the Channel Islands. It is understood that commercial data providers have AIS records available which could be used to inform renewable individual site specific assessments. Both AIS-A and AIS-B data should be used. AIS-B data is required to provide a complete view of commercial shipping, this will address missing commercial vessels smaller than 300 GT, plus provide information on other categories of none AIS-A vessels including recreational and fishing vessels. Whilst the use of AIS-B is not mandatory and therefore not universally adopted by smaller vessels, the confidence and reliability of the data will usefully supplement the commercial vessels identified through AIS-A datasets, however it must be recognised that AIS-B has range limitations relating to the power of transmissions of 2 Watts, giving a range of *circa* 10nm. Therefore local survey or site selection will be required to ensure confidence of spatial coverage.
- Radar data - radar surveys can be used to track the movements of all vessels (in comparison to AIS data which represents only those vessels transmitting their position). No radar survey work has been undertaken to inform this REA. To improve the coverage of vessel traffic data, and specifically to quantify non-AIS craft within Alderney waters, a dedicated radar survey covering a summer and winter period would be necessary which will also provide greater information to define recreational racing areas and RYA cruising routes.

7.3.1.5 Study area

The study area considered by this REA chapter is shown by the boundary on Figure 26. This includes the wider study incorporating the Casquet TSS and traffic within the ITZ.

7.3.2 Impact Assessment

The Draft Plan has the potential to affect commercial shipping and recreational navigation in the study area through a number of impact pathways which are assessed in the following sections:

- Collision risk (Section 7.3.2.1);
- Changes to commercial shipping movement (Section 7.3.2.2);
- Effects on small craft navigation (Section 7.3.2.3);
- Potential for moorings to become a navigational hazard (Section 7.3.2.4);
- Potential for any marker buoys to become a navigational hazard (Section 7.3.2.5);
- Increased/Altered steaming times and distances (Section 7.3.2.6);
- Reduced visibility when barges and construction equipment obstruct views (Section 7.3.2.7);
- Potential for Structures and Cabling to Interfere with Navigational Equipment (Section 7.3.2.8);
- Potential for equipment parts to become detached from devices (Section 7.3.2.9);
- Lighting of tidal works and structures causing confusion to passing vessels (Section 7.3.2.10);

- Changes to risk management and emergency response (Section 7.3.2.11); and
- Cable route risk in respect of vessel anchoring, burial depth and cable protection (Section 7.3.2.12).

In this strategic study it has not been possible to consider each sea area or navigation channel individually and therefore project specific investigations will be required prior to any individual development taking place. It is recommended that developments are subject to a Navigational Risk Assessment (NRA), carried out in accordance with industry standards. Within UK waters, the following publications are used to define the methodology and output from NRAs:

- Department for Transport - Guidance On The Assessment Of The Impact - Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms;
- Maritime and Coastguard Marine Guidance Note 371 ‘Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues’;
- Maritime and Coastguard Marine Guidance Note 372 ‘Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs’; and
- IALA Recommendation ‘O-139’ On The Marking of Man-Made Offshore Structures Edition 1, December 2008.

Commercial shipping is a key activity in Alderney and its territorial waters. Throughout this assessment importance is considered to be low to moderate based on the RYA Medium route connecting England and Alderney and the type of vessels using the harbours (for example Braye Harbour accommodates some passenger ferries and freight vessels, small tankers and relatively small cruise ships).

7.3.2.1 Collision risk

The survey, construction, operation and decommissioning of tidal stream turbines, cable routing and offshore substations has the potential to increase the collision risk of vessels. Collision risk has not been quantified within this assessment as specific development locations and configuration are required to make a meaningful assessment; furthermore this type of assessment is more appropriate at project level. Therefore the consequences of a collision have been considered at a regional scale including the effects on commercial shipping and recreational craft. This assessment assumes developers will complete a NRA to support individual projects, and that these assessments will ensure developments are not sited in high risk locations where effective mitigation cannot be applied. As a general statement, a higher density of traffic provides a greater potential for collision risk. Bailiwick waters to the West of Alderney are located within the ITZ, which controls and reduces the movement of transitory vessels. Bailiwick waters to the East of Alderney overlap with vessel transit routes through the Alderney Race. Throughout this assessment sensitivity is considered to be low to moderate. This takes account of the sensitivity of vessels during adverse weather conditions and in periods of peak tidal flow, with smaller vessels less able to manoeuvre against environmental conditions (predominantly recreational craft and small fishing vessels). The presence of slow moving or stationary installation vessels and equipment is also likely to increase the probability of close quarter encounters and collisions with passing vessels.

During the survey phase for tidal stream turbines and cable routeing, vessel(s) are considered likely to be operating individually or in small numbers, using weather windows to capture good quality marine data. The presence of survey vessels will be recognised through the use of day and night identification lights and shapes as required by the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs). Therefore, the risk of collision is low as survey craft can manoeuvre to avoid close quarters situations and can plan their surveys to avoid peak times for marine traffic. Therefore exposure to change during surveying is considered negligible to low resulting in an insignificant/minor adverse impact.

Vessels associated with construction and decommissioning for tidal stream turbines, and offshore substations have the potential to increase the risk of collision with other craft navigating in the vicinity. These activities have the potential to cause small and recreational vessels to modify their routes to use areas transited by larger vessels, which potentially increasing the risk of encounter or collision. Exposure to change is considered to be low to medium resulting in an insignificant to moderate adverse impact. It should also be noted that Bailiwick waters do not have a Vessel Traffic Services (VTS) covering the area which would assist in increased marine safety.

Similarly for cable routeing there is considered to be an increased risk of collision with vessels along cable routes while cabling is laid. This risk is increased in the proximity to navigation channels (for example, in port and harbour approaches) and through greater vessel activity in these areas. An additional risk is the physical snagging of anchors on cables prior to burial, rock dumping and/or mattressing (although less likely, but still possible). Exposure to change during construction and decommissioning is therefore considered medium to low resulting in an insignificant to moderate adverse impact.

The operation of stationary tidal device arrays and offshore substations are also likely to affect the probability of collisions. This is primarily through the risk of a direct collision or snagging of vessel lines (whilst fishing, anchoring or towing) with structures and their moving parts, whilst vessels are underway, adrift or at anchor. Where renewable arrays are in waters of depths greater than 75m, the structures do not present a danger to surface navigation. However, the presence of substation platforms and submerged structures on the seabed in depths shallower than 75m, which is the case in the REA study area, could pose a risk to navigating vessels. This follows the rationale that tidal devices are stationed *circa* 20m from the bed (to avoid bed turbulence) and have a maximum blade around 10m in diameter, providing a 30m bed-to-blade-tip clearance. Ultra Large Crude Carriers (the deepest draughted vessels) have a maximum draught of around 35m. An Under Keel Clearance allowance of 10m is applied as a maximum working clearance (This approach follows the rationale laid out in the ABPmer report 'Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Waters Final Report' (ABPmer, 2013) developed from a working paper provided by the NOREL sub group on navigation (NOREL, 2012). Overall, exposure to change is considered medium at worst resulting in an insignificant to moderate adverse impact. A full build out of the Draft Plan, however, and the potential installation of up to 4,000 tidal devices in Alderney's territorial waters (see Section 2.2.2) is considered to result in a higher exposure to collision risk during operation and potentially moderate to major adverse impact.

Individual site specific assessments for renewable energy arrays should consider positioning with respect to vessel traffic, routes and available depths. These aspects will be fully considered within a Navigation Risk Assessment (NRA) following industry best practice, such as the MCA's MGN 371. Areas which are not suitably deep to allow vessels to navigate safely, should become safety zones and identified as such on nautical charts with clearance distances clearly marked. The effectiveness of these controls relies on both commercial and recreational vessels maintaining up to date charting information. When considering the positioning of marine renewable energy devices and substation platforms in the study area with respect to commercial shipping and recreational navigation, it is particularly important to take into account the following:

- It is a requirement under the United Nations Convention on the Law of the Sea (UNCLOS) that recognised sea lanes essential to international navigation are not impeded;
- Approaches to ports and harbours must be maintained; and
- Approaches to marinas, anchorages and bay moorings must be maintained.

7.3.2.2 Changes to commercial shipping movement

The survey, construction, operation and decommissioning of tidal stream turbines, cable routing, offshore substations, onshore substations and onshore wind turbine has the potential to result in changes to commercial shipping movement. Commercial shipping movements are intrinsically linked to changes in economic and social patterns and therefore sensitivity is considered moderate throughout this assessment. Currently, commercial shipping through Bailiwick waters (see Figure 27) is predominately HSC routes, passenger vessels and cargo vessels. A mix of other commercial and military vessels also uses the sea area on an *ad hoc* basis. Renewable energy developments will have implications for vessel movements such as through route alterations or through a need to bring in construction plant, equipment and renewable energy installations. These present both an increase in commercial vessel movements and potential for associated craft including survey, maintenance and HSC.

Survey activities are likely to generate very minor increases in overall vessel movements at a Bailiwick water scale and exposure to change is considered negligible to low resulting in an insignificant/minor adverse impact. In terms of the construction and decommissioning phases for all developments commercial vessel traffic will increase at the development site and along the cable corridor. The construction and development of onshore facilities, such as the onshore substation(s) and any wind farm developments will also generate additional commercial vessel movements to transport heavy plant and equipment. Quantification of this increase in marine traffic is not possible at this stage, and will depend on the chosen forms of renewable technology, the installation requirements and associated cabling route(s). However, given that nearly all equipment and plant will require transportation to Alderney, the exposure to change during the onshore construction and decommissioning is assessed to be medium to low Construction craft will be serviced by smaller vessels plying stores, equipment and personnel from nearby bases of operation. This is likely to increase HSC and small cargo vessel movements. Equipment will need shipping into the Alderney or local ports, and may be assembled nearby. Therefore larger cargo vessels would be anticipated, and it is anticipated that local ports will see an increase in cargo vessel traffic. Exposure to change is considered low to medium resulting in an **insignificant to moderate adverse** impact.

During the operational phase, regular maintenance will be required for all developments, with vessels capable of lifting and servicing renewable devices and offshore substations, potentially using local port services. During these periods of operational maintenance, HSC and may be also be used to transfer crew and stores. Exposure to change is considered negligible to low resulting in an **insignificant/minor adverse** impact.

7.3.2.3 Effects on small craft navigation

The construction, operation and decommissioning of tidal stream turbines, cable routing and offshore substations has the potential to result in changes to commercial shipping movement. Recreational navigational routes differ from commercial routes as they aim to keep clear of major commercial shipping routes by travelling in the shallower adjacent waters, or by taking other routes entirely. In general, day sailing and racing areas are close to the shore and in the more sheltered waters. As a result, examining commercial routes alone will not enable the safe positioning of renewable developments. To ensure recreational navigation is correctly accounted for by developments, it is important to consider and safeguard inshore routes for smaller craft. Recreational activity is important to the health and wellbeing of the community as well as being an important economic support for local port and leisure services.

During the construction and decommissioning phase of tidal offshore substations, tidal stream turbines and cable routeing, the most significant effect (other than collisions) is considered to be the displacement of recreational crafts. This could have two impacts; the first is to increase the risk of marine incidents (principally, collisions with other vessels, or grounds of vessels displaced into unfavourable areas) and the second is to act as a deterrent to the use of Bailiwick waters during periods of construction/decommissioning and cabling. Based on the limited information on the area potential effected exposure to change is considered medium and sensitivity medium resulting in **an insignificant to moderate adverse** impact.

In terms of operation it is considered that tidal renewable energy devices are static structures with moving parts, some of which react to the change in tidal direction whereas offshore substations are static structures and would be lit and marked appropriately to meet the requirements of Trinity House. The interaction with recreational boating is therefore focused around collision risk with the moving parts on arrays and safe navigable depths (assessed under 'collisions'). Where renewable developments are in waters of depths greater than 40m, safe passage of recreational vessels can be permitted. This follows the rationale that tidal devices are stationed *circa* 20m from the bed (to avoid bed turbulence) and have a maximum blade around 10m in diameter, providing a 30m bed to blade tip clearance. To provide allowance for tide and wave activity plus an extra margin for safety, a 10m blade tip to surface allowance is made. Therefore, 40m is considered a suitable threshold depth. This approach follows the rationale laid out in the ABPmer report 'Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Waters Final Report' (ABPmer, 2013) developed from a working paper provided by the NOREL sub group on navigation

(NOREL, 2012). Considering that each renewable development will require site specific navigational risk assessment to identify potential effect on small craft exposure to change, at a regional scale the following conclusion has been drawn; the exposure to change during operation is considered low to medium resulting in an **insignificant to moderate adverse** impact.

7.3.2.4 Potential for moorings to become a navigational hazard

There is a small risk that the moorings from tethered arrays may present a risk to vessels navigating adjacent to development sites or those anchoring in an emergency situation (for example, if the vessel has a mechanical breakdown). This risk is more apparent during low water when mooring lengths will be at their greatest. In addition, the presence of underwater moving equipment/blades provides the potential for snagging of vessel mooring lines (during an emergency situation). During construction and decommissioning vessels would remain outside of safety zones and not anchor in the vicinity of the installation craft. Sensitivity is therefore considered moderate and the exposure to change low to negligible resulting in an **insignificant to minor adverse** impact.

In terms of operation, the largest risk of entanglement and snagging is presented to, and from, devices located on the outer extents of the development sites. It is considered any renewable developments with surface or near surface devices would be identified on a chart and appropriately marked with buoyage as a safety zone. Renewable development tidal sites with sufficient water depth and clearances may be safely used by recreational craft, however anchoring within these zones would be prohibited. The effectiveness of these controls relies on both commercial and recreational vessels monitoring up to date charting information and maintaining an effective watch whilst at sea. Sensitivity is therefore considered moderate and the exposure to change low to negligible resulting in an **insignificant to minor adverse** impact.

7.3.2.5 Potential for any marker buoys to become a navigational hazard

Any floating or piled markers provide potential for collision, either accidentally or on purpose (from vessel securing to markers). Anecdotal information shows that contact and collisions with aids to navigation are commonplace, and often result from mariners using markers as waypoints along their passage.

In terms of the construction and decommission phases associated with tidal stream turbines, temporary markers may be associated with construction work, and would normally mark safety zones or be represented as special (yellow) markers. Collision with temporary markers is possible, especially as they may not be updated on charts and navigational products however sensitivity is considered low and exposure to change negligible to low, resulting in an **insignificant to minor adverse** impact.

Similarly for operation the presence of stationary aids to navigation present a risk of collision or contact. There is also a very small risk that mooring buoys could break free of the moorings during extreme weather conditions and collide with the devices they are marking or with other vessels however sensitivity is considered low and exposure to change negligible to low with all impacts assessed as insignificant/minor adverse.

7.3.2.6 Increased/ altered steaming times and distances

The construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substations has the potential to result in changes to steaming times and distances. Tidal stream turbines may cause obstruction and displacement of shipping routes, leading to increased steaming time and therefore increased cost. This will occur where regular vessel traffic routes and development areas overlap. Figure 30 shows a spatial distribution of AIS derived transit routes and the Licence Blocks. Cable corridors will affect shipping during the process of laying cables with temporary deviations being a requirement to avoid cable laying craft and any cable catenary. It is also assumed that safety zones will be used to manage collision risk adding to route deviations.

To quantify deviations, the fuel costs per nautical mile the additional steaming distance can be calculated for each development at the project level. The difference in distance between the original and modified routes determine the fuel cost, based on an assumed fuel consumption rate. To reduce and optimise route deviation, the process of site specific assessment and careful spatial planning of array locations can reduce impacts on routes.

During the construction and decommissioning stages for all developments (tidal stream turbines, offshore substation and cable routeing) it may be necessary to establish safety or avoidance zones for safety purposes. The UK Department of Energy and Climate Change (DECC) publish guidance on establishing safety zones around Offshore Renewable Energy Installations. A safety zone can be established either through the developer's successful application via the licensing authority, or in the case of The States of Alderney, safety zones can be establish within its Territorial Waters by Ordinance. The standard dimensions of 500 metres (the maximum permissible under international law) during construction, major maintenance, possible extension and decommissioning will normally apply; application will be considered on a case-by-case basis taking into account site specific conditions.

The introduction of safety zones into the area will require vessels to move around the activities potentially increasing journey times and steaming distances. The extent to which journey time or distances are affected will be highly variable depending on the location of the development. A range of consultees will be involved in the quantification of costs for changed routes, which would include (but not be limited to) the Chamber of Shipping, individual Ferry Operators, local Councils and representatives of the fishing industry. It should also be recognised that whilst quantification of regular ferry and cargo vessels routes is possible, there could also be an increase in steaming time(s) for vessels to reach fishing grounds, this equates to increased fuel costs and reduced time available for fishing for those fleets limited by days-at-sea restrictions. Most Harbours in the Channel Islands and the Bay of St Malo have tidal restriction due to a range and speed of the tides in the area. As a consequence the regular ferry routes are particularly sensitive to any delays leading to turn around time or missed schedules. This in turn effects turnaround times, the timely arrival of passengers and time sensitive cargos such as fresh food for Channel Island communities. The steaming times provide additional fuel cost to the ship operator, and associated increase in ships emissions. Exposure to change is considered to be medium and sensitivity moderate resulting in an **insignificant to moderate adverse** impact.

Once sited, the operation of tidal stream turbines and associated offshore substations may cause permanent obstruction of navigation routes. Whilst the DECC guidance provides guidance on safety zones (normally up to 50 metres) during the operational phase of renewable, in practice within UK waters, this measure has not been commonly used for the operataion phase by developers or applied by regulators (DECC, 2011).Should a site specific assessment require a safety zone, a quantification of additional steaming distances (and cost of fuel) will be calculated and known prior to licensing the development. On the basis that a site specific assessment is completed, the exposure to change is considered low to negligible and sensitivity moderate. In respect of cable routeing in the operational phase of the development, once cabling is laid it is considered to have no further effect on steaming times and distances and is therefore assessed as negligible to low resulting in an **insignificant/minor adverse** impact.

7.3.2.7 Reduced visibility when barges and construction equipment obstruct views

Reduced visibility from construction, installation and cable laying vessels, plus associated barge craft relates primarily to construction and decommissioning. In addition, there is a limited risk, which is temporary in nature, during operational periods when tidal devices are lifted for maintenance and repair.

During construction and decommissioning of the tidal stream turbines, cable routeing and offshore substations the presence of large installation vessels, barges, jack-up rigs and other construction equipment has the potential to obstruct the view of other vessels, or obscure navigation aids such as lights, buoys and the coastline. This could cause a hazard to shipping in areas where visibility is particularly important for navigation or areas where the topography already constrains visibility. Exposure to change is considered low to negligible and the sensitivity low resulting in an **insignificant/minor adverse** impact.

In terms of operation specifically for tidal stream turbines and offshore substations surface piercing equipment and maintenance vessels could provide temporary obstruction of navigation aids. Exposure to change is considered low to negligible and the sensitivity low resulting in an **insignificant/minor adverse** impact.

7.3.2.8 Potential for structures and cabling to interfere with navigational equipment

There is also the potential for structures, generating systems and seabed cabling to adversely affect navigation equipment including AIS, radar and communications. Magnetic interference can affect compasses, although this is only likely to be an issue in shallow water areas in the operational phase of the development. Exposure to change is considered low to negligible and the sensitivity low resulting in an **insignificant/minor adverse** impact.

7.3.2.9 Potential for equipment parts to become detached from devices

During the operation of tidal stream devices there is a risk that equipment parts from tidal devices could become detached and become a navigation hazard to nearby navigation routes, thereby creating a risk of collision. There is also a small risk that tethered devices could break free of the moorings during extreme weather conditions and collide with other devices or vessels. Given regular maintenance and the equipment parts mainly being heavy (and therefore predominantly sinking), exposure to change is considered low to negligible and the sensitivity low resulting in an **insignificant/minor adverse** impact.

7.3.2.10 Lighting of the tidal works and structures causing confusion to passing vessels

During periods of construction and maintenance the lighting of works from construction, installation and cable laying vessels, plus associated barge craft could be confusing to passing vessels. This is a temporary effect during periods of reduced visibility (fog, heavy rain/sleet/snow, haze, twilight and night time).

During construction and decommissioning of the tidal stream turbines, cable routeing and offshore substations the presence of working lights can provide confusion to passing vessels. All vessels engaged in renewable energy works will carry lights and shapes complying with the requirements of COLREGS. The greater risk of confusion from lighting will be to smaller recreational craft where crews may not have access to a range of navigational aids such as those installed on commercial vessels. The risk of lighting induced confusion can be mitigated through increased awareness from information in notice to mariners and passage planning by craft to avoid construction areas where practical to do so; therefore the exposure to change is considered low to negligible and the sensitivity low.

During the operation of tidal stream turbines and offshore substations, lighting on the structure has the potential to cause confusion to passing vessels. However best practice measures can be used to minimise any potential issues and therefore exposure change is considered negligible to low and sensitivity to change low resulting in an **insignificant/minor adverse** impact.

7.3.2.11 Changes to risk management and emergency response

Search and rescue exercises and operations can take place throughout Bailiwick waters, both within and adjacent to renewable development areas. The presence of tidal arrays and offshore substations has the potential to affect risk management and emergency response during the construction, decommission, cabling and the operational phases of development.

During construction and decommissioning of the tidal stream turbines, cable routeing and offshore substations there is a risk of vessels straying into development safety zones for a range of reasons, including a vessel not under command, or a vessel struggling to maintain its course and speed in heavy weather. In this instance the ship's crew and the emergency services and their personal would be at risk in performing their duties to preserving life at sea; therefore the exposure to change is considered negligible to medium and the sensitivity moderate resulting in an **insignificant to moderate adverse** impact.

During the operational phase of both the stream turbines and the offshore substations the presence of these structures provides an ongoing risk to emergency response. Although the main English Channel shipping routes are clear of the Bailiwick waters, their proximity to development areas presents a significant risk that vessels or hazardous cargoes may inadvertently stray or drift into the area following an accident or breakdown under the influence of wind and tidal stream. Therefore the exposure to change is considered to be negligible to medium and the sensitivity moderate resulting in an **insignificant to moderate adverse** impact. Consideration therefore needs to be given to deploying rescue assets and salvage vessels to assist casualty vessels and for anti-pollution operations. A review of search and rescue provision, including monitoring capability (such as radar and or AIS) should be considered by the Coastguards to ensure operational commitments can be met.

7.3.2.12 Cable route risk in respect of vessel anchoring, burial depth and cable protection

If cables are laid on the seabed there are potential risks in association to vessel anchoring. In areas identified as anchorages, it will be necessary for renewable developments to consider cable burial depth and possibly cable protection. Burying the cables below the seabed or protection to an appropriate depth, would both limit the exposure at the seabed surface and the potential risk. The cable route would be marked on charts and thereby reducing the risk of damage from anchoring vessels, assuming that vessels update their charted information on a regular basis. Any cabling across port approach channels where routine maintenance dredging is carried out would require agreed burial depth and possible armour protection to prevent damage to dredge dragheads and cabling. It is possible that the presence of cable routes which make landfall in areas frequented as anchorages may provide a disincentive to visit the area for recreational craft. The effects will be subject to site specific assessment however the exposure to change is therefore considered to be medium to low and sensitivity moderate resulting in an **insignificant to moderate adverse** impact.

7.3.2.13 Mitigation

A range of mitigation measures will need to be considered at the project-level by the developer to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on commercial and recreational shipping. In addition, best practice measures for other pathways should be considered in relation to other insignificant/ minor adverse pathways. These mitigation measures are summarised in Table 38.

Table 38. Commercial shipping and recreational navigation mitigation

Impact Pathway	Mitigation
Collision	Collision risk has been assessed with the assumption that all commercial vessels that operate within Bailiwick waters comply with the IMO's International Conventions, including: ▪ The International Convention for the Safety of Life at Sea (SOLAS) - the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements. Control provisions

Impact Pathway	Mitigation
	also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the vessel and its equipment do not substantially comply with the Convention. This procedure is known as port State control; ▪ International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) - the STCW Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed. The minimum standards of competence required for seagoing personnel are given in detail in a series of tables in Part A of the Code; and ▪ The Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) – these regulations apply to vessels navigating on the sea, this includes displacement craft, non-displacement craft, wing-in-ground-effect and seaplanes. The purpose of the regulation is the prevention of collisions between two or more vessels. These Conventions mitigate many of the hazards and risks that occur during ship operations, and as such it is important to note in any maritime navigational risk assessment that navigation risk mitigation is already in place, which is frequently sufficient to mitigate hazards to an acceptable level. In order to manage collision risk and minimise disruption to mariners and other users of the sea, safety zones for construction, major maintenance and eventual decommissioning phases will be considered and applied if identified through the NRA process following industry best practice (for example; using UK MCA guidance in MGN 371, and the UK Department of Energy and Climate Change (DECC) guidance entitled 'applying for safety zones around offshore renewable energy installations'). In respect of collision risk, the following specific mitigation measures have been identified for each phase of the development: ▪ Survey vessels - compliance with COLREGS, planning and timing of surveys; ▪ Construction/Decommissioning - marine information dissemination (Notices to Mariners), ensure mariners are aware of proposed works via the issue of chart update, compliance with COLREGS, safe working zones around plant and installation vessels; the possible use of guard boats depending on the outcome of the Navigation Risk Assessment; ; ▪ Cable laying - marine information dissemination (Notices to Mariners), ensure mariners are aware of proposed works via the issue of chart update, compliance with COLREGS, safe working zones around cable laying vessels, the possible use of guard boats depending on the outcome of the Navigation Risk Assessment; and ▪ Operation - site specific planning to minimise collision risk, site selection to identify vessel routes, appropriate buoyage, possible use of safety zones for the operational phase.
Changes to commercial shipping movements	No mitigation
Effects on small craft navigation	▪ Navigational Risk Assessment (NRA) following industry best practice (for example; using UK MCA guidance in MGN 371) ▪ Hydrographic surveys to accurately establish depths and clearances over devices and quantify any effect on local tidal streams and directions
Potential for mooring lines to become a navigational hazard	▪ Marine information dissemination to National charting agencies ▪ Where appropriate establishing safety zones ▪ Compliance with COLREGS

Impact Pathway	Mitigation
Potential for any marker buoys to become a navigational hazard	▪ Marking of devices use the guidance given in the IALA Recommendation 'O-139' on the Marking of Man-Made Offshore Structures (IALA, 2008) ▪ Trinity House guidance on 'provision and maintenance of aids to local navigation', regular maintenance by renewable site operators is required to ensure markers are properly lit, maintained and checked
Increased/ altered steaming times and distances	▪ Detailed site specific assessment of shipping traffic to determine most appropriate location for development ▪ Spatial planning can remove significant interactions ▪ Avoidance of areas where there is risk of major disturbance to shipping traffic ▪ Avoid development in shipping routes of importance to international and inter island navigation
Reduced visibility when barges and construction equipment obstruct views	▪ Marine information dissemination (Notices to Mariners) ▪ Ensure mariners are aware of proposed works via the issue of chart update
Potential for equipment parts to become detached from devices	▪ Regular maintenance of devices part of operator licensing
Lighting on the structure causing confusion to passing vessels	▪ Marine information dissemination (Notices to Mariners) ▪ Ensure mariners are aware of proposed works via the issue of chart update
Changes to risk management and emergency responses	▪ Navigational Risk Assessment (NRA) following industry best practice (for example; using UK MCA guidance in MGN 371) ▪ Review by the Coastguard of rescue provision, including monitoring capability (such as radar and/or AIS) to ensure operational commitments can be met
Cable route risk in respect of vessel anchoring, burial depth and cable protection	▪ Navigational Risk Assessment (NRA) following industry best practice (for example; using UK MCA guidance in MGN 371) ▪ Ensure mariners are aware of cable routeing with issue of chart updates

7.3.2.14 Residual impact

The mitigation measures identified in Section 7.3.2.13 could manage and reduce the potential impacts of the Draft Plan, thereby resulting in a lower level of residual impact. It should be noted that the impact pathway receptor of 'increased/altered steaming times and distances' is inevitable if developments overlap with navigation routes. Spatial planning can reduce the deviation, but cannot remove it. Therefore this impact is assessed at the worst credible level and assumes that mitigation has not reduced its level of significance.

Furthermore, it is not possible with any level of certainty to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on project specific factors. The significance of potential residual impacts have been estimated and are summarised in Table 39.

7.3.2.15 Summary

Table 39. Assessment of the potential effects of the Draft Plan on commercial and recreational shipping and navigation

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Collision risk	N-L	L-M	L-M	Minor/Insignificant	-	I-
		Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
	Construction	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Potential for mooring lines to become a navigational hazard	N-L	M	L-M	Minor/Insignificant	-	-
		Potential for any marker buoys to become a navigational hazard	N-L	L	L-M	Minor/Insignificant	-	-
		Increased/altered steaming times and distances	L-M	M	L-M	Insignificant to Moderate	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency response	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Operation	Collision risk	L-H	L-M	L-M	Major-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
		Effects on small craft navigation	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Potential for mooring lines to become a navigational hazard	N-L	M	L-M	Minor/Insignificant	-	-
		Potential for any marker buoys to become a navigational hazard	N-L	L	L-M	Minor/Insignificant	-	-
		Increased/altered steaming times and distances	N-L	M	L-M	Minor/Insignificant	-	-
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Potential for Structures and Cabling to Interfere with Navigational Equipment	N-L	L	L-M	Minor/Insignificant	-	-
		Potential for equipment parts to become detached from devices	N-l	L	L-M	Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Insignificant	-	-
		Changes to risk management and emergency response	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Potential for mooring lines to become a navigational hazard	N-L	M	L-M	Minor/Insignificant	-	-
		Potential for any marker buoys to become a navigational hazard	N-L	L	L-M	Minor/Insignificant	-	-
		Increased/altered steaming times and distances	L-M	M	L-M	Insignificant to Moderate	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency response	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
Cable Routeing	Survey	Collision risk	N-L	L-M	L-M	Minor/Insignificant	-	I-
		Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
	Construction	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Increased/altered steaming times and distances	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	I-
		Changes to risk management and emergency response	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Operation	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
		Increased/altered steaming times and distances	N-L	M	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency responses	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Cable route risk in respect of vessel anchoring, burial depth and cable protection	L-M	M	L-M	Minor/Insignificant	-	-
	Decommissioning	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
		Increased/altered steaming times and distances	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency response	N-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
Offshore Substations	Construction	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Increased/altered steaming times and distances	L-M	M	L-M	Insignificant to Moderate	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Lighting of tidal works and structures causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency response	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Operation	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
		Effects on small craft navigation	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Increased/altered steaming times and distances	L-M	M	L-M	Insignificant to Moderate	Section 7.3.2.13	Insignificant to Moderate
		Lighting on the structure causing confusion to passing vessels	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency responses	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Decommissioning	Collision risk	L-M	L-M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Effects on small craft navigation	M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
		Increased/altered steaming times and distances	L-M	M	L-M	Moderate to Insignificant	Section 7.3.2.13	Insignificant to Moderate
		Reduced visibility when barges and construction equipment obstruct views	N-L	L	L-M	Minor/Insignificant	-	-
		Changes to risk management and emergency response	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Onshore Substation	Construction	Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Operation	Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
	Decommissioning	Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
Onshore Wind Turbine	Construction	Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant
	Operation	Changes to commercial shipping movements	N-L	M	L-M	Minor/Insignificant	-	-
	Decommissioning	Changes to commercial shipping movements	L-M	M	L-M	Moderate-Insignificant	Section 7.3.2.13	Minor/Insignificant

N Negligible
L Low
M Medium/moderate
H High

7.4 Infrastructure

7.4.1 Baseline Description

The current section describes infrastructure associated with agricultural, commercial and public buildings and public utility facilities on the island (for cables, pipelines and grid connectivity see Section 7.1 and infrastructure associated with transport and traffic see Section 7.9).

Land use zones and their associated facilities are documented in the Land Use Plan (States of Alderney, 2011a; Figure 21) that forms the basis for all new planning applications on Alderney. The Land Use Plan distinguishes between the so-called Designated Area and the Building Area. The Building Area is broken down into eighteen zones and allows for certain construction, extension and renovation works within the limits set out in the Land Use Plan, although discourages such activities within important wildlife habitats within the Building Area. The Designated Area is broken down into six zones with a presumption against development (States of Alderney, 2011). The six zones of the Designated Area and associated infrastructure within each zone are (from AEA, 2011):

- Agricultural zone: the central, north-western and southern parts of the island are mainly used for agricultural purposes. Facilities include farms, greenhouses, agricultural and fishing stores, stables, barns and animal sheds.
- Commercial/Industrial: facilities within this zone are few in number and size. Three facilities are categorised as light industrial; two sheds of Berry's Quarry in the north-east, Ronez Asphalt Production Plant in the north and Platte Saline Gravel Works in the north-west. The rest are hospitality and catering facilities.
- Protected zone: encompasses biologically important terrestrial, freshwater and marine habitats and archaeologically important sites and areas. No development is permitted within this zone unless approved by the Building and Development Control Committee in order to restore or protect a feature or aspect of the Protected Zone.
- Public Utilities zone: facilities include water pumping station, waste treatment and disposal unit, an airport guidance station, civil emergency unit, cemeteries, a slaughterhouse, a TV mast and satellite dish, reservoirs, the lighthouse and the island's power station at the Glacis site, adjacent to Braye harbour. A number of power substations are present around Alderney
- Recreational zone: mainly located around the northern and north-eastern part of the island, recreational facilities are found amongst agricultural and protected zones. Facilities include a football pitch, golf courses, mini-railway and lines, a railway shed, tennis and squash courts and common recreational areas. Facilities within the Recreational Zone are considered further in the Recreation and Tourism Section (Section 7.5). Alderney Railway also runs through the recreational zone, from the harbour to Mannez Quarry in the north-east of the island, operational on Sundays from Easter until September and UK Bank Holidays.
- Residential zone: much of the residential housing on Alderney is situated within the Building Area, although there is a limited residential zone within the Designated Areas to the north of the island.

Figure 21 presents a detailed breakdown of land use and terrestrial infrastructure on Alderney.

7.4.1.1 Future baseline

Due to the limited land resource on the island, the “no development” scenario prevails on most of the island with restrictions from the Building and Development Control Committee. Developments permitted within the Building Area must be consistent with the original designation of the area. Although there is a presumption against development in the Designated Area, some development activities are permitted. Such activities include:

- Cultivation/production of crops, rearing of livestock, fish and crustacean on a commercial basis. Developments are only permitted for the purpose of “appropriate agricultural business”.
- Hospitality, catering, retail and wholesale, workshops, offices and storage areas. Only renovations or rebuilds that do not increase existing total ground floor area and building height are permitted.
- No development unless approved by Committee in order to restore/protect a feature.
- Facilities for providing electricity supply, water, sewerage, waste/rubbish disposal, telecommunications or other public services.
- Recreational facilities.
- Housing and associated facilities.

The above list simply identifies areas of possible future development on Alderney (which by no means are certainties to be taken any further). However, more importantly it indicates the type of developments the local authority feel the island is capable of providing

Planning permission has been granted for the construction of six new houses at Platte Saline, although due to public objection the project has been postponed until a need for new accommodation on the island has been proven. Nevertheless, in the absence of any known significant land or marine developments that are proposed on Alderney or its territorial waters, it is considered that there is unlikely to be any substantial change in associated infrastructure. The developer will need to confirm whether there are any other development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.4.1.2 Limitations and data gaps

There is limited information available on plans for future development of infrastructure on Alderney. There is currently a lack of information on the proposed landfall sites of the tidal device export cables in Alderney and France, other than that identified in Figure 1, to the south-east of the island. Updated information on the location of infrastructure may be required for EIA project level.

7.4.1.3 Study area

Given the uncertainties in the Draft Plan regarding the exact location of onshore cables or substations, the full extent of the study area will need to take account of the entire island, although it is expected that the export power cable associated with Project 1 (The Race) will run ashore on the south-east coast of Alderney. Additionally, it is assumed that the construction of an onshore substation will be necessary infrastructure for the project, although the exact location of this is currently unconfirmed. It is presumed that a 200m x 120m substation will be constructed (based on the London Array offshore windfarm for AC cables) within Mannez Quarry to the east of the island (AEA, 2007). A larger substation may, however, be necessary which would require additional space, particularly if a DC-AC convertor is required.

7.4.2 Impact Assessment

The Draft Plan has the potential to affect the infrastructure of the study area through a number of impact pathways which are assessed in the following sections:

- Cable Crossing Requirements with Existing Marine and/or Terrestrial Infrastructure (Section 7.4.2.1);
- Direct Damage to Existing Terrestrial Infrastructure (Section 7.4.2.2); and
- Reduced Access to Existing Infrastructure for Maintenance or Repair Activity Collision Risk (Section 7.4.2.3).

The importance of infrastructure is considered moderate based on the use and implication of any loss of infrastructure. No highly sensitive infrastructure is identified and all infrastructure is considered built to a suitable standard following best practice measures. Sensitivity is therefore considered to be moderate throughout this assessment.

7.4.2.1 Cable crossing requirements with existing marine and/or terrestrial infrastructure

Cable crossing requirements with existing marine and/or terrestrial infrastructure may be required during the operation of cable routeing. Cable crossing agreements may therefore require or the removal and replacement of infrastructure if no alternative cable route is available.

As discussed in Section 7.1.2.1, Alderney has an onshore network of buried electricity cables (some sections above ground) (Figure 24) that may intersect with the offshore power cable. This is generally controlled and regulated by the organisation that is responsible for the existing network, and any connection requirements would therefore need to be negotiated with AEL (ARE, 2011).

It is recommended that cable routeing follows already existing road and cable routes to minimise disturbance, and impacts to terrestrial infrastructure are likely to be minimal. Additionally considering the onshore substation for a single tidal array is expected to be developed within the Mannez Quarry site, the exposure to change to other terrestrial infrastructure on the island is considered negligible resulting in an insignificant impact. Additional onshore substations may be required for the full build out of the Draft Plan (a minimum of four onshore substations/converter stations, see Section 2.2.2), which would result in a large area of land required, particularly if an HVDC converter station is required. Given the limited infrastructure on Alderney, the exposure to change if all these onshore substations are required is considered to be low resulting in a minor adverse impact.

7.4.2.2 Direct damage to existing terrestrial infrastructure

Direct damage to existing terrestrial infrastructure and associated economic impact may arise from the construction, operation and decommissioning of the onshore substation and wind turbine. For example the planned construction of the substation in Mannez Quarry may potentially impact the Alderney Railway line and station at the quarry. However there is limited infrastructure on Alderney and it is considered likely all infrastructure can be avoided. Exposure to change is therefore considered negligible to low resulting in a minor adverse/insignificant impact.

7.4.2.3 Reduced access to existing infrastructure for maintenance or repair activity

The construction, operation and decommissioning of the onshore substation and onshore wind turbine have the potential to reduce access to existing terrestrial infrastructure for important maintenance or repair activity.

However it is considered the positioning of the onshore substation and turbines can be considered during detailed design in order to avoid reducing access to existing infrastructure or in order to ensure access to existing infrastructure is maintained. Assuming a worst case scenario that changes or alternative access to existing infrastructure may be required exposure to change is considered negligible to low resulting in a minor adverse/insignificant impact.

7.4.2.4 Mitigation

Given that none of the impacts on infrastructure are significantly adverse (i.e. moderate or major), no mitigation measures are considered to be necessary. However it is recognised that impacts can be mitigated by avoiding infrastructure at the project planning and design phase or replacing where necessary.

7.4.2.5 Residual impact

Given that no mitigation measures are required for Infrastructure, the residual impact has not been assessed. The significance of potential impacts has been estimated and summarised in Table 40.

7.4.2.6 Summary

Table 40. Assessment of the potential effects of the Draft Plan on infrastructure

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Cable Routeing	Operation	Cable crossing requirements with existing marine and/or terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
Onshore Substation	Construction	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-
	Operation	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-
	Decommissioning	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-
Onshore Wind Turbine	Construction	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-
	Operation	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-
	Decommissioning	Direct damage to existing terrestrial infrastructure	N-L	M	M	Minor/Insignificant	-	-
		Reduced access to existing infrastructure for maintenance or repair activity	N-L	M	M	Minor/Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

7.5 Recreation and Tourism

7.5.1 Baseline Description

After Jersey and Guernsey, Alderney is the third largest and most northerly inhabited island of the Channel Islands. The main town on Alderney is St Anne (often referred to as St Anne's) which is where the majority of the island's permanent residents are located and also the local Parish. Tourism, particularly during the summer months, is one of the key industries on Alderney. There are a wide range of tourist activities available, including cultural, natural and sporting attractions (ARE, 2009). Alderney's airport (south west) and harbour (north) facilitate transport to the island, with flights and ferries connecting Alderney to the south coast of England, France and other Channel Islands. No regular public transport services operate on Alderney, primarily attributed to the restricted seasonal nature of demand (ARE, 2008). However, the necessity for accommodation and catering services as a direct result of the tourism industry helps to maintain a considerable number of guesthouses, restaurants and public houses on the island (AEA, 2007).

Statistics from the 2009 tourism season have shown that walking, historical/heritage sightseeing and local natural history (flora, fauna and birds) are the main attractions for visitors to the island, followed by photography, cuisine, cycling, camping, fishing, painting, golf, weddings, tennis and sailing (Parmentier, 2010). Another survey was conducted in 2011 to help better understand the economic, social and environmental profile of Alderney (Alderney Economic Strategy Plan)[13]. The survey highlighted that beaches and sea activities (30%), the natural beauty of Alderney (26%) and peace and quiet (22%) were the top three key visitor attractions in 2011 (August and September). The vast majority of visitors to the island originate from the United Kingdom (72%) followed by mainland Europe (18%) and Guernsey (10%). Nevertheless, the report also highlighted the "contraction of the Island's tourism sector" which strongly relies upon transport links, accommodation and hospitality. A large proportion of visitors fly to Alderney, particularly from Southampton; however, the total number of airport passenger movements has steadily declined between 2007 (79,087) and 2012 (63,694) and many visitors to Alderney have stated travel costs were expensive (States of Alderney, 2013).

Nature-related tourism activities (i.e. wildlife-watching) are popular on the island and include walking tours (organised by Alderney Wildlife Trust and the Alderney Society)[14,15] and boat-based seal and bird watching tours (local businessman). Within its 2,000 acres, the island of Alderney has woodland, scrub and wetland, grassland and heathland, beautiful gardens, sandy beaches and rocky shores (States of Alderney website)[16]. The Ramsar site to the west and north of Alderney (Alderney West Coast and the Burhou Islands, see Section 5.6.1) is the main region for seal and bird watching. The Longis Nature Reserve, which encompasses Longis Bay along the south east coast, is also known for migratory birds and there is a dedicated bird hide on Longis Common (ARE, 2009).

13 http://alderney.gov.gg/CHttpHandler.ashx?id=79815&p=0 [Accessed Apr 2013].
14 http://www.alderneywildlife.org [Accessed Apr 2013]
15 http://www.alderneysociety.org [Accessed Apr 2013]
16 http://www.alderney.gov.gg/article/4294/Natural-Environment [Accessed May 2013]

Alderney is also pioneering the Living Islands programme, which has been created in conjunction with the British Wildlife Trusts. Led by the Alderney Wildlife Trust, the programme is working with islanders to:

- Establish the link between the natural and heritage environment and its economic value highlighting the importance of both the natural environment and also the island's built heritage;
- Integrate many aspects of island life into the conservation of both wildlife on the island and in the seas around it and the island's history which stretches over 12,000 years of human habitation; and
- Substantially deepen the involvement of island communities in direct conservation activity.

There are more than 50 miles of walks and paths on the island incorporating various commons, beaches, cliffs and around the town of St Anne. Many of Alderney's beaches are ideal for various water sports, particularly fishing, windsurfing and surfing (AEA, 2007). Longis beach is a popular beach destination for both tourists and local residents (ARE, 2009), suitable for sunbathing, swimming and rock pooling (Visit Alderney website)[17].

Local sports and leisure clubs offer a wide array of recreational activities such as golf, cycling, sailing, scuba diving, horse riding and tennis (AEA, 2007). Recreational areas on Alderney are mainly located in the northern and north-eastern part of the island, described in the Alderney Land Use Plan (States of Alderney, 2011) as the 'Recreational Zone' together with common recreational areas (AEA, 2007). The Recreational Zone includes a football pitch, golf courses, the railway, a railway shed and tennis and squash courts. According to the 2012 States of Alderney Future Economic Planning Roadmap, the busiest dates of the tourist season correspond to several long running events, namely Alderney Week, the Angling Festival, the Alderney Golf Open, the Alderney Hill Climb and Sprint and the Air Race Weekend (States of Alderney, 2012).

Recreational boating and yachting is also a popular activity around Alderney (see Section 7.3), although it is uncommon in The Race given the high tidal streams (hence, the area is considered for possible future tidal developments). It is not necessary to acquire fishing permits along the Alderney coastline or within the harbour, and chartered sea angling excursions take place within the island's territorial waters. The wrecks around Alderney are a popular location for recreational angling (also see Section 7.2) and scuba diving; however, ARE (2009) noted that there are no public records to suggest either of these activities are undertaken at wreck sites within The Race. The potential for elevated underwater noise levels associated with energy generation could be considered a disturbance to participants of recreational diving and swimming activities (also refer to Section 7.6). Furthermore, secondary effect could result through displacement of terrestrial and marine wildlife which, in turn, could lead to a reduction in nature observations and similar recreational activities.

[17] http://www.visitalderney.com [Accessed Apr 2013]

7.5.1.1 Future baseline

The 2012 States of Alderney Future Economic Planning Roadmap (Alderney, 2012) highlights numerous avenues of interest for which the local authority may aim to develop within the tourism industry. For example, construction of a casino to support the current hub of internet-based gambling associated with the island is a possibility. Other areas that are to be considered for development or improvement (Alderney, 2012) include the following:

- Open water swimming;
- Road cycling and mountain biking;
- Triathlon;
- Power boating and sailing regattas;
- Sea kayaking and canoeing;
- Military history;
- "Pot of Gold" style treasure hunts;
- Dark skies policy for sky parties; and
- Shooting events.

The above list simply identifies areas of possible future investment on Alderney (which by no means are certainties to be taken any further). However, more importantly in the scope of this report, it indicates the type of activities the local authority feel the island is capable of providing and highlights the resources which are considered the island's most attractive features; the importance of access to the marine environment (e.g. swimming, kayaking, canoeing and sailing) is particularly relevant. Also, the development of stronger links (transport, publicity, etc.) with neighbours France and the other Channel Islands is a priority to offset Alderney's reliance upon visitors from the United Kingdom (Alderney, 2012).

It is therefore considered that the importance of recreation and tourism is likely to increase in the long-term.

7.5.1.2 Limitations and data gaps

There are no existing records on the number of visitors or the value of tourism to Alderney that may be affected by the Draft Plan. The main data gaps where developers may need to invest in additional survey data collection to inform the socio-economic assessment (taking account of other information that will be required to inform other aspects of the EIA) include:

- Water sports activities, through site-based surveys; and
- Social impacts (understanding community perceptions and values).

7.5.1.3 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of offshore tidal devices, onshore cables or wind turbine), the full extent of the study area will need to take account of the entire island and its territorial waters.

7.5.2 Impact Assessment

The Draft Plan has the potential to affect recreation and tourism in the study area through a number of impact pathways which are assessed in the following sections:

- Sea/Land Use Conflicts of Interest and Access Issues (Section 7.5.2.1);
- Public Safety (Section 7.5.2.2);
- Damage of and/or Alteration to Existing Infrastructure (Section 7.5.2.3);
- Decrease in the Recreational Quality of the Environment (Section 7.5.2.4);
- Underwater Noise Affecting Recreational Diving or Swimming (Section 7.5.2.5); and
- Changes to the Local Economy (Section 7.5.2.6).

Repeat visitors are vital to the sustainability of the tourism industry on Alderney (in August and September 2011, two out of five visitors had previously visited Alderney)[18]. Also, the current economic climate has heightened the demand for good value for money when considering vacation destinations. Given the significance of the tourism industry to the island's economy, the importance of recreation and tourism receptors is considered to be high.

7.5.2.1 Sea/land use conflicts of interest and access issues

Sea/land use conflict of interest and access may occur during construction, maintenance and decommissioning activities of all developments (cable routeing, onshore wind turbine and tidal stream devices, offshore substation and onshore substation) such as if safety zones are put around construction areas preventing access. Therefore, conflicts of interest and access issues could occur due to other uses of the designated project area; for example, this may include kayaking, surfing, windsurfing, sailing, offshore fishing, diving (marine activities), walking, bird-watching, camping and onshore fishing (terrestrial activities) amongst others. The marine environment is considered less likely to have effects than terrestrial. This is because the potential footprint of marine developments with recreational activities is considered smaller than terrestrial and due to conditions where developments are likely to be located (e.g. up to 11 knots in The Race; ARE, 2009). Nevertheless, it is likely that designation of any effects including safety zones would be short term in duration. Exposure is considered to be low at worst and impacts assessed as **minor adverse/insignificant**.

Onshore construction activities will result in alterations to existing land forms and may be considered unpleasant in comparison to the current landscape (see Section 7.8). The beaches and natural beauty of the island are important features for the tourism industry on Alderney, along with peace and quiet; all of which could be disrupted, perhaps irreversibly, by such developments. Furthermore, areas of land may be temporarily closed to the public during construction, maintenance and decommissioning, restricting certain recreational activities (e.g. walking and cycling). It is assumed that if substantial permanent effects such as footpath closure are required then diversions would be put in place. The level of change is dependent on numerous factors including the specific location. Exposure to change is therefore considered to be low to moderate, and impacts assessed as **insignificant to moderate adverse**.

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18 http://alderney.gov.gg/CHttpHandler.ashx?id=79815&p=0 [Accessed Apr 2013].

7.5.2.2 Public safety

The overarching issue associated with public safety relates to the overlap between recreational activities and all elements of the Draft Plan (for impacts relating to noise and air see Sections 7.6 and 7.7 respectively). Best practice measures such as the designation of safety zones and the use of guard vessels in the marine environment would help to ensure public safety during construction, maintenance/operation and decommissioning, whilst providing adequate barriers and warning of the electrical and mechanical dangers of onshore facilities. Exposure to change is therefore considered to be negligible to low and impacts are assessed as **minor adverse/insignificant.**

7.5.2.3 Damage of and/or alteration to existing infrastructure

Sections of road may need to be excavated in order to lay export cables, connecting offshore and onshore devices to substations. Some roads may also need to be re-designed and/or strengthened to support the prospective developments as heavy goods vehicles and machinery will need to be on-site during construction, maintenance and decommissioning phases. Due to the limited infrastructure on Alderney exposure to change is considered to be low at worst and impacts are assessed as **minor adverse/insignificant.**

7.5.2.4 Decrease in the recreational quality of the environment

The draft plan has the potential to affect the recreational quality of the environment. The exposure to change is dependent on factors such as the distance of recreational activities from developments, the number and proportion of permanent features visible and the loss or addition of key components of the landscape and seascape (see also Section 7.8). For example tidal stream turbines are likely to be fully submerged while navigational markers or lighting are the only surface piercing features expected. There is also the potential for displacement of ecological features e.g. birds and marine mammals (see Sections 5.4 and 5.5 respectively), with a knock on effect on wildlife tourism. Overall, exposure to change is considered to be low at worst for tidal stream devices resulting in an **insignificant to minor adverse** impact, but medium for permanent offshore substations for marine aspects resulting in an **insignificant to moderate adverse** impact.

With regards to the onshore substation, this has currently been proposed to be within the Mannez Quarry, which will provide a certain degree of screening from the public and is considered unlikely to affect recreation, therefore the exposure to change is considered to be low resulting in an **insignificant to moderate adverse** impact. Additional onshore substations may be required for the full build out of the Draft Plan (a minimum of four onshore substations/converter stations, see Section 2.2.2), which would result in a large area of land required, particularly if an HVDC converter station is required. The exposure to change if all these onshore substations are required is considered to be medium to high, depending on where they are located on Alderney, resulting in a **moderate to major adverse** impact.

The location of a possible onshore wind turbine is unknown and although the structures have a relatively small and well defined footprint, given the potentially short distance to human receptors and recreational activities such as walking for operation the exposure to change is considered to be medium. Impacts are assessed as **insignificant to moderate adverse** impact.

7.5.2.5 Underwater noise affecting recreational diving or swimming

Noise generated during construction and decommissioning of tidal turbines, cable routeing and offshore substations has the potential to effect recreational divers and swimmers. The exposure to change is largely dependent on the distance from recreational activities and the construction and decommissioning methods used. Cable methods are considered unlikely to result in substantially more noise than that created by other vessel movements. The methods for tidal stream turbines in particular have the potential to use piling machinery which is considered to use machinery which is more likely to generate noise, however considering best practice measures for reducing and assessing noise and the likely distance from recreational diving and swimming activities, exposure to change is negligible to low. Impacts are assessed as **minor adverse/insignificant.**

7.5.2.6 Changes to the local economy

Tourism is one of the major industries on Alderney and, as such, any adverse effects that deter tourists and recreational activities as a result of the Draft Plan could be damaging to the local economy. Whilst the scale and location of the Draft plan is undefined it is considered unlikely to be of a scale that will result in substantial effects on the local economy. There is also a potential for increased job availability on Alderney to support the developments which would counteract any minor effects and potentially result in a positive effect on the local economy overall. Exposure to change is therefore considered negligible. Impacts are assessed as **insignificant.**

7.5.2.7 Mitigation

The following mitigation measures will need to be considered at the project-level by the developer to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on recreation and tourism:

- Best practice measures such as publicising the developments and any associated diversions during construction; and
- Careful consideration of the extent, number and layout of infrastructure to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development (also see Section 7.8).

7.5.2.8 Residual impact

The mitigation measures identified in Section 7.5.2.7 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on recreation and tourism, as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 41 below.

7.5.2.9 Summary

Table 41. Assessment of the potential effects of the Draft Plan on recreation and tourism

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
	Operation	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
	Decommissioning	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
Cable Routeing	Construction	Sea/land use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
	Operation	Sea/land use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
	Decommissioning	Sea/land use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-L	M	H	Minor/Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
Offshore Substations	Construction	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Minor/Insignificant	-	-
	Operation	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-
	Decommissioning	Sea use conflicts of interest and access issues	N-L	M	H	Minor/Insignificant	-	-
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Underwater noise affecting recreational diving or swimming	N-L	M	H	Minor/Insignificant	-	-
		Changes to the local economy	N	M	H	Insignificant	-	-
Onshore Substation	Construction	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-H	M	H	Major to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-
	Operation	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-H	M	H	Major to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-
	Decommissioning	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-H	M	H	Major to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Onshore Wind Turbine	Construction	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-
	Operation	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N-L	M	H	Insignificant	-	-
	Decommissioning	Land use conflicts of interest and access issues	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Public safety	N-L	M	H	Minor/Insignificant	-	-
		Damage of and/or alteration to existing infrastructure	N-L	M	H	Minor/Insignificant	-	-
		Decrease in the recreational quality of the environment	N-M	M	H	Moderate to Insignificant	Section 7.5.2.7	Minor/Insignificant
		Changes to the local economy	N	M	H	Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

7.6 Noise

This section outlines the effects specifically concerning human receptors of noise associated with prospective renewable energy generation developments on Alderney. Baseline information is provided in Section 7.6.1 and the potential impacts are assessed in Section 7.6.2.

7.6.1 Baseline Description

Noise is typically defined as an unwanted sound event, with some noises considered disturbing in terms of their effect(s) on receptors. During planning procedures, any potentially unpleasant noise can lead to distress from residents, local people and businesses (including those reliant on recreation and tourism activities, see Section 7.5). However, there are currently no quantifiable datasets available regarding present day noise levels on Alderney, primarily attributed to the lack of major sources of noise on the island (ARE, 2011). With regards to prospective energy generation developments on Alderney, particularly those planning to harness wind (onshore) and tidal (offshore) energy, there are numerous potential sources of noise that should be addressed. For example, this includes (but is not limited to) increased traffic levels and construction, operation, maintenance and decommissioning activities. Thus, the possible effects of noise on the terrestrial and marine environment (e.g. marine mammals, invertebrates, birds) should be reasonably addressed during each EIA process. This section focuses on likely human receptors of noise; refer to Sections 5.3, 5.4 and 5.5 for information relating to the possible effects of noise on fish and shellfish, ornithology and marine mammals, respectively.

The human environment is typically terrestrial, but can also overlap marine settings; therefore, humans can be considered susceptible to noise inputs from both land and sea. However, humans are predominantly land-based and time spent at sea is generally transient in nature (GREC, 2011). In general, noise sensitive (human) receptors are likely to include schools, hospitals, places of worship and other community facilities (EMEC and Xodus AURORA, 2010). Potential noise sensitive receptors in Alderney include residential dwellings, farms, parkland and conservation areas, industrial, commercial shopping and traffic areas, public buildings (offices, libraries, museums) and the Glacis recycling centre near Crabby (the latter highlighted through consultation) (ARE, 2008). As well as spatial considerations, the sensitivity of receptors may also be linked to temporal factors; particularly should works be planned for unsociable times. The primary sources of anthropogenic noise on Alderney include the electricity generating station, road traffic, air traffic (i.e. aircraft) and shipping/boat traffic. Natural causes also add to ambient noise levels on Alderney, including wind, tides, waves, precipitation and biologically originated (e.g. birds, terrestrial mammals and insects) (GREC, 2011). Despite no data sources being identified on current noise levels on Alderney, source levels would be expected to represent typical rural coastal environments.

There are numerous British and international standards related to the effect of noise on human receptors that may be pertinent to wind and tidal energy developments on Alderney (EMEC and Xodus AURORA, 2010), some of which are listed below:

- British Standard 4142 (BS 4142): Method for rating industrial noise affecting mixed residential and industrial areas;
- British Standard 5228 (BS 5228): Noise and vibration control on construction and open sites;
- British Standard 7445 (BS 7445): Description and measurement of environmental noise;
- British Standard 8233 (BS 8233): Sound installation and noise reduction for buildings - Code of practice;
- Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere (ISO 9613-1);
- Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation (ISO 9613-2); and
- Calculation of Road Traffic Noise, Department of Transport, Welsh Office, Her Majesty's Stationary Office, 1988.

It has recently been reported that noise associated with wind turbines could be harmful to humans, particularly with regards to disturbed sleeping patterns (Hanning and Evans, 2012). Furthermore, the report suggested that wind turbines, either built individually or as part of a group (i.e. wind farm), can be positioned close enough to residential dwellings under current guidelines to cause health problems and recommends that further independent reviews are necessary (also see Harrison, 2011). Thus, it is not simply a case of developers calculating the physical noise that may be produced by prospective developments, but also considering the potential physiological implications as well. In order to best manage potential conflicts, it is advised that developers discuss the possible issues with local authorities, namely the States of Alderney, at an early stage.

7.6.1.1 Future baseline

In the absence of any other known significant land or marine development that is proposed on Alderney or its territorial waters, it is considered that there is unlikely to be any change in ambient noise above current levels. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.6.1.2 Limitations and data gaps

There are no existing acoustic survey records for onshore areas that may be affected by the Draft Plan. Therefore, further work at the project level will involve identifying the scope of baseline surveys to determine normal background levels of noise at identified locations.

7.6.1.3 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of offshore tidal devices, substations, onshore cables or wind turbine), the full extent of the study area will need to take account of the entire island and its territorial waters.

7.6.2 Impact Assessment

To facilitate an accurate assessment of the potential impacts of noise generated from prospective wind and tidal energy developments on Alderney, it will be necessary for developers to carefully consider the various stages of the project separately. In general, this will include the construction, operation, maintenance and decommissioning of the proposed development. It should be appreciated that noise levels could vary considerably between these stages and associated traffic increases are likely to result and must be factored into the assessment. Furthermore, the proximity, volume, frequency and duration of such noises will be crucial to understanding the significance on sensitive human receptors.

The Draft Plan has the potential to affect existing noise levels in the study area through a number of impact pathways which are assessed in the following sections:

- Noise Associated with Increased Shipping Traffic (Section 7.6.2.1);
- Noise Associated with Construction Activities (Section 7.6.2.2);
- Noise During Operation (Section 7.6.2.3);
- Noise Associated with Maintenance Activities (Section 7.6.2.4); and
- Noise Associated with Decommissioning Activities (Section 7.6.2.5).

Background noise on Alderney is considered to be limited based on the sparsely population environment. Sensitivity of human receptors to noise impacts is therefore considered to be moderate for all pathways except construction of the onshore wind turbine where piling and associated machinery may be high. In light of possible health concerns attributed to disturbance from noise, the overall importance of noise impacts on human receptors is considered to be low moderate to high.

7.6.2.1 Noise associated with increased shipping traffic

Increased shipping traffic and associated noise may occur during the construction, operation and decommissioning stages of tidal stream turbines, cable routing and offshore substations. The type of vessels used may contribute to an increase in ambient noise levels, with engine size, efficiency and sound propagation characteristics key contributing factors. Further indirect effects could result, including the displacement of other shipping/boating activities from the project area to other areas around Alderney which may lead to an increased level of ambient noise (e.g. other ships may need to pass closer to land). Also, increased shipping noise may detract marine wildlife from the area, impacting the recreation and tourism industry and have further ecological effects (See Fish and Shellfish Section 5.3.2.3, Ornithology Section 5.4.2.3, Marine Mammals and Turtles Section 5.5.2.3, Nature Conservation 5.6.2.3 and Terrestrial Ecology 5.7.2.3). However shipping traffic is not considered to increase substantially above baseline levels and therefore no associated noise is anticipated on human receptors. Exposure to change is therefore considered low at worst, and impacts are assessed as **minor adverse/insignificant.**

7.6.2.2 Noise associated with construction activities

Noise has the potential to increase during the construction of tidal stream turbines, cable routing, offshore substations, onshore substations and an onshore wind turbine. However in general, constructional noise effects are short-term and localised in nature.

The noise associated with the construction depends on numerous factors such as proximity to human receptors, the design, location of the development and machinery used. For instance, gravity-based structures are favourable given their relatively quick deployment time and limited requirement for excavation (i.e. drilling and piling). If piling is necessary, significant noise levels could be produced. Some localised noise may also be expected during the transportation and installation of equipment, although this is unlikely to create high levels of continuous noise (GREC, 2011). Exposure to changes is considered low at worst resulting in a **minor/insignificant adverse impact** for all developments except the onshore wind turbine. For the onshore wind turbine due to the potential for piling exposure to change is considered medium at worst resulting in an **insignificant to major adverse impact.**

7.6.2.3 Noise during operation

There is the potential for noise to increase during the operation of tidal stream turbines, offshore substations, onshore substations and onshore wind turbine (ARE, 2008; GREC, 2011). Offshore tidal devices, especially those that are fully submerged and further offshore, are considered unlikely to increase the ambient noise levels above natural wave and tidal levels received by human receptors on land. It is possible that tidal devices which partially breach the surface and the offshore substations may increase noise levels due to irregular water displacement; however, this would only be noticeable in close proximity to the device and, thus, would not impact humans on the island. Overall, exposure to change from the offshore tidal devices and offshore substations is considered negligible and impacts associated with operational noise are assessed as **insignificant.**

At many substations, transformers are installed and these can generate a low frequency noise which could affect human receptors. Detection of the noise generated by substations can depend on numerous factors, including how the noise is produced, the type of transformer and the frequency at which the noise is emitted. The effects on human receptors include (amongst others) annoyance, stress, irritation, unease, fatigue, headache, nausea and disturbed sleep (GREC, 2011). Exposure to change from the onshore substations is considered low to medium and impacts associated with operational noise are assessed as **insignificant to moderate adverse.**

Two types of noise are generated by wind energy generation: mechanical (i.e. the movement of turbine blades and internal components) and aerodynamic (i.e. air-foil turbulence) noise. Noise associated with the operation of wind farms has been examined by The Working Group on Noise from Wind Turbines. This group was commissioned by the Energy Technology Support Unit, an agency of the Department of Trade and Industry (DTI) to provide information and advice to developers and planners regarding noise from wind turbines. Exposure to change from the onshore wind devices is considered negligible to low and impacts associated with operational noise are assessed as **insignificant to minor adverse.**

7.6.2.4 Noise associated with maintenance activities

Noise has the potential to increase during the maintenance of tidal stream turbines, cable routing, offshore substations, onshore substations and the onshore wind turbine. However in general, noise effects from maintenance are short-term and localised in nature. The primary source of noise during the maintenance of tidal devices originates from increased shipping activity; see the pathway above for noise impacts associated with shipping traffic (Section 7.6.2.1). Another source of noise could be in relation to the lifting of tidal devices from the seabed for servicing procedures.

In terms of wind energy, whilst regular maintenance is likely to be required (as defined by the manufacturer's manual), this is consider to involve additional noise from mobile cranes and HCV vehicle movements to site with replacement parts. However all background noise levels are unlikely to increase substantially and therefore exposure to change is considered negligible to low and impacts are assessed as **minor adverse/insignificant**.

7.6.2.5 Noise associated with decommissioning activities

An increase in shipping traffic and, by analogy, shipping noise is likely to occur during decommissioning, similar to levels experienced during installation and maintenance of tidal devices. See the pathway above for impacts associated with increased shipping traffic (Section 7.6.2.1). Depending on how a tidal device is fixed to the seabed, there is potential for explosives to be used in order to release the structure in order to be fully removed. Should this be the case, it is highly likely to have an effect on human receptors in terms of noise impact, albeit short term in duration. Alternatively, tidal devices may be left on the seabed if they are not considered to pose any significant adverse effect(s) in the future. Similarly Wind energy decommissioning may involve removing the main foundation base which may result in similar impacts. Overall, it is considered that noise levels during decommissioning will be similar to or less than those experienced during construction activities impacts associated with decommissioning noise. Exposure to changes is considered low at worst resulting in an **insignificant to minor adverse impact.**

7.6.2.6 Mitigation

The following mitigation measures will need to be considered at the project-level by the developer to minimise any potentially significant (i.e. moderate or major) noise impacts of the Draft Plan:

- Perform construction works on the onshore wind turbine during week days and daylight (social) hours;
- Fit or source plant with sound reduction equipment;
- Use screening, enclosures and mufflers to help buffer percussive piling noise;
- Investigate methods to improve sound insulation of substations; and
- Situate substations away from population centres.

7.6.2.7 Residual impact

The mitigation measures identified in Section 7.6.2.6 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on noise levels, as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 42 below.

7.6.2.8 Summary

Table 42. Assessment of the potential effects of the Draft Plan on noise

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with construction activities	N-L	M	M-H	Minor/Insignificant	-	-
	Operation	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with maintenance activities	N-L	M	M-H	Minor/Insignificant	-	-
		Noise during operation	N	M	M-H	Insignificant	-	-
	Decommissioning	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with decommissioning activities	N-L	M	M-H	Minor/Insignificant	-	-
Cable Routeing	Construction	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with construction activities	N-L	M	M-H	Minor/Insignificant	-	-
	Operation	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with maintenance activities	N-L	M	M-H	Minor/Insignificant	-	-
Offshore Substations	Construction	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with construction activities	N-L	M	M-H	Minor/Insignificant	-	-
	Operation	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with maintenance activities	N-L	M	M-H	Minor/Insignificant	-	-
		Noise during operation	N	M	M-H	Insignificant	-	-
	Decommissioning	Noise associated with increased shipping traffic	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with decommissioning activities	N-L	M	M-H	Minor/Insignificant	-	-
Onshore Substation	Construction	Noise associated with construction activities	N-L	M	M-H	Minor/Insignificant	-	-
	Operation	Noise during operation	L-M	M	M-H	Insignificant to moderate	Section 7.6.2.6	Minor/Insignificant
		Noise associated with maintenance activities	N-L	M	M-H	Minor/Insignificant	-	-
	Decommissioning	Noise associated with decommissioning activities	N-L	M	M-H	Minor/Insignificant	-	-
Onshore Wind Turbine	Construction	Noise associated with construction activities	N-M	H	M-H	Major to Insignificant	Section 7.6.2.6	Minor/Insignificant
	Operation	Noise during operation	N-L	M	M-H	Minor/Insignificant	-	-
		Noise associated with maintenance activities	N-L	M	M-H	Minor/Insignificant	-	-
	Decommissioning	Noise associated with decommissioning activities	N-L	M	M-H	Minor/Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

7.7 Air Quality

This section outlines the effects on air quality associated with prospective renewable energy generation developments on Alderney. Baseline information is provided in Section 7.7.1 and the potential impacts are assessed in Section 7.7.2.

7.7.1 Baseline Description

Air quality is of fundamental importance given the obligatory interaction with humans and other living organisms. At present, there are no data available on air quality levels for the Draft Plan area. However, air quality would be expected to be good reflecting the lack of significant point sources of emissions and low density of vehicular traffic on the island. Air pollution levels along the south coast of the United Kingdom are currently low, specifically for the coastal locations of Plymouth (2), Bournemouth (3), Southampton (2) and Portsmouth (2) (index levels 1 to 3 are considered low); this low index indicates that the effects of air pollution are unlikely to be noticed by individuals that are sensitive to airborne pollutants (UK Air Quality Archive website - interactive map)[19].

Air quality standards are devised in order to protect the health of the public. The following three air quality standard documents are of specific relevance to the Draft Plan:

- European Commission (2008)[20] - Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe;
- United Kingdom Secretary of State (2010)[21] - The Air Quality Standards Regulations 2010; and
- States of Guernsey (2010)[22] - Air Quality in Guernsey: Screening and Assessment Document, March 2010.

Many of the standards in the above documents outline long-term air quality objectives. This ensures current scientific knowledge on the effects of each pollutant on human health and the environment are taken into account whilst providing a point of reference for future levels (GREC, 2011). A summary of current European Commission air quality standards are provided in Table 43; note that the United Kingdom's air quality standards adhere to these regulations and, in some cases, set out more stringent objectives.

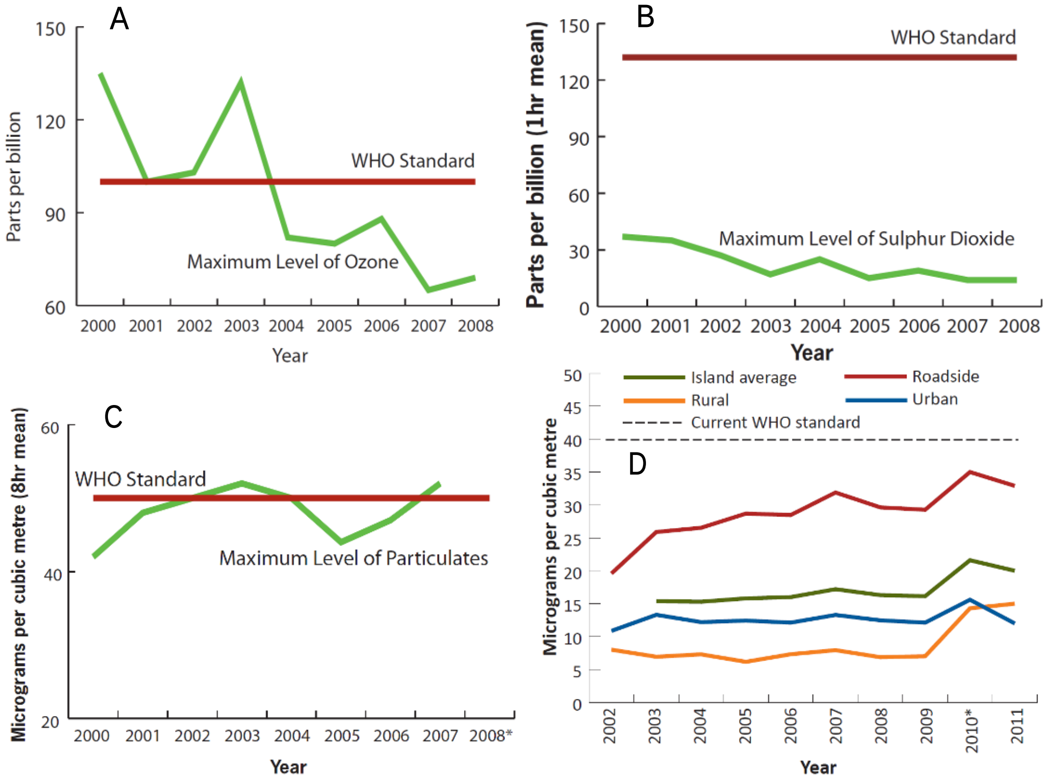
19 http://uk-air.defra.gov.uk/interactive-map [Accessed May 2013]
20 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF [Accessed May 2013]
21 http://www.legislation.gov.uk/uksi/2010/1001/pdfs/uksi_20101001_en.pdf [Accessed May 2013]
22 http://www.sustainableguernsey.info/blog/wp-content/uploads/2010/07/2010-M03-Guernsey-Air-Quality-Screening-and-Assessment-2010.pdf [Accessed May 2013]

Table 43. Summary of air quality standards set by the European Commission (2008)

Pollutant	Concentration	Averaging Period	Permitted Exceedences Each Year
Particles (PM_{10})	50 µg m^{-3}	24 hours	35
	40 µg m^{-3}	1 year	n/a
Particles ($PM_{2.5}$)	25 µg m^{-3}	1 year	n/a
Sulphur dioxide (SO_2)	350 µg m^{-3}	1 hour	24
	125 µg m^{-3}	24 hours	3
Nitrogen dioxide (NO_2)	200 µg m^{-3}	1 hour	18
	40 µg m^{-3}	1 year	n/a
Lead (Pb)	0.5 µg m^{-3}	1 year	n/a
Carbon monoxide (CO)	10 mg m^{-3}	Max daily 8 hour mean	n/a
Benzene (C_6H_6)	5 µg m^{-3}	1 year	25 days averaged over 3 years
Ozone (O_3)	120 µg m^{-3}	Max daily 8 hour mean	n/a
Arsenic (As)	6 ng m^{-3}	1 year	n/a
Cadmium (Cd)	5 ng m^{-3}	1 year	n/a
Nickel (Ni)	20 ng m^{-3}	1 year	n/a
Polycyclic Aromatic Hydrocarbons (PAH)	1 ng m^{-3}*	1 year	n/a
Units: mg = 1 x 10^{-3} grams; µg = 1 x 10^{-6} grams; ng = 1 x 10^{-9} grams.			

It is a reasonable assumption that air quality measurements on Guernsey would be similar to those experienced on Alderney. Air quality has been monitored on Guernsey since 1992 by the States of Guernsey Health and Social Services, with certain pollutant levels reported annually in a 'Guernsey Facts and Figures' document. Measurements are collected from various terrestrial locations on Guernsey, including urban and rural settings; no air quality measurements are taken from the marine environment (GREC, 2011). According to the 2009 report (States of Guernsey, 2009), the maximum annual level of ozone decreased between 2000 and 2008 (Image 6A). Furthermore, the atmospheric concentration of ozone, a by-product of fossil fuel combustion, decreased below the standard set by the World Health Organisation (WHO) after 2004. The maximum level of sulphur dioxide (SO_2) on Guernsey has remained well below the WHO standard throughout the same duration. In contrast, particulate concentrations have fluctuated above and below the WHO standard between 2000 and 2007 (Image 6B).

The most recent Guernsey Facts and Figures report (States of Guernsey, 2012) provides additional information regarding maximum annual occurrence of nitrogen dioxide (NO_2) between 2002 and 2011 (Image 6D). During this period, roadside measurements of nitrogen dioxide were relatively high (and showed fairly consistent increases year on year) compared to rural values and the overall average for Guernsey. Nitrogen dioxide is a greenhouse gas generated from the combustion of fossil fuels (principally by motor vehicles) which, along with other nitrogen oxides, contributes to acid rain, depletion of the atmospheric ozone layer and can have detrimental effects on health (WHO, 2003). Nevertheless, the annual average nitrogen dioxide concentration on Guernsey throughout the monitoring period has consistently been lower than 40 µg m^{-3}; a guideline set by WHO regarding the maximum acceptable concentration to protect the public from chronic exposures to other pollutants typically associated with nitrogen dioxide (States of Guernsey, 2012).



(Figures from Guernsey Facts and Figures 2009 (A-C) and 2012 (D))

Image 6. Maximum annual levels of (A) ozone (O_3), (B) particulates, (C) sulphur dioxide (SO_2) and (D) nitrogen dioxide (NO_2) recorded on Guernsey and the World Health Organisation (WHO) standards

In the past, airborne concentrations of lead (Pb) have been closely monitored and factored into considerations of air quality on Guernsey; however, atmospheric levels have significantly decreased since the quantity of lead was reduced in petrol and the subsequent introduction of unleaded petrol (GREC, 2011). Consequently, atmospheric concentrations of lead on Guernsey are generally well below the standard set by the European Commission (0.5 µg m^{-3} annual average). The chemical compounds benzene (C_6H_6) and 1,3-butadiene (C_4H_6) are connected with emissions from motor vehicles, both of which have associated health risks. Neither is typically monitored on Guernsey, but atmospheric concentrations are not considered to be high (GREC, 2011).

Overall, air quality on Guernsey is considered to be good, with the primary source of pollutants originating from road traffic. Through comparison, it is likely that the greatest source of impurities on Alderney will also be linked to motor vehicles. However, given the relative size of Alderney compared to Guernsey and, by analogy, the reduced total level of motor emissions, it is likely that air quality on Alderney will be better than for Guernsey. Other sources of pollutants on Alderney are the power station, located in the southwest, and aircraft traffic flying to and from the island. It could be argued that an increased reliance upon renewable energy sources compared to the present combustion of fossil fuels would have a positive impact on air quality around Alderney.

7.7.1.1 Future baseline

In the absence of any other known significant land or marine development that is proposed on Alderney or its territorial waters, it is considered that there is unlikely to be any change in air quality from current levels. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.7.1.2 Limitations and data gaps

There are no existing air quality records for onshore areas that may be affected by the Draft Plan. Therefore, further work at the project level will involve identifying the scope of baseline surveys to determine normal background levels in terms of air quality, particularly for landside works.

7.7.1.3 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of offshore tidal devices, onshore cables or wind turbine), the full extent of the study area will need to take account of the entire island and its territorial waters.

7.7.2 Impact Assessment

The Draft Plan has the potential to affect the air quality of the study area through a number of impact pathways which are assessed in the following sections:

- Emissions from Marine Vessels (Section 7.7.2.1);
- Emissions from Road Traffic and Non-Road Mobile Machinery (NRMM) (Section 7.7.2.2); and
- Generation of Airborne Dust (Section 7.7.2.3).

This assessment considers the sensitivity of features to be moderate based on the current good air quality on Alderney and its territorial waters. Based on the potential implications of air quality on the health of the environmental, importance is considered to be high.

7.7.2.1 Emissions from marine vessels

The construction, operation and decommissioning stages of tidal stream turbine, cable routing and offshore substations have the potential to increase vessels and resulting increased emissions. There is no historical information available regarding air quality on Alderney and this is also the case with respect to the surrounding marine environment. At present, the predicted main sources of pollutants are likely to be from marine traffic, including the fishing fleet, pleasure craft and heavy commercial vessels (GREC, 2011). Most international shipping uses low grade residual fuel which generates carbon dioxide (CO_2), nitrogen oxide (NOx) and sulphur oxide (SOx), which are all greenhouse gasses. The European Directive 2005/33/EC has changed the fuel oil sulphur controls for ships in order to improve air quality near ports. Under the Directive, the maximum allowable sulphur content of fuel oil used by ships at berth in EU ports will be 0.1% by mass.

This assessment considers that vessel movements and associated emissions are likely to increase temporarily during all phases of development. An increase in vessel movements is likely to occur during operation as part of maintenance requirements, however construction and decommissioning is considered to have the potential for more vessel movements. However, all vessel movements associated with the Draft Plan are not considered to be significant enough to result in a substantial change to the current air quality. Exposure to change is considered to be low at worse during construction and decommissioning and negligible during operation resulting in a minor adverse/insignificant impact.

7.7.2.2 Emissions from road traffic and non-road mobile machinery (NRMM)

The construction, operation and decommissioning of onshore substations and onshore wind turbines is likely to result in infrequent and short-term increases in vehicle emissions, specifically from increases in traffic for transporting people, parts and machinery (as discussed in Section 7.9). However, all vehicle movements associated with the Draft Plan are not considered to be substantial enough to result in a noticeable change in air quality. Exposure to change is therefore considered negligible to low resulting in a minor adverse/insignificant impact.

7.7.2.3 Generation of airborne dust

Increases in vehicles have the potential to generate infrequent and short-term dust emissions, and additional vehicle emissions specifically from increases in traffic and plant during construction, decommissioning and maintenance. The effect will be dependent on factors such as the weather and surrounding environment. The effects have the potential to be more substantial near sensitive receptors such as residential areas. However no substantial increases in vehicles and associated airborne dust is anticipated and any exposure will be temporary. Exposure to change is therefore considered to be negligible to low resulting in a minor adverse/insignificant impact.

7.7.2.4 Mitigation

Given that none of the impacts on air quality are significantly adverse (i.e. moderate or major), no mitigation measures are considered to be necessary.

7.7.2.5 Residual impact

Given that no mitigation measures are required for air quality, the residual impact has not been assessed. The significance of potential impacts has been estimated and summarised in Table 44.

7.7.2.6 Summary

Table 44. Assessment of the potential effects of the Draft Plan on air quality

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Construction	Emissions from marine vessels	N-L	M	H	Minor/Insignificant	-	-
	Operation	Emissions from marine vessels	N	M	H	Insignificant	-	-
	Decommissioning	Emissions from marine vessels	N-L	M	H	Minor/Insignificant	-	-
Cable Routeing	Construction	Emissions from marine vessels	N-L	M	H	Minor/Insignificant	-	-
		Emissions from road traffic and NRMM	N	M	H	Insignificant	-	-
		Generation of airborne dust	N	M	H	Insignificant	-	-
	Operation	Emissions from marine vessels	N	M	H	Insignificant	-	-
		Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
	Decommissioning	Emissions from marine vessels	N	M	H	Insignificant	-	-
		Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
Offshore Substations	Construction	Emissions from marine vessels	N-L	M	H	Minor/Insignificant	-	-
	Operation	Emissions from marine vessels	N	M	H	Insignificant	-	-
	Decommissioning	Emissions from marine vessels	N-L	M	H	Minor/Insignificant	-	-
Onshore Substation	Construction	Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
		Generation of airborne dust	N-L	M	H	Minor/Insignificant	-	-
	Operation	Emissions from road traffic and NRMM	N	M	H	Insignificant	-	-
	Decommissioning	Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
Onshore Wind Turbine	Construction	Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
		Generation of airborne dust	N	M	H	Insignificant	-	-
	Operation	Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-
	Decommissioning	Emissions from road traffic and NRMM	N-L	M	H	Minor/Insignificant	-	-

N Negligible
L Low
M Medium/moderate
H High

7.8 Landscape and Seascape

7.8.1 Baseline Description

Alderney is similar to the other Channel Islands in having sheer cliffs broken by stretches of sandy beach and dunes. Trees are rather scarce, as many were cut down in the 17th Century to fuel the lighthouses on Alderney and the Casquets. Those trees that remain include cabbage trees and there are some small woods dotted about the island. The main town in Alderney, St Anne, features an imposing church and an unevenly cobbled high street. Other settlements include Braye, Newtown, Longis, Crabby and Mannez.

The Alderney Land Use Plan (States of Alderney, 2011a) sets out conditions for potential land use within specific zones on the island. The location of these zones is shown in Figure 21. Although no specific landscape character assessment has been undertaken for Alderney, there are conditions within several of the zones, to 'maintain the character and landscape value', or the 'visual amenity' of that zone. These are as follows:

- Zone 2A: Grand Hotel Site: This is area is reserved for residential development including social housing. Consideration should be given to the effect of any proposal on the skyline;
- Zone 2B: Area Adjacent to Butes Lane: Any development is to be low density residential. Consideration should be given to the effect of any proposal on the skyline;
- Zone 6: Existing Ribbon Development to the South-east of Routes Carrieres - Infill low-density development only. Plans for new dwellings should demonstrate that the dwelling fits in with the topography of the site and its existing wooded landscape, and include landscape proposals for the finished project;
- Zone 7C: Inner Harbour: The Inner Harbour, including the surrounding lower quays, is of historic importance to the island and currently used by local commercial fishing and boating interests. It includes a bunkering service and chandlers on the Quay together with fishermen's huts and related local Marine interests. Any future development will be required to recognise the importance of retaining the visual appearance of this area to prevent any physical changes which may detract from the present historical environment;
- Zone 8: Fort Zone: Any development is to be sympathetic to the location and visual impact of the fort, and should recognize and protect the special features of each fort and its location. Non-development of a fort is also an option. Any proposed development is to respect the topography of the site and its surroundings and include landscape proposals for the finished project. Special consideration should be given to the effect of any proposal on the skyline;
- Zone 10B: Middle Slopes of Cotil du Val: Development shall not occur on land above the 40 metre contour line. The ridge height of any development should not be above the 45 metre contour. No property will have direct vehicular access onto Newtown Road. New roads and services will be required as outlined in the Cotil du Val Design Guide (SPG). The presence of mature trees in this Zone is important to minimize the impact of development and to preserve the natural appearance of the hillside. Existing mature trees should be retained as part of any development plan;

- **Zone 10C: Area Bounded by Fontaine David, Braye Road and the Northern Property Boundary of Audeville Estate:** Low density development only. Plans for new dwellings should demonstrate that the dwelling is in keeping with the topography of the site and its existing wooded landscape;
- **Zone 14A: Land Adjacent to Le Petit Val:** Any development is to be medium density. Consideration should be given to the effect of any proposal on the skyline;
- **Zone 14C: Land Adjacent to Rue de La Saline:** Any development is to be medium density. Consideration should be given to the effect of any proposal on the skyline;
- **Zone 15: Val Field (To the West of and Adjacent to Le Val):** Any development should be in keeping with the current townscape/ landscape of St Anne and include some significant benefit for the community;
- **Zone 19: Berry's Quarry:** This area is reserved for the development of business and industrial uses. The site will be sufficiently screened to minimise any adverse effect on the character of the area and any proposal is to be accompanied by full landscape and planting plans. The site will be properly laid out with buildings, parking, access and open storage areas designed to be in sympathy with the landscape character of the area; and
- **Zone 20: Whitegates (South Side):** This area is reserved for future provision of social housing, including the replacement of the demolished housing on the north side of the road. The overall development plan and individual plans for new dwellings should demonstrate that the proposed development fits in with the topography of the site and its surround, and include landscape proposals for the finished project.

The 'Protected Zone' in the Alderney Land Use Plan, designed to protect areas of biological and archaeological importance are described further in Terrestrial Ecology Section 5.7 and Terrestrial Archaeology Section 6.2 respectively.

7.8.1.1 Future baseline

In the absence of any other known significant land or marine development that is proposed in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the landscape and seascape character of the area in the short to medium term. The developer will need to confirm whether there are any development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.8.1.2 Limitations and data gaps

No landscape character assessment currently exists for Alderney. The Alderney Land Use Plan provides some relevant information on the landscape and visual value of different areas (see Section 7.8.1).

At the project-level, it is recommended that developers consult with the States of Alderney at the earliest opportunity as this will help identify potential sensitivities and conflicts. The landscape and seascape impact assessment should refer to standard methodologies used in the UK, as set out in the Guidelines for Landscape and Visual Impact Assessment, produced by the Landscape Institute and the Institute of Environmental Management and Assessment (GLVIA, 2002). Desk based review and any fieldwork should cover the following in more detail:

- Landform and geological characteristics;
- Coastal shape and dynamics, nature of seascape;
- Relationship of coastline to hinterland, and coast to seascape;
- Vegetation pattern, extent and screening;
- Identification and understanding of human activity, trends and pressures on land and sea;
- Built development of settlement, houses, and other built infrastructure; and
- Designated or protected areas (biological and archaeological importance).

Developers may need to conduct a field survey to selected viewpoints identified during the baseline survey. At each selected point a photograph should be taken which can be used to create photomontages of the proposed development which will aid the assessment.

7.8.1.3 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of onshore cables or wind turbine), the full extent of the study area for landscape and seascape will need to take account of the entire island and its territorial waters.

7.8.2 Impact Assessment

The Draft Plan has the potential to affect the landscape and seascape character of the study area through a number of impact pathways (EMEC and Xodus AURORA, 2010). These are assessed in the following sections:

- Increased Traffic (Section 7.8.2.1);
- Lighting (Section 7.8.2.2);
- Requirements for Temporary Housing and Work Facilities (Section 7.8.2.3);
- Introduction of Permanent Feature (Section 7.8.2.4);
- Introduction of Regular Geometric, Man-Made Forms (Section 7.8.2.5);
- Change in Perception of Area (Section 7.8.2.6);
- Alterations to Existing Land Forms (Section 7.8.2.7);
- Construction of Access Roads and Piers (Section 7.8.2.8); and
- Changes in Land Cover and Land Use Patterns (Section 7.8.2.9).

The sensitivity of human receptors to the use of the disused Mannez Quarry for the onshore substation is considered to be medium given that it is lower than ground level and as such will be mostly screened from view. The precise location of other elements of the Draft Plan are currently unknown and given the overall low population, remoteness and the general openness of sea views on Alderney, the sensitivity of human receptors to any changes in the landscape and seascape character of the study area is considered as a worst case to be high.

Although the coastline is not unique in the Channel Islands or in Europe, it is protected in the Alderney Land Use Plan and is of value to those living and visiting Alderney. The landscape and seascape character of the coastline is therefore considered to be of moderate importance.

Other areas within the island and offshore, including the Mannez Quarry which is a brownfield site, are considered to be of low importance in terms of landscape and seascape value.

7.8.2.1 Increased traffic

The Draft Plan is likely to result in an increase in boat and road traffic during all phases of the development which could impact the existing landscape and seascape character of the study area.

This change is likely to be mostly temporary, occurring mainly during construction and decommissioning, with boat and road traffic levels decreasing slightly during operation, although still above baseline levels due to any maintenance requirements.

The exposure to changes in traffic tends to reduce with increasing distance from human receptors and therefore road traffic is considered to have a slightly greater visual exposure compared to marine traffic. Furthermore, the existing level of shipping normally seen in the vicinity of the island is relatively high (see Section 7.3.1) and therefore the exposure to visual change of a relatively small number of additional vessels is considered to be low resulting in an insignificant to moderate adverse impact.

7.8.2.2 Lighting

Lighting is likely to be required during construction and decommissioning of the Draft Plan. For the most part, construction will take place during the day and in good visibility where additional lighting is unlikely to be required. However, during adverse weather conditions (e.g. fog, heavy rain) and any evening or night time work, additional lighting is likely to be necessary.

During operation, the tidal stream turbines, will have navigational markers that will need to be lit. Other marine elements of the Draft Plan, namely the offshore substations, will need to be marked in accordance with the International Association of Lighthouse Authorities (IALA) standards. The onshore elements of the Draft Plan (onshore substation and wind turbine) will also require some lighting. The exposure to changes in lighting reduces with increasing distance from human receptors and therefore onshore lighting will result in a greater exposure to lighting than marine lighting. Although Alderney is relatively rural and the existing levels of light pollution are very low, the changes in lighting, particularly for the onshore elements of the Draft Plan are localised and, therefore the exposure to change is considered to be low, resulting in an insignificant to moderate adverse impact.

Cables are unlikely to require any navigational markers or lighting during operation and therefore there will be no change in exposure and in turn no visual impact.

7.8.2.3 Requirements for temporary housing and work facilities

Existing hotels and/or guest houses on Alderney may not be able to accommodate all external contractors and therefore there may be a need to provide temporary housing for work contractors during the construction and decommissioning phases of the Draft Plan. Work facilities may also be required during these phases of works. These additional buildings, although only of a temporary nature, will result in a potential visual impact. If these are exclusively located in the coastal 'Protected Zone' as outlined in the Alderney Land Use Plan, then they will have a greater potential impact compared to other inshore areas of the island. It is unlikely that all elements of the Draft Plan will take place at the same time and therefore the number of workmen and facility requirements is likely to be relatively small. Overall, the exposure to change is considered to be low resulting in an **insignificant to moderate adverse** impact.

7.8.2.4 Introduction of permanent feature

There are a number of ways in which the tidal stream arrays, offshore and onshore substations, and onshore wind turbine may impact on the landscape and seascape resource during operation. The scale and form of the permanent features could prove inappropriate and intrusive in the context of the existing landscape and seascape, or could involve the loss or fragmentation of important and distinctive landscape and seascape components. In addition, the introduction of permanent features in protected areas defined in the Alderney Land Use Plan could affect the integrity of a national resource.

The exposure to change is largely dependent on the distance from the development, the number and proportion of permanent features visible and the loss or addition of key components of the landscape and seascape, and issues relating to the aspect, lighting and weather on changes perception of the landscape and seascape character.

With regard to tidal stream turbines, these will be fully submerged during operation and the only surface piercing features will be any navigational markers and lighting requirements and therefore the exposure to change is considered to be low resulting in an **insignificant to minor adverse** impact at worst.

The offshore substations will be a permanent feature that have a height above the water surface of around 14m[23]. Given that these structures are likely to be within visible range from Alderney (less than 10km distance) and that a number of these will be required for proposed tidal stream development (up to a maximum of six for the full build out of the Draft Plan, see Section 2.2.2), the magnitude of exposure to change is considered to be medium to high in the context of the existing seascape resulting in a **moderate to major adverse** impact.

With regards to the onshore substation, this has been proposed to be within the Mannez Quarry, which will provide a certain degree of screening from the public and therefore the exposure to change is considered to be low resulting in an **insignificant** impact. Additional onshore substations may be required for the full build out of the Draft Plan (a minimum of four onshore substations/converter stations, see Section 2.2.2), which would result in a large area of land required, particularly if an HVDC converter station is required. The exposure to change if all these onshore substations are required is considered to be medium to high, depending on where they are located on Alderney, resulting in a **moderate to major adverse** impact.

23 Based on the topside height dimensions provided for Thanet substation on the 4C Offshore website.

The location of a possible onshore wind turbine is unknown and although the structure has a relatively small and well defined footprint, given the potentially short distance to human receptors and difficulty in screening, the exposure to change is considered to be medium resulting in a **moderate adverse** impact.

7.8.2.5 Introduction of regular geometric, man-made forms

A number of components to the Draft Plan will result in the permanent introduction of regular geometric, manmade structures in an otherwise natural, remote, wild or sparsely settled landscape/seascape. Given that the tidal turbine devices will be submerged and the only surface piercing features will be navigational markers or lighting, the exposure to change is considered to be low resulting in an **insignificant to minor adverse** impact.

Although spatially distinct, the offshore substations will result in a dominant man-made feature of the seascape and therefore the exposure to change is considered to be medium to high resulting in a **moderate to major adverse** impact.

The onshore substation for a single tidal array will be enclosed within the Mannez Quarry and therefore the exposure to change is considered to be low to existing residents and visitors to Alderney resulting in an **insignificant** impact. A minimum of four onshore substations/converter stations might be required for the full build out of the Draft Plan (see Section 2.2.2). This would result in a medium to high exposure to change and a **moderate to major adverse** impact.

With respect to the onshore wind turbine, the exposure to change is considered to be medium given that it is likely to be very visible on Alderney and a substantial change from the baseline landscape character. This will result in a **moderate adverse** impact.

7.8.2.6 Change in perception of area

Certain components of the Draft Plan will result in a change in the perception of the existing landscape and seascape during operation. The exposure to changes as a result of the tidal turbine devices is considered to be low given that they are submerged, any navigational markers or lighting requirements are only likely to be visible to the West where the horizon is not backlit by mainland France, and the frequency of any maintenance requirements (i.e. vessel movements, lifting of devices etc.) is anticipated to be rare and intermittent. This will result in an **insignificant to minor adverse** impact.

There maintenance activity associated with the offshore substations is likely to be of a similar scale and given their more visible nature, the exposure to change is considered to be medium resulting in a **moderate adverse** impact.

The perception of the area proposed for the onshore substation will change from a disused quarry to a more active, working landscape. However, given that the area is mostly enclosed and screened from the public, the exposure to change is considered to be low, resulting in an **insignificant** impact. In terms of the full build out of the Draft Plan, however, the exposure to change is considered to be medium to high, resulting in a **moderate to major adverse** impact.

The exposure to change brought about by the onshore wind turbine will to some extent be dependent on its location which is as yet unknown. Operational and maintenance activity required is likely to be minimal and therefore assuming a worst case scenario, the exposure to change is considered to be medium resulting in a **moderate adverse** impact.

7.8.2.7 Alterations to existing land forms

The construction activities associated with the cable routeing, onshore substation and wind turbine will result in alterations to existing land forms. In the case of the cable routeing, the installation of cables across the shore is likely to involve excavation and trenching, and as such there could be visible scarring of the shore (DTI, 2005). Given that the nature of the change will be short term and temporary, the exposure to change is considered to be low despite the possible proximity to sensitive human receptors resulting in an **insignificant to moderate adverse** impact.

Any bunding requirements for the onshore cables will result in a permanent, small change in the aspect and elevation of the existing land form (i.e. the coastal profile). The exposure level associated with this potential change is considered to be medium resulting in a **minor to moderate adverse** impact

The onshore substation will result in temporary and permanent changes to the existing land form during construction and operation respectively. The overall exposure is considered to be low, however, given that the proposed siting of the substation in the Mannez Quarry will be partially screened resulting in an **insignificant** impact. In terms of the full build out of the Draft Plan, however, the exposure to change is considered to be medium to high, resulting in a **moderate to major adverse** impact.

The change to the existing land form brought about by the onshore wind turbine is considered to be low during construction given the temporary nature of the change resulting in a **minor to moderate adverse** impact, and medium during operation given the permanent nature of the change resulting in a **moderate adverse** impact.

7.8.2.8 Construction of access roads and piers

It is likely that the onshore substation and wind turbine components to the Draft Plan will require the construction of new or upgrade of existing access roads and/or piers. With regard to the onshore substation, the existing contours of the land at the quarry location could be used to mask visual impacts of the access roads and therefore the exposure to change is considered to be low during both construction and operation resulting in a **minor to moderate adverse** impact. For the full build out of the Draft Plan, however, the exposure to change is considered to be medium, given the unknown and large area of land required for the onshore substations/converter stations. This will result in a **moderate adverse** impact. The exposure to change resulting from any access roads and/or piers required for the construction and operation of the onshore wind turbine will depend on the exact position of the device and the existing available infrastructure. Given that this information is currently unknown, the magnitude of the exposure is considered to be medium resulting in a moderate adverse impact.

7.8.2.9 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on landscape and seascape:

- Careful consideration of the extent, number and layout of tidal stream turbines and offshore substations to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development;
- Siting of onshore development to minimise effects on seascape and landscape character and on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible;
- Design of onshore development to fit with the scale and character of existing buildings and to minimise impacts on coastal features and on views;
- Use of existing infrastructure where possible, such as tracks and buildings, to avoid the introduction of new features; upgrading existing infrastructure where necessary;
- Screening of permanent features by planting (using native species), fencing or carefully designed earth bunds that relate to the coastal landforms of the site and its immediate context where appropriate;
- Reinstatement of vegetation following construction where temporary access tracks/compounds are required;
- Use of construction materials paying attention to their composition, texture, colour and form to blend into the surrounding landscape/seascape, including the use of local rock or stone; and
- Minimise lighting requirements, where possible, particularly in more remote landscapes and seascapes.

7.8.2.10 Residual impacts

The mitigation measures identified in Section 7.8.2.9 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on the landscape and seascape, as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 45.

7.8.2.11 Summary

Table 45. Assessment of the potential effects of the Draft Plan on landscape and seascape

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
	Construction	Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	L	Minor/ Insignificant	-	-
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
	Operation	Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Introduction of permanent features	L	H	L	Minor/ Insignificant	-	-
		Introduction of regular geometric, man-made forms	L	H	L	Minor/ Insignificant	-	-
		Lighting	L	H	L	Minor/ insignificant	-	-
		Change in perception of an area	L	H	L	Minor/ insignificant	-	-
	Decommissioning	Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	L	Minor/ insignificant	-	-
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
Cable Routeing	Survey Construction	Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Alterations to existing landforms	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
	Operation	Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Lighting	Negligible	H	L-M	Insignificant	-	-
		Alterations to existing landforms	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
	Decommissioning	Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
Offshore Substations	Survey	Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
	Construction	Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
	Operation	Introduction of permanent feature	M-H	H	M	Moderate to major	Section 7.8.2.9	Minor
		Introduction of regular geometric, man-made forms	M-H	H	M	Moderate to major	Section 7.8.2.9	Minor
		Increased boat/road traffic	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Change in perception of an area	M	H	M	Moderate	Section 7.8.2.9	Minor

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
	Decommissioning	Increased boat/road traffic	M	H	L-M	Moderate/ Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
Onshore Substation	Survey	Increased boat/road traffic	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
	Construction	Increased boat/road traffic	M	H	M	Moderate	Section 7.8.2.9	Minor
		Lighting	L	M	L	Insignificant	-	-
		Construction of access roads and piers	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Alterations to existing landforms	L-H	M	L-M	Insignificant to major	Section 7.8.2.9	Minor/Insignificant
	Operation	Introduction of permanent feature	L-H	M	L-M	Insignificant to major	Section 7.8.2.9	Minor/Insignificant
		Introduction of regular geometric, man-made forms	L-H	M	L-M	Insignificant to major	Section 7.8.2.9	Minor/Insignificant
		Increased boat/road traffic	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Lighting	L	M	L	Insignificant	-	-
		Construction of access roads and piers	L-M	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Alterations to existing landforms	L-H	M	L-M	Insignificant to major	Section 7.8.2.9	Minor/Insignificant
		Change in perception of an area	L-H	M	L-M	Insignificant to major	Section 7.8.2.9	Minor/Insignificant
	Decommissioning	Increased boat/road traffic	M	H	M	Moderate	Section 7.8.2.9	Minor
		Lighting	L	M	L	Insignificant	-	-
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
Onshore Wind Turbine	Survey	Increased boat/road traffic	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
	Construction	Increased boat/road traffic	M	H	M	Moderate	Section 7.8.2.9	Minor
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Construction of access roads and piers	M	H	M	Moderate	Section 7.8.2.9	Minor
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant
		Alterations to existing landforms	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
	Operation	Introduction of permanent feature	M	H	M	Moderate	Section 7.8.2.9	Minor
		Introduction of regular geometric, man-made forms	M	H	M	Moderate	Section 7.8.2.9	Minor
		Increased boat/road traffic	M	H	M	Moderate	Section 7.8.2.9	Minor
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Construction of access roads and piers	M	H	M	Moderate	Section 7.8.2.9	Minor
		Alterations to existing landforms	M	H	M	Moderate	Section 7.8.2.9	Minor
		Change in perception of an area	M	H	M	Moderate	Section 7.8.2.9	Minor
	Decommissioning	Increased boat/road traffic	M	H	M	Moderate	Section 7.8.2.9	Minor
		Lighting	L	H	M	Moderate/Minor	Section 7.8.2.9	Minor/Insignificant
		Requirements for temporary housing, work facilities	L	H	L-M	Moderate to insignificant	Section 7.8.2.9	Minor/Insignificant

N Negligible
L Low
M Medium/moderate
H High

7.9 Traffic and Transport

7.9.1 Baseline Description

There are no regular public services on Alderney and transport is primarily by taxi, car, motorcycle or bike. There are reportedly no traffic lights, no roundabouts and no traffic jams in Alderney (VisitAlderney Website).

There is also a railway on the island, which runs as a tourist attraction along a coastal route from the harbour up to the north east coast and operates on bank holidays and weekends during the summer season (i.e. Easter to end September).

Alderney Airport is the only airport on the island and is located south west of St Anne. Built in 1935, Alderney Airport was the first airport in the Channel Islands. Its facilities include a hangar, the Airport Fire Station and low cost, duty-free and tax-free Avgas refuelling. In 2011 the airport handled 64,165 passengers and 6,652 total air transport movements (comprising 6,628 passenger and 24 cargo aircraft), a decrease compared to previous years (Civil Aviation Authority, 2012). Passengers travelled by scheduled flights from Southampton, Guernsey, Jersey (via Guernsey) or private aircraft from the UK and Continent (Alderney Government website).

Alderney is unique amongst Channel Islands airports, in having three operational runways. The main runway, 08/26 is 880 m long and is mainly asphalt. The two secondary runways are both grass: 14/32 is 732 m long and 03/21 has a length of 497m. The main runway is equipped with low intensity lighting and portable lighting being available on runway 14/32. These runways are only opened seasonally/temporarily subject to weather conditions and required usage (i.e. number of flights).

Braye Harbour (also known as Alderney Harbour) is the main harbour on the island and is located on the north side of the Island of Alderney. It accommodates a passenger ferry from France and Guernsey and cargo vessels. It is also used by a small local fishing fleet and recreational boats (ARE, 2009). Further detailed baseline information is provided in the Commercial and Recreational Shipping and Navigation section (Section 7.3).

7.9.1.1 Future baseline

Alderney's population has declined steadily in recent years, according to data from Guernsey's Social Security Department (BBC News website). Figures from March 2011 showed 2,111 people lived in the island, a drop of nearly 200 compared with March 2007. This trend has continued with the latest Alderney Census indicating that the population was 1,903 at the end of April 2013. Since the last population census was conducted in 2001, the population has declined by 17% (Island Analysis, 2013). There are no known proposals to modify the existing road transport infrastructure on Alderney and, therefore, the overall trend in road traffic is anticipated to stay at least the same or decline slightly from present levels in the short to medium term.

Alderney Airport has been running at a loss for a number of years and representatives from Alderney Airport are planning to seek more autonomy over the running of the facility (BBC

News website). One of the options being considered is the downgrading of the airport. The number of aircraft passengers and air transport movements is, therefore, likely to continue to show a downward trend in the short to medium term.

In terms of marine traffic, there is a proposal to develop a marina in Braye Harbour (Yachting and Boating World website), which if approved may encourage more people to visit and use the harbour. The developer will need to confirm the status of these proposals and whether there are any other development proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

7.9.1.2 Limitations and data gaps

No data gaps or further work have been identified for the purposes of the REA.

At the project-level, developers will need to engage in early consultation with the States of Alderney to determine whether there are any potential issues, such as congested areas or forthcoming road works. Developers should undertake an initial desk-based assessment of the baseline traffic conditions in the development area. This assessment should highlight the main routes that the development will be serviced by and the number and types of vehicles that are likely to use this route. Sensitive receptors should also be identified. The States of Alderney may be able to supply data in relation to road use.

In order to assess the adequacy of the access routes to the site, developers may need to undertake a construction transport assessment. This will include a swept path analysis (to ensure free passage of large vehicles and loads along the route, around bends etc.) and a structural assessment of all roads and bridges. The assessment will need to include any plans for remedial or upgrading works required to facilitate safe access.

In assessing onshore traffic and transport it is important to consider the different survey methods available and select the most appropriate method for the survey area which will capture the data required if in fact a survey is needed. Survey methods include but are not necessarily limited to the following:

- Automatic traffic counts by pneumatic tube or radar;
- Manual traffic counts;
- Video traffic surveys - generally undertaken by consultancies using specialised video equipment;
- Pedestrian survey conducted by trained staff or video equipment;
- Questionnaire designed to gather selected data, such as preferred route and mode of transport;
- Journey time survey - conducted manually or using technology, such as GPS;
- Parking Survey; and
- Junction/roundabout turning counts which can be undertaken manually or using video equipment.

In assessing the significance of onshore traffic of a development at the EIA project-level, developers should refer to the Institute of Environmental Assessment Guidance (1993). This is considered to be the most authoritative, widely recognised and adopted best practice guide for traffic impact assessment in the EIA process, where the project itself is not a road traffic scheme (EMEC and Xodus AURORA, 2010). This guidance contains information on determining the magnitude and significance of environmental impacts of road traffic.

7.9.1.3 Study area

Given the uncertainties regarding the Draft Plan (e.g. exact location of onshore cables), the full extent of the study area for traffic and transport is considered to be limited to the location of existing transport infrastructure on the island. Marine traffic is fully covered in the Commercial and Recreational Shipping and Navigation section (Section 7.3).

7.9.2 Impact Assessment

The Draft Plan has the potential to affect traffic and transport in the study area through a number of impact pathways which are assessed in the following sections:

- Increased Traffic (Section 7.9.2.1);
- Increase in Size of Vehicles (Section 7.9.2.2);
- Increase in Size and Weight of Vehicle Loads (Section 7.9.2.3);
- Damage to Roads (Section 7.9.2.4);
- Traffic Congestion (Section 7.9.2.5);
- Potential Road Hazards (Section 7.9.2.6); and
- Creation of Dirt and Dust by Vehicles (Section 7.9.2.7).

The sensitivity of the traffic and transport receptors on Alderney are considered to be high given that the existing infrastructure comprise small aeroplanes and single lane roads primarily in low population/rural areas.

The existing infrastructure provides an amenity for a relatively low population (*circa* 2,000 inhabitants) and also the many visitors to the island. The main road network on the island comprises a circular route with various intersecting smaller roads and therefore it should be possible to use alternative routes if there is a need to avoid potential impacts arising from the Draft Plan. Taking all these considerations into account, the overall importance of traffic and transport receptors is considered to be low to moderate.

7.9.2.1 Increased traffic

The Draft Plan will result in an increase in road traffic on Alderney. This exposure to change is anticipated to be negligible during any pre-construction survey and maintenance work during the operational phase, resulting in an **insignificant** impact. The greatest magnitude of change will be experienced during construction and decommissioning phases, although the nature of the change will only be temporary lasting for the period of the proposed programme of works which is currently unknown. Additional onshore substations may be required for the full build out of the Draft Plan (a minimum of four onshore substations/converter stations, see Section 2.2.2), which are likely to involve a number of construction workers and associated traffic, particularly if an HVDC converter station is required. The exposure to change is anticipated to be moderate to high resulting in a **minor to moderate adverse** impact. .

It is considered unlikely that the existing level of air traffic would be affected by the Draft Plan, although there may be more demand for seats on planes to Alderney during certain phases of the Draft Plan, in particular the construction and decommissioning phases in which the highest number of workmen are anticipated to be required on site.

7.9.2.2 Increase in size of vehicles

There is likely to be an increase in the need to use heavy goods vehicles (HGVs) during the construction of certain onshore components of the Draft Plan, namely the shore and land-side cable routeing, onshore substation(s) and wind turbine. This would result in an increase in the mean size of vehicles using roads on Alderney. There is no information on the required number and types of vehicles at the plan-level stage, and therefore as a worst case the overall change in the exposure is considered to be medium to high, particularly if the full build out of the Draft Plan goes ahead (see Section 2.2.2), resulting in a **minor to moderate adverse** impact, given that it will only be temporary lasting for the duration of the proposed programme of works.

7.9.2.3 Increase in size and weight of vehicle loads

The construction of certain onshore components of the Draft Plan are likely to lead to an increase in the size and weight of loads being carried by vehicles, especially on rural roads (e.g. typical rural vehicles such as tractors and trailers may be used, but carrying far heavier loads than would be typical of normal use). Based on the existing level of uncertainty regarding the exact configuration of vehicles required for the full build out of the Draft Plan, the assessment has assumed that as a worst case the overall change in exposure will be medium to high resulting in a **minor to moderate adverse** impact.

7.9.2.4 Damage to roads

The increased use of heavy vehicles during the construction of onshore components of the full build out of the Draft Plan will increase the likelihood of road damage. Without the introduction of any mitigation measures, the exposure to change is considered to be medium to high, resulting in a **minor to moderate adverse** impact, given that the existing road infrastructure on Alderney consists of small single-lane roads.

7.9.2.5 Traffic congestion

The increase in the number of vehicles on the road during the construction of onshore components of the full build out of the Draft Plan has the potential to increase the likelihood for traffic congestion. The overall change in exposure, however, is considered to be low, resulting in an **insignificant to moderate adverse** impact given the existing low levels of traffic and the various alternative access routes that can be used to get across different parts of the island.

7.9.2.6 Potential road hazards

The increase in the number of vehicles on the road as a result of the full build out of the Draft Plan has the potential to increase the risk of road hazards such as equipment falling off HGVs. Without the use of best practice mitigation measures, the overall change in exposure is considered to be low and the impact is **insignificant to moderate adverse**.

7.9.2.7 Creation of dirt and dust by vehicles

As discussed in the Air Quality section (Section 7.7.2.3), increases in vehicles have the potential to generate infrequent and short-term dust emissions and spread dirt from site operations. The effect will be dependent on factors such as the weather and surrounding environment. This is considered to be most substantial near sensitive receptors such as residential areas. However no substantial increases in vehicles and associated dust and dirt is anticipated and any exposure will be temporary. Exposure to change is therefore considered to be negligible to low, and impacts assessed as **insignificant to moderate adverse**.

7.9.2.8 Mitigation

The following mitigation works will need to be applied at the EIA project-level by the developer, as appropriate, to minimise any potentially significant (i.e. moderate or major) impacts of the Draft Plan on traffic and transport:

- Preparation of a Traffic Management System (TMS) which details all of the mitigation measures proposed to be undertaken;
- Planned routes which will mean that development traffic avoids sensitive receptors or narrow sections of road (although this may not always be possible in rural areas);
- Widening of narrow sections of road or the introduction of passing places. Temporary widening should be fully considered where possible, including reinstatement options;
- Installation of a temporary road to avoid sensitive receptors such as a village centre;
- The developer is likely to be required to pre-agree to repair any damage caused to roads at the end of the project;
- Time separation between heavy goods vehicle (HGV) movements;
- The avoidance of peak traffic times;
- Monitoring of road damage;
- Increasing the number of axles of the vehicles used in order to reduce road damage and vibrations;
- Depending on the nature of works it may be necessary to install washing areas to prevent dirt and dust; and
- Loads may be covered and their size monitored.

7.9.2.9 Residual impact

The mitigation measures identified in Section 7.9.2.8 could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, it is not possible with any level of certainty, to determine the exact level of residual impact on the landscape and seascape, as the extent of mitigation achievable will be heavily dependent on many project specific factors. However, the significance of potential residual impacts have been estimated and summarised in Table 46.

7.9.2.10 Summary

Table 46. Assessment of the potential effects of the Draft Plan on traffic and transport

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
Tidal Stream Turbines	Survey	Increased traffic	N	H	L-M	Insignificant	-	-
	Construction	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
	Operation	Increased traffic	N	H	L-M	Insignificant	-	-
	Decommissioning	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
Cable Routeing	Survey	Increased traffic	N	H	L-M	Insignificant	-	-
	Construction	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size of vehicles	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size and weight of vehicle loads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Damage to roads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Traffic congestion	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Potential road hazards	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Creation of dirt and dust by vehicles	N-L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
	Operation	Increased traffic	N	H	L-M	Insignificant	-	-
	Decommissioning	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
Offshore Substations	Survey	Increased traffic	N	H	L-M	Insignificant	-	-
	Construction	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
	Operation	Increased traffic	N	H	L-M	Insignificant	-	-
	Decommissioning	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
Onshore Substation	Survey	Increased traffic	N	H	L-M	Insignificant	-	-
	Construction	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size of vehicles	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size and weight of vehicle loads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Damage to roads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Traffic congestion	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Potential road hazards	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Creation of dirt and dust by vehicles	N-L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
	Operation	Increased traffic	N	H	L-M	Insignificant	-	-
	Decommissioning	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
Onshore Wind Turbine	Survey	Increased traffic	N	H	L-M	Insignificant	-	-
	Construction	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size of vehicles	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Increase in size and weight of vehicle loads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor
		Damage to roads	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor

Development	Phase	Impact Pathway	Exposure to Change (Magnitude and Likelihood)	Sensitivity of Change	Importance of Feature	Significance	Mitigation	Residual Impact
		Traffic congestion	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Potential road hazards	L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
		Creation of dirt and dust by vehicles	N-L	H	L-M	Insignificant to moderate	Section 7.9.2.8	Insignificant to minor
	Operation	Increased traffic	N	H	L-M	Insignificant	-	-
	Decommissioning	Increased traffic	M	H	L-M	Minor/Moderate	Section 7.9.2.8	Insignificant to minor

N Negligible
L Low
M Medium/moderate
H High

8. Cumulative Effects

The consideration of cumulative impacts is included within various legislative frameworks and/or guidance of particular relevance to this REA. Cumulative impacts are referred to in the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) on the assessment of certain plans and programmes on the environment. The Directive requires information to be provided on "the likely significant impacts including cumulative and synergistic impacts… on the environment." Separately, the EC Habitats Directive (92/43/EEC) requires that where a plan or project is likely to have a significant effect on a Natura 2000 site, Special Areas of Conservation (SAC) designated under the Habitats Directive, or Special Protection Areas (SPA) classified under the EC Birds Directive (2009/147/EC codified version), either individually or in combination with other plans or projects, shall be subject to Appropriate Assessment (AA) (as part of an HRA) of its implications for the site, in view of the site's conservation objectives. In addition, the Commission's Guide to the Consents Process for obtaining a Licence in relation to renewable energy systems under the Renewable Energy (Alderney) Law 2007 (ACRE, 2011a; b), includes the consideration of cumulative impacts as part of any EIA.

This REA has taken a holistic approach to the consideration of cumulative impacts. The main cumulative impacts associated with the potential full build out of the Draft Plan alone have been considered separately within each of the relevant topic chapters. The full build out of the Draft Plan is assumed to potentially comprise the following (see Section 2.2.2):

- Approximately 4000 tidal turbines being installed in Alderney's territorial waters;
- A minimum of 367km of intra- and inter-array cabling;
- Approximately 30km cable routing for the export interconnector cable between Alderney and France;
- A minimum of four onshore substations/converter stations and/or six offshore substations; and
- One onshore wind turbine.

The tidal turbines are likely to be concentrated in the areas that have the highest flows and least constrained in terms of cost, physical constraints, environmental effects and grid connection. Should concurrent installations occur where there is a clustering of device arrays, the cumulative impacts could be of greater significance than if they are installed on separate occasions. The same applies if the installation of tidal device arrays is continuous over a longer period of time.

The influence of the totality of current and future human pressures on the environment (i.e. the potential overlap between direct and indirect impacts brought about by the Draft Plan and those resulting from other relevant plans, projects and activities) and the extent to which this might give rise to significant cumulative effects have been taken into account in this chapter. The study area for this cumulative impact assessment will need to encompass any pathways which connect the Draft Plan with other relevant plans, projects and/or activities. The extent of the study area will need to take account of the full mobile range of receptors (e.g. mobile species, movements of vessels) and where these receptors may overlap with the changes brought about by the Draft Plan in combination with other plans, projects and/or activities. Given these considerations, the relevant plans, projects and/or activities that have been identified at this stage as potentially having cumulative impacts with the Draft Plan are:

- The Britain to Alderney interconnector part of the FABLink project;
- West Normandy Marine Energy is helping to coordinate and support all the marine renewable energy projects within the Basse-Normandie region which includes current and future regional developments. Current proposed tidal developments on the French side of the Race (Raz Blanchard) are detailed below and have been included in the cumulative impact assessment.
- GDF SUEZ has signed an industrial partnership agreement with four companies to develop a pilot tidal project on the French side of the Race (Raz Blanchard). Industrial maintenance specialist Cofely Endel, turbine manufacturer Voith Hydro, French shipbuilder Constructions Mécaniques de Normandie and ACE1 are joining GDF for the 3MW to 12MW development. GDF is aiming to secure the required approvals in order to install the three-to-six-turbine plant by 2016. The partnership has already selected the HyTide turbine designed by the manufacturer Voith Hydro to equip all or part of this future pilot plant;
- French naval defence company DCNS proposes to put 10 tidal turbines into the French side of the Race (Raz Blanchard) by 2016;
- Guernsey's Renewable Energy Commission's (GREC, currently referred to as the Renewable Energy Team) plan for marine renewable energy in Guernsey, Sark and Herm Waters (GREC, 2011);
- The States of Guernsey (SoG) plan to extend the island's territorial waters (TW) from three to 12nm which will potentially increase the possibility of exploiting offshore wind and other marine renewable energy sources;
- Potential designation of Marine Protected Areas (MPAs) in the wider area, including for the Gulf of Normandy and Brittany by the Agence des Aires marines Protegees;
- Ongoing fishing activities - As discussed in Section 7.2.1.3, in the absence of any other known significant marine development that is proposed in Alderney and its territorial waters, it is considered that there is unlikely to be any change in the commercial fishing activity of the area in the short to medium term;
- Shipping activities; and
- Air travel - As discussed in Section 7.9.1.1 there is the potential that Alderney airport will be downgraded.

The developer will need to confirm the status of these plans, projects and activities and whether there are any additional proposals in the planning domain that would need to be taken into account as part of the EIA at the project level.

8.1 Limitations and Data Gaps

There is currently limited information on the location and extent of other plans, project and/or activities. In addition there are no clear thresholds in order to fully assess potential cumulative effects. At a project level, EIAs should endeavour to keep up-to-date with ongoing industry research and other plans, projects and activities within the study area, and where appropriate, undertake investigations in order to quantify and assess cumulative effects.

8.2 Cumulative Impact Assessment

Table 47 below identifies any potential overlap of the plans, projects and/or activities with the physical, biological, historic and human environment receptors considered within this REA. Consideration is then given to the relevant pathways and an assessment undertaken of potential effects for each receptor.

Table 47. Potential overlap of plans, projects and/or activities with the Physical, Biological, Historic and Human Environment Receptors

Receptor	FABLink (Cable)	GDF SUEZ (Tidal)	DCNS (Tidal)	GREC	SoG TW	Potential MPAs	Fishing Activities	Shipping	Air Travel
Marine geomorphology		x	x	x	x				
Physical Processes		x	x	x	x				
Water Quality	x	x	x	x	x			x	
Benthic Ecology	x	x	x	x	x		x		
Pelagic Ecology	x	x	x	x	x		x	x	
Fish and Shellfish	x	x	x	x	x		x	x	
Ornithology	x	x	x	x	x		x	x	
Marine Mammals		x	x	x	x		x	x	
Nature Conservation	x	x	x	x	x		x	x	
Terrestrial Ecology	x			x	x				
Marine Archaeology	x	x	x	x	x		x		
Terrestrial Archaeology	x			x	x				
Cables, pipelines and Grid Connections	x	x	x	x	x		x		
Commercial and Recreational Fisheries	x	x	x	x	x	x	x	x	
Commercial and Recreational Shipping and Navigation	x	x	x	x	x		x	x	
Infrastructure	x	x	x	xx	x				x
Recreation and Tourism	x	x	x	x	x		x	x	x
Noise	x	x	x	x	x		x	x	x
Air Quality	x	x	x	x	x		x	x	x
Landscape and Seascape	x	x	x	x	x		x	x	x
Traffic and Transport	x	x	x	x	x		x	x	x

8.2.1 Marine Geomorphology

Cumulative effects could occur on marine geomorphology such as from alteration of seabed form and features by the Draft Plan, GDF Suez, DCNS, GREC and SoG TW. Once all tidal devices are installed hydrodynamic changes, have the potential to alter the location and size of seabed features, such as sandbanks. As discussed in Section 4.1 of particular importance are any effects on the sandbanks, for example the Alderney South Banks Subtidal Sandbank. Details of the location and extent of all potential effects were unknown at the time of writing, however it is considered the changes will be relatively small when compared to the wider study area. Additionally due to the substantial distance of the projects from the Draft Plan and the sandbanks in Alderney's territorial waters, no significant impacts are anticipated.

8.2.2 Physical Processes

Cumulative effects could occur on physical processes such as from alterations to tidal regime and sediment transport by the Draft Plan GDF Suez, DCNS, GREC and SoG TW. All tidal turbines have the potential to cause hydrodynamic changes which can alter tidal flow and the stability, location and size of seabed features such as sandbanks. As with marine geomorphology, and as discussed in Section 4.2 of particular importance are any effects on the sandbanks, for example the Alderney's South Banks. Similarly to marine geomorphology, whilst details of the location and extent of all potential effects are unknown, it is considered the changes will be relatively small when compared to the wider study area. Additionally due to the substantial distance of the projects from the Draft Plan and the sandbanks in Alderney's territorial waters, no significant impacts are anticipated.

8.2.3 Water Quality

Cumulative effects could occur to water quality as a result of non-toxic contamination from the Draft Plan in addition to GDF Suez, DCNS, GREC, SoG TW or spillages and contaminants from shipping and FABLink. However, as discussed in Section 4.3 best practice measures are considered to reduce the risks associated with spillages from vessels. Additionally whilst factors such as the superficial sediments, historic contamination and underlying geological properties are unknown, it is considered given the energetic hydrodynamic regime within Alderney's territorial waters and the wider study area, any sediment plumes or pollution will be rapidly dispersed. Therefore no significant impacts are anticipated.

8.2.4 Benthic Ecology

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW and FABLink have the potential to result in cumulative effects such as from further loss and/or damage to benthic habitats. However as discussed in Section 5.1 effects are typically short-term and localised. Additionally it is likely the changes will be relatively small when compared to the extent of benthic habitats in the wider study area. Whilst it is considered that details of sensitive habitats are currently unknown, they will be addressed through the EIA process and appropriate mitigation such as by micro siting. Therefore it should be possible to avoid significant cumulative effects on benthic ecology receptors.

8.2.5 Pelagic Ecology

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW and FABLink have the potential to result in cumulative effects on pelagic ecology (potential effects are discussed in Section 5.2). However plankton is considered widespread across the study area and no substantial effects are anticipated from the plans, project and activities. Therefore no significant impacts are anticipated.

8.2.6 Fish and Shellfish

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW FABLink, shipping and fisheries activities have the potential to result in cumulative effects on fish and shellfish (potential effects are discussed in Section 5.3) such as disturbance of migratory routes. The majority of impacts to fish are likely to be localised and this reduces the likelihood of significant interaction with other projects. There is some uncertainty associated with the significance of potential collision impacts between fish and tidal turbines and the effects of EMF associated with power cables as a result of implementation of the Draft Plan. The implications of cumulative effects as a result of these impact pathways, therefore, necessarily remain uncertain. These uncertainties can be managed through application of best practice mitigation measures and through a process of iterative review of the plan taking account of monitoring data collected during implementation of early developments under the plan. Co-operation with regulators in France and the Channel Islands should also be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices. Through this process of project-level monitoring and iterative plan review, it will be possible to ensure that the Draft Plan is implemented in a manner that can avoid significant cumulative impacts.

8.2.7 Ornithology

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW, FABLink, shipping and fisheries activities have the potential to result in cumulative effects on ornithology (potential effects are discussed in Section 5.4) increasing the potential for further effects such as from further changes to/loss of habitat, visual disturbance or collision/entrapment risk. As discussed in Section 5.6 cumulative effects could also impact the integrity of designated sites. The majority of impacts to birds are likely to be localised and this reduces the likelihood of significant interaction with other projects. There is some uncertainty associated with the significance of potential collision impacts between birds and tidal turbines and the effects of disturbance associated with construction and operation of energy developments under the Plan. The implications of cumulative effects as a result of these impact pathways, therefore, necessarily remain uncertain, particularly given the mobility of many bird species. These uncertainties can be managed through application of best practice mitigation measures and through a process of iterative review of the plan taking account of monitoring data collected during implementation of early developments under the plan. Co-operation with regulators in France and the Channel Islands should also be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices. Through this process of project-level monitoring and iterative plan review, it will be possible to ensure that the Plan is implemented in a manner that can avoid significant cumulative impacts.

8.2.8 Marine Mammals

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW, shipping and fisheries activities have the potential to impact marine mammals. The potential for effects is discussed further in Section 5.5 and includes increased collision risk and effects from noise and vibration (as discussed in Section 5.6 cumulative effects could also impact the integrity of designated sites). The majority of impacts to marine mammals are likely to be localised and this reduces the likelihood of significant interaction with other projects. There is some uncertainty associated with the significance of potential collision impacts between marine mammals and tidal turbines. The implications of cumulative effects as a result of this impact pathway, therefore, necessarily remain uncertain. This uncertainty can be managed through application of best practice mitigation measures and through a process of iterative review of the plan taking account of monitoring data collected during implementation of early developments under the plan. Co-operation with regulators in France and the Channel Islands should also be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices. Through this process of project-level monitoring and iterative plan review, it will be possible to ensure that the Plan is implemented in a manner that can avoid significant cumulative impacts.

8.2.9 Nature Conservation

The Draft Plan together with effects from FABLink, GDF Suez, DCNS, GREC, SoG TW, fisheries activities and shipping have the potential to impact on nature conservation interests. The potential for effects is discussed further in Section 5.6 and include loss/damage and disturbance to foraging grounds specifically in relation to mobile species. The majority of impacts to nature conservation features are likely to be localised and this reduces the likelihood of significant interaction with other projects. There is some uncertainty associated with the significance of potential collision impacts between mobile features and tidal turbines. The implications of cumulative effects as a result of this impact pathway, therefore, necessarily remain uncertain. This uncertainty can be managed through application of best practice mitigation measures and through a process of iterative review of the plan taking account of monitoring data collected during implementation of early developments under the plan. Co-operation with regulators in France and the Channel Islands should also be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices. Through this process of project-level monitoring and iterative plan review, it will be possible to ensure that the Plan is implemented in a manner that can avoid significant cumulative impacts.

8.2.10 Terrestrial Ecology

GREC, SoG TW and the landfall of the FABLink project have the potential to result in further effects on terrestrial ecology such as the loss of protected species. However with the exception of mobile species such as birds (covered above) all effects are considered to be localised and impacts on sensitive species that are sites specific should be mitigated through EIAs. Therefore no significant cumulative impacts are anticipated.

8.2.11 Marine Archaeology

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW, FABLink and fisheries activities have the potential to result in a cumulative effect on marine archaeology. The potential impact of multiple pressures of all the potential effects is uncertain and should be assessed within the environmental assessments at the project level. However in general it is considered substantial effects can be avoided through appropriate positioning of plans, projects and the scale of the activities are considered small and unlikely to result in a significant cumulative impact.

8.2.12 Terrestrial archaeology

GREC, SoG TW and the landfall of FABLink have the potential for further effects on terrestrial archaeology such as the direct loss of assets. However all effects are considered to be localised and impacts should be mitigated through EIAs. Therefore no significant cumulative impacts are anticipated.

8.2.13 Cables, Pipelines and Grid Connections

The Draft Plan together with GDF Suez, DCNS, GREC, SoG TW, FABLink and fishing activities have the potential to increase the need for cable and pipeline crossings; however, no significant cumulative impacts are anticipated.

8.2.14 Commercial and Recreational Fisheries

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW, potential MPAs, FABLink and fisheries activities have the potential to result in a cumulative effect on commercial and recreational fisheries. In particular, commercial fisheries activities are considered to have a significant impact on fish stocks. Furthermore, the potential future designation of MPAs would result in a displacement of fisheries activities. The scale of the majority of plans, projects and activities are considered small and unlikely to result in a cumulative impact within the wider study area. Commercial fisheries have the potential to affect a wider area, however it is considered that the current baseline will not change significantly. Therefore no significant impacts are anticipated.

8.2.15 Commercial and Recreational Navigation

The Draft Plan in combination with GDF Suez, DCNS, GREC, SoG TW and FABLink and fisheries activities has the potential to result in a cumulative effect on commercial and recreational navigation. However the scale of the majority of plans, projects and activities are considered small and unlikely to result in a cumulative impact within the wider study area. Therefore no significant impacts are anticipated and no variations to the current baseline.

8.2.16 Infrastructure

The Draft Plan together with GDF Suez, DCNS, GREC, SoG TW, FABLink and air travel activities have the potential to involve the removal or replacement of existing terrestrial infrastructure. However any effects are considered localised and no significant cumulative impacts are anticipated.

8.2.17 Recreation and Tourism

All plans, projects and activities have the potential to affect recreation and tourism (potential effects are highlighted in Section 7.5). However whilst effects may occur they are considered likely to be small and localised. No effects are anticipated at a scale that will result in a cumulative impact on recreation and tourism.

8.2.18 Noise

All plans, projects and activities have the potential to create noise (potential effects are highlighted in Section 7.6) however due to the distances between plans, projects and activities and the general localised range of noise effects no substantial increase in the current noise levels are anticipated and therefore no significant impacts foreseen.

8.2.19 Air Quality

All plans, projects and activities have the potential to affect air quality (potential effects are highlighted in Section 7.7). However due to the distances between plans, projects and activities and the general small localised effects anticipated no significant impacts are anticipated. The wider and potentially most substantial effect is likely to be from air travel, however as discussed in Section 7.5 for the Draft Plan area air travel is declining and overall air quality is not anticipated to alter significantly from current background levels.

8.2.20 Landscape and Seascape

All plans, projects and activities have the potential to affect landscape and seascape (potential effects are highlighted in Section 7.8) however due to the distances between plans, projects and activities and the small localised effects anticipated, no significant impacts are anticipated.

8.2.21 Traffic and Transport

All plans, projects and activities have the potential to affect traffic and transport (potential effects are highlighted in Section 7.9) such as through increases in vessels and vehicles. However any increases are likely to be temporary and no substantial changes in the current traffic and transport levels are anticipated.

8.3 Conclusion

The potential for cumulative effects alongside the other plans, projects and activities known to occur in the wider region has been assessed. For most receptor groups, the wide spatiotemporal separation of individual projects within the broad study area means that there is limited potential for interaction between projects. However, for mobile features, such as fish, birds and marine mammals, it is possible that they could be exposed to cumulative impacts as a result of movements within their geographic ranges. Furthermore, there is some uncertainty concerning some of the potential impacts to mobile features, for example, relating to damage/mortality to individuals as a result of collision with rotating blades of tidal energy devices. To manage such risks and to ensure that the Draft Plan can be implemented in a manner that avoids significant cumulative effects, a process of iterative plan review should be adopted. This process should collect and analyse monitoring data from initial deployments under the Plan and seek similar information from other regulators to inform iterative review of the Plan during its implementation. In this way, new information on the effects of the Plan can be used to guide its future implementation and thus ensure that significant adverse effects can be avoided.

In implementing the Plan it will also be important to ensure that robust project level assessments are undertaken and that appropriate mitigation measures are incorporated into project design.

9. Summary of Data Gaps, Impacts, Mitigation and Monitoring

Potentially moderate or major significant adverse impacts that will require mitigation are summarised in the Table 48 below. These are the key impact pathways that will need particular consideration by individual developers at the EIA project level.

Table 48. Key potential impacts

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
Marine geomorphology	Alteration of seabed form and features during operation, construction and decommissioning of tidal stream turbines	Insignificant to major	Insignificant to minor
Physical processes	Alterations to tidal regime and sediment transport during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
Benthic ecology	Direct loss and/or damage to benthic habitats during construction and operation of tidal stream turbines, cable routeing and offshore substations	Insignificant to major	Insignificant to minor
	Potential for non-native species introductions during construction of tidal stream turbines, cable routeing and offshore substations	Insignificant to moderate	Insignificant to minor
Fish and shellfish	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision/entrapment risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Insignificant to moderate	Insignificant to minor
Ornithology	Changes to foraging habitat availability during construction of tidal stream turbines and offshore substations	Insignificant to moderate	Insignificant to minor
	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Minor to major	Insignificant to minor
	Collision risk during operation of onshore wind turbine	Minor to moderate	Insignificant to minor
Marine mammals and turtles	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Moderate to major	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Minor to moderate	Insignificant to minor
Nature conservation	Loss/damage and/or disturbance during construction, operation and decommissioning	Insignificant to major	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
	of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine		
	Loss or changes to foraging grounds during construction, operation and decommissioning of tidal stream turbines, cable routeing	Insignificant to moderate	Insignificant to minor
	Noise/vibration during construction of tidal stream turbines and offshore substations	Insignificant to major	Insignificant to minor
	Collision risk during operation of tidal stream turbines and onshore wind turbine	Minor to major	Insignificant to minor
	Visual disturbance during construction of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Potential for non-native species introductions during construction of tidal stream turbines, cable routeing and offshore substations	Insignificant to moderate	Insignificant to minor
	Electromagnetic field (EMF) effects during operation of cables	Insignificant to moderate	Insignificant to minor
Terrestrial ecology	Loss/damage and/or disturbance during construction, operation and decommissioning of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Noise/vibration during survey, construction and decommissioning of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Noise/vibration during operation of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Visual disturbance during operation of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Marine archaeology	Direct damage during survey, construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to major	Insignificant to minor
	Indirect damage during construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to major	Insignificant to minor
Terrestrial archaeology	Direct damage during construction and operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Visual impacts during construction and operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Exclusion areas during operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
Cables, pipelines and grid connectivity	Impact to existing grid during construction of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Commercial and recreational fisheries	Increased congestion during construction, operation and/or decommissioning of tidal stream turbines, cable routeing, offshore substations and onshore substation	Insignificant to moderate	Insignificant to minor
	Temporary and long term displacement	Moderate to major	Insignificant to

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
	during operation of tidal stream turbines, cable routeing and offshore substations		minor
	Damage to fishing gear during operation of tidal stream turbines, cable routeing	Moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Damage to fishing gear during operation of tidal stream turbines, cable routeing	Insignificant to moderate	Insignificant to minor
Commercial and recreational shipping and navigation	Collision risk during construction, operation and decommissioning of cable routeing and offshore substations, and during construction and decommissioning of tidal stream turbines	Insignificant to moderate	Insignificant to minor
	Collision risk during operation of tidal stream turbines	Insignificant to major	Insignificant to minor
	Changes to commercial shipping movements during construction and decommissioning of tidal stream turbines, cable routeing, offshore substation, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Effects on small craft navigation during construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to moderate	Insignificant to minor
	Increased/altered steaming times and distances during construction and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to moderate	Insignificant to moderate
	Changes to risk management and emergency response during construction, operation and decommissioning of tidal stream turbines, cable routeing and offshore substation	Insignificant to moderate	Insignificant to minor
Recreation and Tourism	Decrease in the recreational quality of the environment during construction, operation and decommissioning of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Land use conflicts of interest and access issues during construction, operation and decommissioning of onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
Noise	Noise during operation of onshore substation	Insignificant to moderate	Insignificant to minor
	Noise associated with construction activities of onshore wind turbine	Insignificant to major	Insignificant to minor
Landscape and seascape	Increased boat/road traffic during survey, construction, operation and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Requirements for temporary housing, work facilities during construction and	Insignificant to moderate	Insignificant to minor

Receptor	Potential Impact Pathway	Impact Significance	Residual Impact Following Mitigation
	decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine		
	Lighting during construction, operation and/or decommissioning of cable routeing, offshore substations and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Alterations to existing landforms during construction and operation of cable routeing, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Introduction of permanent feature during operation of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Introduction of regular geometric, man-made forms during operation of offshore substations, onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
	Construction of access roads and piers during construction and operation of onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Change in perception of an area during operation of onshore substation and onshore wind turbine	Insignificant to major	Insignificant to minor
Traffic and transport	Increased traffic during construction and decommissioning of tidal stream turbines, cable routeing, offshore substations, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Increase in size of vehicles during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Increase in size and weight of vehicle loads during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Damage to roads during construction of cable routeing, onshore substation and onshore wind turbine	Minor to moderate	Insignificant to minor
	Traffic congestion during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Potential road hazards during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor
	Creation of dirt and dust by vehicles during construction of cable routeing, onshore substation and onshore wind turbine	Insignificant to moderate	Insignificant to minor

Established industry best practice procedures and impact reduction measures have been considered as part of this REA to mitigate significant moderate or major impacts outlined in Table 48 above are summarised in Table 49 below.

Table 49. Key potential mitigation measures

Receptor	Potential Mitigation	Report Section
Marine geomorphology	▪ Amendment of site design, including reduction in the number of tidal devices and/or array location to minimise energy extraction at those locations where the tidal regime controls key seabed features (e.g. sandbanks) or where protected features are present (i.e. Alderney South Banks Subtidal Sandbank); ▪ Optimisation of array design; ▪ Development of a cable burial / protection plan; ▪ Minimisation of cable, device and offshore substation footprints; and ▪ Use of scour protection measures.	4.1.2.2
Physical processes	▪ Amendment of site design, including reduction in the number of tidal arrays and/or change in the location of the array and substation to reduce potential shoreline and seabed effects; ▪ Optimisation of array design; and ▪ Development of a cable burial / protection plan.	4.2.2.3
Benthic ecology	▪ Reduction in the number of tidal devices and associated cables in order to minimise the area of substratum loss and/or damage; and ▪ Avoid any sensitive habitats (e.g. eelgrass beds) at the project planning and design phase. With a potential full build out of the Draft Plan, there will still be approximately 97% of the seabed across all the licence blocks available for micro-routeing (see Section 5.1.2.2). Such micro-routeing may need to be considered further at the EIA project-level by the developer.	5.1.2.7
Fish and shellfish	▪ Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Avoid construction during sensitive seasons, e.g. breeding/peak egg laying/spawning seasons, in feeding grounds and during migration times of migratory fish; ▪ Good construction practice to minimising noise and vibration; ▪ Minimise use of high noise emission activities such as piling; and ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).	5.3.2.11
Ornithology	▪ Undertake iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Mitigation that is likely to be required to protect marine mammals from collision risk will also protect diving birds. These include: o Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure; and o Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically. ▪ Restrict piling (if required) to periods of low species activity periods within annual and diurnal cycles as appropriate to avoid excessive displacement of species by underwater noise caused by infrastructure installation (piling); and	5.4.2.9

Receptor	Potential Mitigation	Report Section
	▪ Where appropriate to the local species ensuring that piling (if required) commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors.	
Marine mammals and turtles	▪ Automatic shutdown of rotary mechanism by proximity sensor to avoid death or injury by collision with tidal infrastructure; ▪ Marine mammal monitoring undertaken for a defined period of time during initial operation with potential turbine shutdown when a mammal is within 50m of turbine rotors; ▪ Regular surveillance for carcasses and post mortem evaluation of carcass stranding and assessment of cause of death; ▪ Establishment of an active sonar system which detects marine mammals at sufficient range from the turbine to allow a precautionary shutdown to occur automatically; and ▪ Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Restrict any piling to periods of low species activity within annual and diurnal cycles as appropriate to avoid displacement of species by underwater noise caused by infrastructure installation (piling); ▪ Where appropriate to the local species, ensure that piling commences using an agreed soft start procedure; the gradual increase of piling power, incrementally over a set time period, until full operational power is achieved. The soft-start duration should be a period of not less than 20 minutes. The soft-start procedure will vary according to hammer and pile design and other factors; ▪ Ensuring that piling activities do not commence until half an hour has elapsed during which marine mammals have not been detected in or around the site. The detection should be undertaken both visually (by Marine Mammal Observer) and acoustically using appropriate Passive Acoustic Monitoring equipment. Both the observers and equipment must be deployed at a reasonable time before piling is due to commence. This should include ensuring that at times of poor visibility e.g. night-time, foggy conditions and sea state greater than that associated with force 2 winds, enhanced acoustic monitoring of the zone is carried out prior to commencement of relevant construction activity; and ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable).	5.5.2.11
Nature conservation	▪ Consider a zone of avoidance around designated sites (this will vary depending on the sensitivity of qualifying interest features and the spatiotemporal scale of pressures brought about by activities associated with specific projects); ▪ Minimisation of survey / construction / decommissioning works in designated sites; ▪ Consider alternative installation methods (including non-invasive measures such as Horizontal Directional Drilling (HDD)) to avoid an adverse effect on site integrity;	5.6.2.14

Receptor	Potential Mitigation	Report Section
	▪ Careful consideration of the design and placement of structures to minimise effects, e.g. for tidal turbines the number, size and spacing between and avoiding key migratory routes; ▪ Selection of device type to minimise effects such as collision/entrapment risk or visual; ▪ Avoid sensitive sites /species e.g. seabed habitats such as maerl beds, seagrass beds which have a particularly strong ecosystem function in supporting different life stages for fish and shellfish; ▪ Avoid siting devices in or near particularly sensitive areas e.g. seal haul out sites, seabed fish spawning/nursery grounds, key bird foraging/breeding sites; ▪ Avoid construction work during sensitive time periods for fish, e.g. breeding, migration and spawning events; ▪ Avoid cable-laying through sensitive areas, e.g. spawning and feeding grounds; ▪ Creation of new habitat creation e.g. where rock armouring has been used; ▪ Iterative reviews of the Draft Plan taking account of information available from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Plan. Co-operation with regulators in France and the Channel Islands should be pursued to ensure that as much as possible can be learnt from early deployments of tidal energy devices; ▪ Produce a cable laying plan to minimise EMF at or above the seabed. This will include consideration of cable design and installation (e.g. bury cables where practicable); and ▪ Reference should also be made to mitigation measures recommended for other specific receptor topics including Fish and Shellfish, Ornithology, Marine Mammals and Terrestrial Ecology.	
Terrestrial ecology	▪ Re-routeing of cables and relocating development to less sensitive areas; ▪ Habitat creation schemes to compensate for the loss of terrestrial habitat with ecological value; and ▪ Relocation of sensitive faunal species.	5.7.2.5
Marine archaeology	▪ Careful consideration of the extent, number and layout of tidal devices and offshore substations to minimise both the direct and indirect impacts on receptors identified to be sensitive to the development; ▪ On selection of the development area, undertaking a geophysical survey of the seabed surface and subsurface with associated archaeological interpretation to identify potential maritime archaeology; ▪ On selection of the development area, undertaking a geotechnical survey with associated archaeological interpretation to investigate the potential for prehistoric land surfaces and characteristics; ▪ Locating tidal devices and offshore substations to minimise direct damage to identified archaeological sites; and ▪ Cable export design to minimise direct damage to identified archaeological sites; and ▪ Undertaking more detailed assessments to investigate the extents of indirect impacts.	6.1.2.4
Terrestrial archaeology	▪ Careful consideration of the location of the onshore development to minimise both the direct and visual impacts on the receptors identified to be sensitive to the development; ▪ Siting of the onshore development to minimise effects on the built heritage and character, as well as on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible;	6.2.2.4

Receptor	Potential Mitigation	Report Section
	▪ On site selection, complete a more detailed archaeological assessment identifying the archaeological sites in proximity to the development area; and ▪ Locate the onshore substation and wind turbine to minimise direct damage to identified archaeological sites.	
Cables, pipelines and grid connectivity	▪ Follow best practice measures, including the mapping of known infrastructure and the use of cable awareness technology (CAT) scans, and ▪ Consultation with Alderney Electricity Ltd in order to identify existing infrastructure at the project planning and design phase and requirements for replacing where necessary.	7.1.2.2
Commercial and recreational fisheries	▪ Reduction in the number of tidal devices and associated cables in order to minimise the displacement of fishing activities; ▪ Avoid sensitive sites/species/periods e.g. arrays and cable routes should where possible avoid identified fishing grounds; and ▪ Cable and device design should reduce snagging risks.	7.2.2.6
Commercial and recreational shipping and navigation	▪ All commercial vessels that operate within Alderney waters must comply with: o IMO conventions of Safety of Life and Sea (SOLAS); and o International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). ▪ Carry out site specific planning during operational phase to minimise collision risk, site selection to identify vessel routes, use of exclusion zones; ▪ Undertake a Navigational Risk Assessment (NRA) following industry best practice; ▪ Carry out hydrographic surveys to accurately establish depths and clearances over devices and quantify any effect on local tidal streams and directions; ▪ Where appropriate establishing safe working zones, exclusion zones and avoidance areas; ▪ Compliance with the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS); ▪ Marking of devices using the guidance provided in the International Association of Lighthouse Authorities (IALA) Recommendation 'O-139' on the Marking of Man-Made Offshore Structures; ▪ As stipulated in Trinity House guidance on 'provision and maintenance of aids to local navigation', undertake regular maintenance to ensure markers are properly lit, maintained and checked; ▪ Undertake a detailed site specific assessment of shipping traffic to determine most appropriate location for development; ▪ Avoid areas where there is risk of major disturbance to shipping traffic; ▪ Avoid development in shipping routes of importance to international and inter island navigation; ▪ Marine information dissemination (Notices to Mariners); ▪ Ensure mariners are aware of proposed works via the issue of chart update; ▪ Regular maintenance of devices part of operator licensing; and ▪ Review by the Coastguard of rescue provision, including monitoring capability to ensure operational commitments can be met.	7.3.2.13
Recreation and Tourism	▪ Best practice measures such as publicising the developments and any associated diversions during construction; and ▪ Careful consideration of the extent, number and layout of infrastructure to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development.	7.5.2.7

Receptor	Potential Mitigation	Report Section
Noise	▪ Perform construction works on the onshore wind turbine during week days and daylight (social) hours; ▪ Fit or source plant with sound reduction equipment; ▪ Use screening, enclosures and mufflers to help buffer percussive piling noise; ▪ Investigate methods to improve sound insulation of substations; and ▪ Situate substations away from population centres.	7.6.2.6
Landscape and seascape	▪ Careful consideration of the extent, number and layout of tidal stream turbines and offshore substations to minimise impacts on seascapes and visual receptors identified as being of higher sensitivity to such development; ▪ Siting of onshore development to minimise effects on seascape and landscape character and on views, avoiding prominent hill tops and open sites and using existing landform and woodland to provide screening where possible; ▪ Design of onshore development to fit with the scale and character of existing buildings and to minimise impacts on coastal features and on views; ▪ Use of existing infrastructure where possible, such as tracks and buildings, to avoid the introduction of new features; upgrading existing infrastructure where necessary; ▪ Screening of permanent features by planting (using native species), fencing or carefully designed earth bunds that relate to the coastal landforms of the site and its immediate context where appropriate; ▪ Reinstatement of vegetation following construction where temporary access tracks/compounds are required; ▪ Use of construction materials paying attention to their composition, texture, colour and form to blend into the surrounding landscape/seascape, including the use of local rock or stone; and ▪ Minimise lighting requirements, where possible, particularly in more remote landscapes and seascapes.	7.8.2.9
Traffic and transport	▪ Preparation of a Traffic Management System (TMS) which details all of the mitigation measures proposed to be undertaken; ▪ Planned routes which will mean that development traffic avoids sensitive receptors or narrow sections of road (although this may not always be possible in rural areas); ▪ Widening of narrow sections of road or the introduction of passing places. Temporary widening should be fully considered where possible, including reinstatement options; ▪ Installation of a temporary road to avoid sensitive receptors such as a village centre; ▪ The developer is likely to be required to pre-agree to repair any damage caused to roads at the end of the project; ▪ Time separation between heavy goods vehicle (HGV) movements; ▪ The avoidance of peak traffic times; ▪ Monitoring of road damage; ▪ Increasing the number of axles of the vehicles used in order to reduce road damage and vibrations; ▪ Depending on the nature of works it may be necessary to install washing areas to prevent dirt and dust; and ▪ Loads may be covered and their size monitored.	7.9.2.8

It is particularly important to note that there are key gaps in understanding of how tidal arrays will affect a given feature of the marine environment. This is particularly the case for mobile features (including fish, birds and marine mammals), for example, damage/mortality of individuals as a result of collision with rotating blades of tidal energy devices. To manage such risks and to ensure that the Draft Plan can be implemented in a manner that avoids significant effects, a process of **iterative plan review** should be adopted. This process should collect and analyse monitoring data from initial deployments under the Plan and seek similar information from other regulators to inform iterative review of the Draft Plan during its implementation. In this way, new information on the effects of the Draft Plan can be used to guide its future implementation and thus ensure that significant adverse effects can be avoided.

There are several areas of uncertainty associated with characterising the baseline environment. The data gaps that will need to be considered by individual developers at the EIA project level are discussed in more detail within each of the topic assessment chapters and summarised in Table 50 below. It is recommended that developers discuss and agree any proposed survey and/or modelling approaches with relevant stakeholders and regulators (i.e. the Commission).

Table 50. Summary of potential data , survey and/or modelling requirements

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
Marine geomorphology	▪ Superficial seabed sediments (at a minimum including composition and particle size, geochemical properties and contaminants); ▪ Morphodynamic features (small- to large-scale); and Seabed geology.	▪ Side scan sonar, video or photographic survey to identify the seabed sediments and geomorphology; ▪ Time series of swathe bathymetry which, placed into context using historical chart analysis, could determine the mobility of any seabed features; ▪ Seabed sediment grab samples to ‘ground-truth’ the surveys of sediment composition; and ▪ Geophysical surveys of the development area.
Physical processes	▪ Wave regime for approximately 6 months or until representative events have been captured; and ▪ Tidal regime for a minimum of a spring-neap tidal cycle.	▪ ADCP and/or wave buoy; and ▪ Possible numerical modelling (hydrodynamics and sediments).
Water quality	▪ Suspended sediment concentrations; ▪ Water quality measurements; and ▪ Seabed sediment contamination.	▪ ADCP for determination of suspended sediment concentrations; ▪ Water sample collection at pertinent tidal states to allow minimum and maximum contamination levels to be measures; and ▪ Seabed sediment sampling.
Benthic ecology	▪ Characterisation of intertidal and subtidal benthic communities where there is a paucity of data.	▪ Benthic grab samples for faunal and sediment analysis; ▪ Videos/photography surveys; ▪ Trawling surveys; ▪ Acoustic mapping (e.g. multibeam acoustic ground discrimination systems or sidescan data acquisition);

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
		▪ Diver sampling; ▪ Intertidal Phase 1 habitat mapping techniques; and ▪ Intertidal quadrat sampling.
Fish and shellfish	▪ Characterisation of abundance and distribution of fish and shellfish.	▪ Videos/photography surveys; and ▪ Trawling surveys.
Ornithology	▪ Description of abundance and density of foraging seabirds, passage and overwintering waterbirds utilising coastal habitat; ▪ Impacts of noise on prey species of birds.	▪ Established seabird at sea and coastal waterbird monitoring techniques; ▪ Power analysis of the boat-based seabird survey data; ▪ Collision risk modelling; ▪ OWF collision models and population models; and ▪ Habitat modelling.
Marine mammals	▪ Monitoring programme to understand potential impacts, particularly of tidal stream turbines.	▪ Aerial surveys; ▪ Land or boat based counts at haul-out sites; ▪ Vantage point surveys; ▪ Boat based surveys; ▪ Photo ID; ▪ Telemetry; ▪ Stranding and carcass ID; ▪ Towed Hydrophone array protocol; and ▪ Autonomous Acoustic Monitoring (e.g. cetacean pods (C-PODs)).
Terrestrial ecology	▪ Characterisation of terrestrial ecology.	▪ Phase 1 habitat surveys covering the terrestrial footprint of proposed works; ▪ Phase 2 survey or key species listing may be adequate in certain areas; ▪ Bat potential and bat activity surveys; ▪ Protected species surveys; and ▪ Invasive species surveys.
Marine archaeology	▪ Characterisation of the marine archaeological heritage and especially the maritime archaeology (e.g. location of protected wrecks).	▪ Videoing of the seabed; ▪ Multi-beam eco sounder survey (surface) ; ▪ Side-scan sonar survey (surface) ; ▪ Seismic profiling (sub-surface); ▪ Sediment coring (boreholes and vibrocores); ▪ Diver surveys/investigations; or ▪ Radiocarbon dating.
Terrestrial archaeology	▪ SMR data; and ▪ Presence of protected heritage, including Scheduled Monuments and Listed Buildings.	
Cables, pipelines and grid connectivity	▪ Proposed landfall sites of the tidal device export cables in Alderney and France; ▪ Inter-array cable configuration; and ▪ Existing terrestrial cable infrastructure.	
Commercial and recreational fisheries	▪ Up-to-date sea fisheries statistics for the Bailiwick of Guernsey registered fleet, and specifically the Alderney based fleet (including fish landings data, fishing	

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
	effort data, fishing vessel movements and value of fishing industry to local economy).	
Commercial and recreational shipping and navigation	▪ Information on Marine Environmental High Risk Areas (MEHRAS); ▪ Potential search and rescue activity within the study area and the types of aircraft and vessels which may be used; ▪ AIS data for Alderney; ▪ Military activity within the area by UK and European countries; and ▪ Information on racing areas in Alderney Waters and the wider study area to inform the understanding of recreational use.	
Infrastructure	▪ Proposed landfall sites of the tidal device export cables in Alderney and France; ▪ Up-to-date information on the location of infrastructure.	
Recreation and Tourism	▪ Records on the number of visitors; and ▪ Value of tourism to Alderney.	▪ Site-based surveys of watersports activities; and ▪ Survey of community perceptions and values.
Noise	▪ Characterisation of background levels of noise.	▪ Noise baseline surveys.
Air quality	▪ Characterisation of background levels of air quality.	▪ Air quality baseline surveys.
Landscape and seascape	▪ Landscape character assessment; ▪ Landform and geological characteristics; ▪ Coastal shape and dynamics, nature of seascape; ▪ Relationship of coastline to hinterland, and coast to seascape; ▪ Vegetation pattern, extent and screening; ▪ Identification and understanding of human activity, trends and pressures on land and sea; ▪ Built development of settlement, houses, and other built infrastructure; and ▪ Designated or protected areas (biological and archaeological importance).	▪ Baseline field survey; and ▪ Additional field survey to key viewpoints to create photomontages.
Traffic and transport	▪ Baseline traffic conditions, including main traffic routes; and ▪ Identification of sensitive receptors.	▪ Swept path analysis (to ensure free passage of large vehicles and loads along the route, around bends etc.); ▪ A structural assessment of all roads and bridges; ▪ Automatic traffic counts by pneumatic tube or radar; ▪ Manual traffic counts;

Receptor	Potential Data/ Information Requirements	Potential Survey and/or Modelling Requirements
		▪ Video traffic surveys - generally undertaken by consultancies using specialised video equipment; ▪ Pedestrian survey conducted by trained staff or video equipment; ▪ Questionnaire designed to gather selected data, such as preferred route and mode of transport; ▪ Journey time survey - conducted manually or using technology, such as GPS; ▪ Parking Survey; and ▪ Junction/roundabout turning counts which can be undertaken manually or using video equipment.
Cumulative effects	▪ Up-to-date information on location and extent of other plans, projects and/or activities.	▪ Specific survey and/or modelling requirements may be required to quantify and assess key cumulative effects.

10. Consultation

The following consultees were consulted at the scoping phase (see Appendix A) and will continue to be consulted at key stages in the REA process. This includes both statutory (assigned by asterisk) and other key stakeholders and consultees, following The Renewable Energy (Alderney) Ordinance, 2008 (Section 7.1.a.i - 7.1.b), which was amended by The Renewable Energy (Alderney) (Amendment) Ordinance, 2013:

- ACE;
- Alderney Harbour Officer*;
- Alderney Fisheries Officer*;
- Alderney Sailing Club;
- Alderney Licensed Fishing Vessel Owners Association;
- Alderney Diving Club;
- Alderney Wildlife Trust*;
- Alderney Maritime Trust;
- Alderney Renewable Energy Ltd*;
- The Alderney Society;
- Alderney Electricity Ltd*;
- Channel Islands Coastguard;
- Cofely Endel;
- Constructions Mécaniques de Normandie;
- DCNS;
- French Affaires Maritime and Cross Joburg;
- GDF SUEZ;
- Guernsey Health and Social Services Department (HSSD);
- Guernsey Harbour Master;

- Guernsey Sea Fisheries;
- Inspectors appointed under the Health and Safety at Work (Alderney) Ordinance 2003;
- Joburg Traffic;
- Maritime and Coastguard Agency (UK);
- Ministère de L'Écologie;
- Natural England;
- Préfecture maritime de la manche et de la mer du nord;
- Royal Yachting Association [and its equivalent French Counterpart];
- Sark Harbour Master;
- Shipping companies operating in the Channel Islands and St Malo;
- States of Alderney CEO*;
- Trinity House;
- UK Hydrographic Office; and
- Voith Hydro.

11. References

ABP Research & Consultancy Ltd, 2000. Humber International Terminal (HIT) Ornithological Survey: Annual Monitoring Report 1999/2000, ABP Research & Consultancy Ltd, Research Report No. R.882.

ABP Research & Consultancy Ltd, 2001. Immingham Outer Harbour, Environmental Statement, August 2001, ABP Research & Consultancy Ltd, Research Report No. R.903.

ABPmer, 2002. ABP Teignmouth Quay Development Environmental Statement. ABP Marine Environmental Research Ltd, Report No. R.984a.

ABPmer, 2005. Potential Nature Conservation Impacts of Marine Renewable Energy Projects in Wales. Report for the Countryside Council for Wales.

ABPmer, 2007. Implications of New Conservation Designations for Key Business Activities. ABP Marine Environmental Research Ltd, Report No. R.1394. Report for The Crown Estate.

ABPmer, 2008. Atlas of UK Marine Renewable Energy Resources. Date of access (07 February 2013) http://www.renewables-atlas.info/.

ABPmer, 2009. Wet Renewable Energy and Marine Nature Conservation: Developing Strategies for Management. ABP Marine Environmental Research Ltd, Report No. R.1451.

ABPmer, 2010a. Report to Inform Appropriate Assessment for the Pentland Firth Strategic Area (PFSA) Leasing Round. Report for The Crown Estate February 2010; ABP Marine Environmental Research Ltd, Report No. R.1602.

ABPmer, 2010b. Humber Estuary: Environmental Management and Monitoring Plan: Data 2009 January 2010. ABP Marine Environmental Research Ltd, Report No. R.1587.

ABPmer, 2011. Habitats Regulations Appraisal of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters. ABP Marine Environmental Research, Research Report R.1722.

ABPmer, 2012. Marine Scotland Licensing and Consents Manual, covering Marine Renewables and Offshore Wind Energy Development. Available as draft for consultation.

ABPmer, 2013. Habitats Regulations Appraisal of Draft Plan for Offshore Wave and Tidal Energy in Scottish Territorial Waters. ABP Marine Environmental Research, Research Report R.1863.

ABPmer, 2013 (in preparation). Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Waters Final Report. Report R.2045, May 2013.

ACRE, 2011a. Guide to the Consents Process for obtaining a Licence in relation to marine renewable energy systems under the Renewable Energy (Alderney) Law 2007 MARINE. Draft.

ACRE, 2011b. Guide to the Consents Process for obtaining a Licence in relation to land based renewable energy systems under the Renewable Energy (Alderney) Law 2007 LAND. Draft.

ACRE, 2012. Guidance notes: Shipping and Navigation. Available online: http://www.acre.gov.gg/files/library/Guidance%20Notes%20Shipping%20and%20Navigation.pdf

AEA, 2007. Strategic Tidal Stream Assessment for Alderney. Report to ACRE. Ed 43120001.

Alderney Wildlife Trust, 2008. Alderney Wildlife: The Magazine of the Alderney Wildlife Trust. Issue 20, Autumn 2008.

Alderney Wildlife Enterprise, 2011. Seabird and marine mammal survey: Longis Bay and associated areas. A report submitted to Alderney Commission for Renewable Energy.

Alderney Wildlife Enterprise, 2011. Seabird and marine mammal survey: Longis Bay and associated areas. A report submitted to Alderney Commission for Renewable Energy.

Alderney Wildlife Trust, 2012. Alderney West Coast and Burhou Islands Ramsar Site Management Strategy 2012 - 2016.

Alexandersson H., Tuomenvirta H., Schmith T. and Iden K., 2000. Trends of storms in NW Europe derived from an updated pressure data set. Climate Research, 14, 71-73.

ARE, 2008. The Alderney Race Environmental Statement. 20 May 2008.

ARE, 2009. The Alderney Race 500 MW Environmental Statement.

ARE, 2011. Strategic Environmental Assessment (SEA) for the ARE Tidal Development Programme: Appropriate Assessment - Stage 2.

Arena, P. T., Jordan, L. K. B. and Spieler, R. E., 2007. Fish assemblages on sunken vessels and natural reefs in southeast Florida. Hydrobiologia 580: 157-171.

ASCOBANS, 2003. Disturbance to cetaceans by shipping: Ship Collisions with Whales. 10th Advisory Committee Meeting Document AC10/Doc. 7(P)Bonn, Germany, 9 - 11 April 2003.

Attrill, M., 2012. Marine Renewable Energy: necessary for safeguarding the marine environment?

AWT, 2012a. Alderney West Coast and Burhou Islands Ramsar Site Management Strategy: 2012-2016. May 2012.

AWT, 2012b. Annual Ramsar Project Review 2012. October 2012.

AWTE, 2011. Intertidal biotope habitat survey: Longis Bay and Associated areas. A report submitted to the Alderney Commission for Renewable Energy, March 2011.

AWTE, 2012a. Intertidal biotope habitat survey: The South Coast of Alderney. A report submitted to the Alderney Commission for Renewable Energy, June 2012.

AWTE, 2012b. Intertidal Phase II littoral fixed photography monitoring survey: Longis Bay and associated areas. A report submitted to the Alderney Commission for Renewable Energy, June 2012.

AWTE, 2013a. Intertidal biotope habitat survey: Hanaine Bay. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

AWTE, 2013b. Intertidal biotope habitat survey: North of Houme Herbet area. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

AWTE, 2013c. Intertidal biotope habitat survey: Brinchetais Ledge. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

AWTE, 2013d. Intertidal Phase II littoral fixed photography monitoring survey: The Brinchetais Ledge. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

AWTE, 2013e. Intertidal Phase II littoral fixed photography monitoring survey: North of Houmet Herbe area. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

AWTE, 2013f. Intertidal Phase II littoral fixed photography monitoring survey: Hanaine Bay. A report submitted to the Alderney Commission for Renewable Energy, January 2013.

Axelsson, M., Dewey, S., Allen, C. and Doran, J., 2011. Alderney South Banks acoustic and environmental survey 2011 - the environmental survey report. A report to the Alderney Commission for Renewable Energy (ACRE) by Seastar Survey Ltd., 80 pages.

Bailey, H., Senior, B., Simmons, D., Ruskin, J., Picken, G. and Thompson, P.M., 2010. Assessing underwater noise levels during pile-driving at an offshore wind farm and its potential effects on marine mammals. Marine Pollution Bulletin 60: 888-897.

Baines, M.E. and Evans, P.G.H., 2012. Atlas of the Marine Mammals of Wales. CCW Monitoring Report No. 68. 2nd edition. 139pp.

Barber, J. R., Crooks, K. R. and Fristrup, K. M., 2009. The cost of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution, 25:3, 180 - 190.

Beaugrand, G., Ibanez, F. and Reid, P. C., 2000. Spatial, seasonal and long-term fluctuations of plankton in relation to hydroclimatic features in the English Channel, Celtic Sea and Bay of Biscay. Marine Ecology Progress Series 200: 93-102.

BERR, 2008. Review of cabling techniques and environmental effects applicable to the offshore wind farm industry - Technical Report

BirdLife International, 2012. BirdLife Seabird Wikispace [online]. Available at: http://seabird.wikispaces.com/ [Last accessed May 2012].

Black & Veatch, 2005. Phase II UK Tidal Stream Energy Resource Assessment. Issue 3 - July 2005. Prepared by Black & Veatch for use by the Carbon Trust.

Bloomfield, A. and Solandt, J.L., 2008. Basking Shark Watch: 20 year report (1987-2006).

Bois, P., Bailly du., Dumas, F., Solier, L., and Voiseux, C., 2012. *In-situ* database toolbox for short-term dispersion model validation in macro-tidal seas, application for 2D-model. Continental Shelf Research.

Caldwell, D., 2011. Optimising the location of tidal turbines in Alderney waters to minimise power output variability. Unpublished thesis. School of Applied Sciences, Cranfield University.

Carter, C., 2007. Marine Renewable Energy Devices: A Collision Risk for Marine Mammals? MSc Thesis, University of Aberdeen.
Civil Aviation Authority, 2012. Civil Aviation Authority Annual Statistics 2012.

Clark, J., Dolman, S.J. and Hoyt, E., 2010. Towards Marine Protected Areas for Cetaceans in Scotland, England and Wales: A scientific review identifying critical habitat with key recommendations. Whale and Dolphin Conservation Society, Chippenham, UK, 178pp.

Cochran, W.W. and Graber, RR., 1958. Attraction of nocturnal migrants by lights on a television tower Wilson Bulletin 70: 38:380. Cited in Ecology Consulting 2001 Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/1434.

Coleman, R.A., Salmon, N.A and Hawkins, S.J., 2003. Sub-dispersive human disturbance of foraging oystercatchers Haematopus ostralegus. Ardea, 91 263-268.

Commission for Renewable Energy (ACRE) by Seastar Survey Ltd., 80 pages.

Dadswell, M. J. and Rulifson, R., 1994. Macrotidal estuaries: a region of collision between migratory marine animals and tidal power development. Biological Journal of the Linnean Society 51: 93-113.

Daunt, F., Camphuysen, C.J., Humphreys, E.M., Hamer, K.C., Wanless, S. and Skov, H., 2005. Local/daily scale hydrography, prey and seabird interactions.

Daunt, F., Wanless, S., Peters, G., Benvenuti, S., Sharples, J., Grémillet, D. and Scott, B., 2006. Impacts of oceanography on the foraging dynamics of seabirds in the North Sea. In Top Predators in Marine Ecosystems: Their Role in Monitoring and Management (eds I. Boyd, S. Wanless & C.J. Camphuysen), pp 177-190. Cambridge University Press, Cambridge, UK.

David, JA., 2006. Likely sensitivity of bottlenose dolphins to pile-driving noise. Water and Environment Journal 20: 48-54.

Defra, 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Volume 1. Department for Environment, Food and Rural Affairs (Defra) in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Northern Ireland.

Department of Energy and Climate Change (DECC), 2011. Applying for safety zones around offshore renewable energy installations 'Guidance Notes'. November, 2011 (revised). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80785/safety_zones.pdf

Department of Energy and Climate Change (DECC), 2009. UK Offshore Energy Strategic Environmental Assessment: Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil & Gas and Gas Storage. DECC, London, 339p (excl. appendices) http://www.offshore-sea.org.uk/consultations/Offshore_Energy_SEA/index.php

Department of Trade and Industry (DTI), 2005. Guidance on the Assessment of the Impact of Offshore Wind Farms. Seascape and Visual Impact Report.

Desholm, M., Kahlert, J., 2005. Avian Collision Risk at an Offshore Wind Farm. Biology Letters 1: 296-298.

Diederichs, A., Grünkorn, T., Nehls, G., 2008. Offshore windfarms-disturbance or attraction for harbour porpoises? First results of T-pod investigation in horns rev and nysted. In: (Ed) Evans, PGH. Proceedings of the ASCOBANS/ECS workshop offshore windfarms and marine mammal. Impacts and methodologies for assessing impacts.

Dirksen S., Spaans A.L. and van der Winden J., 2000. Studies on Nocturnal Flight Paths and Altitudes of Waterbirds in Relation to Wind Turbines: A Review of Current Research in the Netherlands. In Proceedings of the National Avian-Wind Power Planning Meeting III, San

Diego, California, May 2000. Prepared for the National Wind Coordinating Committee. Ontario: LGL Ltd.

Dirksen S., van der Winden J. and Spaans A.L., 1998. Nocturnal collision risks of birds with wind turbines in tidal and semioffshore areas. In Ratto CF and Solari G (eds). Wind Energy and Landscape. Rotterdam: Balkema, 99-108pp.

Dix, J.K., Lambkin, D.O. and Cazenave, P.W., 2007. Development of a Regional Sediment Mobility Model for Submerged Archaeological Sites. English Heritage MALSF project no. 5524. School of Ocean and Earth Science, University of Southampton, U.K. 156pp.

Doran, J., 2011. Alderney Southbank. Phase 2: Drop-Down Camera Survey Field Report.

Doyle, J., Goodwin. L. and Loveridge, J.E., 2007. The Decline of inshore Bottlenose Dolphins (Tursiops truncatus) in South West England. Poster at the 21st Annual Conference of the European Cetacean Society, 22-25 April, San Sebastian, Spain.

Drewitt A.L. and Langston R.H.W., 2006. Assessing the impacts of wind farms on birds. Ibis 148, 29-42.

Dunn, J., Still, R., Harrop, H., 2012. Britain's Sea Mammals: Whale, dolphins, porpoises and seals, and where to find them. WILDGuides. 128pp Marine Food-web Processes: an Ecosystem Approach to Sustainable Sandeel Fisheries in the North Sea: IMPRESS Final Report (ed C.J. Camphuysen), pp 163-180. NIOZ-rapport, 2005-5, NIOZ, Texel, Netherlands.

Durrel Wildife Conservation Trust, 2008. Atlantic Puffin Fratercula artica and other seabirds at Plemont, Jersey, Channel Islands. Report to Plemont estate.

Ecology Consulting, 2001. Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/1434 http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file20258.pdf

Edwards, M., M. Heath and A. McQuatters-Gollop, 2010. Plankton in MCCIP Annual Report Card 2010-11, MCCIP Science Review, 10pp. www.mccip.org.uk/arc.

Eggleton, J., Dolphin, T., Ware, S., Bell, T., Aldridge, J., Silva, T., Forster, R., Whomersley, P., Parker, P. and Rees J., 2011. Natural Variability of Turbidity in the Regional Environmental Assessment (REA) Areas, their ecological significance and sensitivity. Project 09-P114. Cefas, Lowestoft, 188pp.

Ellis, J. R., A. Cruz-Martinez, B. D. Rackham and Rogers, S.I., 2005. The distribution of chondrichthyan fishes around the British Isles and implications for conservation. Journal of Northwest Atlantic Fishery Science, 35, 195-213.

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J., 2012. Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147: 56 pp.

Ellis, J.R., Morel, G., Burt, G. and Bossy, S., 2010. Preliminary observations on the life history and movements of skates (Rajidae) around the Island of Jersey, western English Channel. Journal of the Marine Biological Association of the United Kingdom, Volume 91 / Special Issue 06 / September 2011, pp 1185-1192.

Eloire, D., Somerfield, P. J., Conway, D. V. P., Halsband-Lenk, C., Harris, R. and Bonnet, D., 2010. Temporal variability and community composition of zooplankton at station L4 in the Western Channel: 20 years of sampling. Journal of Plankton Research 32(5): 657-679.

EMEC and Xodus AURORA, 2010. Consenting EIA and HRA Guidance for Marine Renewable Energy developments in Scotland: Part Four - Wave and Tidal Annex. Report for Marine Scotland.

Enstipp, MR., Daunt, F., Wanless, S., Humphreys, EM., Hamer, KC., Benvenuti, S. and Grémillet, D., 2006. Foraging energetics of North Sea birds confronted with fluctuating prey availability. Top Predators in Marine Ecosystems: Their Role in Monitoring and Management (eds.) Boyd, I., Wanless, S., Camphuysen, CJ. pp 191-210. Conservation Biology 12. Cambridge University Press, Cambridge, UK.

Entec UK Limited, 2007. OpenHydro Subsea Tidal Array Installation - Alderney: Interim Seabird and Marine Mammal Report.

ERM, 1996. South Humber Power Station, Pyewipe, Bird Monitoring Study, April 1996.
European Commission, 2008. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

Evans and Prior, 2012. Protecting the harbour porpoise in UK seas: Identifying a network of draft SACs for the harbour porpoise in the UK. A report to WWF UK.

Evans, P.G.H. and Teilmann, J. (editors), 2009. Report of ASCOBANS/HELCOM Small Cetacean Population Structure Workshop. ASCOBANS/UNEP Secretariat, Bonn, Germany. 140pp.

Evans, P.G.H., I.L. Boyd and C.D. MacLeod, 2010. Impacts of Climate Change on Marine Mammals in MCCIP Annual Report Card 2010-11, MCCIP Science Review, 14pp.

Evans, W.R. and Manville, A.M., 2000. Avian mortality at communication towers. Transcripts of Proceedings of the Workshop on Avian Mortality at Communication Towers August 11 Cornell University Ithaca NY Cited in Ecology Consulting 2001 Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/143.

Everaert J., Devos K. and Kuijken E., 2001. Windturbines en vogels in Vlaaneren: Voorlopige Larsen JK and Guillemette M, 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. Journal of Applied Ecology 44: 465-702.

Freon, P. and Dagorn, L. 2000. Review of fish associative behaviour: toward a generalisation of the meeting point hypothesis. Rev. Fish. Biol. Fisheries 10: 183-207.

Frid, C., Andonegi, E., Depestele, J., Judd, A., Rihan, D., Rogers, S. and Kenchington, E., 2012. The environmental interactions of tidal and wave energy generation devices. Environmental Impact Assessment Review 32: 133-139.

Furness, RW. and Tasker, ML., 2000. Seabird-fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance, and identification of key areas for sensitive seabirds in the North Sea. Marine Ecology Progress Series 202: 253-264.

Garcia-Soto, C. and Pingree, R. D., 2009. Spring and summer blooms of phytoplankton (SeaWiFS/MODIS) along a ferry line in the Bay of Biscay and western English Channel. Continental Shelf Research 29(8): 1111-1122.

Garthe, S. and Hüppop, O., 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41: 724-734.

Gaston, A.J., 2004. Seabirds: A Natural History. Christopher Helm A & C Black, London, UK.

Gaston, A.J., Jones, IL. 1998. The Auks. Oxford University Press, Oxford, New York.

GECC, 2010. Channel Sea Marine Mammal Sighting Network: 2010 Yearly Review.

GECC, 2011. Réseau d'Observateurs des Mammifères Marins en Mer de la Manche: Bilandel'Année 2011.

Gill, AB., Gloyne-Phillips, IT., Neal, KJ. And Kimber, JA., 2005. The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms - a review. Report to COWRIE, London, 90pp.

Gill, J.P., Townsley, M. and Mudge, G.P., 1996. Review of the Impacts of Wind Farms and Other Aerial Structures Upon Birds. Scottish Natural Heritage Review no. 21, Edinburgh, UK: Scottish Natural Heritage.

GREC, 2011. Regional Environmental Assessment of Marine Renewable Energy. July 2011. Version 1. Guernsey Renewable Energy Commission.

Grecian, WJ., Inger, R., Attrill, MJ., Bearhop, S., Godley, BJ., Witt, MJ. and Votier, SC., 2010. Potential Impacts of wave-powered marine renewable energy installations on marine birds. IBIS: The International Journal of Avian Science 152: 683-697.

Griffin L., Rees E., and Hughes B., 2010. The Migration of Whooper Swans in Relation to Offshore Wind Farms Final Report to COWRIE Ltd. March 2010 (COWRIE Project Code: SWAN-06-08).

Grochowski, N. T. L., Collins, M. B., Boxall, S. R. and Salomon, J. C., 1993. Sediment transport predictions for the English Channel using numerical models. Journal of the Geological Society, 150, 683-695.

Guernsey Sea Fisheries Section, 2010. States of Guernsey Commerce and Employment Sea Fisheries Section, Statistical Report, 2010.

Guernsey Sea Fisheries Section, 2011. States of Guernsey Commerce and Employment Sea Fisheries Section, Statistical Report, 2011.

Hamer, KC., Humphreys, EM., Garthe, S., Hennicke, J., Peters, G., Grémillet, D., Phillips, R. A., Harris, MP. and Wanless, S., 2007. Annual variation in diets, feeding locations and foraging behaviour of gannets in the North Sea: flexibility, consistency and constraint. Marine Ecology Progress Series 338: 295-305.

Härkönen, T., Brasseur, S., Teilmann, J., Vincent, C., Dietz, R., Abt, K. and Reijnders, P., 2007. Status of grey seals along mainland Europe from the Southwestern Baltic to France. NAMMCO Sci. Publ. 6:57-68.

Hassani, S., Dupuis, L., Elder, J.F., Caillot, E., Gautier, G., Hemon,A., Lair, J.-M. and Haelters, J., 2010. A note on harbour seals (Phoca vitulina) distribution and abundance in France and Belgium. NAMMCO Sci. Publ. 8:107-116.

Haynes, S.G., Blunden, L.S., and Bahaj, A.S., 2013. Feasibility study of the impacts of a proposed tidal array installation in Alderney South Banks. University of Southampton. March 2013. In confidence- Draft Final Report v1.

Highfield, J. M., Eloire, D., Conway, D. V. P., Lindeque, P. K., Attrill, M. J. and Somerfield, P. J., 2010. Seasonal dynamics of meroplankton assemblages at station L4. Journal of Plankton Research 32(5): 681-691.

Hill, 2008. Patella vulgata. Common limpet. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30/05/2013]. Available from: http://www.marlin.ac.uk/speciessensitivity.php?speciesID=4050.

Hiscock, 2007. Eunicella verrucosa. Pink sea fan. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30/05/2013]. Available from: http://www.marlin.ac.uk/speciessensitivity.php?speciesID=3317.

Hockin, D., Ounsted, M., Gorman, M., Keller, V. and Barker, MA., 1992. Examination of the effects of disturbance of birds with reference to its importance in ecological assessments. Journal of Environmental Management 36: 253-286.

Hoelzel, A.R., Potter, C.W and Best, P.B., 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of the bottlenose dolphin. Proc. R. Soc. Lond. B, 265, 1177-1183.

Hoelzel, R.A., 2002. Marine Mammal Biology: An evolutionary approach. Blackwell Publishing. 452pp.
Holden, P and Cleeves, T., 2002. RSPB Handbook of British Birds.

Holligan, P.M., 1979. Dinoflagellate blooms associated with tidal fronts around the British Iles. In: Taylor D. L. and Seliger Howard H. (eds.). International conference on Toxic Dinoflagellate blooms, 31 Oct. - 5 Nov. 1978, Key Biscayne (Florida), pp. 249-256. Elsevier, New York.

HSE, 2001. Wind and wave frequency distributions for sites around the British Isles. Prepared by Fugro GEOS for the Health and Safety Executive. Offshore Technology Report 2001/030.

HSE, 2002. Environmental Considerations. Offshore Technology Report 2001/010. Health and Safety Executive.

HSE, 2005. Wave Mapping in UK Waters. HSE Research Report Number RR392.

Huddleston J, (ed), 2010. Understanding the environmental impacts of offshore windfarms (COWRIE).

Institute of Environmental Assessment, 1993. Guidelines for the Environmental Assessment of Road Traffic, 1993, Institute of Environmental Assessment.

Irigoien, X., Harris, R. P., Head, R. N. and Harbour, D., 2000. North Atlantic Oscillation and spring bloom phytoplankton composition in the English Channel. Journal of Plankton Research 22(12): 2367-2371.

Island Analysis, undated. Alderney: Economic Strategy Plan. Available online:
http://alderney.gov.gg/CHttpHandler.ashx?id=79815&p=0

Jackson, 2008. Axinella dissimilis. Yellow staghorn sponge. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30/05/2013]. Available from:
http://www.marlin.ac.uk/speciessensitivity.php?speciesID=2695.

JNCC, 2005. Information Sheet on Ramsar Wetlands (RIS). Ramsar information sheet: UK22002, Alderney West Coast and Burhou Islands. Produced by JNCC: Version 3.0, 13/06/2008.

JNCC, 2008. The deliberate disturbance of marine European Protected Species: Interim guidance for English and Welsh territorial waters and the UK offshore marine area.

JNCC, 2010a. UK priority species pages - Version 2. UK Priority Species data collation Pipistrellus pygmaeus. Updated on 15/12/2010. Available online: http://jncc.defra.gov.uk/_speciespages/519.pdf

JNCC, 2010a. UK priority species pages - Version 2. UK Priority Species data collation Anguis fragilis. Updated on 15/12/2010. Available online: http://jncc.defra.gov.uk/_speciespages/2039.pdf

Johns, D., 2008. SEA8 Plankton - The Plankton Ecology of the SEA 8 area. Report commissioned by DECC.

Jouenne, F., Lefebvre, S., Veron, B. and Lagadeuc, Y., 2007. Phytoplankton community structure and primary production in small intertidal estuarine-bay ecosystem (eastern English Channel, France). Marine Biology 151: 805-825.

Kaiser, MJ., 2002. Predicting the displacement of the common scoter Melanitta nigra from benthic feeding areas due to offshore windfarms. COWRIE Report COWRIE-BEN-03-2002, 68p.

Kenyon N. H. and Cooper W. S., 2005. Sand banks, sand transport and offshore wind farms. DTI Strategic Environmental Assessment Area 6 technical report.

Kenyon N.H. and Stride A.H., 1970. The tide-swept continental shelf sediments between the Shetland Isles and France. Sedimentology, 14: 159 - 173.

Kenyon, N.H. and Cooper, W.S., 2004. Sand banks, sand transport and offshore wind farms.

Kiszka, J., Van Canneyt, O., Macleod, K., Walker, D. and Ridoux, V., 2007. Distribution, encounter rates and habitat characteristics of toothed cetaceans in the Bay of Biscay and adjacent waters from platform of opportunity data. ICES Journal of Marine Science 64, 1033-1043.

Kiszka, J.J., Hassani, S. and Pezeril, S., 2004. Distribution and status of small cetaceans along the French Channel coasts: using opportunistic records for a preliminary assessment. Lutra 47: 33-46.

Laist, D. W., A. R Knowlton, J. G. Mead, A. S. Collet and M. Podesta, 2001. Collisions between ships and great whales. Marine mammal Science 17(1):35-75.

Langston, R., 2010. Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.

Langston, R.H.W. and Pullan, J.D. 2003. Wind farms and birds: an analysis of the effects of wind farms on birds, and. Guidance on Environmental Assessment Criteria and Site Selection Issues. Report by Birdlife International on behalf of the Bern Convention. Sandy, UK: RSPB.

Larsen J.K. and Guillemette M., 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. Journal of Applied Ecology 44: 465-702.

Learmonth, J.A., Macleod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P. and Robinson, R.A., 2006. Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44: 431-464.

Liley, D. and Fearnley, H., 2011. Bird Disturbance Study, North Kent 2010/11. Footprint Ecology.

Liley, D., Stillman, R. and Fearnley, H. 2011. The Solent Disturbance and Mitigation Project Phase II. Results of bird disturbance fieldwork 2009/2010. January 2011.

Linley, E. A. S., Wilding, T. A., Black, K., Hawkins, A. J. S. and Mangi, S., 2007. Review of the reef effects of offshore wind farm structures and their potential for enhancement and mitigation. Report to the Department for Business, Enterprise and Regulatory Reform. RFCA / 005 / 0029P.

Liret, C., 2001. Domaine vital, utilisation de l'espace et des ressources : les grands dauphins, Tursiops truncatus, de l'île de Sein. PhD thesis, Université de Bretagne Occidentale, Brest.

Liret, C., Baines, M.E., Evans, P.G.H., Hammond, P.S. and Wilson, B., 2006. Atlantic bottlenose dolphins: conservation and management. Oceanopolis, Brest, France. 56pp.

Liret, C., Creton, P., Evans, P.G.H., Heimlich-Boran, J.R., and Ridoux, V., 1998. English and French coastal Tursiops from Cornwall to the Bay of Biscay, 1996. Photo-Identification Catalogue. Project sponsored by Ministère de L'Environment, France and Sea Watch Foundation, UK. 100pp.

Liret, C., P. Creton, G. Le Moal and V. Ridoux, 1996. Dolphin home range and reserve zonation: do we need field studies to define management policy? European Research on Cetaceans 10: 15-19.

Louis, M., Béesau J., Gally, Barbraud, C. and Guinet, C., 2010. Demography and social structure of a bottlenose dolphin population in the English Channel. Poster Presentation. http://gecc-normandie.org/wp-content/uploads/2011/04/POSTER_ECS-GECC.pdf.

Lowe J, Howard T, Pardaens A, Tinker J, Holt J, Wakelin S, Milne G, Leake J, Wolf J, Horsburgh K, Reeder T, Jenkins G, Ridley J, Dye S, Bradley S., 2009. UK Climate Projections Science Report: Marine and coastal projections. Met Office Hadley Centre: Exeter.

LWEC, 2013. Terrestrial Biodiversity Climate Change Impacts Report Card 2012 -13.

Madsen, P.T., Wahlberg, M., Tougaard. J., Lucke, K and Tyack, P., 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs.

Marine Ecology Progress Series 309: 279-295.

Marine Connection and The Wildlife Trusts, 2007.The South West Dolphin Report.

Marine Conservation Research International, 2011. Final Report of a Survey for Harbour Porpoises Conducted from R/V Song of the Whale in French and British waters of the English Channel, May to June 2011. A report funded supported by IFAW.

Marinelife, 2010. Marinelife's Charm II Newsletter-April 2010.

Marine Management Organisation (MMO), 2013 (in preparation). Spatial Trends in Shipping Activity. MMO Project No: 1042 August 2013. UNPUBLISHED

Marubini, F., 2010. Charting Progress 2 Healthy and Biological Diverse Seas Feeder report: Section 3.6: Turtles. Published by Department for Environment Food and Rural Affairs on behalf of UK Marine Monitoring and Assessment Strategy - UKMMAS. p540-549. In: UKMMAS (2010) Charting Progress 2 Healthy and Biological Diverse Seas Feeder Report (Eds. Frost, M and Hawkridge, J).

Masquelier, S., Foulon, E., Jouenne, F., Ferreol, M., Brussaard, C. P. D. and Vaulot, D., 2011. Distribution of eukaryotic plankton in the English Channel and the North Sea in summer. Journal of Sea Research 66: 111-122.

Matulla, C., Schöner, W., Alexandersson H., von Storch H. and Wang XL., 2007. European storminess: late nineteenth century to present. Climate Dynamics, DOI 10.1007/s00382-007-0333-y.

McMillan, A., Johnson, A., Worth, D., Tawn, J. and Hu, K., 2011. Coastal flood boundary conditions for UK mainland and islands. Project SC060064/TR3: Design swell waves. Environment Agency, Flood and Coastal Erosion Risk Management Research and Development Programme.

Metoc, 2010. Morecambe Bay Cable Crossing Feasibility Study. Cable Installation and Pylon Feasibility Study to National Grid. Report Reference. 1286/RN2372. Draft Issued 26 May 2010.

Mitchell, I. and F. Daunt, 2010. Seabirds in MCCIP Annual Report Card 2010-11, MCCIP Science Review, 12pp. www.mccip.org.uk/arc.

Morel, G.M., Shrivers, J., Bossy, S.F. and Meyer, C.G., 2012. Residency and behavioural rhythmicity of ballan wrasse (Labrus bergylta) and rays (Raja spp.) captured in Portelet Bay, Jersey: implications for Marine Protected Area design. Journal of the Marine Biological Association of the United Kingdom / FirstView Article, pp 1-8. DOI: http://dx.doi.org/10.1017/S0025315412001725.

Natural England and JNCC, 2010. Departmental Brief: Outer Thames Estuary. Special Protection Area. JNCC, Peterborough, 21p.

Nedwell, J.R., Langworthy, J. and Howell, D., 2003a. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore wind farms, and comparison with background noise. Subacoustech Report ref: 544R0423, published by COWRIE.

Nedwell , J.R., Parvin, S.J., Edwards, B., Workman, R., Brooker, A.G. and Kynoch, J.E., 2007a. Measurement and interpretation of underwater noise during construction and operation of offshore wind farms in UK waters. Subacoustech Report No. 544R0738 to COWRIE Ltd.

Nedwell, J.R., Turnpenny, A.W.H., Lovell, J., Parvin, S.J., Workman, R., Spinks, J.A.L. and Howell, D., 2007b. A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise. Subacoustech Report No. 534R1231.

Neill, S.P., Jordan, J.R., and Couch, S.J., 2012. Impact of tidal energy convertor (TEC) arrays on the dynamics of headland sand banks. Renewable Energy 37 (2012), 387 - 397.

NGIA, 2004. PUB. 191 Sailing Directions (Enroute) English Channel. Eleventh Edition.

Nguyen, 2011. A sea resource map of Alderney and the impacts of the tidal renewable energy project on navigational activity of commercial ships. University of Bristol. Faculty of Engineering. Department of Civil Engineering. Master of Science in Water and Environmental Management.

NOREL NAV SUB Group, 2012 (in preparation). Draft Copy: 'Under Keel Clearance - Policy Paper Guidance To Developers in Assessing Minimum Water Depth Over Devices'. December 2012. UNPUBLISHED.

Not, F., Latasa, M., Marie, D., Cariou, T., Vaulot, D. and Simon, N., 2004. A single species, Micromonas pusilla (Prasinophyceae), dominates eurkaryotic picoplankton in the western English Channel. Applied and Environmental Microbiology 70(7): 4064-4072.

ODPM, 2005. A practical guide to the Strategic Environmental Assessment Directive. Practical guidance on applying European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment". September 2005. Scottish Executive, Welsh Assembly Government, Department of the Environment, Northern Ireland, Office of the Deputy Prime Minister: London.

Open Hydro, 2008. The Alderney Race Environmental Statement

Osiris Projects, 2009a. Alderney Race Tidal Power Development Areas and Preliminary Interconnector Cable Routes. Hydrographic, Geophysical and Oceanographic Surveys. Report Volume 1: T61 and T75 Hydrographic and Geophysical Survey Results (Final).

Osiris Projects, 2009b. Alderney Race Tidal Power Development Areas and Preliminary Interconnector Cable Routes. Hydrographic, Geophysical and Oceanographic Surveys. Report Volume 2: T74 Hydrographic and Geophysical Survey Results (Draft).

Osiris Projects, 2009c. Alderney Race Tidal Power Development Areas and Preliminary Interconnector Cable Routes. Hydrographic, Geophysical and Oceanographic Surveys. Report Volume 3: Interconnector Cable Routes - Hydrographic and Geophysical Survey Results (Final).

Osiris Projects, 2009d. Alderney Race Tidal Power Development Areas and Preliminary Interconnector Cable Routes. Hydrographic, Geophysical and Oceanographic Surveys. Report Volume 5: Fixed Location ADCP Deployments - Phase 1.

OSPAR, 2009. Background document for Basking Shark Cetorhinus maximus. Prepared by APECS for OSPAR.

Pace, D.S., Miragliuolo, A. and Mussi, B. 2006. Vessels and dolphins: scars that tell stories. Fins, p 19.

Parmentier, J., 2010. The Channel Island of Alderney: PR & Marketing Annual report 2009. Available online: http://alderney.gov.gg/CHttpHandler.ashx?id=75408&p=0.

Parvin, S.J., Nedwell, J.R., Kynoch, J., Lovell, J. and Brooker, A.G., 2008. Assessment of underwater noise from dredging operations on the Hastings shingle bank. Report No. Subacoustech 758R0137.

Percival, S.M., 2000. Birds and wind turbines in Britain. Br. Wildlife 12: 8-15.

Petersen I.K., Fox A.D. and Clausager I., 2003. Distribution and numbers of birds in Kattegat in relation to the proposed offshore wind farm south of Læsø -Ornithological impact assessment. Department of Wildlife Ecology and Biodiversity. National Environmental Research Institute, Ministry of Environment, Denmark.

Petersen I.K., Clausager I. and Christensen T.J., 2004. Bird numbers and distribution on the Horns Rev. offshore windfarm area. Annual Status Report 2003. Report commissioned by Elsam Engineering A/S 2003. Rønde, Denmark: National Environmental Research Institute, 34pp.

Pettersson J., 2005. The impact of offshore wind farms on bird life in southern Kalmar Sound, Sweden. A final report based on studies 1999-2003. Report to the Swedish Energy Agency. ISBN 91- 631-6878-2. 124pp.

Pierpoint, C. 2008. Harbour porpoise (Phocoena phocoena) foraging strategy at a high energy, near-shore site in South West Wales, UK. Journal of the Marine Biological Association of the United Kingdom, 2008, 88(6) 1167-1173.

Pinnegar, J., Watt, T. and Kennedy, K. 2012. Climate Change Risk Assessment for the Marine and Fisheries Sector. Climate Change Risk Assessment Report.

PMSS Ltd. 2007. Wave Dragon Pre-Commercial Wave Energy Device. Environmental Statement. A report for Wave Dragon Wales Ltd

Proctor, R., Holt, J.T. and Balson, P.S., 2001 Sediment deposition in offshore deeps of the western North Sea: Questions for models. Estuarine, coastal and shelf science, 53, 553-567.

Røstad, A., Kaartvedt, S., Klevjer, T. A and Webjørn, M., 2006. Fish are attracted to vessels. ICES Journal of Marine Science 63: 1431-1437.

Redman, A., Abercromby, G., Dufour, E., Franc, P. Garcia Sanabria, I., Mayal, Oritz, J. F., Mbuk, O. and Mirval, L., 2011. A feasibility study of marine renewable energy in the Channel Islands. Cranfield University.

Reid J.B., Evans P.G.H. and Northridge S.P., 2003. Atlas of Cetacean distribution in North West European waters, 76 pages, colour photos, maps. Paperback, ISBN 1 86107 550 2.

Richardson, W.J., Green Jr., C.R., Malme, C.I. and Thomson, D.H., 1995. Marine Mammals and Noise. Academic Press, New York.

Robinson, K.P., O'Brien. Berrow, S.D., Cheney, B ., Marina, C., Eisfield, S.M. Haberlin, D., Mandleberg, L., O' Donovan, M., Oudejans, M.G., Conoe, R., Stevick, P.T., Thompson, P.M and Whooley, P., 2012. Discrete or not so discrete: Long distance movements by coastal bottlenose dolphins in UK and Irish waters. Journal of Cetacean Research Management 12, 365-371.

Rodriguez, F., Fernandez, E., Head, R. N., Harbour, D. S., Bratbak, G., Heldal, M. and Harris, R. P., 2000. Temporal variability of viruses, bacteria, phytoplankton and zooplankton in the western English Channel off Plymouth. Journal of the Marine Biological Association of the United Kingdom 80: 575-586.

Royal Haskoning, 2011. SeaGen Environmental Monitoring Programme Final Report. Marine Current Turbines.

Ruddock, M and Whitfield, D.P., 2007. A Review of Disturbance Distances in Selected Bird Species. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

San Martin, E., 2005. Latitudinal variation in plankton size spectra along the Atlantic Ocean. University of Southampton, School of Ocean and Earth Science, Doctoral Thesis , 191pp.

Sanderson, W.G., 1996. Rare Marine Flora and Fauna in Great Britain: the development of criteria for assessment. Provisional list of Rare and Scarce Marine Species (not red-listed). Joint Nature Conservation Committee. Peterborough.

SCANS-II, 2008. Small Cetaceans in the European Atlantic and North Sea. Final Report to the European Commission under project LIFE04NAT/GB/000245. Available from Sea Mammal Research Unit, University of St. Andrews, 54pp.

Scottish Executive, 2007. Scottish Marine Renewables: Strategic Environmental Assessment (SEA). Report prepared for the Scottish Executive by Faber Maunsell and Metoc PLC http://www.seaenergyscotland.net/SEA_Public_Environmental_Report.htm.

Schulte-Pelkum, N., Wieskotten, S., Hanke, W., Dehnhardt, G. and Mauck, B., 2007. Tracking of biogenic hydrodynamic trails in harbour seals (Phoca vitulina). Journal of Experimental Biology 210(5): 781-787.

SCOS, 2012. Scientific Advice on Matters Related to the Management of Seal Populations: 2011. Report by SMRU, St. Andrew's University.

Scottish Executive, 2007. Scottish Marine Renewables: Strategic Environmental Assessment (SEA). Report prepared for the Scottish Executive by Faber Maunsell and Metoc PLC http://www.seaenergyscotland.net/SEA_Public_Environmental_Report.htm.

Seawatch Foundation, 2006. Cetaceans of South-West England.

Seawatch Foundation, 2007. The short-beaked common dolphin in UK waters.

Soanes, L.M., Atkinson, P.A., Gauvain, R.D., and Green, J.A., 2013. Individual consistency in the foraging behaviour of Northern gannets: Implications for interactions with offshore renewable energy developments. Draft paper.

Société Jersiaise, 2008. Common Terns at Les Ecrehous June 2008.

States of Alderney, 2006. Alderney Land Use Plan 2006 (map). Available online: http://alderney.gov.gg/CHttpHandler.ashx?id=76952&p=0.

States of Alderney, 2011a. Alderney Land Use Plan. Approved November 16, 2011. Available online: http://alderney.gov.gg/CHttpHandler.ashx?id=76902&p=0.

States of Alderney, 2011b. Fisheries Management: A White Paper. 14 July 2011 v8.

States of Guernsey, 2010. Air Quality in Guernsey: Screening and Assessment Document (March 2010). A report produced by the Office of Environmental Health and Pollution Regulation.

States of Jersey, 2012. Les Écréhous and Les Dirouilles Ramsar Management Plan.

Strod, T., Arad, Z., Izhaki, I. and Katzir, G., 2004. Cormorants keep their power: visual resolution in a pursuit-diving bird under amphibious and turbid conditions. Current Biology 14: R376-R377 T.

Sun, J. W. C. and Narins, P. M., 2005. Anthropogenic sounds differentially affect amphibian call rate. Biological Conservation, 121, 419 - 427.

Tanji, K., Grattan, S., Grieve, C., Harivandi, A., Rollins, L., Shaw, D., Sheikh, B., Wu, L., 2007. Salt Management Guide for Landscape Irrigation with Recycled Water in Coastal Southern California, a Comprehensive Literature Review.

Teilmann J., Sveegaard S., Dietz R., Petersen I.K., Berggren P. and Desportes G., 2008. High density areas for harbour porpoises in Danish waters. NERI Technical Report. 657. National Environmental Research Institute, University of Aarhus. Aarhus, Denmark. 84 pp.

Thaxter, C.B, Lascelles, B, Sugar, K, Cook, A.S.C.P, Roos, S, Bolton, M., Langston, R.H.W., and Burton, N.H.K., 2012. Seabird foraging Ranges as a Preliminary Tool for Identifying Candidate Marine Protected Areas. Biological Conservation. doi: 10.1016/ j.biocon.2011.12.009.

Thaxter, CB., Daunt, F., Hamer, KC., Watanuki, Y., Harris, MP., Grémillet, D., Peters, G., Wanless, S., 2009. Sex-specific food provisioning in a monomorphic seabird, the Common Guillemot Uria aalge: nest defence, foraging efficiency or parental effort? Journal of Avian Biology 40: 75-84.

Thaxter, C.B., Wanless, S., Daunt, F., Harris, M.P., Benvenuti, S., Watanuki, Y., Grémillet, D., Hamer, K.C. 2010. Influence of wing loading on trade-off between pursuit-diving and flight in Common Guillemots and razorbills. J.Exp. Biol. 213: 1018-1025.

The Crown Estate, 2013, 'Transmission infrastructure associated with connecting offshore generation'.

Thomsen, F., Laczny, M. and Piper, W., 2006. A recovery of harbour porpoises (Phocoena phocoena) in the southern North Sea? A case study off Eastern Frisia, Germany. Helgoland Marine Research, 60, 189-195.

Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W., 2006. Effects of offshore wind farm noise on marine mammals and fish. Biola, Hamburg, Germany on behalf of COWRIE Ltd. 62pp.

Tollit, D., Wood, J., Broome, J and Redden, A., 2011. Detection of Marine Mammals and Effects Monitoring at the NSPI (OpenHydro) Turbine Site in the Minas Passage during 2010. Report prepared by the Sea Mammal Research Unit Ltd and Acadia Centre for Estuarine Research for the Fundy Ocean Research Centre for Energy (FORCE).

Tougaard, J., Carstensen, J., Henriksen, OH., Skov, H. andTeilmann, J., 2003a. Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef. Technical report to Techwise A/S. Hedeselskabet.

Tougaard, J., Ebbesen, I., Tougaard, S., Jensen, T. and Teilmann, J., 2003b. Satellite tracking of Harbour Seals on Horns Reef. Use of the Horns Reef wind farm area and the North Sea. Commissioned by Tech-wise A/S. Fisheries and Maritime Museum, Esbjerg. 42 pp.

Tyler-Walters, 2008. Zostera marina. Common eelgrass. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30/05/2013]. Available from: http://www.marlin.ac.uk/speciessensitivity.php?speciesID=4600> aND.

UKBAP, 2008a. UK Biodiversity Action Plan Priority Habitats Descriptions. Coastal Sand Dunes Edited by Ant Maddock [online]. Available from: http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-09-CoastSandDunes.pdf

UKBAP, 2008b. UK Biodiversity Action Plan Priority Habitats Descriptions. Maritime Cliff and Slopes. Edited by Ant Maddock [online]. Available from: http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-34-MaritimeCliffSlopes.pdf

UKBAP, 2008c. UK Biodiversity Action Plan Priority Habitats Descriptions. Lowland Mixed Deciduous Woodland. Edited by Ant Maddock [online]. Available from: http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-30-LowlandMixedDecWood.pdf

UKMMAS, 2010. Charting Progress 2 Healthy and Biological Diverse Seas Feeder Report (Eds. Frost, M and Hawkridge, J).

Vanhoutte-Brunier, A., Fernand, L., Menesguen, A., Lyons, S., Gohin, F. and Cugier, P., 2008. Modelling the Karenia mikimotoi bloom that occurred in the western English Channel during summer 2003. Ecological Modelling 210(4): 351-376.

Veron, P.K. and Lawlor, M., 2009. The dispersal and migration of the Northern Gannet from Channel Islands breeding colonies Seabird 22, 34/37.

Vincent, C., Fedak, M.A., Meynier, L., Saint-Jean, C. and Ridoux, V., 2005. Status and conservation of the grey seal Halichoerus grypus in France. Biol. Conserv. 126:62-73.

Visbeck M., Hurrell JW., Polvani L. and Cullen HM., 2001. The North Atlantic Oscillation: Past, present and future. Proceedings at the 12th Annual Symposium on Frontiers of Science: Vol. 98, 12876-12877.

Votier, SC., Birkhead, TR., Oro, D., Trinder, M., Grantham, MJ., Clark, JA., McCleery, RH. and Hatchwell, BJ., 2008. Recruitment and survival of immature seabirds in relation to oil spills and climate variability. Journal of Animal Ecology 77: 974-983.

WDCS, 2005. Report of a cetacean survey in the Western Approaches of the English Channel, February-March 2005. A report by the whale and dolphin conservation society.

WDCS, 2009. UK - Vessel Collisions. http://www.wdcs.org/submissions_bin /uk_vessel_collisions.pdf.

Wernham, C.V., Peach, W.J. and Browne, S.J. 1997. Survival rates of rehabilitated guillemots. BTO Research Report 186. British Trust for Ornithology, Thetford.

White, M., 1835. A general description of the south coasts of England and Ireland, and a detailed account of The Channel Islands.

Widdicombe, C. E., Eloire, D., Harbour, D., Harris, R. P. and Somerfield, P. J., 2010. Long-terms phytoplankton community dynamics in the western English Channel. Journal of Plankton Research 32(5): 643-655.

Wilhelmsson, D., Malm, T. and Ohman, M. C., 2006. The influence of offshore windpower on demersal fish. ICES Journal of Marine Science 63: 775-784.

Wilson, B., Batty, RS., Daunt, F., Carter, C., 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban.

Wilson, S. H., 2005. A study into the likelihood of tidal farming becoming commercially viable on Alderney. Cranfield University School of Industrial and Manufacturing Science MSc Thesis. September 2005.

Wilson, J.C., Elliott M., Cutts N.D., Mander L., Mendão V., Perez-Dominguez R. and Phelps A., 2010. Coastal and Offshore Wind Energy Generation: Is It Environmentally Benign? Energies, Vol 3, pp. 1383-1422.

Witt, M.J., Broderick, A.C., Johns, D.J., Martin, C., Penrose, R., Hoogmoed, M.S. and Godley, B.J., 2007a. Prey landscapes help identify potential foraging habitats for leatherback turtles in the NE Atlantic. Marine Ecology Progress Series 337, 231-243.

Witt, M.J., Penrose, R., & Godley, B.J. 2007b.Spatio-temporal patterns of juvenile marine turtle occurrence in waters of the European continental shelf. Mar Biol. 151:873-885.

Wood, C., 2008. Seasearch survey of Alderney 2008.

Wood, C., 2010. Seasearch survey of Alderney 2010. May 2010.

Wood, C., 2007. Seasearch survey of Alderney June and August 2007. A report to the Alderney Wildlife Trust. December 2007.

World Health Organisation (WHO), 2003. Health aspects of air pollution with particulate matter, ozone and nitrogen dioxide. Report on a WHO Working Group. Bonn, Germany. 13-15 January 2003. WHO Regional Office for Europe, Copenhagen.

Young, G., Lawlor, M., Paintin, T., Atkinson, M. and Watson, J., 2012. A Working List of the Birds of the Channel Islands.

Young, H.G., Dryden, M. and Pinel, J. 2011 Conservation Status of Jersey's Birds: Jersey's bird populations in the 21st Century. Durrell Wildlife Conservation Trust, Jersey.

Zollett, EA. and Rosenberg, AA. 2005. A review of cetacean bycatch in trawl fisheries of New Hampshire. Literature review, Prepared for the Northeast Fisheries Science Centre.

11.1 Websites

4C Offshore website:
http://www.4coffshore.com/windfarms/

Alderney Wildlife Trust website. Reserves.
http://www.alderneywildlife.org/pages/reserves.php [Last accessed 13 May 2013.]

Alderney Wildlife Trust website:
http://www.alderneywildlife.org/index.php

Alderney Records Centre Alderney Records Centre website:
http://www.alderneyrecordscentre.org/html/livedata.php?type=hist

BBC News website. Alderney Airport seeks autonomy to help manage losses. 14 May 2012
http://www.bbc.co.uk/news/world-europe-guernsey-18038629 [Last accessed March 2013.]

CARtographie des HAbitats Marins (CARTHAM) website:
http://cartographie.aires-marines.fr/?q=node/43&page=1

EUSeaMap website:
http://jncc.defra.gov.uk/page-5020#Interactivemap

Island Life website. The Natural History of Alderney.
http://www.islandlife.org/natural_history_of_alderney.htm [Last Accessed 13 May 2013.]

IUCN Red List website.
http://www.iucnredlist.org/

La Societe Guernesiaise website:
http://www.societe.org.gg/sections/ornithology.html

Les Programmes de Surveillance website.
http://www.surveillance.eaufrance.fr/eaux-de-surface/site/FRHC04-1/

Programme d'acquisition de connaissances sur les oiseaux et les mammifères marins en France métropolitaine (PACOMM) website:
http://www.aires-marines.fr/Connaitre/Habitats-et-especes-pelagiques/Oiseaux-et-mammiferes-marins-en-metropole

States of Alderney website:
http://alderney.gov.gg/article/4072/Travel-Traffic-and-Transport

Subterranea Britannica website:
http://www.subbrit.org.uk/sb-sites/sites/a/alderney/

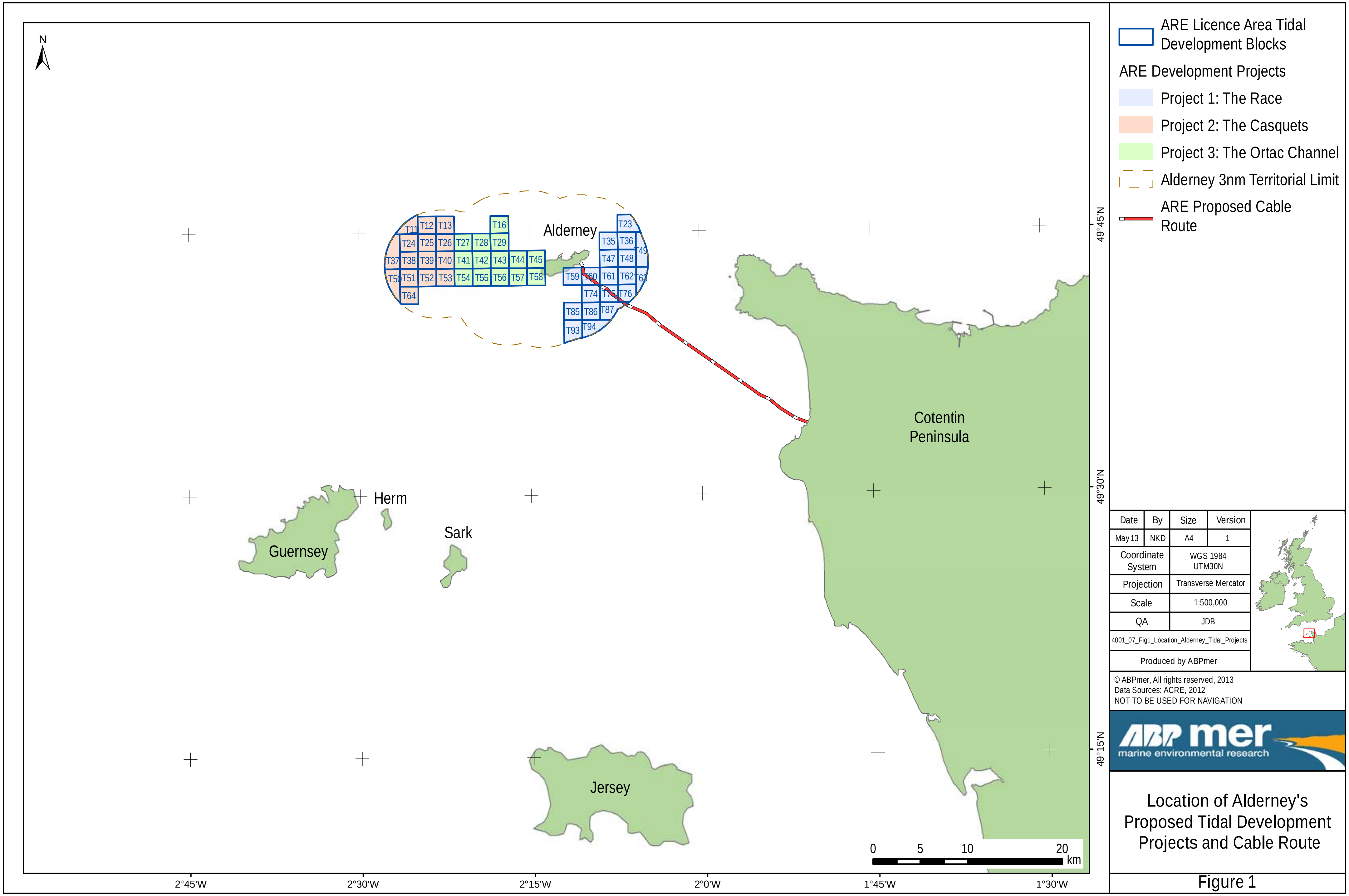
United Kingdom Climate Change Impact Programme website:
http://www.ukcip.org.uk/

Visit Alderney website:
http://www.visitalderney.com/attractions/railway/

Wildlife Extra website:
http://www.wildlifeextra.com/

Yachting and Boating World website. Thread: Alderney Marina.
http://www.ybw.com/forums/showthread.php?321560-Alderney-Marina [Last accessed March 2013]

Figures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Version
May13
NKD
A4
1
Coordinate System
WGS 1984 UTM30N
Projection
Transverse Mercator
Scale
1:500,000
QA
JDB
4001_07_Fig1_Location_Alderney_Tidal_Projects
Produced by ABPmer
© ABPmer, All rights reserved, 2013
Data Sources: ACRE, 2012
NOT TO BE USED FOR NAVIGATION
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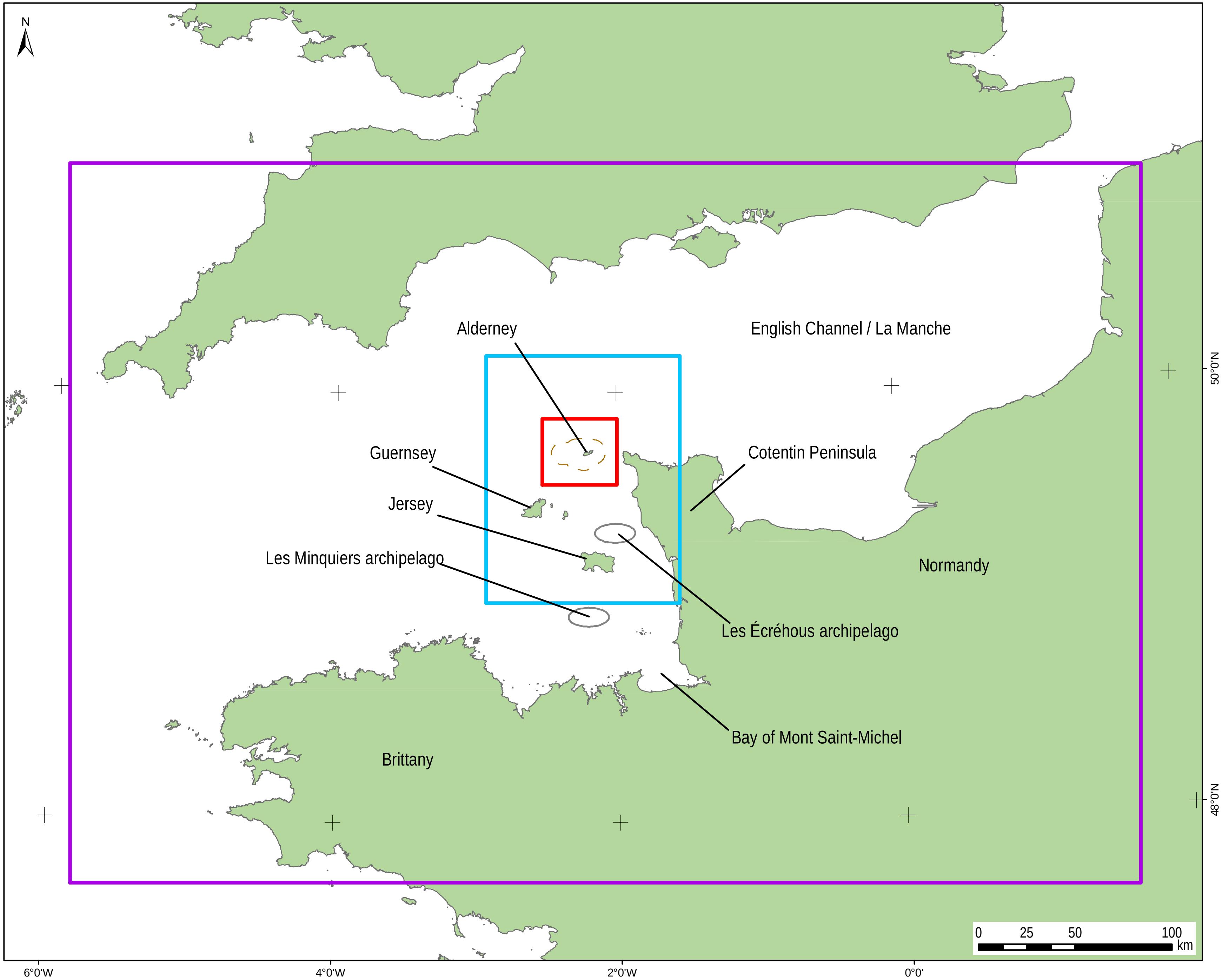
Location of Alderney's Proposed Tidal Development Projects and Cable Route
Figure 1



Main Study Area
Wider Study Area
Mobile Natura 2000 Features Study Area
Alderney 3nm Territorial Limit

Date	By	Size	Version
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Projection	Transverse Mercator		
Scale	1:2,750,000		
QA	JDB		
4001_07_Fig2_REA Study Areas.mxd			
Produced by ABPmer			

Data Sources: ACRE, 2012
NOT TO BE USED FOR NAVIGATION

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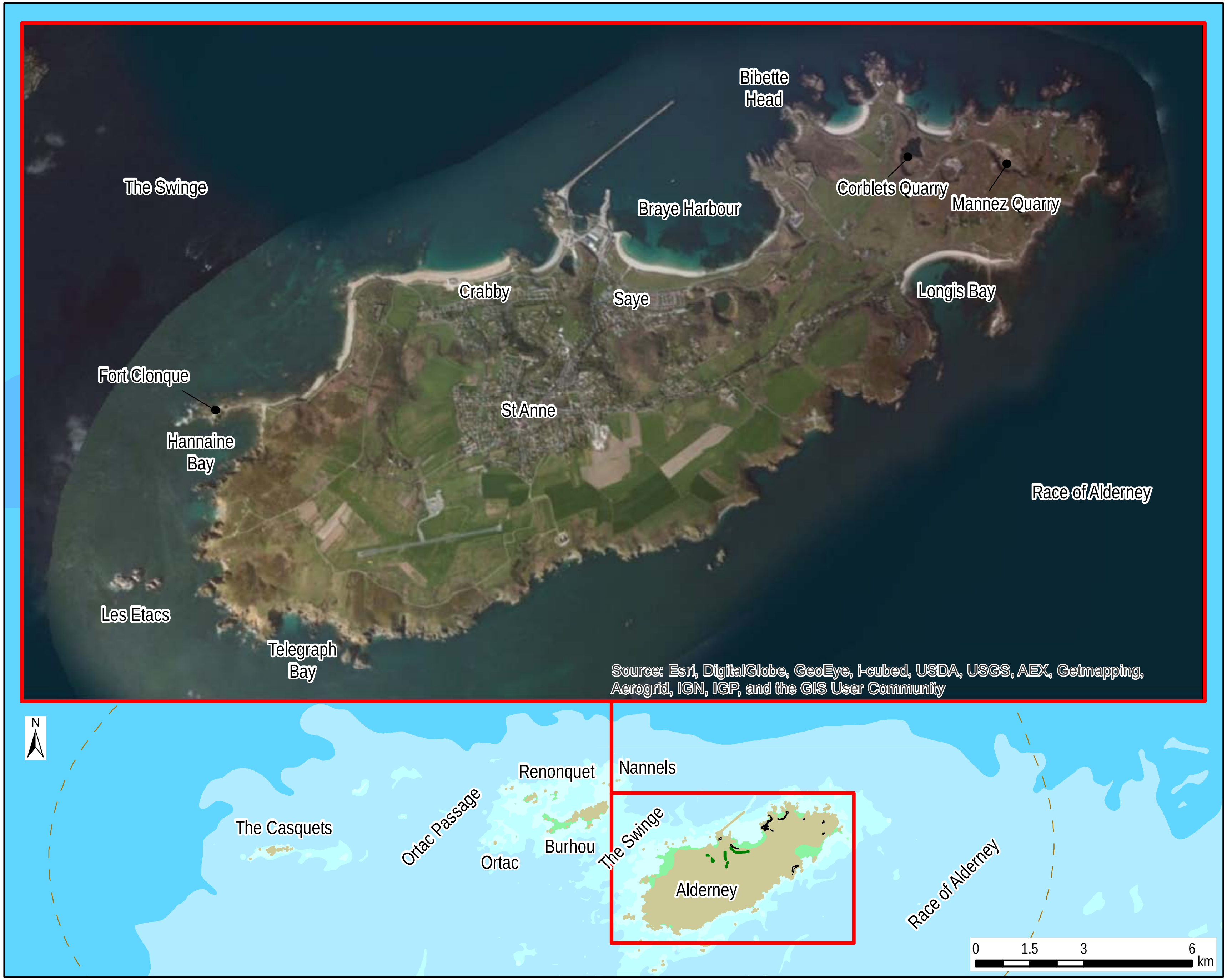
REA Study Areas

Figure 2

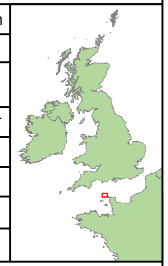


Alderney 3nm Territorial Limit

Depth (mCD)

- Drying
- <= 10 m
- <= 20 m
- <= 50 m
- <= 100 m
- <= 500 m

Date	By	Size	Version
May 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:50,000		
QA	JDB		
4001_07_Fig3_Location_Map.mxd			
Produced by ABPmer			



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Location Map of Alderney

Figure 3

Photograph Legend

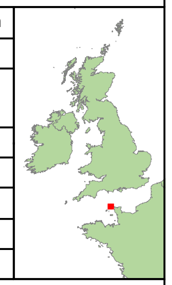
1. Platte Saline Beach (Photo By blugger. Selected for Google Earth - ID:17825781)
2. Alderney Breakwater (Photo by blugger. ID:17825626)
3. Saye Bay from the Air (Photo by blugger. Selected for Google Earth - ID:17825868)
4. Fort Corblets (Photo by ATG10. Google Earth ID: 37577221)
5. Longis Bay Beach (Photo by blugger. Selected for Google Earth - ID: 17825756)
6. Telegraph Bay looking towards the Cotentin Coast (105o) (c)gs. (Photo by c010gne1. Selected for Google Earth ID: 35887087)

Date	By	Size	Version
May 13	NKD	A3	1

Coordinate System	WGS 1984 UTM30N
Projection	WGS 1984
Scale	1:30,000
QA	JDB

4001_07_Fig4_Photomontage.mxd

Produced by ABPmer



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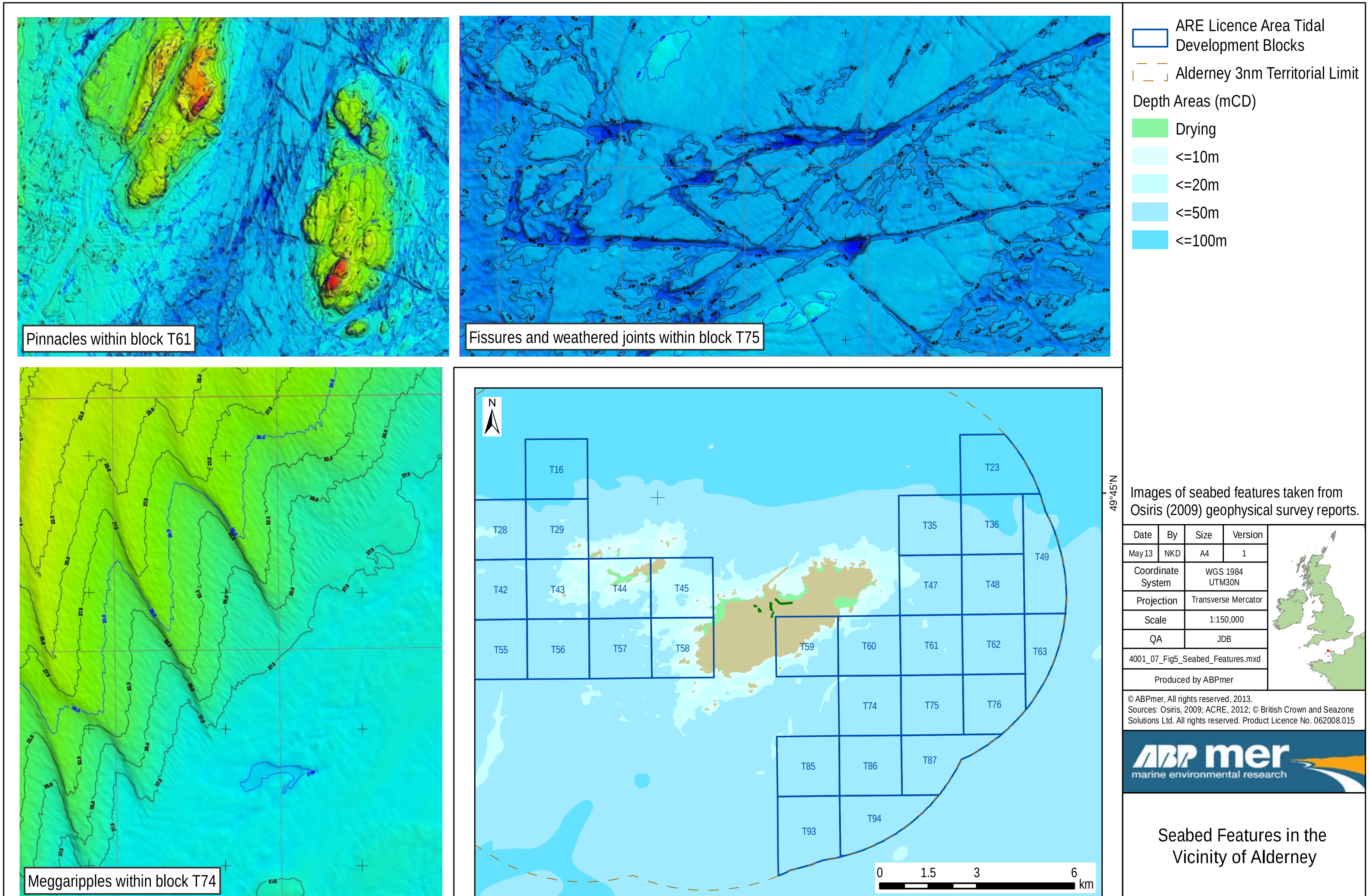
Photomontage of Coastal Features of Alderney

Figure 4



Pinnacles within block T61
Fissures and weathered joints within block T75
Meggaripples within block T74
N
T16
T23
T28
T29
T35
T36
T42
T43
T44
T45
T47
T48
T49
T55
T56
T57
T58
T59
T60
T61
T62
T63
T74
T75
T76
T85
T86
T87
T93
T94
0 1.5 3 6 km
2°15'W
49°45'N
ARE Licence Area Tidal Development Blocks
Alderney 3nm Territorial Limit
Depth Areas (mCD)
Drying
<=10m
<=20m
<=50m
<=100m
Images of seabed features taken from Osiris (2009) geophysical survey reports.
Date | By | Size | Version
May13 | NKD | A4 | 1
Coordinate System | WGS 1984 UTM30N
Projection | Transverse Mercator
Scale | 1:150,000
QA | JDB
4001_07_Fig5_Seabed_Features.mxd
Produced by ABPmer
© ABPmer, All rights reserved, 2013.
Sources: Osiris, 2009; ACRE, 2012; © British Crown and Seazone Solutions Ltd. All rights reserved. Product Licence No. 062008.015
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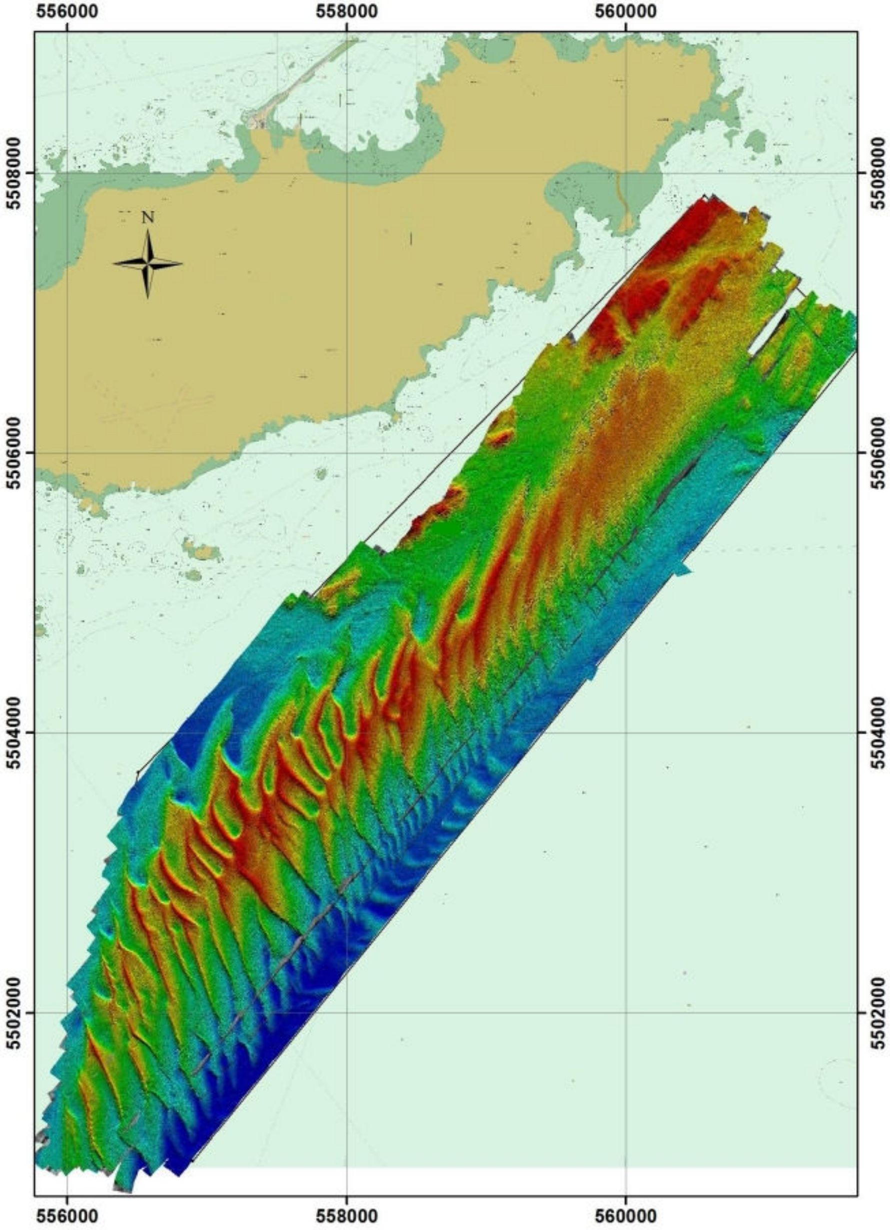
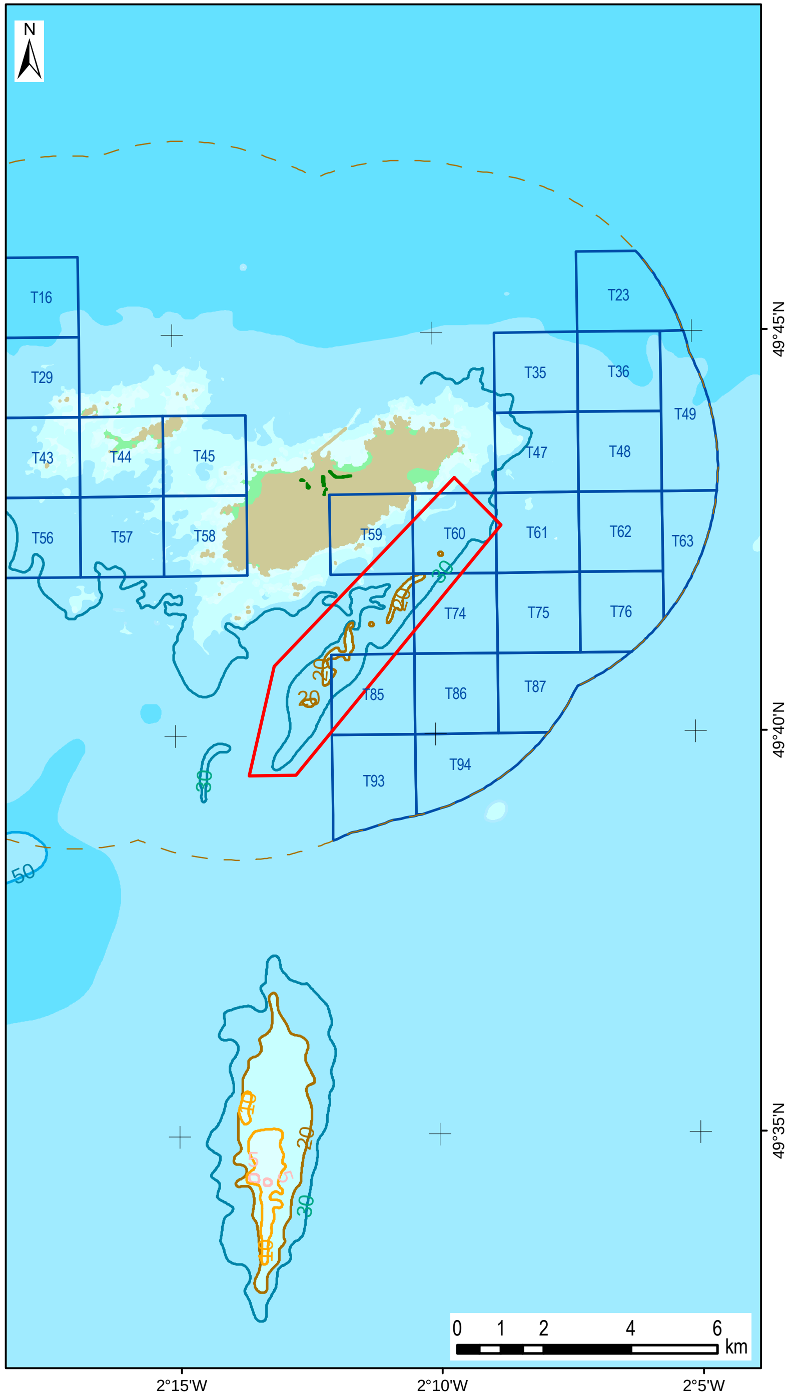
Seabed Features in the Vicinity of Alderney

Figure 5



Swath bathymetry of the Alderney South Banks Survey Area in 2011
(UTM North Zone 30)

Image taken from Axelsson, M., Dewey, S., Allen, C. and Doran, J. (2011). Alderney South Banks Acoustic and Environmental Survey 2011 – Environmental Survey Report. A report to the Alderney Commission for Renewable Energy (ACRE) by Seastar Survey Ltd.



ARE Licence Area Tidal Development Blocks

South Banks Survey Area

Alderney 3nm Territorial Limit

Sandbank Contours (mCD)

- 5 m
- 10 m
- 20 m
- 30 m
- 50 m

Depth Areas (mCD)

- Drying
- <= 10 m
- <= 20 m
- <= 50 m
- <= 100 m

Date	By	Size	Version
Jun 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:175,000		
QA	JDB		
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Produced by ABPmer			

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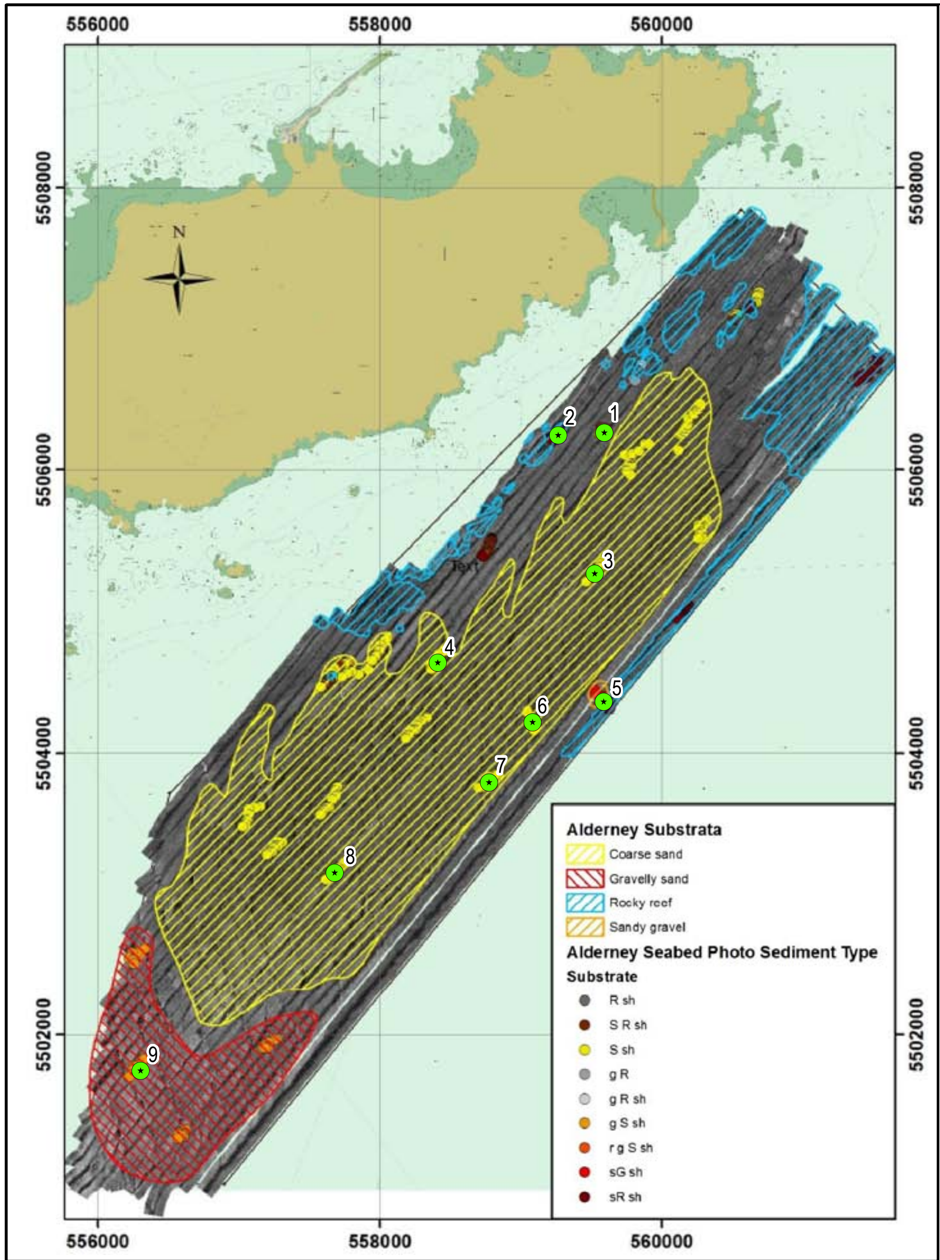
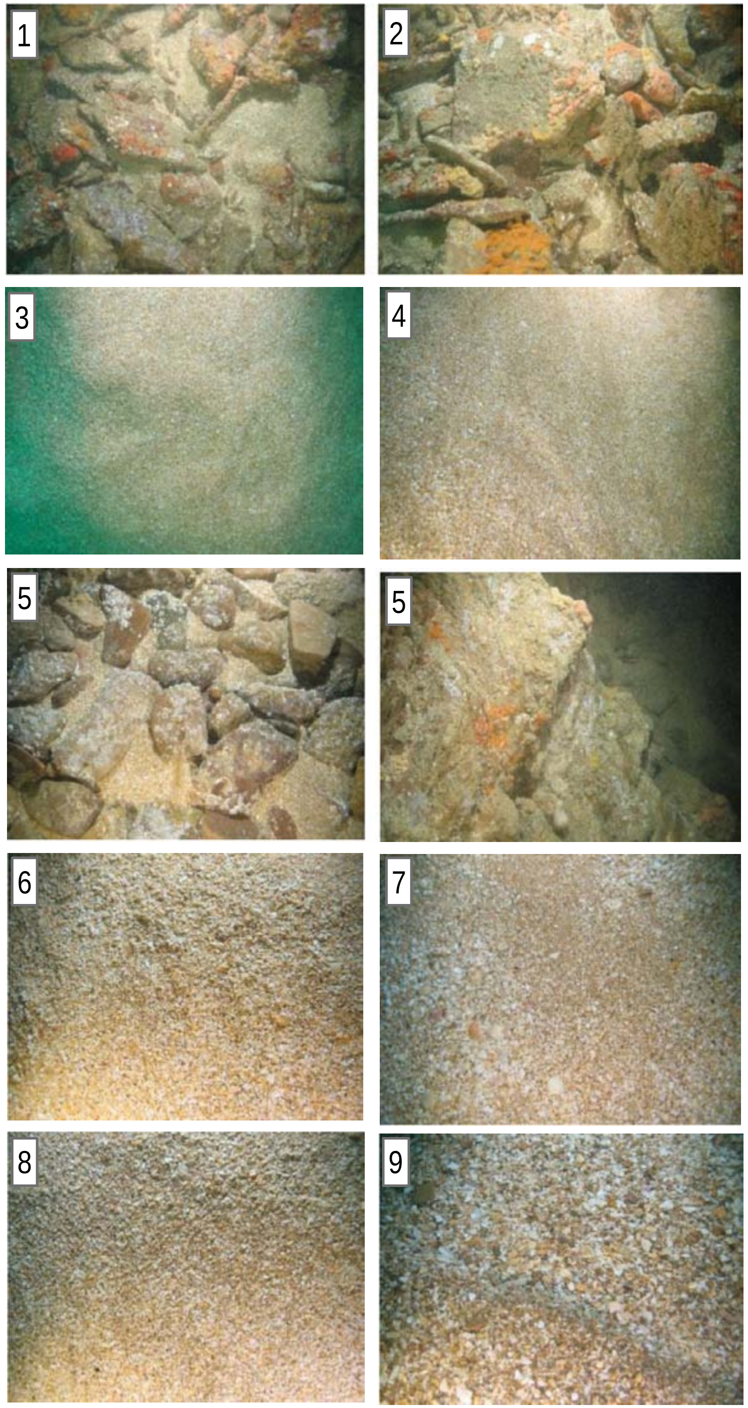
Swath Bathymetry of Alderney South Banks

Figure 6



Substrata Map of the Alderney South Banks Survey Area in 2011.
Substrata polygons overlying drop-down camera locations and
sidescan sonar imagery (UTM North Zone 30)
(Seastar Survey, 2011)



South Banks Survey Area

Location of Selected Drop-Down Camera Samples

Figure and images taken from Axelsson, M., Dewey, S., Allen, C. and Doran, J. (2011) Alderney South Banks Acoustic and Environmental Survey 2011 – Environmental Survey Report.
A report to the Alderney Commission for Renewable Energy (ACRE) by Seastar Survey Ltd.

Date	By	Size	Version
Jun 13	NKD	A4	1
Coordinate System		WGS 1984 UTM30N	
Projection		Transverse Mercator	
Scale		1:53,500	
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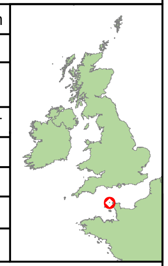
Produced by ABPmer			



Data Sources: Seastar Survey, 2011

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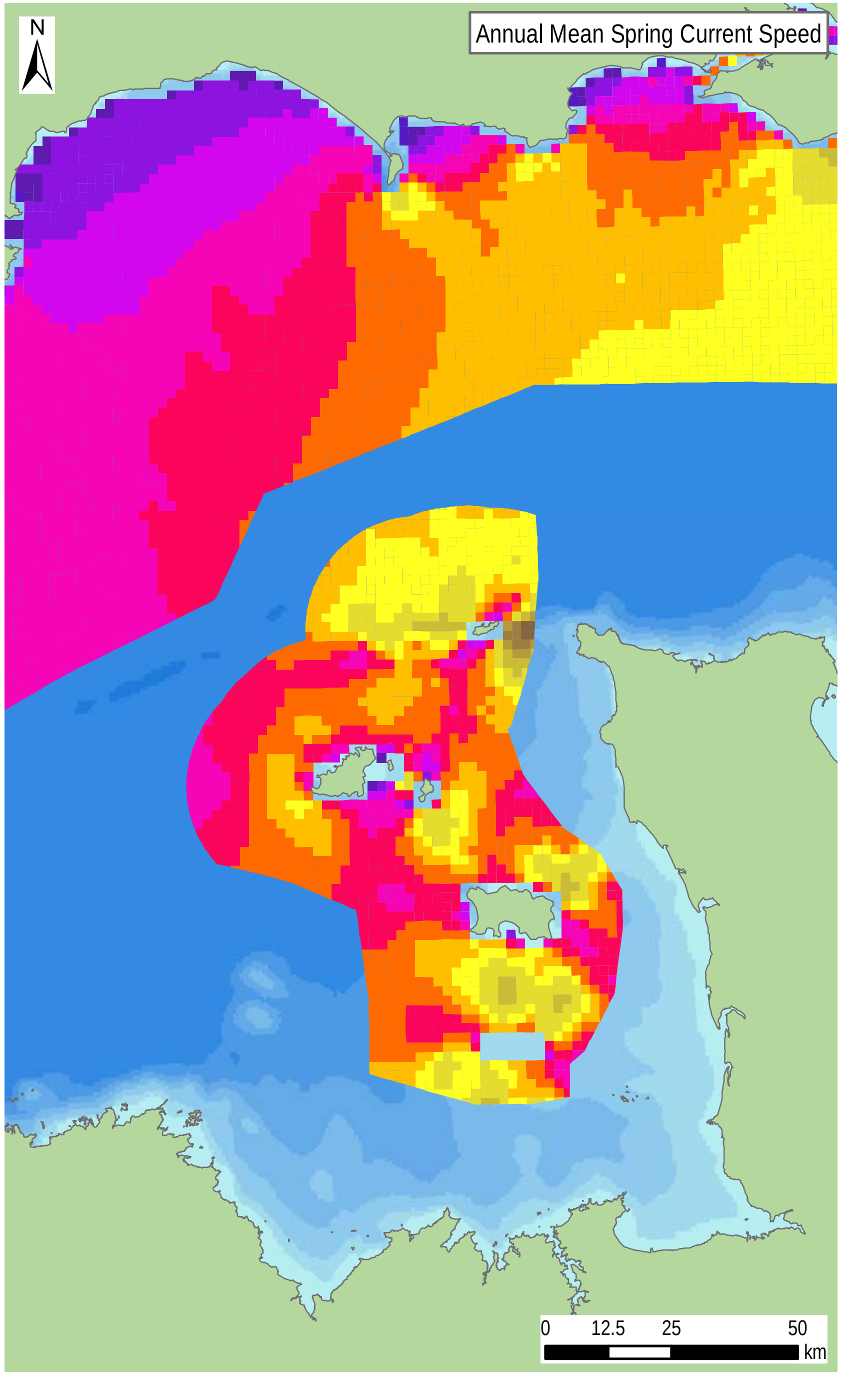
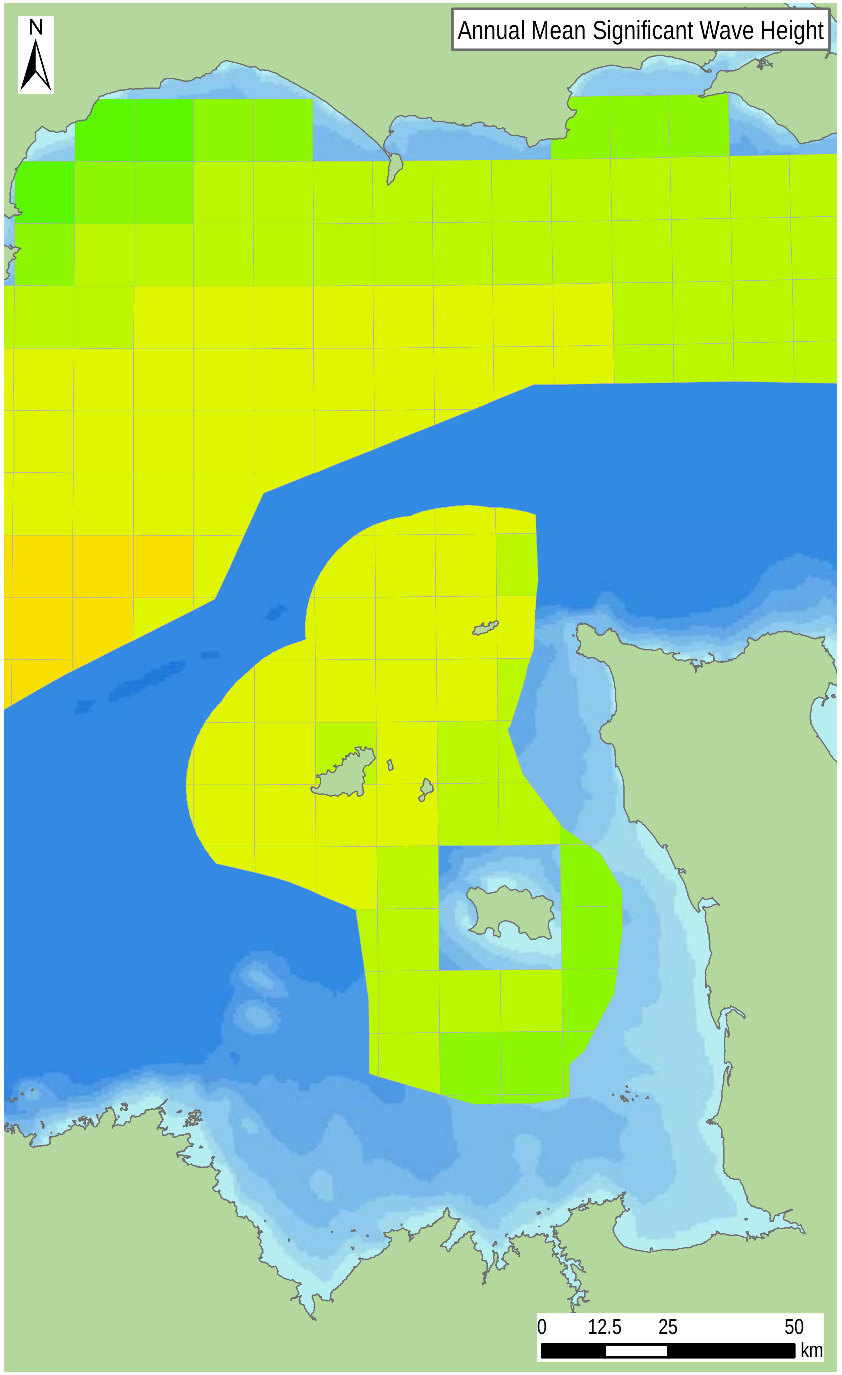
Seabed Sediment Characteristics of Alderney South Banks

Figure 7





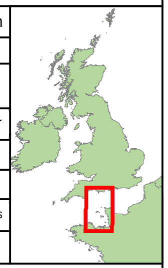
Annual Mean Spring Current Speed (m/s)

> 4.00	1.26 - 1.50
3.51 - 4.00	1.01 - 1.25
3.01 - 3.50	0.76 - 1.00
2.51 - 3.00	0.51 - 0.75
2.01 - 2.50	0.26 - 0.50
1.76 - 2.00	0.11 - 0.25
1.51 - 1.75	< 0.11

Annual Mean Significant Wave Height (m)

> 2.75	1.51 - 1.75
2.51 - 2.75	1.26 - 1.50
2.26 - 2.50	1.01 - 1.25
2.01 - 2.25	0.76 - 1.00
1.76 - 2.00	< 0.76

Date	By	Size	Version
Jun 13	JDB	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1: 50,000,000		
QA	NKD		
4001_07_Fig8_Current_Speed_Wave_Heights			
Produced by ABPmer			



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Annual Spring Current Speeds and Annual Wave Heights in the Wider Study Area

Figure 8

NOTE: The star in the figure indicates the position of the end of the outfall referred to in Salomon, et al., 1991.

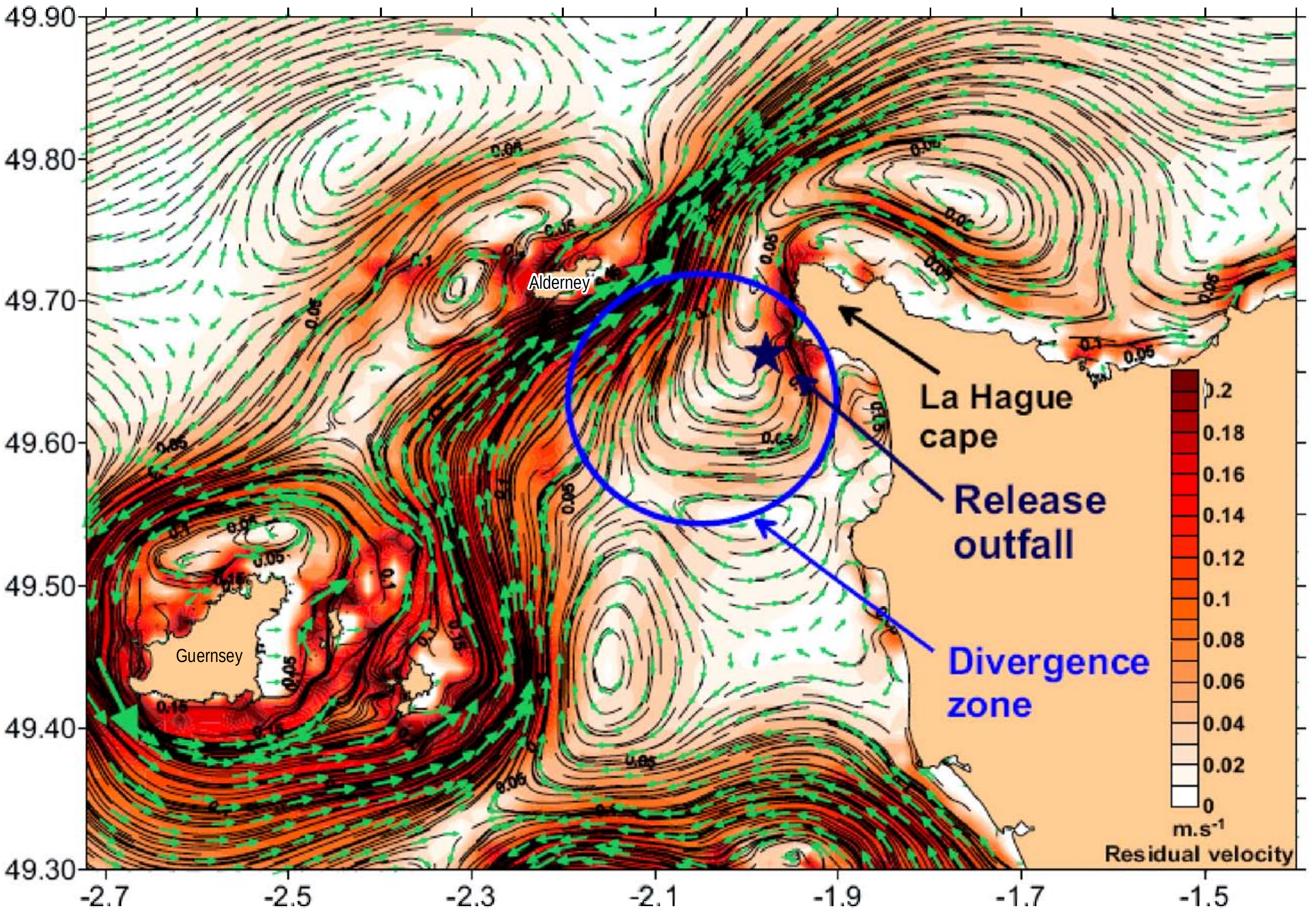
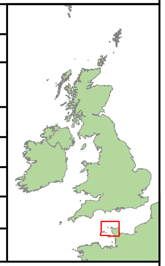


Figure taken from P. Bailly du Bois, F. Dumas, L. Solier and C. Voiseux, In-situ database toolbox for short-term dispersion model validation in macro-tidal seas, application for 2D-model, Continental Shelf Research, doi:10.1016/j.csr.2012.01.011.
Figure originally published in Salomon, et al. (1991). Mathematical model of 125Sb transport and dispersion in the Channel. In: Radionuclides in the study of marine processes, Norwich, UK, 10-13 Sept 1991, Ed Kershaw JP, Wood-head DS Elsevier Applied Science 74-83.

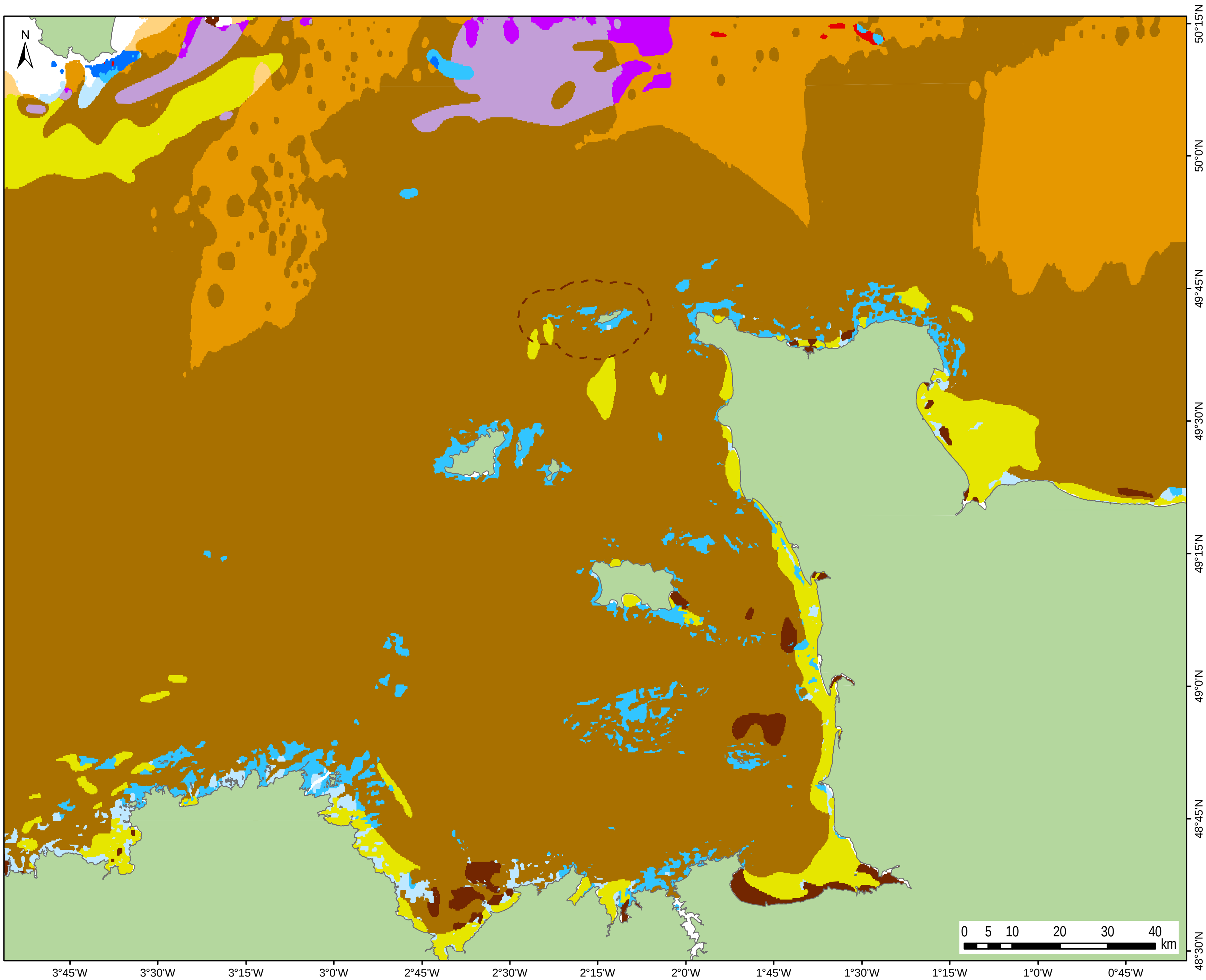
Date	By	Size	Version
Jun 13	JDB	A4	1
Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	NKD		
4001_07_Fig9_Current_Speeds_Cable			
Produced by ABPmer			



Data Sources: Bois et al., 2012

Tidal Current Speeds along the Proposed Interconnector Cable Route

Figure 9



Alderney 3nm Territorial Limit

EUNIS Habitat Type

- A4.1
- A4.2
- A4.27
- A4.33
- A5.13
- A5.14
- A5.25 or A5.26
- A5.27
- A5.37
- A5.44
- A5.45

Date	By	Size	Version
May 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:1,100,000		
QA	JDB		
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Produced by ABPmer			

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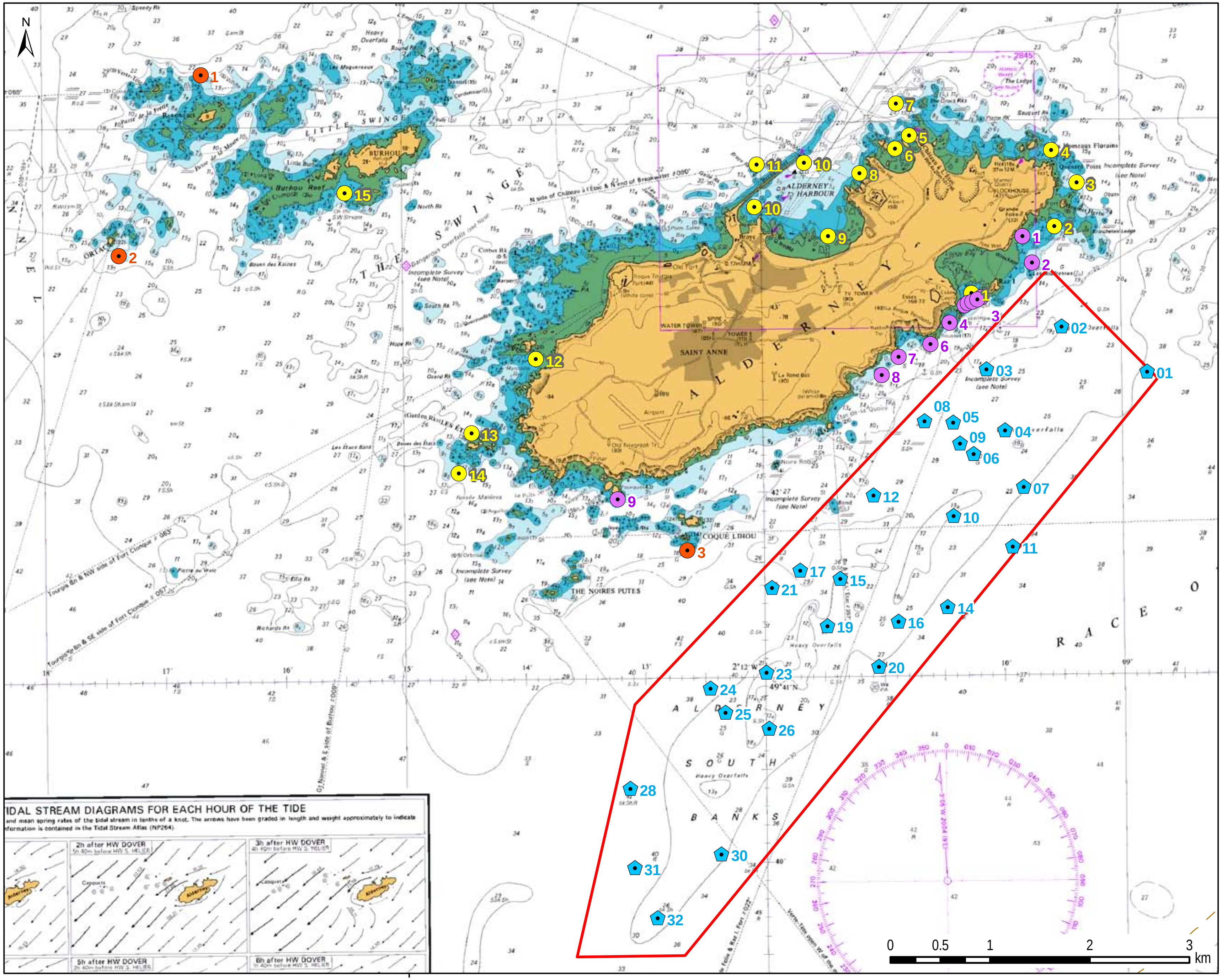
Broad-Scale Benthic Habitats

Figure 10



2°15'W

Seastar Survey South Banks Survey Area

Seastar Survey Drop-Down Camera Sample Locations

Seasearch Diver Surveys

2007 Sample Locations

2008 Sample Locations

2010 Sample Locations

NOTE: Seasearch diver survey locations shown in this figure are approximate.

Date	By	Size	Version
May 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:54,000		
QA	JDB		
4001_07_Fig11_Subtidal_Sample_Points			
Produced by ABPmer			

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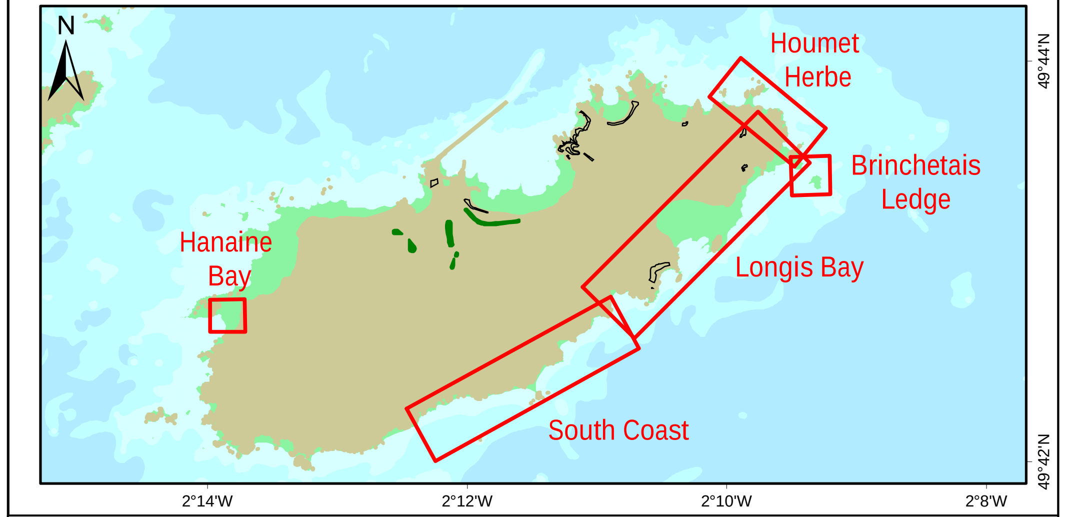
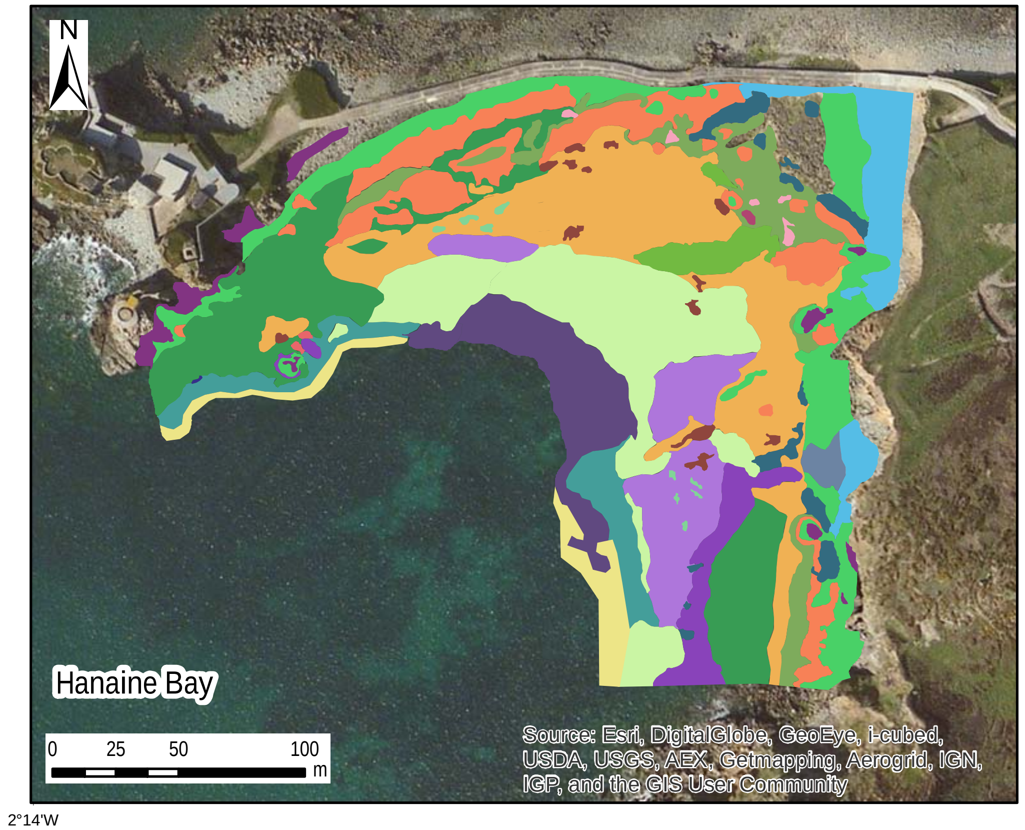
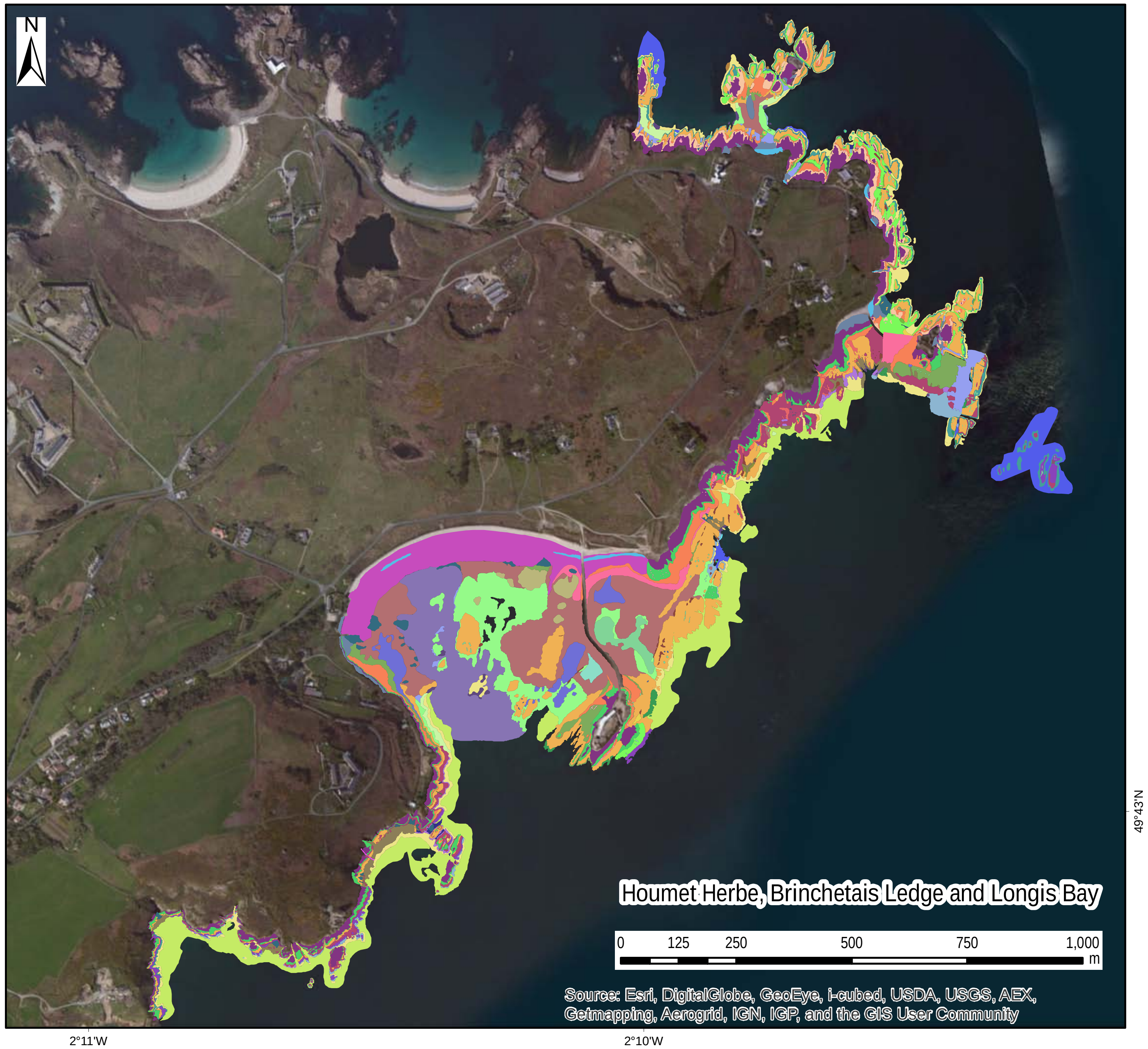
Subtidal Sample Locations

Figure 11







Biotope Classification

- IR.FIR.SG.CrSpAsAn
- IR.HIR.KFaR.LhypR
- IR.HIR.KSed.LsacSac
- IR.HIR.KSed.Sac
- IR.HIR.KSed.XKScrR
- LR.FLR.CVOV.FaCr
- LR.FLR.CvOv.AudCla
- LR.FLR.Eph.Ent
- LR.FLR.Eph.EntPor
- LR.FLR.Eph.EphX
- LR.FLR.Lic.Ver
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.Ver.Ver
- LR.FLR.Lic.YG
- LR.FLR.Rkp.Cor.Bif
- LR.FLR.Rkp.Cor.Cor
- LR.FLR.Rkp.FK.Sar
- LR.FLR.Rkp.G
- LR.FLR.Rkp.SwSed
- LR.HLR.FR.Coff.Coff
- LR.HLR.FR.Him
- LR.HLR.FR.Mas
- LR.HLR.FR.Osm
- LR.HLR.FR.Pal
- LR.HLR.FT.FserTX
- LR.HLR.MusB.Cht
- LR.HLR.MusB.Cht.Cht
- LR.HLR.MusB.Cht.Lpyg
- LR.HLR.MusB.Sem.Fves.R
- LR.HLR.MusB.SemSem
- LR.LLR.F.Asc.FS
- LR.LLR.F.Asc.X
- LR.LLR.F.Fserr.X
- LR.LLR.F.Fspi.X
- LR.LLR.F.Fves.X
- LR.MLR.BF.Fser.Bo
- LR.MLR.BF.Fser.R
- LR.MLR.BF.FspiB
- LR.MLR.BF.FvesB
- LR.MLR.BF.PelB
- LR.MLR.BF.Rho
- LS.LCS.Sh.Barsh
- LS.LMx
- LS.LSA.MuSa.MacAre
- LS.LSa.MoSa.BarSa
- LS.LSa.St.Tal

Date	By	Size	Version
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Scale		1:8,000	
QA		QA	
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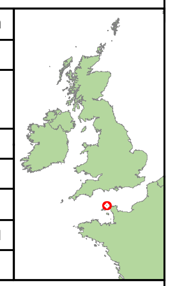
Produced by ABPmer			



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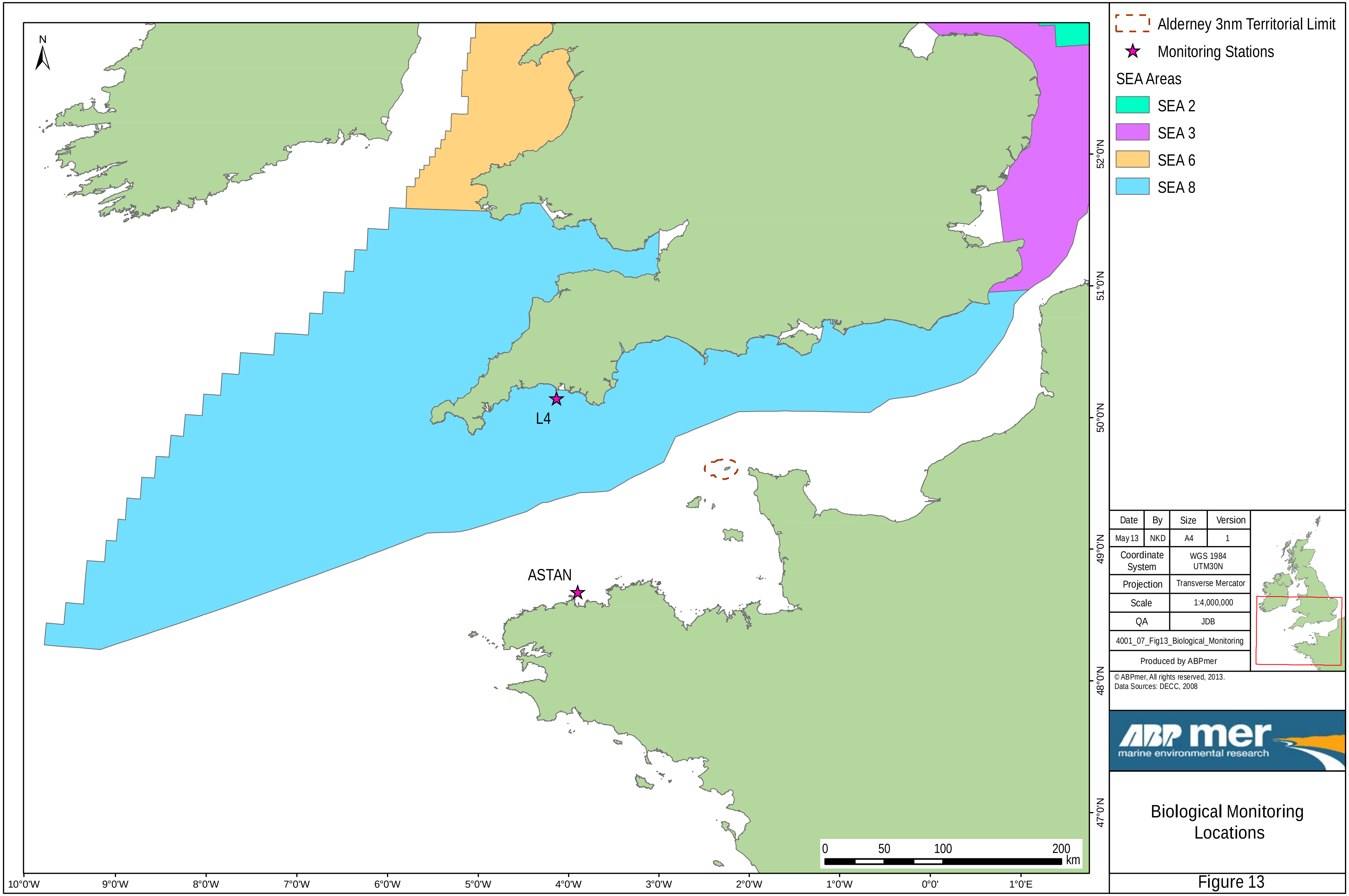
Intertidal Biotopes Map

Figure 12



N
L4
ASTAN
52°0'N
51°0'N
50°0'N
49°0'N
48°0'N
47°0'N
10°0'W
9°0'W
8°0'W
7°0'W
6°0'W
5°0'W
4°0'W
3°0'W
2°0'W
1°0'W
0°0'
1°0'E
0
50
100
200
km
Alderney 3nm Territorial Limit
Monitoring Stations
SEA Areas
SEA 2
SEA 3
SEA 6
SEA 8
Date
By
Size
Version
May 13
NKD
A4
1
Coordinate System
WGS 1984 UTM30N
Projection
Transverse Mercator
Scale
1:4,000,000
QA
JDB
4001_07_Fig13_Biological_Monitoring
Produced by ABPmer
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Data Sources: DECC, 2008
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Biological Monitoring Locations
Figure 13

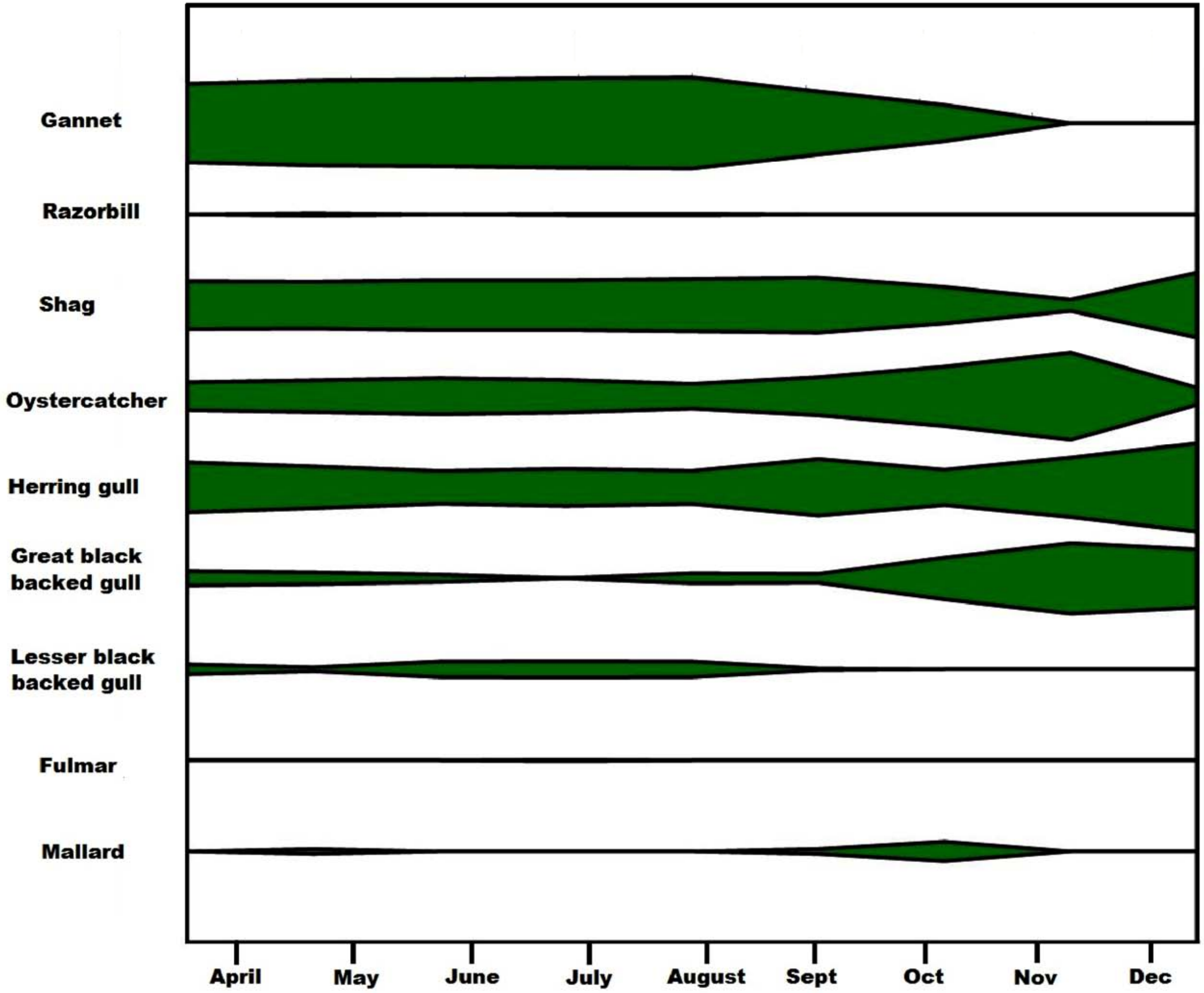


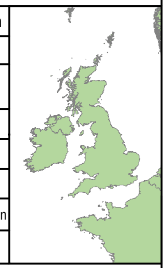
Figure taken from Alderney Wildlife Trust, 2011. Seabird and Marine Mammal Survey. Longis Bay and Associated Areas. A report submitted to Alderney Commission for Renewable Energy

Date	By	Size	Version
Sep 13	JDB	A4	1

Coordinate System	N/A
Projection	N/A
Scale	N/A
QA	NKD

4001_07_Fig14_Bird_Mean_Composition

Produced by ABPmer



Data Sources: Alderney Wildlife Trust Enterprises Ltd, 2011

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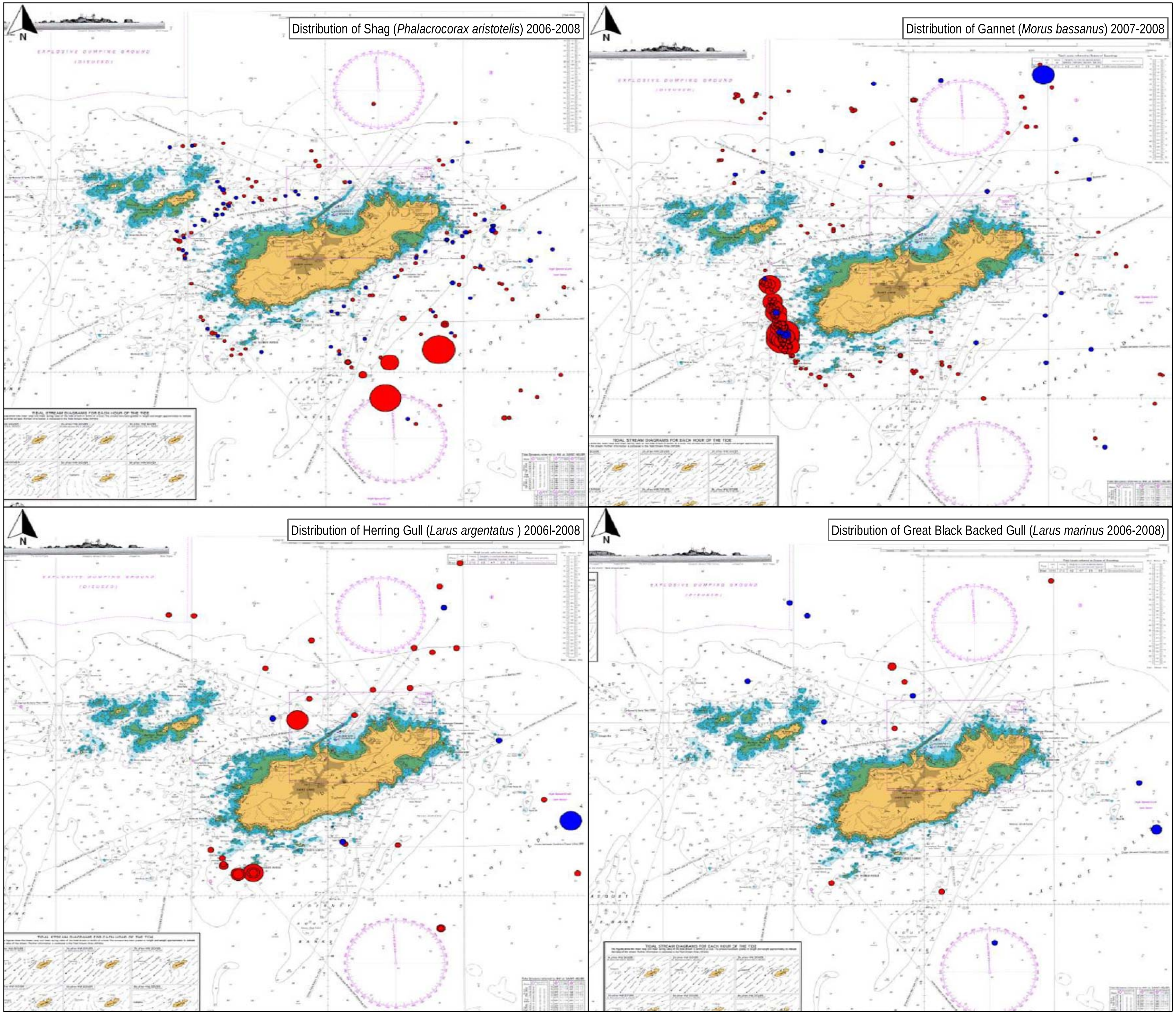
Mean Composition Of The Nine Key Bird Species Observed Across Each Survey Month Within The Survey Area, 2010

Figure 14



Distribution of Shag (*Phalacrocorax aristotelis*) 2006-2008

Shags recorded March - August 2007

50+ 25 5

Shags recorded Sept 2007 - Feb 2008

50+ 25 5

Distribution of Gannet (*Morus bassanus*) 2007-2008

Gannets recorded March - August 2007

50+ 25 5

Gannets recorded Sept 2007 - Feb 2008

10 5 1

Distribution of Herring Gull (*Larus argentatus*) 2006-2008

Herring Gulls recorded March - August 2007

10 5 1

Herring Gulls recorded Sept 2007 - Feb 2008

10 5 1

Distribution of Great Black Backed Gull (*Larus marinus* 2006-2008)

Great Black Backed Gull March - August 2007

10 5 1

Great Black Backed Gull Sept 2007 - Feb 2008

10 5 1

Figures taken from Barr S. & Power P.B., 2009. The Alderney Race 500 MW Environmental Statement. A report to Alderney Renewable Energy.

Date	By	Size	Version
May 13	JDB	A3	1
Projection		N/A	
Scale		N/A	
QA		NKD	
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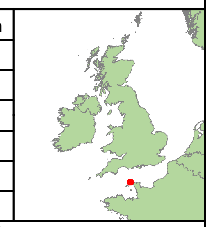
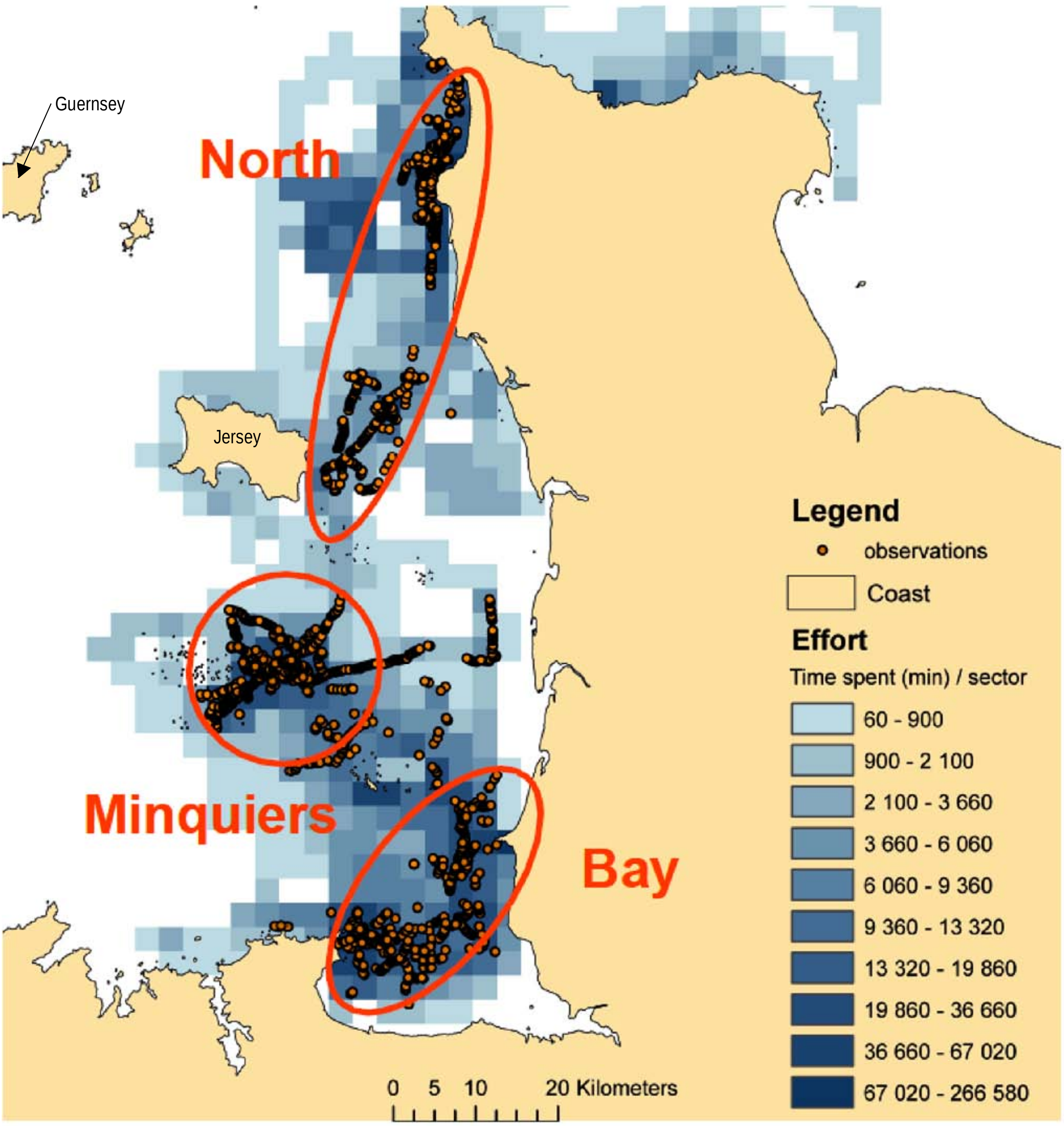
Produced by ABPmer			



Data Sources: Barr et al., 2009

Distribution of Seabird Species Observed around Alderney (2006 to 2008)

Figure 15



Date	By	Size	Version
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Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	NKD		
4001_07_Fig16_Dolphin_Sightings.mxd			
Produced by ABPmer			

Data Source: Louis et al., 2010

Image taken from Louis M., Beesau J., Gally F., Barbraud C., Guinet C. Demography and social structure of a bottlenose dolphin population in the English Channel. 2010

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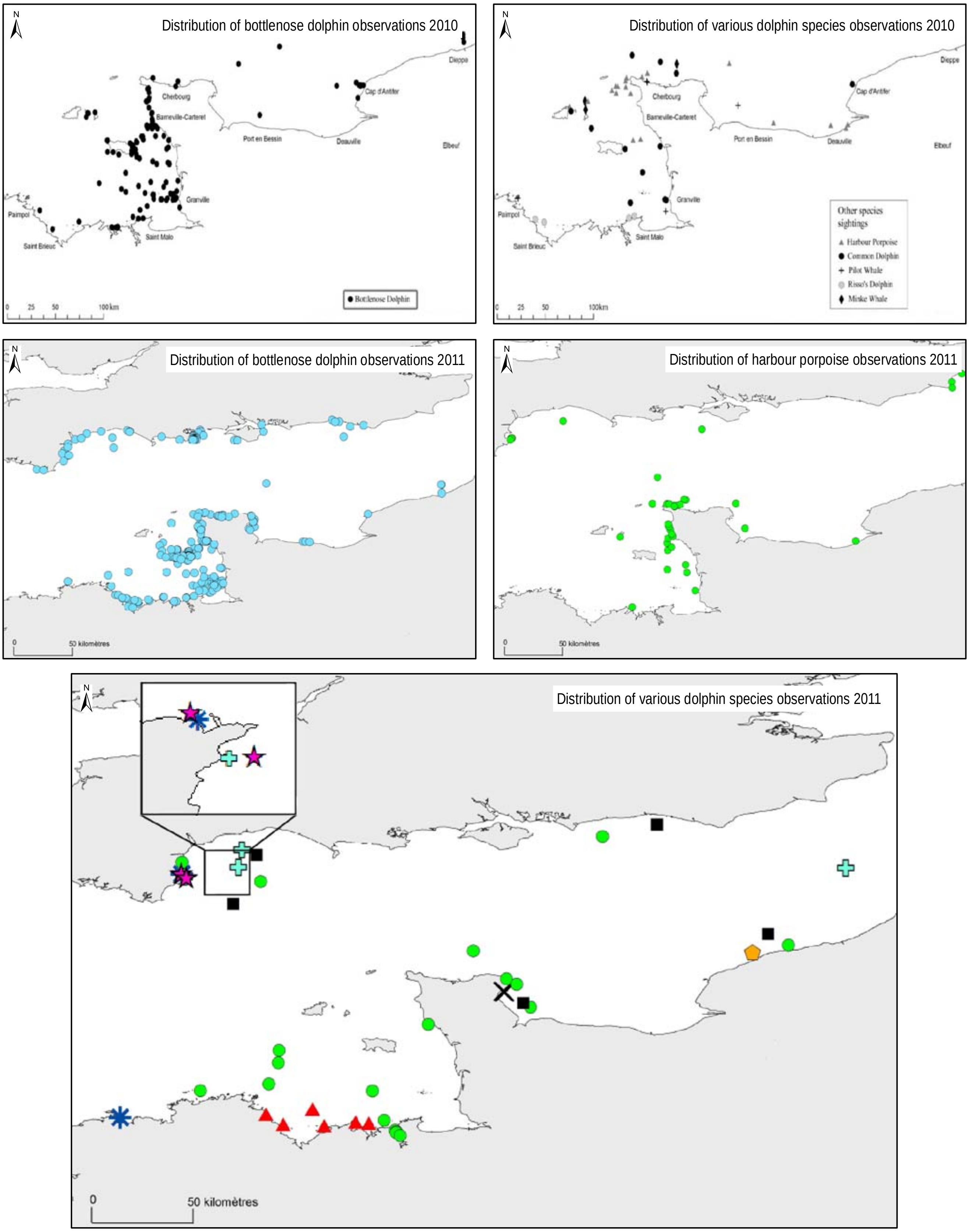
Sighting Areas for Bottlenose Dolphin Identification in the English Channel

Figure 16



Bottlenose Dolphin
Harbour Porpoise
Humpback whale
Sperm whale
Common dolphin
Risso's dolphin
Short finned pilot whale
White beaked dolphin
Small whale
Common whale

Date	By	Size	Version
Sep 13	JDB	A4	1
Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	NKD		
07_Fig17_Dolphins_2010_2011.mxd			
Produced by ABPmer			

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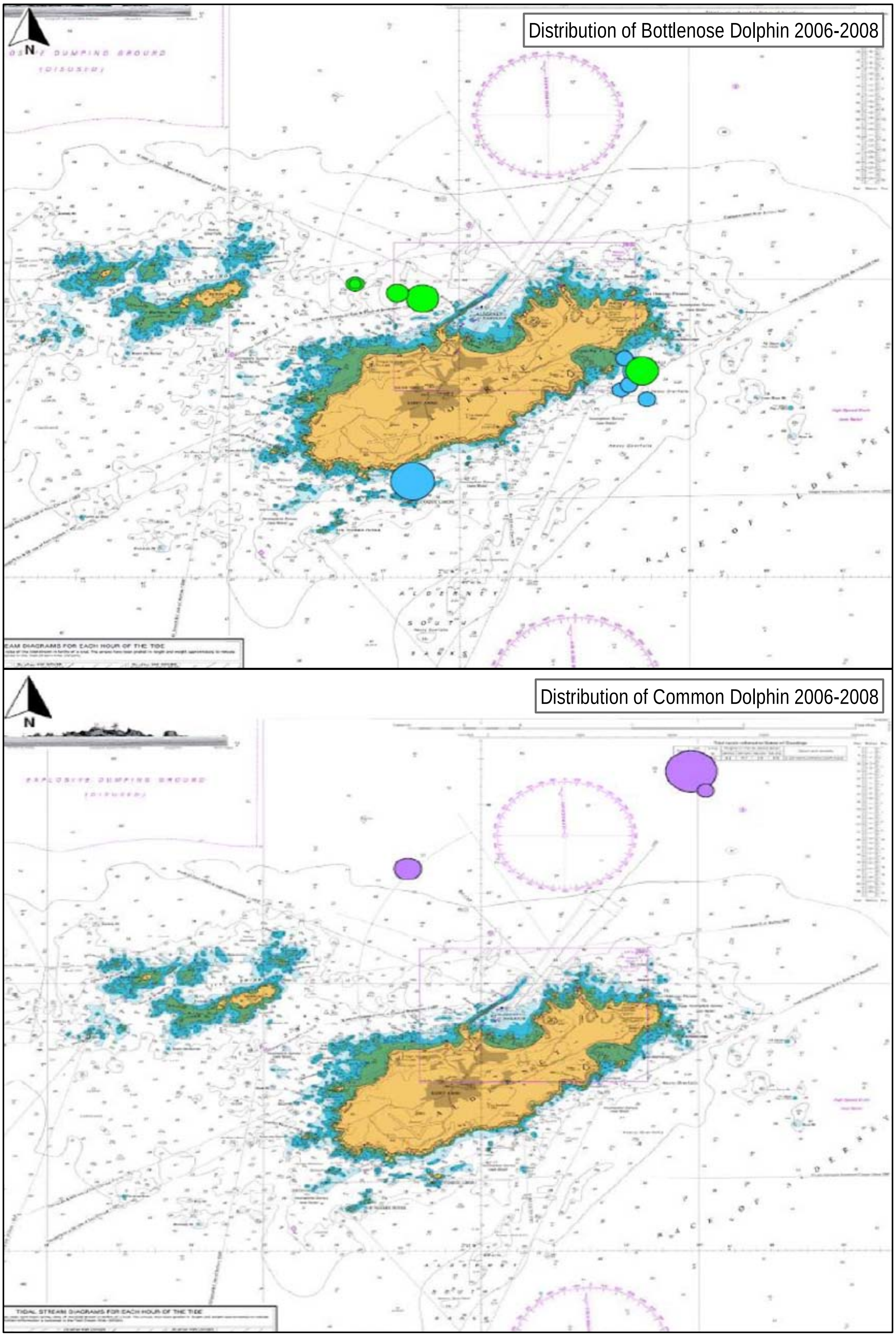
Distribution of Dolphin Observations in 2010 and 2011

Figure 17



Date	By	Size	Version
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Projection	N/A		
Scale	N/A		
QA	NKD		
4001_07_Fig18_Dolphin_Distribution.mxd			
Produced by ABPmer			

Data Sources: Barr et al., 2009

Distribution of Bottlenose Dolphin 2006-2007

10 5 1

Distribution of Bottlenose Dolphin 2007-2008

10 5 1

Distribution of Common Dolphin 2006-2008

10 5 1

Figures taken from Barr S. and Power P.B., 2009. The Alderney Race 500 MW Environmental Statement. A report to Alderney Renewable Energy.

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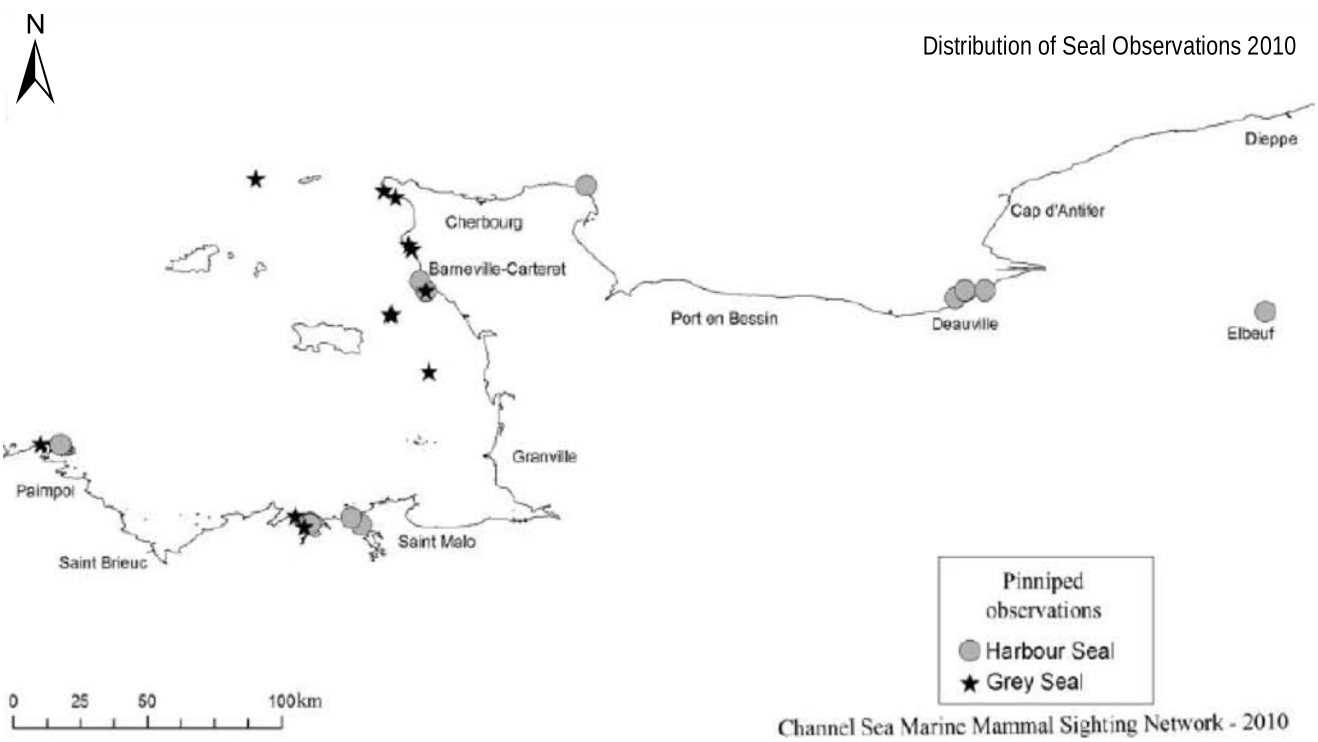
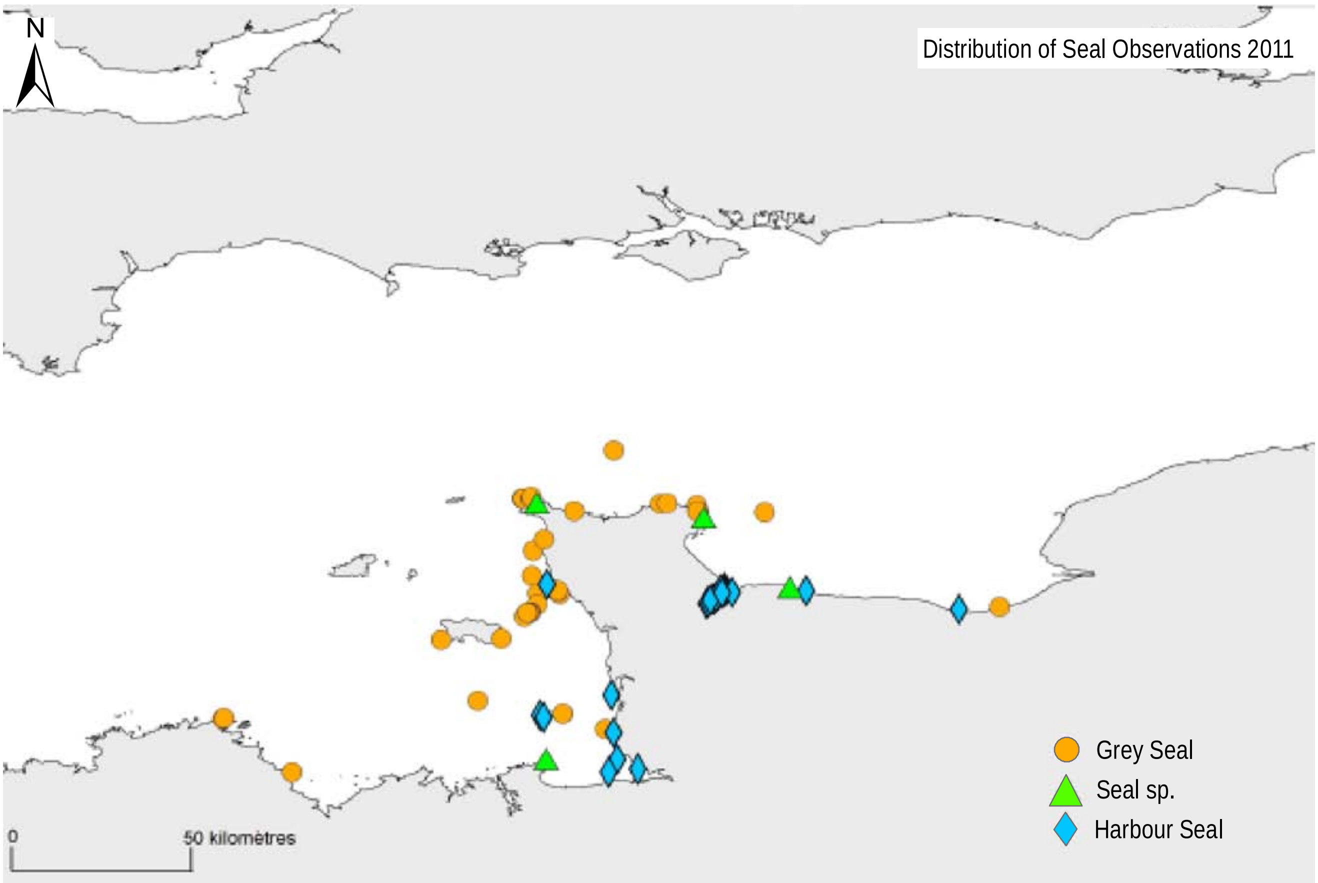
Distribution of Bottlenose Dolphin and Common Dolphin around Alderney (2006 to 2008)

Figure 18





Date	By	Size	Version
Sep 13	JDB	A4	1
Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	NKD		
4001_07_Fig19_Seals_2010_2011.mxd			
Produced by ABPmer			

Data Sources: Cotentin Cetacean Study Group, GECC, 2010.

Figures taken from Channel Sea Marine Mammal Sighting Network Yearly Review, 2010.

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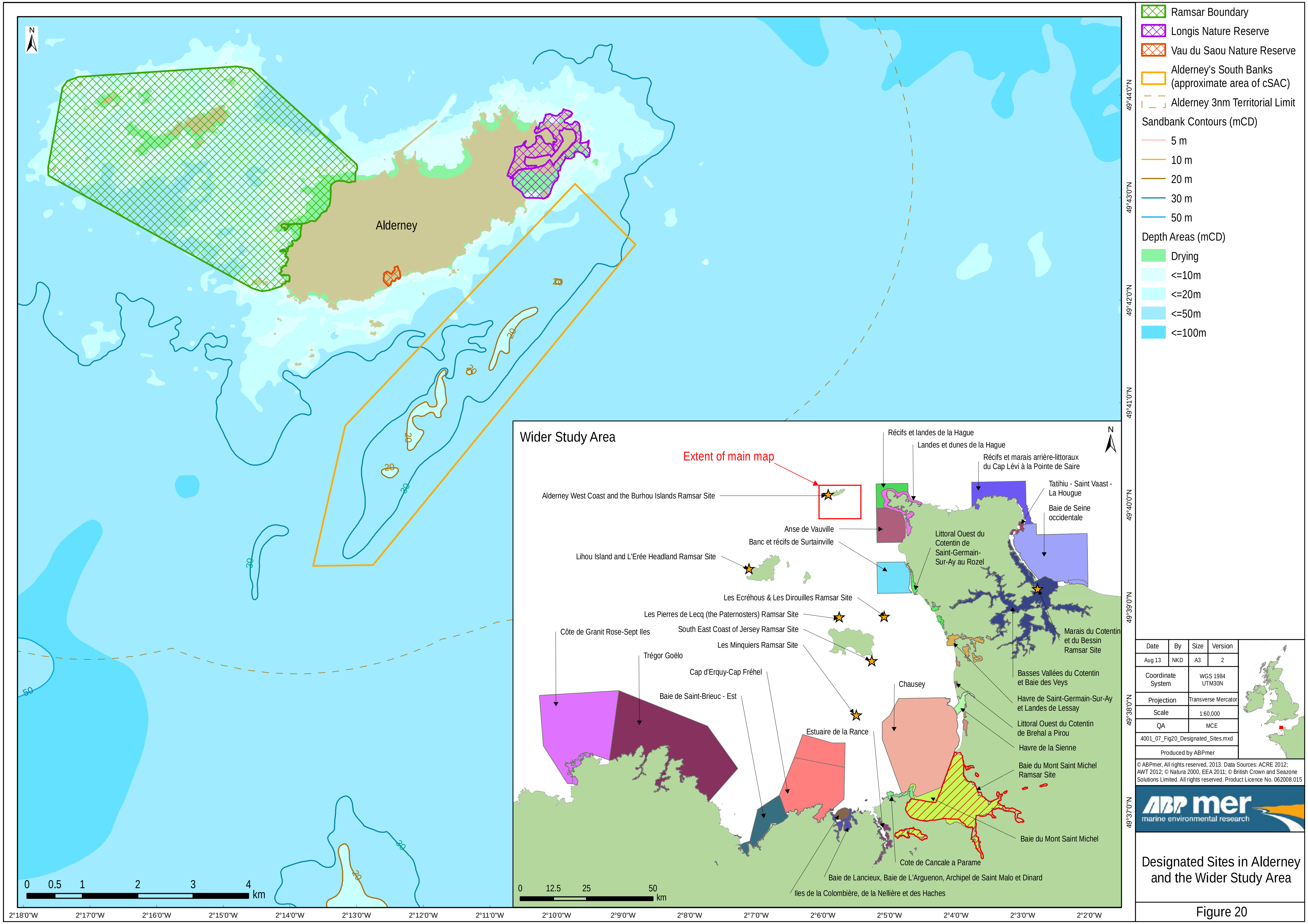
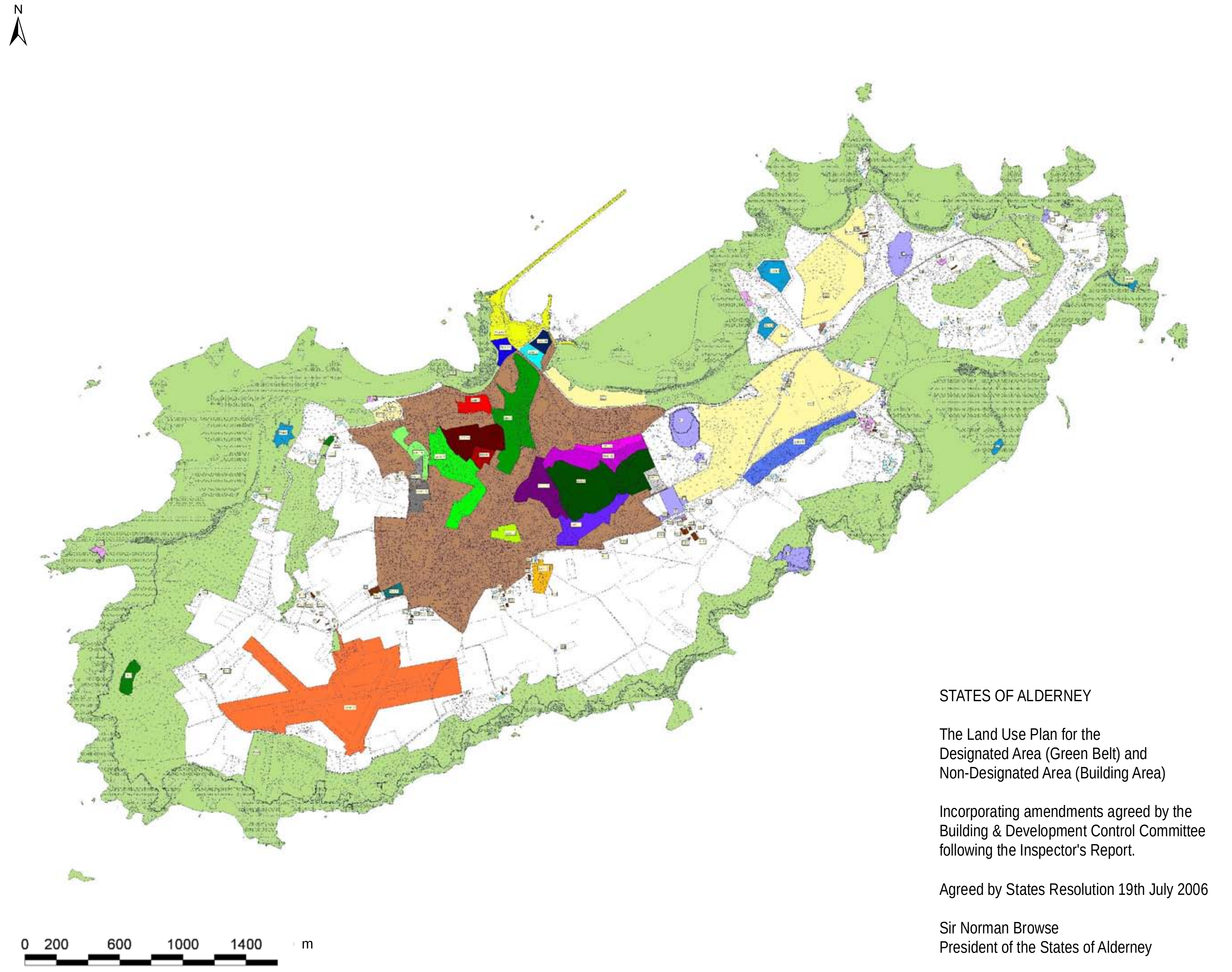
Distribution of Grey and Common Harbour Seal Observations in 2010 and 2011

Figure 19



Designated Sites in Alderney and the Wider Study Area

Figure 20



	Agricultural Zone - Designated Area
	Agricultural Buildings within Agricultural Zone
	Commercial Zone - Designated Area
	Protected Area Zone - Designated Area
	Protected Area Properties - Designated Area
	Public Utility Zone - Designated Area
	Recreational Zone - Designated Area
	Residential Zone - Designated Area

Building Area (Non-designated Area)

	Zone 1
	Zone 2A
	Zone 2B
	Zone 3
	Zone 4
	Zone 5
	Zone 6
	Zone 7A
	Zone 7B
	Zone 7C
	Zone 8
	Zone 9
	Zone 10A
	Zone 10B
	Zone 10C
	Zone 11
	Zone 12
	Zone 13
	Zone 14A
	Zone 14B
	Zone 15
	Zone 16
	Zone 17
	Zone 18
	General Building Area (Non-designated Area)

STATES OF ALDERNEY

The Land Use Plan for the
Designated Area (Green Belt) and
Non-Designated Area (Building Area)

Incorporating amendments agreed by the
Building & Development Control Committee
following the Inspector's Report.

Agreed by States Resolution 19th July 2006

Sir Norman Browse
President of the States of Alderney

Date	By	Size	Version
Sep 13	NKD	A4	1
Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	JDB		
4001_07_Fig21_Alderney_Land_Use.mxd			
Produced by ABPmer			

Data Sources: States of Alderney, 2006

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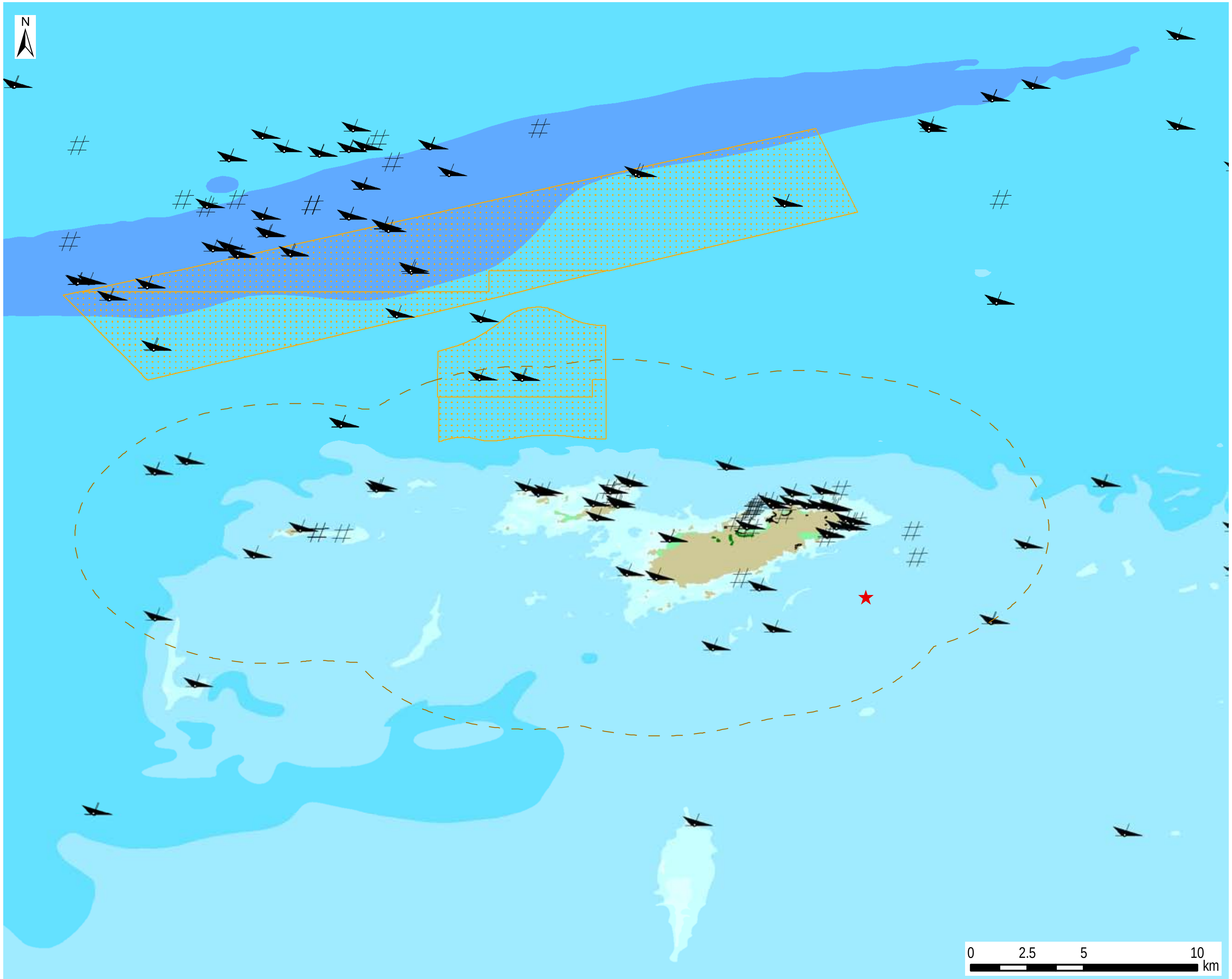
Alderney's
Land Use Plan

Figure 21



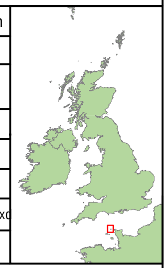
Wrecks (SeaZone,2012)
Obstructions (SeaZone, 2012)
Wreck (Osiris, 2009)
Dumping ground (closed)
Alderney 3nm limit

Depth Areas (mCD)

Drying
<=10m
<=20m
<=50m
<=100m
<=500m

Wreck and obstruction data from SeaZone Solutions dataset (2012); and referred to in Osiris Hydrographic and Geophysical survey report (2009).

Date	By	Size	Version
Sep 13	JDB	A4	1
Coordinate System	GCS WGS 1984		
Projection	N/A		
Scale	1:240,000		
QA	NKD		
4001 - 07_Fig22_Historical_Wrecks.mxd			
Produced by ABPmer			



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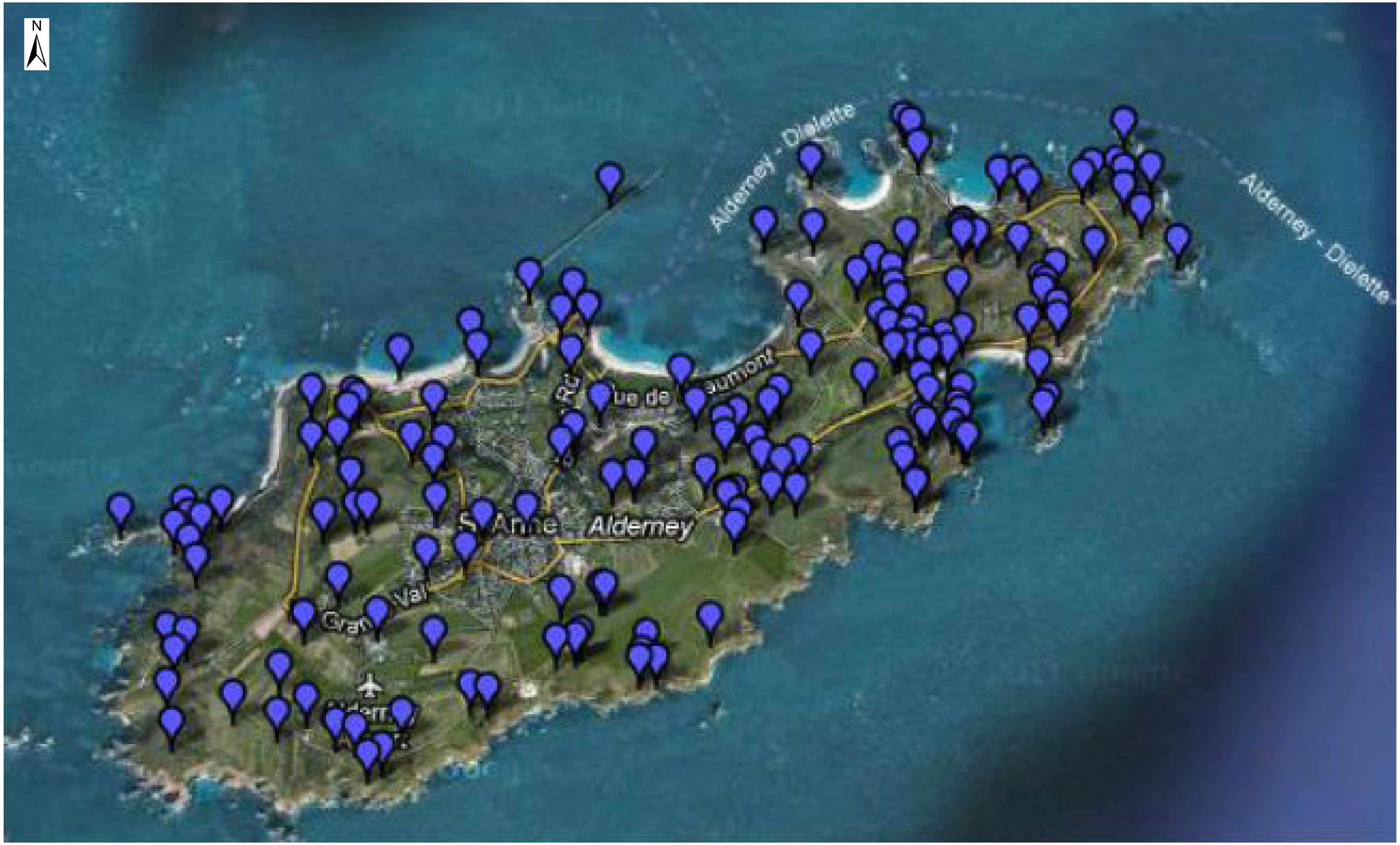
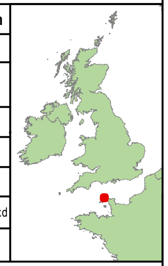
Historical Wrecks and Obstructions

Figure 22





Date	By	Size	Version
Mar 14	NKD	A4	1
Coordinate System	N/A		
Projection	N/A		
Scale	N/A		
QA	JDB		
4001_07_Fig23_Sites_and_Monuments.mxd			
Produced by ABPmer			

Data Sources: Alderney Records Centre, 2013

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Alderney's Sites and Monuments Records

Figure 23

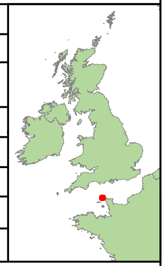
N

Date	By	Size	Version
May 13	NKD	A4	1

Coordinate System	N/A
Projection	N/A
Scale	N/A
QA	JDB

4001_07_Fig24_Onshore_Electricity.mxd

Produced by ABPmer



Data Sources: Murphy, 2004 cited in Caldwell, 2011

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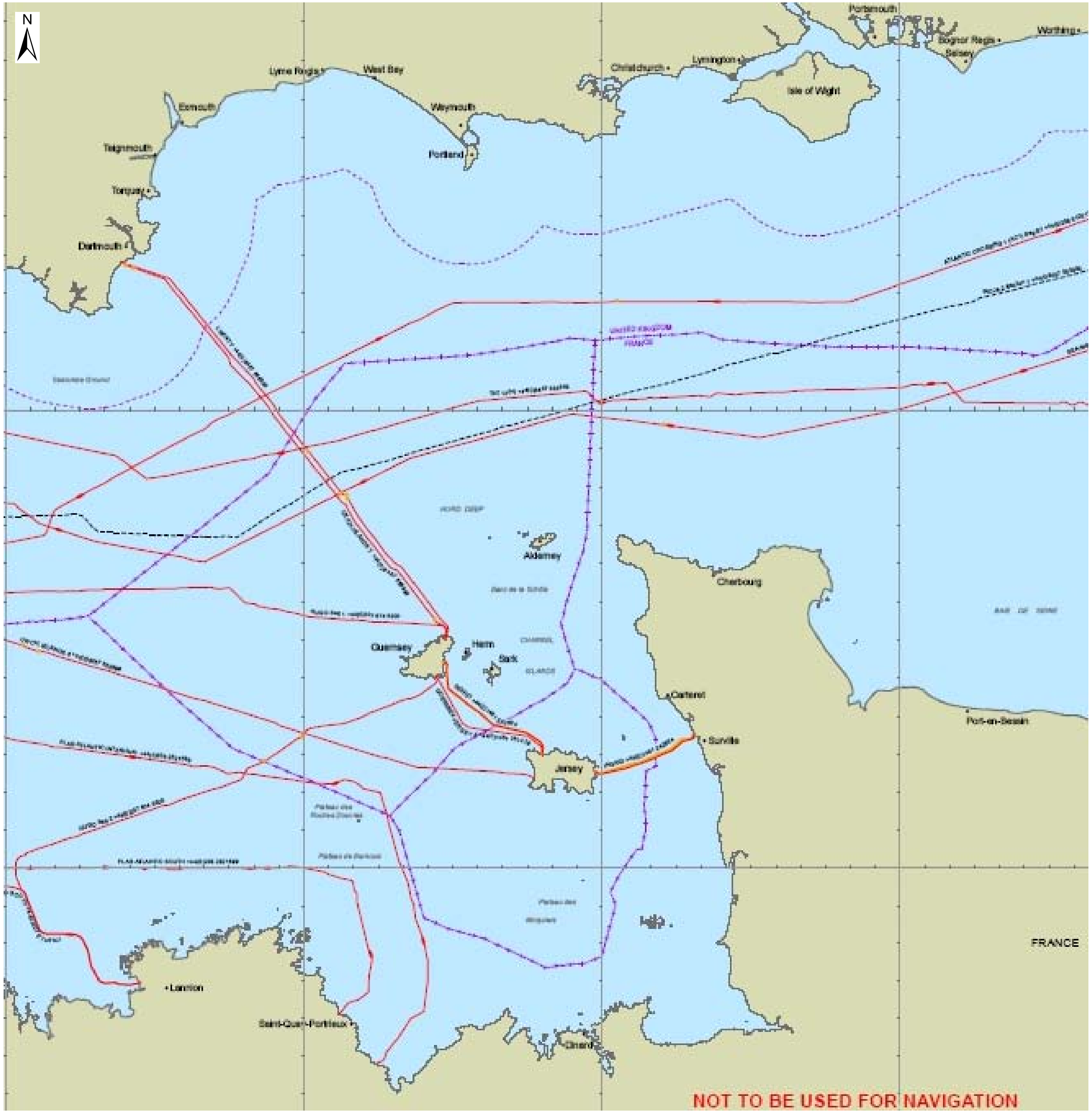
Alderney's Onshore Electricity Transmission Grid

Figure 24



Final Splice
Repeater
In Use Subsea Telecomms Cables
In Use Subsea Power Cables
Out of Service Subsea Cables
International Maritime Boundary
12 Mile Fishing Limit

All information on cable routes, structures and boundaries shown in this figure have been extracted from the Kingfisher Cable Awareness Chart: English Channel, dated January 2013.

Date	By	Size	Version
Jun 13	NKD	A4	1
Coordinate System		N/A	
Projection		N/A	
Scale		N/A	
QA		JDB	
4001_07_Fig25_Subsea_Electricity.mxd			
Produced by ABPmer			

Data Sources: Kingfisher Cable Awareness Charts, 2013

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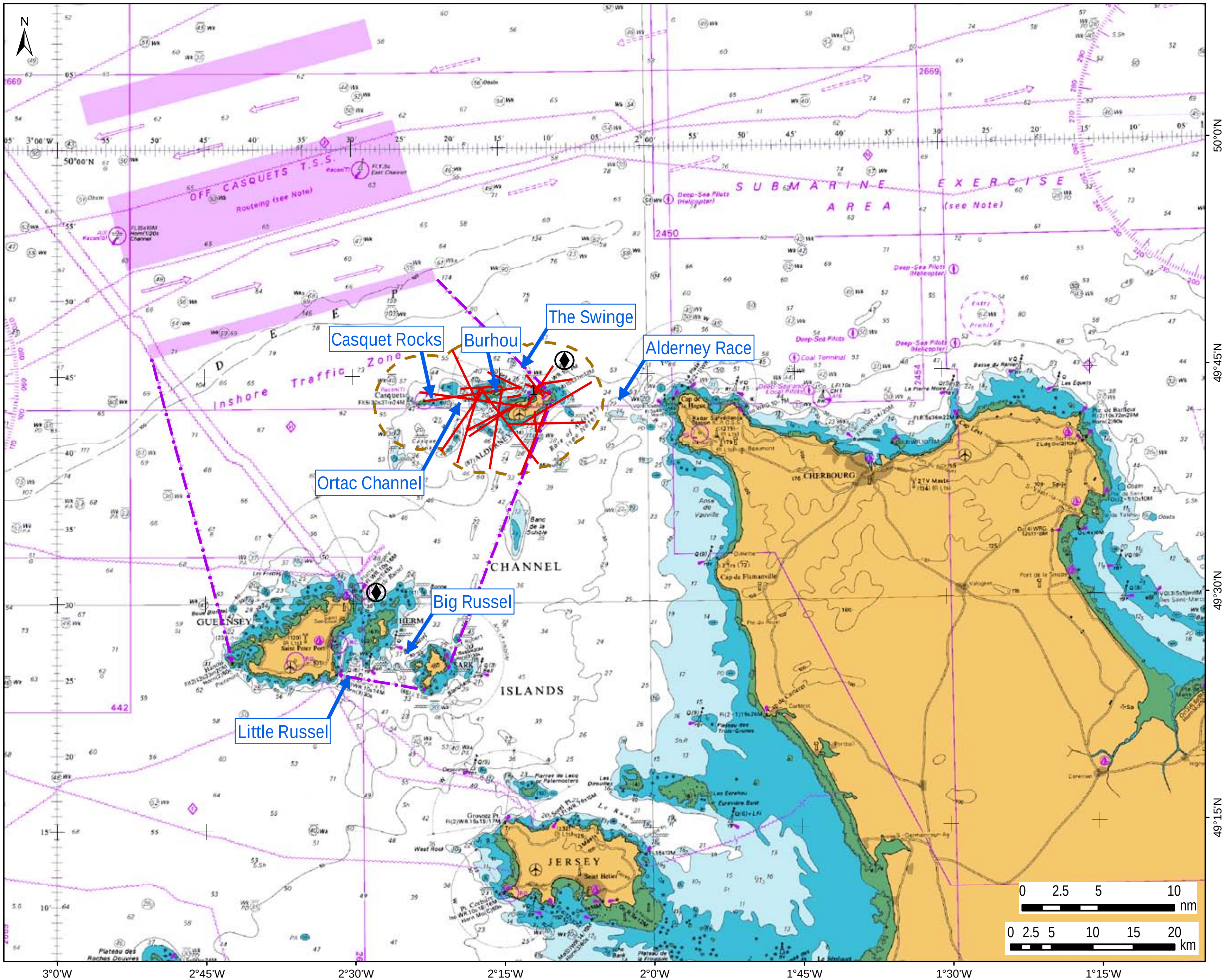
Alderney's Subsea Electricity Transmission Grid

Figure 25



Alderney 3nm Territorial Limit
Inshore Traffic Zone
Navigation Leading Lines
Pilot Boarding Place

Date	By	Size	Version
May 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:650,000		
QA	JDB		
4001_07_Fig26_Navigational Features			
Produced by ABPmer			

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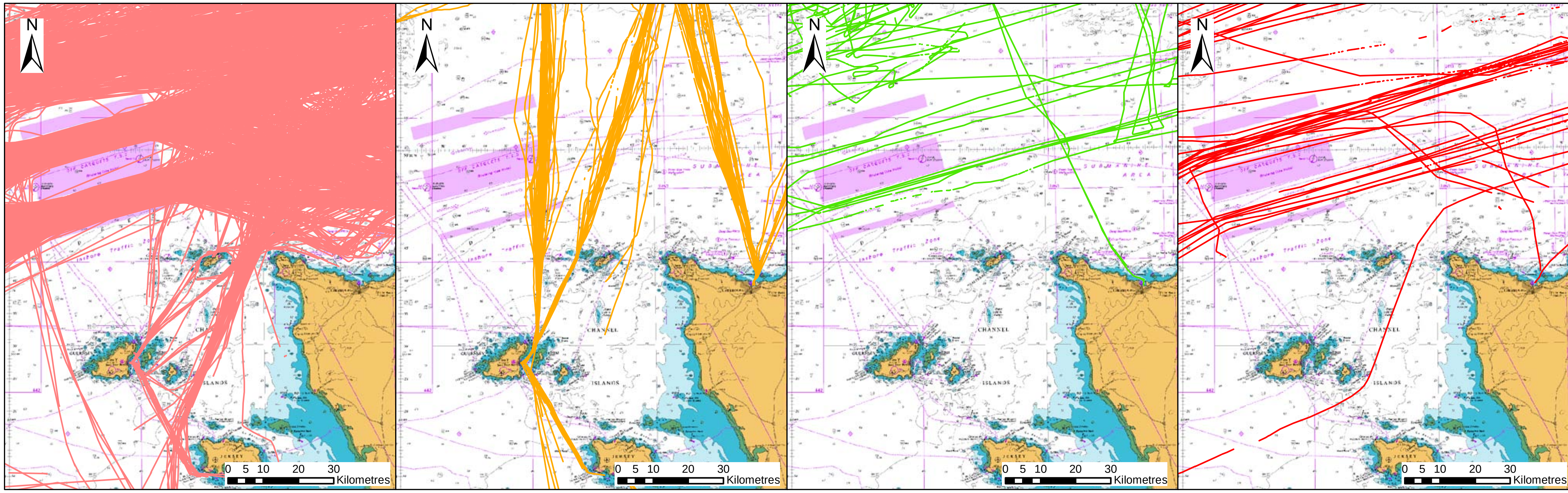
Navigational Features

Figure 26



Cargo (7)

High Speed Craft (4)

Military or Law Enforcement Vessels

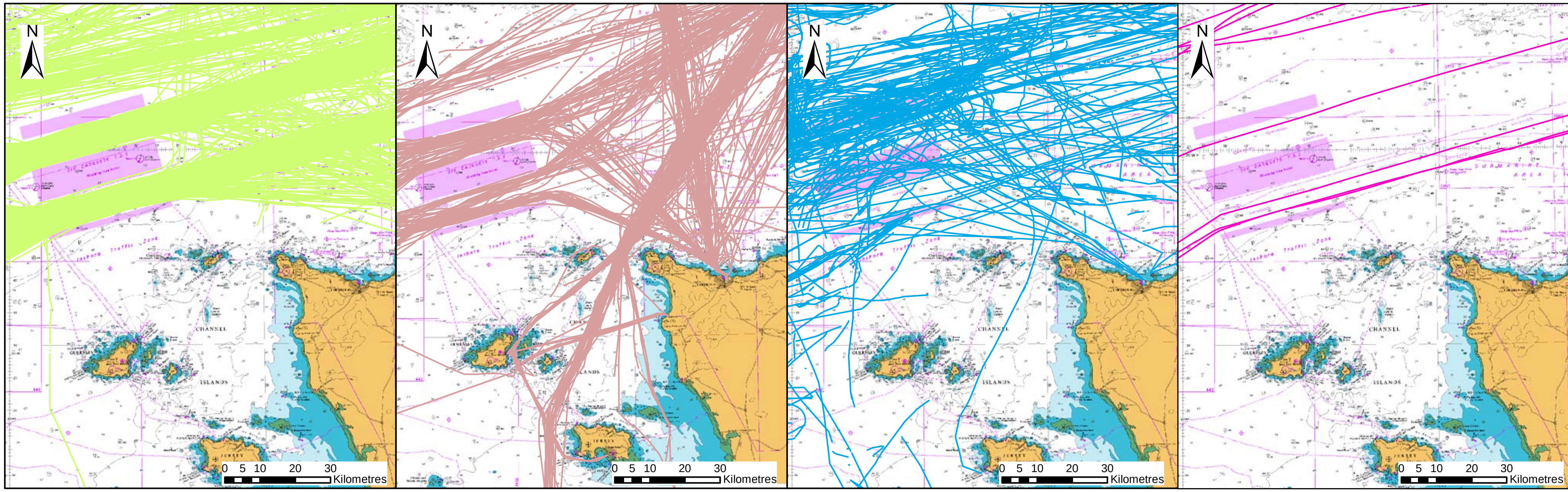
Port Service Craft (2)

Tankers (8)

Passenger Vessels (6)

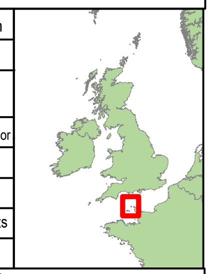
Fishing/Leisure (9)

Vessels engaged in dredging or underwater operations (including diving) (13)



Composite plot of 28 days from the following periods:
April 01 to 07, 2010
July 01 to 07, 2010
October 01 to 07, 2010
January 01 to 07, 2011
Data Source: Marine Management Organization (MMO), 2013 (in preparation). 'Spatial Trends in Shipping Activity'. September 2013. UNPUBLISHED

Date	By	Size	Version
Aug 13	JDB	A3	2
Coordinate System	WGS 1984 UTM Zone 30N		
Projection	Transverse Mercator		
Scale	1:1,300,000		
QA	NKD		
4001_07_Fig27_AIS_A_Vsl_Transits			
Produced by ABPmer			



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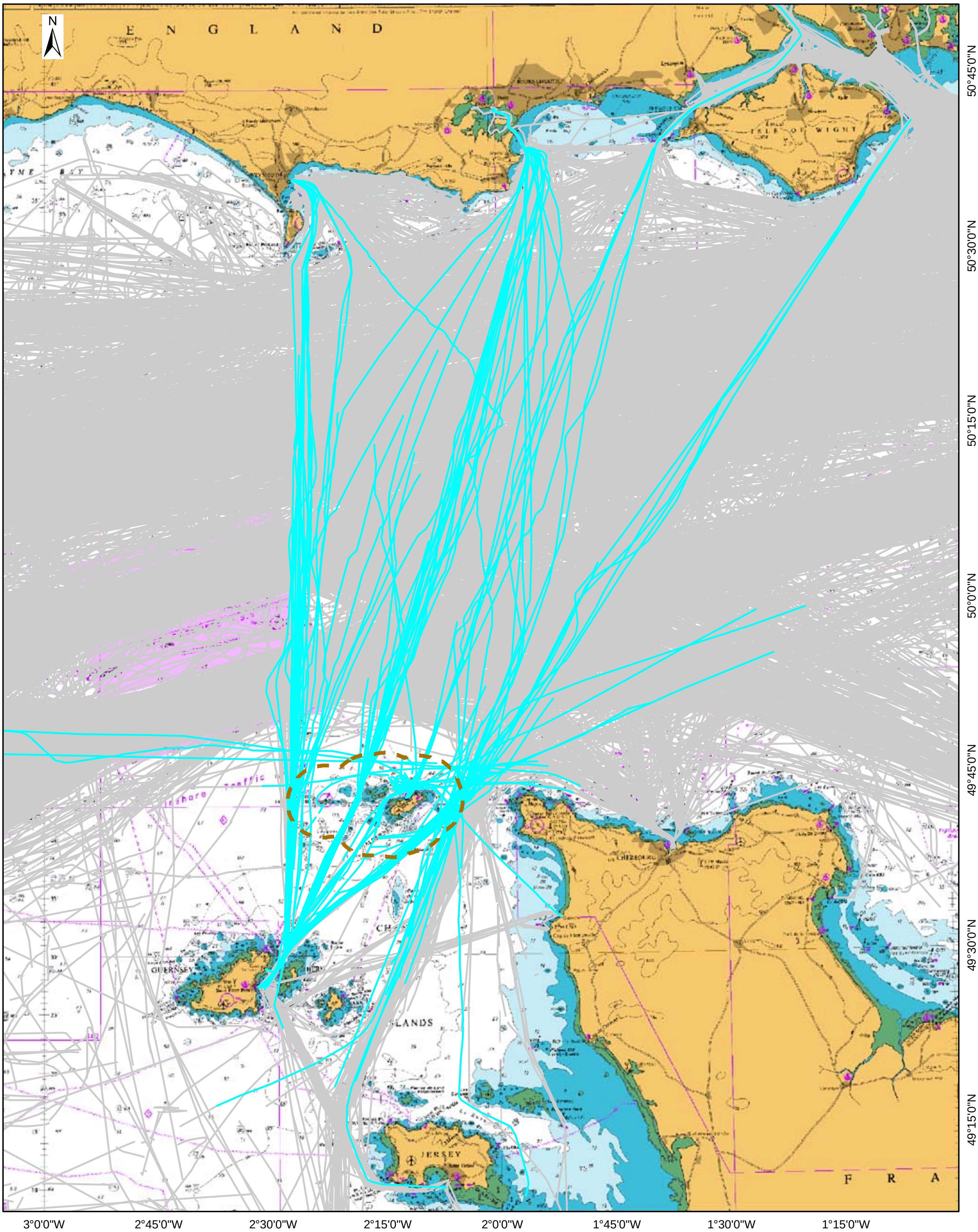
AIS-A Vessel Transit Lines

Figure 27



Date	By	Size	Version
Aug 13	JDB	A4	2
Coordinate System	WGS 1984 UTM Zone 30N		
Projection	Transverse Mercator		
Scale	1:880,000		
QA	NKD		
4001_07_Fig28_AIS_A_Vsl_3nm.mxd			
Produced by ABPmer			

Alderney 3nm Territorial Limit

Transit Lines that Intersect 3nm Territorial Limit

All Transit Lines

Composite plot of 28 days from the following periods:
April 01 to 07, 2010
July 01 to 07, 2010
October 01 to 07, 2010
January 01 to 07, 2011

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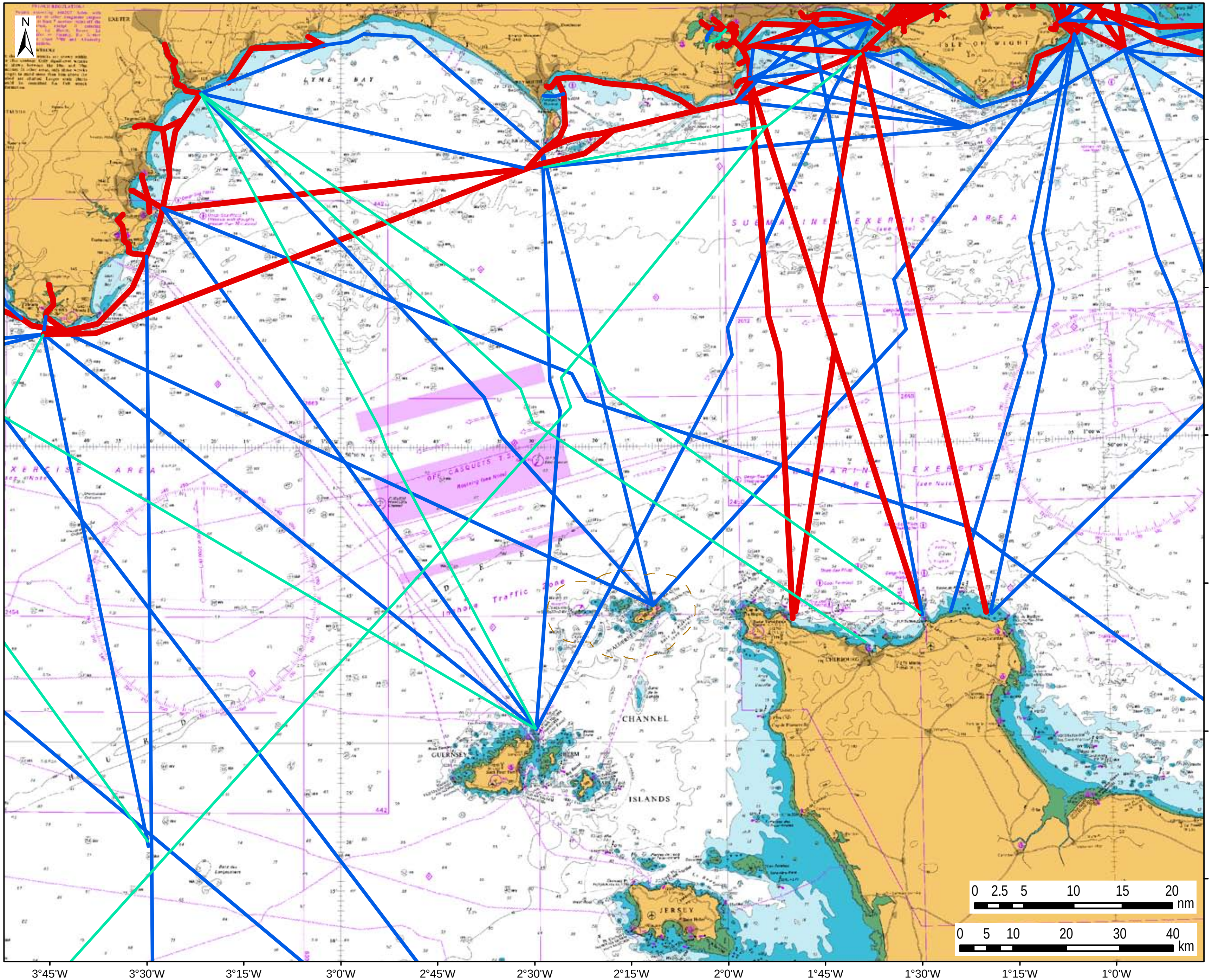
AIS-A Vessel Transits Intersecting with Alderney 3nm Territorial Limit

Figure 28

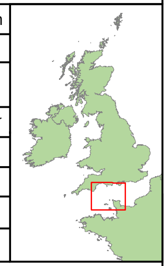


Alderney 3nm Territorial Limit

RYA Cruising Routes (2008)

- Heavy
- Medium
- Light

Date	By	Size	Version
May 13	NKD	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:1,000,000		
QA	JDB		
4001_07_Fig29_RYA Cruising Routes			
Produced by ABPmer			



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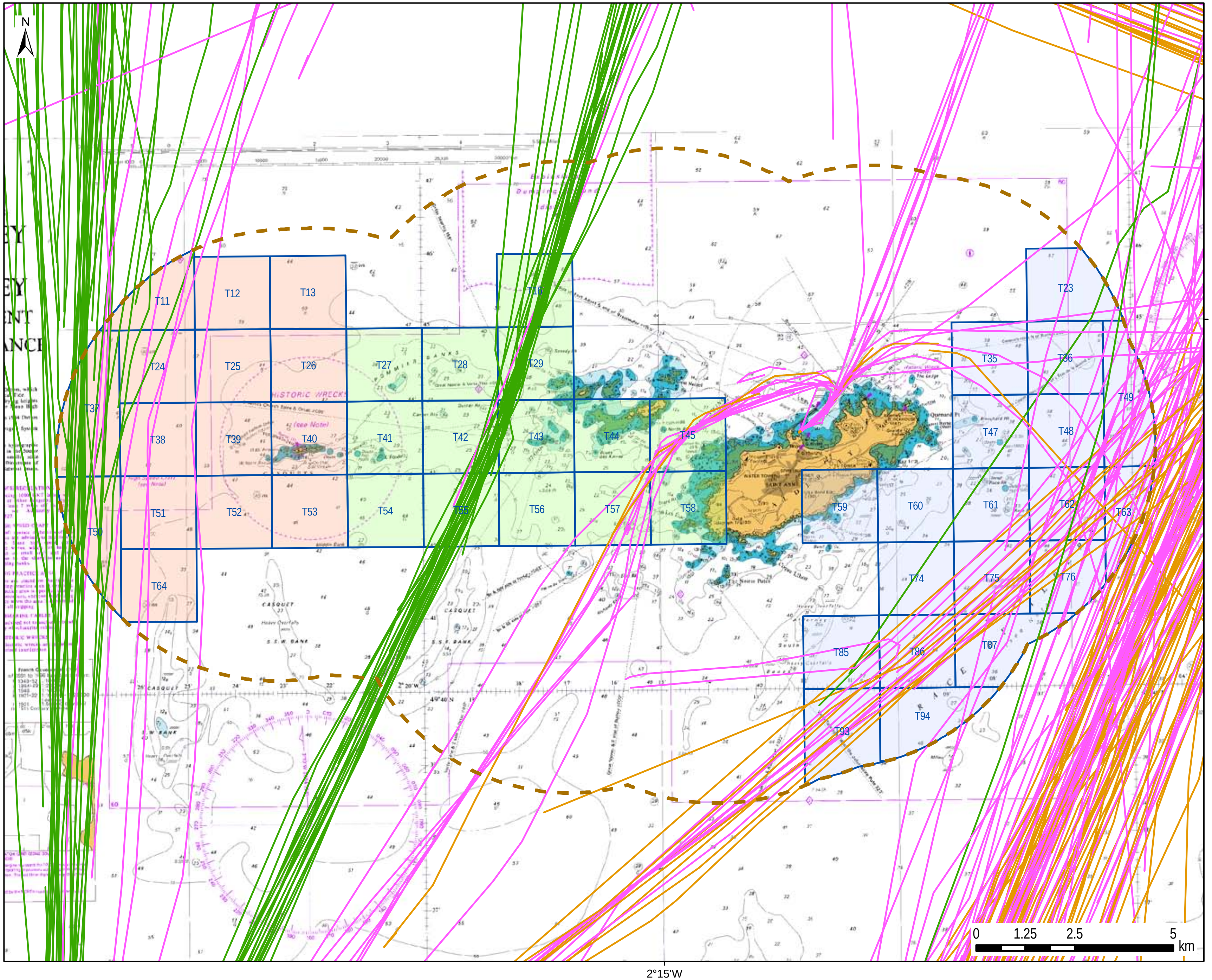
RYA Cruising Routes

Figure 29



Alderney 3nm Territorial Limit

Vessel Type

- High Speed Craft (HSC)
- Passenger Vessels
- Cargo Vessels

ARE Licence Area Tidal Development Blocks

ARE Development Projects

- Project 1: The Race
- Project 2: The Casquets
- Project 3: The Ortac Channel

Date	By	Size	Version
May 13	JDB	A4	1
Coordinate System	WGS 1984 UTM30N		
Projection	Transverse Mercator		
Scale	1:135,000		
QA	FMM		
4001_07_Fig1_Location_Alderney_Tidal_Projects			
Produced by ABPmer			

Data Sources: ACRE, 2012, Seazone Solutions Limited
NOT TO BE USED FOR NAVIGATION

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Alderney's Proposed Tidal Development Projects and Shipping Routes

Figure 30

Appendices

Appendix A

Consultation Summary

Appendix A. Consultation Summary

The REA has been taken forward in two phases, a scoping phase followed by a detailed assessment phase. The stakeholder comments that have been received over these two phases, and the relevant sections in this Final REA Environmental Report report where these issues have been addressed are provided in the following sections.

A1. Scoping Phase

The scoping phase of the REA has been undertaken to identify the potential environmental issues associated with a Draft Plan and to determine the scope of work required for the subsequent stages of the REA process. The findings of the scoping study for the Draft Plan were presented within a Scoping Report and sent to relevant stakeholders in April 2013 for consultation, all of which are listed in Table A1 below. This included both statutory stakeholders and interested parties from Alderney, other Channel Islands, the British Isles and France. Stakeholders were invited to comment on the Scoping Report.

Table A1. List of Stakeholders

Stakeholder
Alderney Harbour Officer*
Alderney Fisheries Officer*
Alderney Sailing Club
Alderney Licensed Fishing Vessel Owners Association
Alderney Diving Club
Alderney Wildlife Trust*
Alderney Maritime Trust
Alderney Renewable Energy Ltd*
Alderney Electricity Ltd*
DCNS
Jersey Harbour Master
French Affaires Maritime and Cross Joburg
GDF Suez** (includes ACE/Cofely Endel/Voith Hydro/Constructions Mecaniques de Normandie)
Guernsey Health and Social Services Department (HSSD)
Guernsey Harbour Master
Guernsey Sea Fisheries
Inspectors appointed under the Health and Safety at Work (Alderney) Ordinance 2003
Joburg Traffic
Maritime and Coastguard Agency (UK)
Ministère de L'Écologie
Natural England
Préfecture maritime de la manche et de la mer du nord
Royal Yachting Association
Federation Francaise de Voile
Sark Harbour Master
States of Alderney CEO*
The Alderney Society
Trinity House
UK Hydrographic Office

Shipping Companies Operating in the Channel Islands And St Malo
Alderney Shipping
Condor Ltd
Huelin Renouf
Vedettes du Cotentin
For Information Only
Alderney Politician (NH)
Guernsey Renewable Energy Team (RET)
States of Jersey
For Information Only Continued
La Societie Serquaise and Sark Fisheries Committee
DREAL Basse-Normandie
Frances Energies Marines
West Normandy Marine Energy
Agence des aires marines protégées
Central Direction of Energy and Climate at the Ministry of Environment
* Statutory Stakeholder; ** Invitation sent through as one point of contact

A total number of seven stakeholder responses have been formally received by the Commission from the following organisations:

- Alderney Licensed Fishing Vessel Owners Organization;
- Alderney Maritime Trust;
- Alderney Renewable Energy Ltd;
- Alderney Wildlife Trust;
- The Alderney Society;
- Guernsey Harbour Master; and
- Maritime and Coastguard Agency (UK).

Detailed responses from Stakeholders were received either as letters or emails, for which the comments raised are presented in full in Table A2. This table refers to the actions undertaken and relevant section(s) in the REA where these issues have been addressed.

Table A2. Summary of issues received in the Scoping Opinions

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
Mark Gaudion, Alderney Harbour Master and Sea Fisheries Officer (received 05-06-13)	No comment	N/A	N/A
Raymond Gaudion, Chairman, Alderney Licensed Fishing Vessel Owners Organization (received 02-05-13)	Commercial and Recreational fishing should not be in the same section, 8.2. The effects of this proposed project will be unique to the commercial fishing industry.	Point noted. Due to the broad area covered by the Draft Plan this REA considers commercial and recreational fishing in the same section under different sub headings where possible. The use of separate sections should be considered further at a project level.	N/A
	Alderney's commercial fisherman has had to purchase fishing licenses which give unrestricted access to Bailiwick waters under the terms of that license. These licenses are not cheap.	Noted.	N/A

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	The report anticipates restricted access to slipways and births during all phases of the works. Commercial fishermen require unrestricted access to load and unload gear particularly at times of low water.	Noted. Reference made to best practice measures including consultation with the local fishing community ensure such issues are addressed.	7.2.2.6
	Atlantic Crayfish are a species caught in Alderney waters. One local boat has scallop dredging gear.	Point noted.	7.2.1
	The most important point to make is that the entire fulltime commercial fisherman has to multitask to make a living. To lose one aspect of their fishing methods makes inshore commercial fishing uneconomic therefore not viable. The proposed areas of development shown in figure 1 exclude such a large area of potting ground that potting for lobster and crab will not be commercially viable. The areas left will not sustain enough pots. The loss of lobster and crab income will put fulltime fisherman out of business. In the scoping report there is not another business that faces this prospect due to this development.	Point noted. Please note Figure 1 does not represent the extent of area to be excluded by fishermen. This can be addressed further at a project specific level. The Commercial and Recreational Fisheries impact assessment provides further information on the temporary and long term displacement of fishing activities as a result of the Draft Plan.	7.2.2.1
	The issue of financial compensation will no doubt be raised as a means of placating the commercial fisherman but how do you compensate for the loss of a traditional industry at present or in the future?	Noted. Reference and to be discussed further at a project specific level including consultation with the local fishing community ensure such issues are addressed.	7.2.2.6
Mike Harrisson, Alderney Maritime Trust (received 20-04-13)	Please be so kind as to explain how this Scoping Survey might affect the Maritime Trust and in particular the two Exclusion Zone areas North of Mannez Lighthouse and round the Casquets, including details of sub-sea monitoring equipment to be used and probable dates.	It is not possible to determine the implications of the Draft Plan on the two Exclusion Zone areas given the lack of project-specific information at the plan level. This will need further consideration at the project-level by individual developers. Details of possible baseline surveys that may be required at the project-level have been outlined in Section 6.1.1.2 of the REA.	6.1.1.2
Alderney Renewable Energy Ltd (received 02-05-13)	Page 2 (paragraph 2) - Limited should be included in the Alderney Renewable title - Also on page (i) in abbreviations.	Noted and amended in REA to Alderney Renewable Energy Limited	All Sections where necessary
	Page 2 (paragraph 4) - Transmission Capital should be Transmission Investment LLP - this occurs several times throughout the document.	Noted and amended to Transmission Investment LLP throughout REA	All Sections where necessary
	Page 2 (paragraph 4) - FAB Link in two words and not FABLink - this occurs several times throughout the document.	Noted and amended to FAB Link throughout REA	All Sections where necessary
	Page 6 (Section 2.1.2, paragraph 1) - No mention of National Grid connection agreements in the UK.	There is no mention of the National Grid connection agreements in the UK because the Draft Plan is only considering the potential export cable route to France.	1.2.3
	Page 6 (Section 2.1.2, paragraph 1) - The cable size will be no less than 2000 MW.	Noted	1.2.3
	Page 9 (Section 5.1.1, paragraph 2, line 4) - The sentence beginning “Sandy bays...” does not seem to make sense.	Noted	N/A to REA
David Thornburrow, Vice President, The Alderney Society (received 02-05-13)	In recent years the integrity of the protective Green Belt laws has increasingly been undermined both by property owners and by the States' planning committees. As it became very obvious The Alderney Society, The Alderney wildlife Trust and increasingly the public are very worried about building within the existing boundaries of the Green Belt. Land based impacts of the April 2013 Scoping Report.	Point noted	N/A

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	(Section) 2.1.2 Interconnector Cable Routes and Onshore Substation - paragraph 3 ".... ARE has investigated terrestrial sites on Alderney and has identified Mannez Quarry as a potential location for the substation/converter station. Both AC but particularly DC converter stations are very large and would be likely need to be delivered by barge, accessing a temporary jetty local to substation/converter station location."		
	(Section) 7.2.3 Data Gaps and Further Work. We note that "further archaeological information .... will be requested from the Alderney Maritime Trust and La Societe Guernesiaise." The more detailed archaeological knowledge of the Alderney Society must be added. Although this clause in the Scoping Report states that further archaeological advice will be sort from the AMT and La Societe Guernesiaise, no mention is made of seeking advice from the Alderney Society - its advice should be sort.	Noted	N/A
	Although large scale terrestrial building work is not anticipated in the near future, when it does happen, it is likely to have a pretty enormous impact on the eastern part of the Green Belt. It is to be hoped that ARE will reveal its terrestrial building plans sooner rather than later.	Noted	N/A
Peter Gill, Guernsey Harbour Master (received 23-04-13)	The report has identified consultation with the French. I wonder if the scope of the French consultation identified is sufficient politically. I suspect that the limited room for navigation in the Race might be more politically sensitive than a scientific / measurable matter. It's not a problem that any other REA has had to address yet.	Noted	N/A
	The figures at the end of the report all print in a somewhat geographically distorted fashion. (not a big deal). However, more importantly, figures 13 and 14 are both misleading insofar as Fig 13 does not portray the international maritime boundaries or the 12 mile fishing limits correctly. Fig 14 is a very poor representation of navigational features - In particular the legend shows an inshore traffic zone, the scope of which is entirely different to that depicted. Navigational features might also include, for example, lighthouses and even the headland at Jobourg.	Points noted. Source of Figure 13 or 25 in the REA amended. The REA contains more detail on navigation features.	Section 7.3
Graeme Proctor, Maritime and Coastguard Agency (received 25-04-13)	The REA environmental report should supply detail on the possible impact on navigational issues for both Commercial and Recreational craft, viz.	Both commercial, and recreational navigation is considered within the REA.	7.3
	Collision Risk.	Collision risk is incorporated within the REA.	7.3.2.1
	Navigational Safety.	Navigational safety is considered throughout the commercial and recreational shipping section.	7.3
	Visual intrusion and noise.	Visual is considered separately specifically under recreation and tourism. Noise is also considered separately.	7.5 and 7.6
	Risk Management and Emergency response.	Changes to risk management and emergency responses are considered.	7.3

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Marking and lighting of site and information to mariners.	Lighting on the structure causing confusion to passing vessels is considered.	7.3
	Effect on small craft navigation and communication equipment.	Reference is made in relation to the need for radar data to be analysed at a project level.	7.3
	The risk to drifting craft in adverse weather or tidal conditions.	Specific development locations and configuration are required to make a meaningful assessment in relation to collision risk including the risk to drifting craft in adverse weather or tidal conditions. This type of assessment is highlighted within the REA as more appropriate at project level.	7.3
	The likely squeeze of small craft into the routes of larger commercial vessels.	Specific development locations and configuration are required to make a meaningful assessment in relation to collision risk including The likely squeeze of small craft into the routes of larger commercial vessels. This type of assessment is highlighted within the REA as more appropriate at project level.	7.3
	A Navigational Risk Assessment (NRA) will need to be submitted in accordance with MGN 371 (and 372) and the DTI/DfT/MCA Methodology for Assessing Wind farms (the methodology remains the same for wave and tidal projects).	An NRA will be required as part of any consent application when the details of the Draft Plan are known and the Navigation risks can be accurately assessed. A NRA is not considered necessary at the REA stage.	7.3
	Particular attention should be paid to cabling routes and burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary.	Noted	7.2.2.6
Roland Gauvain, Alderney Wildlife Trust (received 14-06-13)	Section 2.1 of scoping report - would it not be appropriate to list or even note FAB interconnection independently here as it may not specifically be linked to renewable energy device deployment?	FAB Link is considered in the Draft Plan overview (Section 1.2) and also separately under 'cable routing' subsections in the relevant impact assessment sections throughout the REA.	All Sections
	Section 2.1.1 Scoping Report - Can we confirm the intent to ensure the EIA is undertaken not only on a per phase basis but if there are any interphase installations such as a Pre-phase 1 trial device, or an additional area of cabling otherwise up planned?	Detailed phasing requirements for the complete build out are unknown at present. Each part of the build out will be dealt with separately by developers according to published consenting requirements.	N/A
	Section 2.1.1 Scoping Report - Obviously note the inclusion of an above surface structure given previous reassurances to island in general that only subsurface structures would be installed?	Subsea substations are under development but not yet operational. They may, however, be a practical consideration for developers in future at the project level. At this stage, the REA has applied worst-case assumptions throughout the assessment.	N/A
	Section 2.1.2 Scoping Report - Given FAB Link is highlighted here we would repeat need to include in the draft plan overview as its later inclusion could invalidate elements of the REA	FAB Link is considered in the Draft Plan overview (Section 1.2) and also separately under 'cable routing' subsections in the relevant impact assessment sections throughout the REA.	All Sections
	Section 2.12 Scoping Report - Need for 3 year ecological baseline in a number of key areas including fish and shellfish	This is not considered feasible for this to be undertaken at the plan-level given the large study area and level of uncertainties associated with the location of elements of the Draft Plan. However, the recommendation has been noted for EIAs at the project-level.	5.1.1.4 and 5.3.1.2
	Section 2.2. Scoping Report - Does this paragraph reference this Draft Development Plan or a wider concept of renewables. There are certainly a wide range of alternative renewable options both tidal and wind which can be considered to the outline specifics of this plan which may have smaller or greater potential impacts.	There are a number of uncertainties in the Draft Plan. The REA is being undertaken notwithstanding these uncertainties to inform renewable energy developers of the environmental considerations and risks associated with future development plans on the island or within its territorial waters. It should be used to support individual licence applications and EIAs that will need to be	N/A

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
		undertaken at the project level by individual developers.	
	Section 3 Scoping Report - use of 'good practice' - Previously ACRE and ARE have used the term 'best practice' is this an intended change of use	No, the use of the term 'good practice' is considered analogous with 'best practice'.	N/A
	Section 3 Scoping Report - reference to ODPM, 2005: good practice guidance - ODPM 2005 as we understand it is a UK reference, previously the commission had looked at European best practice is this a specific change of direction?	No, this UK reference relates to UK guidance on the implementation of European SEA Directive.	N/A
	Section 4.1 Scoping Report - Key issues to be considered - Economic and Social???	Socioeconomic issues are considered under the Human Environment receptor.	7
	Section 5.1.1 Scoping Report - "Alderney's coastline is devoid of fine sediments…muddy sands" - There are several km of sandy beach and a reasonable spread from shingle down to silts lying behind the breakwater	Misquoted. "Alderney's coastline is mainly devoid of fine sediments…". Within that same paragraph the location of sandy beaches etc. is described.	4.1.1.1
	Section 5.1.1 Scoping Report - "sea defences are located…" - mostly these are military defences which have no specific purpose for sea defences and may have displacement effect associated with them.	Noted and relevant sections updated.	4.1.1.1 and
	Section 5.1.1 Scoping Report - Haynes *et al.* - Would it be possible to see this report please	Noted.	N/A
	Section 5.13 Scoping Report - Data Gaps and Further Work - Given the high energy nature of the environment ongoing monitoring of sites such as the casquets banks will be needed to better understand baseline geomorphology and natural background fluctuations	Point noted and added to REA	4.1.1.4
	Section 5.2.2.2 Scoping Report - Previously mentioned has been cable burying or alternatively leaving the cables exposed is narrowing the proposal without any specific information?	Given the existing sediments and hydrodynamics of the study area, cables are most likely to be mainly placed directly on the seabed and covered with protection (i.e. rock dumping or mattressing) for the majority of the cable routes. However, other possible methods (including burial) have been considered throughout the REA in the relevant impact assessment sections.	All Sections
	Section 5.2.2.4 Scoping Report - Current practice is to sea dump large amounts of subsoil and other discard from building and trenching processes. Given the scale of the processes being talked about 1-3ha of building for the on island substations would this not be an impact?	Specific project level details are unknown at the plan level. It is for the developer to ensure that best practice waste management measures are applied (e.g. re-use of material on site) at the EIA project level.	N/A
	Section 5.2.2.5 Scoping Report - As above	See above.	N/A
	Section 5.2.3 Scoping Report - No indication of how extensive or over what time period?	Further information has been provided in the REA.	4.2.1.4
	Section 5.3.1 Scoping Report - "SSC values do not exceed 2 mg/l" - Any other sources for this assumption? Given simple visual observations of Longis Bay where up to 2m of sediment over 500m of beach can be sifted within a few days it would indicate that within the onshore areas there are periods of much higher loading which may need to be considered?	There will be spatiotemporal variability in SSC (e.g. is sandy shores during stormy weather) but there is presently very little available scientific information on this parameter to go into any further detail.	4.3.1
	Section 5.3.1 Scoping Report - Has there been any SSC measurements conducted on island to support these assumptions?	No field measurements have been made available for the REA. However, remote sensing data has provided indicative surface SSC values.	4.3.1
	Section 5.3.2 Scoping Report - Main Assessment Issues - This does not seem to take into account the on shore cabling route especially if landing through areas such as	This has been taken into account in the REA.	4.3.2

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Longis Bay. Is there any reference material to support this statement?		
	Section 5.3.2.1 Scoping Report - Toxic contamination - Given presence of the two nuclear facilities would not piling or placement of turbines in the Race for example have the potential of displacing locked in sediments with the associated issues of contamination? Advise please	The potential release of toxic contamination locked in the seabed sediments has been assessed in the REA.	4.3.2.3
	Section 5.3.3 Scoping Report - ARE data from 2011 EIA	Noted	N/A
	Section 6.1.1.2 Scoping Report - Possibly important to note the predominance of high energy habitats as these would be the most notably affected by hydrodynamic changes	Point noted.	5.1.1
	Section 6.1.3 Scoping Report - Existing intertidal baseline relevant to Race site and only nominally of value in 2 areas.	Benthic ecology baseline extended where possible within the REA. Limitations and data gaps are also described (Section 5.1.1.4).	5.1
	Section 6.2.3 Scoping Report - General no outline of broader data necessary for an adequate environmental baseline for pre-installation monitoring	Point noted.	N/A
	Section 6.3.1 Scoping Report - Wood both 2007,8 & 10 only surveyed limited sites and recorded fish and shellfish as a by-product of their primary work so this is a limited source.	Point noted and made in REA.	5.3.1
	Section 6.3.1 Scoping Report - We are yet to review Ellis *et al* 2012 but otherwise we would note a lack of specific data on fish and shellfish including commercial species for the island which will hamper future assessments	Point noted. Limitations and data gaps are considered further within REA.	5.3.1.2
	Section 6.3.2.1 Scoping Report - Query potential issue if introduction of invasive species of shellfish?	Existing invasive species and their possible introduction is considered within the Benthic Ecology baseline and impact assessment.	5.1
	Section 6.3.3 Scoping Report - Doesn't address the general poor location specific baseline data and need for an adequate pre-instillation baseline.	Point noted. Limitations and data gaps are considered further within REA.	5.3.1.2
	Section 6.4.1 Scoping Report - “7000” breeding pairs - 7,800 AWT 2011	We do not have the AWT 2011 report. 7000 breeding pairs is based on an approximate value provided in AWT 2012.	5.4.1
	Section 6.4.1 Scoping Report - “160 occupied burrows” - 175 AOB, AWT 2012	The text has been amended.	5.4.1
	Section 6.4.1 Scoping Report - “up to 1000 birds” - Not sure how we say 1000 in population as only number I have is 420 rung in 2008	Point noted and text amended to clarify.	5.4.1
	Section 6.4.1 Scoping Report - “approximately 1200 occupied nests” - Figures for this vary dramatically depending on survey methodology	Point noted and text amended.	5.4.1
	Section 6.4.2.1 Scoping Report - Sub surface collision risk diving birds, Changes to water quality, Increased turbidity impacting on foraging rates, Changes to food source leading to changed foraging rates or times	These pathways are included in the assessment.	5.4.2
	Section 6.4.2.1 Scoping Report - Toxic contamination - Currently very sensitive to this	Point noted.	5.4.2.7
	Section 6.4.2.1 Scoping Report - Changes in bird foraging patterns caused by the presence of surface structures	This pathway is included in the assessment.	5.4.2.5
	Section 6.4.3 Scoping Report - “travelling over 600km” - During course of two foraging trips?	Text included.	5.4.1

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Section 6.5.1 Scoping Report - In 2012 we recognized the repeat presence of Grey Seal pups in the late summer early Autumn on the Burhou reefs (M. Broadhurst) and the Trust is now starting to identify this as a potential breeding site, not simply a haul.	Point noted and included in baseline characterisation.	5.5.1
	Section 6.5.2.1 Scoping Report - Though covered by current wording, further clarification of potential impact on forage species and subsequent displacement effect would be appreciated	Impact pathway is included in the assessment.	5.5.2.5
	Section 6.5.2.2 Scoping Report - Given the areas up for renewables investigations we cannot see that damage to haul sites is likely to occur under current proposals	The location of inter/intra array and export cables associated with the ARE Projects 2 (The Casquets) and 3 (The Ortac Channel) are unknown. Furthermore, given that the Draft Plan also includes any other potential developer wishing to exploit the remaining tidal resource of Alderney's waters this impact pathway is still considered potentially relevant and has been included in the REA.	5.5.2.10
	Section 6.5.2.3 Scoping Report - Again impact on prey species and subsequent knock impact should be noted separately	This is included within the changes to foraging habitat impact pathway assessment. In addition, the fish and shellfish impact assessment section provides additional information on this issue.	5.5.2.5 and 5.3.2
	Section 6.5.3 Scoping Report - Accepting GECC, Alderney based and other records already exist, what length of Baseline does this coping envisions necessary for EIA level assessment?	Point noted. Limitations and data gaps are considered further within REA.	5.5.1.2
	Section 6.6.1 Scoping Report - gannet numbers - Again based on photographic survey counts this figure is now believed to be closer to 7,800 pairs and 2.3% world population	Point noted and added to baseline characterisation.	5.6.1
	Section 6.6.1 Scoping Report - Longis nature reserve - It also contains a number of UK BAP species and habitats	Point noted and text added.	5.6.1
	Section 6.6.1 Scoping Report - sites within wider study area - No note of the proposed new French National Parc designation for adjacent waters, possibly up to Alderney's territorial waters, which is due for designation 2013/14	No information on this proposed site has been made available for the REA, however, the Commission has consulted the relevant French authorities. The REA has recommended that the developer confirm the status of existing designated sites and whether any new sites have been proposed or designated at the EIA project level.	5.6.1
	Section 6.6.2.2 Scoping Report - Socio economic and infra structural effect is listed separately. However, in the case of new substations being built on Alderney, or a new power line arriving on Alderney, plus consideration of a move towards electric and away from oil, all raise the issue of large scale infra structural redevelopment i.e. lots of digging and laying of new cable paths, transformer stations, throughout the island and these have obvious and large scale conservation impacts	Point noted. The impact assessment takes on board these considerations.	5.6.2
	Section 6.6.2.4 Scoping Report - Is the reference to wind turbine under onshore substation a mistake? list of impacts for a substation is appropriate	Yes, this is an error in the text	N/A
	Section 6.7.1 Scoping Report - Given the broad nature of the REA these specific references to a study limited to only a small area specifically assessed for one proposal may be miss leading and it is rather down to	Point noted. Limitations and data gaps are considered further within REA.	5.7.1.2

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	the scoping to establish a specific area of effect and the data available for that or deal with the wider island diversity?		
	Section 6.7.1 - Since the work listed in this scoping has been done the IUCN lists and UK BAP lists have developed significantly so it would be appropriate to look at the background data again and see what status these sites have under current regulations	The baseline description of terrestrial ecology has been updated to take account of the revised list of UK BAP priority habitats available on the JNCC website following the publication of the Species and Habitats Review Report (Biodiversity Reporting and Information Group (BRIG), 2007) and also the latest IUCN Red List of Threatened Species.	5.7.1
	Section 6.7.2.2 Scoping Report - During earlier discussions cabling of up to 3 x 1GW was discussed, if this scale of cabling was to take place would EMF need to be considered?	Potential EMF effects are considered under relevant marine receptors (i.e. fish and marine mammals).	5.3.2.10 and 5.5.2.9
	Section 6.7.3 Scoping Report - Of limited use and needs updating, Phase 2 needs completing for this area, key species listing may be partially adequate depending on area of effect	Point noted and included within the REA.	5.7.1.2
	Section 8.1.3 Scoping Report - As we understand it a new power source such as this would probably bring with it a requirement for a complete up-rating of existing power network, this has potential for large scale human impact at a variety of levels?!	Potential impacts of cable routing on human receptor topics are covered in the REA.	7
	Section 8.2.1.3 Scoping Report - and significant areas of coastline which might be effected by cable laying are used by recreational anglers (v. limited impact)	Point noted and included within the REA.	7.2.1.2
	Section 8.3.1.2 Scoping Report - Alderney's official second anchorage is Longis visited by 10s if not 100+ boats per annum and large vessels quite regularly shelter outside of Longis and drop anchor	Point noted and included within the REA.	7.3.1.2
	Section 8.3.2.2 Scoping Report - Potential economic issues of displacing Race based traffic into French waters and vice-versa	The changes to commercial shipping movements as a result of the Draft Plan has been assessed.	7.3.2.2
	Section 8.4.2.4 Scoping Report - damage to existing terrestrial infrastructure - and associated economic impact	Point noted and included within the REA.	7.4.2.2
	Section 8.5.1 Scoping Report - Living Islands - Nature and Heritage tourism initiative piloted in Alderney as part of a British Islands wide Wildlife Trusts project	Point noted and included within the REA.	7.5.1
	Section 8.5.2.1 Scoping Report - Displacement of key species such as puffin, seals impacting on local tourism providers	This is considered within the assessment.	7.5.2.4
	Section 8.5.3 Scoping Report - Data gaps/further work - Big data gap, Living Islands project is hoping to reduce this gap and details can be sort from the new manager in July/August 2013	See above.	N/A
	Section 8.6.1 Scoping Report - During 2011 EIA scoping noise impacts was flagged up as one of the most sensitive issues for the general public on Alderney	Point noted and taking account of in noise assessment.	7.6.2
	Section 8.6.1 Scoping Report - no data sources for Alderney noise levels - Qualify; how many island environments have you got noise data from with Alderney's specific natural and infrastructural mix: i.e. low population but own airport, limited road network but 1.5% worlds gannets within 200m of coastline?	Point noted. Limitations and data gaps are considered further within REA.	7.6.1.2
	Section 8.6.2.4 Scoping Report - noise from substation - Potentially very significant impact on QL	Point noted and taking account of in noise assessment.	7.6.2.3

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Section 8.6.3 Scoping Report - Again what extent of baseline, given airport noise fluctuation, local population variability and seabird associated noise a baseline needs to assess a full annual cycle, possibly several	The scope of baseline surveys will need to be determined by the individual developers at the EIA project level.	N/A
	Section 8.7.1 Scoping Report - As with comments on noise	See above.	N/A
	Section 8.8.3 Scoping Report - Data gaps “further work needed” - Particularly necessary if the REA recognizes that surface substations may be deployed as this is not an acknowledged part of any previous development proposals and public perception is that ACRE would not allow this type of facility.	Point noted.	N/A
	Section 8.9.2.2 Scoping Report - Once vehicles are imported to the island for construction previous experience (i.e. commercial quay) suggests that they will stay on island and vehicle size on the island can then increase to match	Given the uncertainties regarding this potential impact, it is not possible to assess this at the plan level. Individual developers will need to consider this potential impact pathway at the EIA project level.	N/A
	Section 8.9.2.4 Scoping Report - As in previous comment	See above.	N/A
	Section 9 Scoping Report - French National Parc	This is not relevant to the legislative requirements of cumulative effects assessment which are underpinned by the SEA Directive and Habitats Directive.	N/A
	Section 9 Scoping Report - Given Alderney's limited cover by convention and EU designation we would want to see AA requirements extended to Ramsar sites as well	Point noted. The potential impacts on the Ramsar site have been assessed in the Nature Conservation section of the REA.	5.6.2
Roy Burke, States of Alderney (received 21-05-13)	No comment	N/A	N/A

A2. Assessment Phase

The second assessment phase of the REA has involved providing a more detailed baseline characterisation for each relevant environmental receptor that has been scoped in as part of the preceding scoping phase and undertaking an assessment of potentially significant effects of the Draft Plan on these receptors, with a focus on developing strategic and project level mitigation measures and monitoring recommendations. The findings of the assessment phase were presented in a Draft REA Environmental Report and made available to relevant stakeholders identified in Table A1 above in September 2013 via the Commission’s website (http://www.acre.gov.gg/library.php). Stakeholders were invited to comment on the Draft REA Environmental Report, to assist in the development of the Final REA Environmental Report (this report).

A total number of seven stakeholder responses were formally received by the Commission. This included:

- Agence des Aires Marines Protégées;
- Alderney Licensed Vessel Owners Organization;
- Alderney Renewable Energy;
- Alderney Wildlife Trust;
- Maritime and Coastguard Agency;
- Préfecture Maritime de la Manche et de la Mer du Nord; and
- States of Alderney Harbour Master.

The comments raised by stakeholders are provided in full in Table A3. This table includes the actions undertaken and relevant section(s) in this report where these issues have been addressed.

Table A3. Summary of comments to the Draft REA Environmental Report

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
Agence des Aires Marines Protégées, Karine Dedieu (received 19-12-13)	There appears to be many gaps in knowledge concerning physical and biological receptors, which need to be filled in order to properly characterise the baseline state of the marine environment and the impact in the short and long term for future projects. In this context, it would appear useful to develop common strategies for data acquisition, especially useful would be to standardise methods of acquisition and development of collaborative databases.	The Iterative Plan Review (IPR) process that is proposed as a plan-level mitigation measure to ensure that significant adverse effects can be avoided will involve taking account of information from other trial deployments elsewhere and monitoring data collected during implementation of early developments under the Draft Plan. Co-operation with regulators in France (including the Agence des Aires Marines Protégées) and the Channel Islands will be pursued by the Alderney Commission of Renewable Energy to ensure that as much as possible can be learnt from early deployments of tidal energy devices. Any relevant and publicly available information will be provided to developers to ensure that project-level assessments are based on the latest evidence.	5.3.2.11, 5.4.2.9, 5.5.2.11, 5.6.2.14 and 8.3
	Concerning the assessment of local and cumulative impacts, a guide on evaluating environmental impacts for offshore turbine technologies will very soon publish as part of the GHYDRO project led by France Energies Marine. In relation to any projects in close proximity to those developed by France, it might be useful to establish and agree a standard assessment matrix, particularly in relation to the consideration of cumulative impacts.	This report has now been published and is available on http://www.france-energies-marines.org/content/download/21291/146987/file/GHYDRO.pdf. The developer of any project under the Draft Plan should aim to take account of the latest research and guidance (such as this report) in relation to their individual project-level assessments. They will also need to consider other plans, project and activities within the study area, including any nearby French developments, and where appropriate, undertake investigations in order to quantify and assess cumulative effects. As part of this process, the developer will need to consult with French developers, which will provide the opportunity to consider the need to develop a standard assessment approach.	8.1
	In addition, France Energies Marines leads experimental studies on the tidal test site located off the island of Brehat, which presents some similar characteristics to the natural environment of Alderney. Results of these studies could improve the estimation of potential impacts and complement evidence made available from the EMEC test sites in Orkney.	See above.	N/A
	The Agency will shortly show the results of a major program, called CARTHAM, mapping marine habitats French waters, focusing on Natura 2000 sites. This study to be delivered during the first half of 2014, could provide complementary information on the characterization and distribution of habitats in the French part of the Raz Blanchard tidal site.	This baseline information may be useful at the project level, particularly with regards to the interconnector cable route between Alderney and France, and this will need to be considered individually by developers. Reference to this information has been included in the Limitations and Data Gaps sub-section of the Benthic Ecology section.	5.1.1.4
	Another pilot programme by the Agency involving scientific partners, called PACOMM involves the acquisition of data on birds and marine mammals in French waters (2010-2014). This study is evaluating the distribution of seabirds and marine mammals, as well as human activities, boats, waste and their spatial and temporal variability, and will be published in 2014. This will therefore complement the existing baseline characterisation of the relevant receptors.	This baseline information may be useful at the project level and will need to be considered individually by developers. Reference to this information has been included in the Limitations and Data Gaps sub-section of the Ornithology and Marine Mammal sections.	5.4.1.2 and 5.5.1.2

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Regarding water quality, there is a French WFD water body (FRHC04), which extends from Cap de Carteret to Cap de la Hague, which may provide additional baseline information.	Any baseline information that is available for this water body may be useful at the project level, particularly with regards to the interconnector cable route between Alderney and France. Reference to this information has been included in the Limitations and Data Gaps sub-section of the Water Quality section.	4.3.1.2
Alderney Licensed Vessel Owners Organization, Raymond Gaudion, Chairman (received 21-11-13)	The report fails to take into account the points made in my response to the scoping report particularly the dynamic nature of the Alderney fleet. To make the point again the wet fish efforts feed the potting efforts for each boat providing bait as a by catch. The potting efforts supply an income when wet fish are scarce. The reduction of any one of these methods of fishing will result in economic failure for the fleet.	Please refer to Table A2 in Appendix A which includes your scoping response and provides an action/response to each comment, cross-referencing to the relevant section of the REA where the issue is considered in more detail. Following a meeting with you on 18 February 2014, we appreciate the dynamic nature of the fleet and your concerns with the Draft Plan for renewable energy in Alderney. The Commission will therefore continue to engage with your organisation to ensure that the Draft Plan is implemented in such a way as to avoid and/or minimise any significant adverse impact.	Table A2 in Appendix A
	7.2.2.1 Paragraph 3 'Permanent displacement may ultimately lead to a reduction in fishing opportunities to the extent that the commercial fleet may be permanently reduced'. This is an understatement.	The Draft REA has concluded that the long term displacement of fishing activities will result in a moderate to major adverse impact and therefore we feel that the importance of this issue has been recognised. Mitigation measures for this significant adverse impact have been proposed for consideration by developers at the project level. In order for mitigation measures to be most effective they will need to be discussed and agreed with local fishermen at the project level by individual developers when further details and information on specific development is known. The Commission welcome continued dialogue with your organisation to facilitate this process.	7.2.2.1 and 7.2.2.6.
	There are other issues with this report however the demise of the Alderney fishing fleet is inevitable even if only a small proportion of the total potential area is developed.	In addition to the mitigation measures that have been highlighted for developers to consider at the project level, the Commission is committed to adopting an iterative plan review process. This process will involve collecting and analysing data from initial deployments under the Draft Plan and seeking similar information from other regulators to inform the implementation of the Draft and ensure it is carried out in a manner that avoids significant adverse effects.	9
	I do not see in this report any other business that will be forced to close by this project.	See comment above.	N/A
	Ultimately the decisions will be made by Alderney politicians who are already trying to 'handcuff' the Alderney commercial fleet with the Fisheries Management White Paper.	The Commission is not involved in the Fisheries Management White Paper and would therefore recommend that any comments to this Paper be directed to the States of Alderney.	N/A
Alderney Renewable Energy, Declan Gaudion (received 22-11-13)	In summary, this report presents a clear representation of the current stage of assessment in the context of ARE's Draft Plan and as such we have no amendments. The report clearly: • Acknowledges where we are in the development cycle; • Assumes worst case scenario – currently assuming 1MW per turbine up to 4GW of installed capacity = 4000 turbines; • Notes the proposed development is 2GW @ 2 MW per unit = 1000 turbines; • Has not identified any significant impacts across the 17 receptors (once mitigation has assumed to have been implemented);	Points noted.	N/A

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	• Is a "scene setter" for the development phase; • Will assist in the development of Environmental Statement and Environmental Assessment that will form a significant part of a consent application; • Is a tool to capture the impact of the full plan once the detail has been established through the consenting process and any other cumulative effects from outside the ARE licence area; and • Supports an approach of design-deploy-monitor cycle allowing for each subsequent deployment to benefit from referenced experience.		
Alderney Wildlife Trust	When starting to consider the REA process undertaken to produce the document under review it would seem important to note the scarcity of contact with the consultancy, ABPmer. As there is no other Alderney based governmental or non-governmental body specifically responding to environmental concerns (in regards to the marine consents process), and given the scarcity of environmental baseline data (recognised in the REA), this does raise some concerns. To my knowledge the contact between the Trust and ABPmer has been limited to the receipt of the Scoping and REA documents and a very limited amount of email traffic where documents were sought to support the REA. No face to face contact occurred to ensure the two parties engaged directly on the issues covered within the REA. This in its own right limits the Trust's ability to respond to what is a very important process and given the nature of the Alderney's community the absence of a stakeholder engagement workshop or presentation would seem somewhat unwise.	We acknowledge your concerns regarding the lack of face-to-face consultation with ABPmer to date. A key requirement for this project has been the development of a transparent engagement strategy. Both statutory and other key stakeholders have been consulted, following The Renewable Energy (Alderney) Ordinance, 2008 (Section 7.1.a.i – 7.1.b), which was amended by The Renewable Energy (Alderney) (Amendment) Ordinance 2013. This has taken the form of PDF documents available for download from the Commission's website and inviting stakeholders to provide feedback at key stages of the project, namely the submission of the Scoping Report and Draft REA Environmental Report. In addition, ABPmer has contacted by email and/or telephone relevant organisations throughout the scoping and assessment phases of the project for up-to-date available baseline information as appropriate. It was felt that the need for any further engagement would depend on the level of interest generated by the report and any significant issues of concern being raised by stakeholders. The Commission has since held a meeting with the Alderney Wildlife Trust in February 2014 to present the key outcomes of the consultation on the Draft Environmental Report and discuss any issues prior to finalising it.	
	My review of the document was halted when I reached section '4.3.2.4. Mitigation', which contains the statement: 'Given that water quality is not afforded any formal level of protection in Alderney, the assessment has concluded that no significant water quality effects will result from the Draft Plan (Table 9.).' Given the very clear statement in the REA's summary that 'the Commission is committed to adopting best practice' it is of real concern that the qualification above, which appears to translate as "due to the absence of existing legislation no effect will result", is contained within an REA undertaken on behalf of the Commission. I had understood that the purpose of the REA was to establish Alderney's intent to become a location where the best possible practice would be maintained throughout the Environmental Impact process. Though the REA would appear to be a useful document on a number of levels, I do not feel that I, nor the Trust, should endorse any mechanism which does not commit itself to raising the standards of practice within	We would like to reassure you that the Commission is committed to adopting best practice and for this reason the REA has been undertaken on a voluntary basis despite there being no statutory requirement to undertake a formal Strategic Environmental Assessment (SEA). We accept that the choice of words in Section 4.3.2.4 is unhelpful and rather misleading and is a product of the assessment methodology that has been applied throughout the REA (see Tables 2 to 4 in Section 2.2.2). This methodology has been developed from a range of sources, statutory guidance, consultations and ABPmer's extensive previous impact assessment experience and is in adherence with UK best practice. This methodology requires the 'importance' in terms of level of protection to be taken into account in the estimation of impact significance. The importance of the water quality receptor has been assessed as negligible as there are no formal standards in Alderney. In addition to the consideration of importance, the 'exposure to change' and 'sensitivity of features' are other key inputs to the assessment of impact	2.2.2 and 4.3.2

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	Alderney's waters to the best possible level, that meaning to UK best practice or better.	significance. In terms of levels of exposure associated with water quality, these are considered to range from negligible to low depending on the type of Draft Plan development, the phase of the development and the specific impact pathway (see Sections 4.3.2.1 to 4.3.2.3 for further justification of each element). The sensitivity of water quality changes brought about by the Draft Plan is considered to range from negligible to low given that the study area is a very dynamic environment and is well flushed. Furthermore, apart from local to discharge points or the historical munitions dumping ground, there is unlikely to be significant sediment contamination given the predominance of rocky/coarse substrate. The overall conclusion that no significant water quality effects will result from the Draft Plan is therefore a result of the evaluation of all of these considerations and not just a reflection of the lack of statutory protection afforded to marine waters around Alderney.	
	I would note that my review of the water quality section of the REA leads me to accept a number of the conclusions. However, I would challenge the potential impacts assessment on turbidity and sediment loading and the 'insignificant' classification of short and medium term impacts on birds from both deployment and operation (http://www.intes.com/articles/meps/49/m049p001.pdf) and on benthic habitats.	With regard to the impacts on ornithological features associated with the release of sediments during construction, these have been assessed as 'insignificant to minor adverse significant' (see Section 5.4.2.6), in part reflecting the limited amount of fine sediment available for resuspension within Alderney waters. The Haney and Stone (1988) paper you have provided as a link concludes that "water clarity has yet to be clearly implicated as an influence on the allocation of foraging tactics in aerial seabirds". The assessment that has been undertaken by ABPmer considers the sensitivity of diving seabirds to this effect to be low and therefore this could be considered a worst case assessment given that the evidence from the Haney and Stone paper does not consider there to be a significant link between turbidity and occurrence of diving birds and would suggest a negligible sensitivity leading to an insignificant effect. Please also note that the impact associated with the re-suspension of sediments on benthic ecology is not considered to be insignificant and has been assessed as 'insignificant to moderate adverse significant' depending on the relative sensitivity of benthic species (see Section 5.1.2.3).	5.1.2.3 and 5.4.2.6
	Despite the obvious scarcity of data to inform the Introduction, specifically 1.2 Draft Plan Description and Need, this section of the REA document does not seem to provide clear enough delineation of the upper and lower boundaries of the scale of potential development, to support its subsequent assessment of impact. This failure leads to conclusions such as the insignificant-minor designation of impact of onshore power distribution and handling, in relation to Mannez Quarry. This designation is made without any clear description of the scales of development and therefore the subsequent mitigation measures suggested are not adequately supported to ensure the class of post mitigation impact is fairly judged.	A clearer description of the boundaries of the scale of potential Draft Plan development that has been considered in the REA is provided in the assessment methodology (Section 2.2.2). In summary, the totality of pressures that would be brought about by the potential full build out of the Draft Plan has been taken into account throughout the REA as an upper worst case scenario. In some instances, the impacts associated with a single array have also been assessed in order to provide further context (and a lower boundary) but the final conclusions are based on the full build out scenario.	2.2.2
	The REA document recognises the scarcity of data in regards the different environmental baselines, yet throughout the document the	Recommendations for further desk-based review and/or survey work at the EIA project level are provided in the 'Limitations and Data Gaps'	4.1.1.4, 4.2.1.4, 4.3.1.2,

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
	recommendations for data acquisition, and the timeframes for such acquisition, seem to be lacking. Given the absence of existing legislation and policy requirements for EIA processes it would seem appropriate for the REA document to offer focus on the type, scale and timeframe for additional baseline assessment prior, during and post installation. Though elements of this are undertaken within the document, the clarity seems to vary dependant on the receptor, and timeframes for additional assessment are seldom, if at all, addressed.	sections of each of the receptor chapters (e.g. see Section 4.2.1.4 for Physical Processes). It is not considered appropriate at the strategic plan-level stage to provide guidance on the necessary timescales of this data acquisition given that these will be based on site specific issues that will only be known at the project level stage. However, guidance is provided on possible methodologies and individual developers are advised to discuss proposed methodologies and survey design with relevant stakeholders and regulators prior to undertaking any such further work. To manage any remaining uncertainties (e.g. scheme details at project-level, collision risk to mobile features and in-combination effects) and to ensure that the Draft Plan can be implemented in a manner that avoids significant effects, a process of iterative plan review is proposed. This process should collect and analyse monitoring data from initial deployments under the Plan (i.e. survey, deploy and monitor) and seek similar information from other regulators to inform iterative review of the Draft Plan during its implementation. In this way, new information on the effects of the Draft Plan can be used to guide its future implementation and thus ensure that significant adverse effects can be avoided.	5.1.1.4, 5.2.1.2, 5.3.1.2, 5.4.1.2, 5.5.1.2, 5.6.1.2, 5.7.1.2, 6.1.1.2, 6.2.1.2, 7.1.1.2, 7.2.1.4, 7.3.1.4, 7.4.1.2, 7.5.1.2, 7.6.1.2, 7.7.1.2, 7.8.1.2, 7.9.1.2, 8.1 and 9
	Scalability: the document appears to often inadequately reconcile the scale of the draft plan to the local context of the island and its community. For example, how can developments which could occupy more than 2% (ARE proposal for use of Mannez Quarry) of the island's land area, sited within an existing nature reserve, and the island's designated area be judged to be of low impact after mitigation as simplistic as erection of earth banking?	We appreciate that the full build out of the Draft Plan will lead to a number of significant issues in terms of the local context of the island and its community. We consider these to have been fully taken into account as reflected by the high number of moderate and major adverse impacts that have been concluded by the assessment. The impact to the existing Longis Nature Reserve as a result of constructing an onshore substation at Mannez Quarry is assessed as insignificant to moderate adverse in the Nature Conservation chapter (see Section 5.6.2.6). A number of mitigation measures have been identified that will need to be considered at the EIA project-level by the developer as appropriate, including avoidance of this site and/or habitat creation schemes to compensate for the loss of terrestrial habitat with ecological value. These mitigation measures could reduce the potential impacts of the Draft Plan, thereby resulting in lower levels of residual impact. However, we acknowledge that it is not possible with any level of certainty to determine the exact level of residual impact as the extent of mitigation achievable will be heavily dependent on many factors which will only be known at the project-level. The significance of potential residual impact has therefore only been estimated throughout the draft REA. In order to manage this uncertainty a process of iterative plan review will be adopted as a plan-level mitigation measure (see comment above).	5.6.2.6, 5.6.2.14 and 5.6.2.15
	Sections of the document considering social and community impact of development again appear to take a lightweight approach and require dangerously low levels of assessment in regards community impacts, other than those that are associated with a simple physical process such as road maintenance.	The draft REA has drawn on existing guidance where relevant, including the Marine Scotland Licensing and Consents Manual and Marine Scotland's Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland. These documents include guidance on undertaking assessments of impacts on land-side receptors (e.g. landscape and visual, onshore	2.2.2

Stakeholder	Comment	Action (Including Clarification Sought/Received, if Applicable)	Section(s) in REA
		traffic and transport) and provide further detail on the likely scope of the investigations required, including sources of information/data; survey requirements; potential impacts and mitigating actions; and potential monitoring requirements. It is therefore considered that the draft REA has followed UK best practice throughout both the marine and land-side topics of the assessment.	
	In conclusion, though the REA seems to meet the requirements of Strategic Environmental Assessment (SEA Directive 2001/42/EC), excepting the caveats imposed by the requirement to define the document as an REA, the Trust has serious concerns as to how the consultant reconciles the local context at various levels with the standard SEA/REA approach. Therefore we would ask the Commission for a clear definition as to 'best practice' and that they consider the implications of the points made above, prior to approving the final document.	See above comments.	
UK Maritime and Coastguard Agency (received 28-11-2013)	Overall the document captures the key areas of concern from a navigation and shipping perspective, although specific project detail remains limited, which will of course have to be populated with detailed Navigation Risk Assessment (NRA) data in accordance with the requirements laid down in MGN 371.	Point Noted. Reference to MGN 371 included more clearly in the Mitigation Table.	7.3.2.13
	The document makes numerous references to exclusion zones as mitigation measures. 'Exclusion Zones' are designed as temporary measures used in emergency response situations and can only be invoked and retracted by UK SOSREP.	Exclusion Zone replaced with with 'Safety Zone' where applicable. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80785/safety_zones.pdf	7.3.2.1 7.3.2.4 7.3.2.5 7.3.2.6 7.3.2.11 7.3.2.13
	7.3.2.6 indicates that 50m safety zones should be implemented around operational turbines. DECC guidance indicates that operational safety zones can be applied for, but needs to be supported by a detailed justification. The point being made is that operational safety zones cannot be assumed as default mitigation. The current paper plays heavily on the safety zone approach, making assumptions in regard to mitigation, some modification to this approach will be required for the project specific NRA's	The DECC guidance has been incorporated into the text and a reference added linking to: *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80785/safety_zones.pdf* Wording changes made to elaborate on safety zones during construction, operation and decommissioning phases.	7.3.2.6
	Under keel Clearance will need to be fully explored within project NRA's, a guidance paper is available from the MCA which addresses how to take this forward,	The NOREL working paper on Under Keel Clearance has been incorporated within the Collision Risk Section 7.3.2.1. A reinforcing statement about Navigation Risk Assessment has been added.	7.3.2.1
	Within 7.3.2.4 states there is a small risk from the hazard created by the moorings, taking account of the comment above, this statement is considered erroneous	The objective of section 7.3.2.4 is to identify the hazard of snagging vessel lines with renewable devices in an emergency situation (when a vessel cannot move under its own power and therefore anchors). The text has been modified to make this point more clearly.	7.3.2.4
	Interpretation of mitigation ie charting and marking makes significant assumptions about the mariner both accessing and accounting for this data, many of the users within the area will be leisure craft, greater physical mitigation measures will be required before assumptions can be made with regard to mitigation as stated.	Mitigation (Table 38) reviewed, considering the recreational mariner. The optional use of guard boats added where appropriate.	7.3.2.12 Table 38
	One comment on report structure, the figures are contained at the end of the document with an annex, this makes reading time consuming	The point is noted, on this occasion, the style of report uses Figures at the end of the documents.	

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	and disruptive, moving back and forward from text to annexe. The document would flow better with figures embedded within the text at the point of reference.		
	MCA will of course provide support guidance to the development of the project specific NRA's, it may be useful if your consultants come forward with more specific project information allowing an informed approach to the NRA activity to be undertaken.	The report recommends and identifies that Navigation Risk Assessments should support applications for Renewable Devices, the role of the regulator is commented upon.	7.3.2.12
Préfecture Maritime de la Manche et de la Mer du Nord, Vice Admiral Emmanuel Carlier (received 29-11-13)	It appears that the export of tidal energy from the Draft Plan will involve an interconnector cable to France. This will involve the temporary use of the French territorial sea along the proposed cable route up to its landfall position. This procedure must be investigated by the départementale de la mer et du littoral de la Manche (DDTM Manche) who have been copied into this response.	Point noted.	N/A
	As you know, the development of tidal energy is also being proposed on the French side of the Race. This arm of the sea is a vital shipping lane serving the islands of Jersey and Guernsey as well as for ships going to Granville (France) or who need shelter from easterlies in the Channel. For this reason, maritime authorities of the Anglo-normades islands and the Préfecture Maritime de la Manche et de la Mer du Nord want a shipping lane free of tidal devices in the Race. A common approach was taken and relayed by the Maritime and Coastguard Agency (MCA) to bring this matter before l'Anglo French Safety of Navigation Group (AFSONG).	Point noted.	N/A
States of Alderney Harbour Master, Mark Gaudion (received 25-11-13)	Our key areas of interest are obviously fisheries and navigation. My understanding is that further details on these will be made available once further development work has been completed. We have no changes to propose at this stage, acknowledging the current level of detail and look forward to receiving the final version of this report.	Further details will be made available by the developer as part of any assessments undertaken at the project-level.	N/A

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Appendix B

Biotopes Recorded Around Alderney

Appendix B. Biotopes Recorded Around Alderney

Table B1. Seasearch biotopes and features of interest recorded around Alderney

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
1a	Longis Bay and Raz Island	Fine sand (up to 7.5m depth)	Extensive eelgrass beds cover most of the entrance to the Bay (3-7.5m)	Burrowing worms and anemones, and two- spot gobies Gobiosculus flavescens, were abundant. 46 species of seaweeds were present, including the peacock's tail, Padina pavonica, which is very scarce in British waters	IR.MIR.KR.Lhyp Laminaria hyperborea and foliose red seaweeds on moderately exposed infralittoral rock SS.SSa.IFiSa infralittoral fine sand SS.SMp.SSgr.Zmar Zostera marina/angustifolia beds on lower shore or infralittoral clean or muddy sand
		Rocky slopes and ridges	Two species of forest kelps, the widespread cuvie Laminaria hyperborea, and the southerly golden kelp Laminaria ochroleuca. A small amount of the invasive japweed Sargassum muticum was present but it did not appear to be becoming dominant Rich understorey of red seaweeds, and an extensive mixed algal community were present in the more sheltered rocky areas		
2a	Baie du Grounard	Steep sided rocky reefs	Most surfaces were seaweed dominated with thongweed Himanthalia elongata on upper surfaces, and occasional kelps, cuvie L. hypberborea and furbelows Saccorhiza polyschides.	Notable at this site were scour tolerant anemones, daisy anemone, Cereus pedunculatus and gem anemone, Aulactinia verrucosa	LR.HLR.FR.Him Himanthalia elongata and red seaweeds on exposed to moderately exposed lower eulittoral rock
		Vertical and overhanging rock faces	Encrusting coralline algae and a short animal turf consisting mainly of bryozoans and sea squirts.		
3a	St Esquere Bay	Medium to large boulders on bedrock (9-10m depth)	Kelp forest and a dense understorey of foliose and filamentous red seaweeds	The more shallow habitats were notable for the lack of fauna, either sessile or mobile and whilst there was a little more animal life present in the deeper habitat it was still relatively impoverished.	IR.HIR.KFaR.LhypR Laminaria hyperborea with dense foliose red seaweeds on exposed infralittoral rock IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock
		Flat cobble and pebble seabed (9-12m)	Kelp park of Laminaria ochroleuca and an understorey of red seaweeds		
		Larger boulders (11-13m)	Kelp cover and an understorey of dense oaten pipes hydroid, Tubularia indivisa, a typical inhabitant of current swept areas		
4a	Cats Bay, Quenard Point and Fort Homeaux Florains	Rocky margins	Seaweed dominated, with large brown seaweeds, thongweed Himanthalia elongata, furbelows Saccorhiza polyschides and cuvie Laminaria hyperborea all dominating different areas and always with an understorey of other mixed red and brown seaweeds.	55 species of seaweed recorded Two very characteristic Channel Island species were present, the ormer Haliotis tuberculata and the black face blenny Tripterygion deleasi. The ormer does not occur on the north side of the English Channel and the black face blenny has a restricted distribution from Dorset to the south coast of Cornwall.	IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock IR.MIR.KR.Lhyp Laminaria hyperborea and foliose red seaweeds on moderately exposed infralittoral rock IR.FIR.IFou Infralittoral fouling seaweed communities SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna
		Gully bottoms were filled with boulders or cobbles	Dominated by green seaweeds, limited fauna on the steeper gully sides		
		Tide-swept rocks	Kelp forest of golden kelp Laminaria orchroleuca below 10m, becoming kelp park with pod weed, Halidrys siliquosa also common.		

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
5a	Bay west of Château à L'Étoc	Shallow water with cobbles and smaller boulders	Dense seaweed growths, including large brown seaweeds such as furbelows, Saccorhiza polyschides (common), oarweed, Laminaria digitata (occasional), thongweed, Himanthalia elongata (frequent) and japweed Sargassum muticum (rare).	No unusual species were recorded.	LR.HLR.FR.Him Himanthalia elongata and red seaweeds on exposed to moderately exposed lower eulittoral rock
6a	Saye Bay	Sand with a few low exposed rocks	Sparse bed of eelgrass, Zostera marina The kelp forest on the shallow rocks marking the west side of the bay was dominated by golden kelp, Laminaria ochroleuca with other large brown and a variety of red seaweeds also present.	There were no unusual species recorded, though the black face blenny, Tripterygion deleasi, was present on the steep faces at the western entrance to the bay.	IR.HIR.KFaR.LhypRVt Laminaria hyperborea and red seaweeds on exposed vertical rock IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna SS.SMp.SSgr.Zmar Zostera marina/angustifolia beds on lower shore or infralittoral clean or muddy sand
		Vertical and overhanging rock surfaces	Low growing seaweed cover, or where they were overhanging, a sparse animal turf Upward facing surfaces were dominated by thongweed, Himanthalia elongata, or cuvie, Laminaria hyperborea.		
7a	West of The Grois Rocks	Low lying rocks	Dominated by faunal turf rather than seaweeds	A variety of sponges (9 species recorded) of which the orange sea squirt, Stolonica socialis dominated and the yellow staghorn sponge Axinella dissimilis was common. Unusual species included pink sea fans, Eunicella verrucosa (R), which is a Biodiversity Action Plan species in the UK, and the sponge Adreus fasicularis, which is listed as nationally rare in the UK.	CR.HCR.XFa mixed faunal turf communities on high energy circalittoral rock SS.SCS.CCS circalittoral coarse sediment
8a	Bibette Head	Intertidal boulders	Dense cover of seaweeds, in the shallowest parts this was dominated by serrated wrack, Fucus serratus, then by thongweed, Himanthalia elongata and finally furbelows, Saccorhiza polyschides.	Though densities were low, there was a good variety of sponges (8 species). The black face blenny, Tripterygion deleasi was also present here.	LR.HLR.FR.Him Himanthalia elongata and red seaweeds on exposed to moderately exposed lower eulittoral rock IR.HIR.KSed.Sac Saccorhiza polyschides and other opportunistic kelps on disturbed sublittoral fringe rock IR.MIR.KR.Lhyp.Pk Laminaria hyperborea park and foliose red seaweeds on moderately exposed lower infralittoral rock SS.SCS.ICS infralittoral coarse sediment
		Deep rock outcrops	Kelp park of Laminaria hyperborea with Halidrys siliquosa		
		Vertical rock faces	Animal turf of sponges, bryozoans and sea squirts.		
9a	Braye Bay foreshore	Intertidal shore	Seaweed dominated with a number of typically intertidal animals such as barnacles, beadlet and gem anemones, dog whelks, shanny and porcelain crab.	There were no unusual species recorded in this habitat.	LR.LLR.F.Fserr Fucus serratus on sheltered lower eulittoral rock

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
10a	Braye Breakwater	Boulder slope down to 3m depth at the inner end and 17m depth at the outer end.	Seaweed dominated by a kelp forest of cuvie Laminaria hyperborea, with significant amounts of furbelows Saccorhiza polyschides. At the inner site other large brown seaweeds included thongweed Himanthalia elongata, mermaid's tresses Chorda filum and japweed Sargassum muticum. There was also an understorey of smaller red and brown seaweeds. At the outer end of the breakwater the kelp and most of the seaweeds did not extend below 15m and the last 2m of boulders had silted surfaces, with many cupcorals, both the common Devonshire cup-coral, Caryophyllia smithii and the scarce scarlet and gold cup-coral, Balanophyllia regia.	The outer site was unusual in that it included both plant and animal dominated habitats. There was a good range of species which included the scarce scarlet and gold cup-coral and also the ormer, Haliotis tuberculata.	IR.LIR.K.LhypLsac Mixed Laminaria hyperborea and Laminaria sacchaina on sheltered infralittoral rock
11a	Braye Rock	Rock	Surfaces dominated by a rich animal turf of sponges (16 species recorded), ascidians (especially Stolonica socialis) and bryozoans (especially Bugula spp.)	The variety of sponges was notable and included relatively unusual species such as Adreus fasicularis, Haliclona fistulosa, Homaxinella subdola and a white species of Tethya, as well as significant numbers of more common south-westerly species such as Axinella dissimilis, Polymastia boletiformis and Axinella damicornis. Other relatively scare or more local species included pink sea fan, Eunicella verrucosa, yellow cluster anemones, Parazoanthis axinellae, here found in abundance, red mullet, Mullus surmuletus and black face blenny Tripterygion deleasi.	CR.HCR.XFa.ByErSp Bryozoan turf and erect sponges on tide-swept circalittoral rock SS.SSa.CMuSa circalittoral muddy sand
12a	Hannaine Bay	Hard surfaces	Dominated by predominantly brown seaweeds. The main species were serrated wrack Fucus serratus, in the intertidal zone and thongweed Himanthalia elongata and furbelows Saccorhiza polyschides in the shallow sublittoral. Pink encrusting algae were common on the rocks and there were red coralline seaweeds growing in the areas of solidified sand.	There were no unusual species recorded, except for the ormer, Haliotis tuberculata, and very few sessile animals present.	LR.MLR.BF.Fserr Fucus serratus on moderately exposed lower eulittoral rock IR.HIR.KSed.Sac Saccorhiza polyschides and other opportunistic kelps on disturbed sublittoral fringe rock SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna
13a	Les Étacs (north)	Bedrock	Dominated by a kelp forest of cuvie Laminaria hyperborea with an understorey of red and smaller brown seaweeds.	Species recorded included the nationally scarce sponge Adreus fasicularis, and the black face blenny Tripterygion deleasi.	IR.HIR.KFaR.LhypR.Ft Laminaria hyperborea forest with dense foliose red seaweeds on exposed upper infralittoral rock

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
		Vertical and overhanging surfaces	Mixed fauna of sponges (10 species), ascidians (especially Stolonica socialis) and bryozoans (mainly Bugula and Crisia spp.).		SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna
14a	Les Étacs (south)	Bedrock and boulders	Dominated by a kelp forest of cuvie Laminaria hyperborea with an understorey of red and smaller brown seaweeds	Abundance of jewel anemones, Corynactis viridis, which were not recorded on the north side. As on the north side, the species recorded included the nationally scarce sponge Adreus fasicularis, and the black face blenny Tripterygion deleasi.	IR.HIR.KFaR.LhypR.Ft Laminaria hyperborea forest with dense foliose red seaweeds on exposed upper infralittoral rock SS.SCS.CCS circalittoral coarse sediment
		Vertical and overhanging surfaces	Hydroid, bryozoan and jewel anemone short turf with many sponges and sea squirts.		
15a	The Lugg, Burhou	Flat seabed with cobbles and small boulders	Dominated by seaweeds wherever there was a sufficiently firm surface for attachment. In the cobble and pebble zone the seaweeds were ephemeral in nature and would be broken off in times of wave swell.	56 species of seaweed recorded	SS.SSa.IfiSa.ImoSa infralittoral mobile clean sand with sparse fauna SS.SMp.KSwSS.LsacR Laminaria saccharina and red seaweeds on infralittoral sediments
1b	Renonquet (North)	Shallow, upper surfaces	Kelp forest of Laminaria hyperborea with an understorey of red seaweeds and sponges	Rich circalittoral fauna dominated by sponges (17 species recorded)	IR.HIR.KFaR - Kelp forest on high energy infralittoral rock CR.HCR.XFa.SpAnVt - Steep or vertical bedrock walls with a fauna turf of sponges and anemones
		Vertical gulley walls	Diverse mixed sponge turf with areas of oaten-pipe hydroids, Tubularia indivisa, and orange sea squirts, Stolonica socialis.		
2b	Ortac	Steep to vertical rock walls, boulders, cobbles, pebbles and coarse sand	Upper hard surfaces had a kelp park of mixed Laminaria hyperborea and L. ochroleuca, whilst all hard surfaces, both steep and upward facing, had large populations of oaten-pipe hydroids, Tubularia indivisa, typical of very high energy sites	The domination of the rock surfaces by oaten pipe hydroids is the characterising feature.	IR.HIR.KFaR - Kelp forest on high energy infralittoral rock IR.HIR.KFaR - Kelp park on high energy infralittoral rock and boulders CR.HCR.FaT.CTub - Tide-swept steep or vertical bedrock walls dominated by oaten pipe hydroids, Tubularia indivisa, and sponges
3b	Coque Lihou	Steep surfaces	Animal dominated with a dense covering of oaten pipe hydroids, Tubularia indivisa, and areas dominated by elegant anemones, Sagartia elegans, and a mixed turf of sponges and orange sea squirts, Stolonica socialis	The habitats and species present here were very similar to those at Ortac.	IR.HIR.KFaR - Kelp forest on high energy infralittoral rock IR.HIR.KFaR - Kelp park on high energy infralittoral rock and boulders CR.HCR.FaT.CTub - Tide-swept steep or vertical bedrock walls dominated by oaten pipe hydroids, Tubularia indivisa, and sponges
		Low buolders	Kelp, Laminaria hyperborea, as forest on the upper surfaces and as park on the lower boulders		
1c	Baie du Grounard	Steep sided rocky reefs	Seaweed dominated with much thongweed Himanthalia elongata on upper surfaces, with occasional kelps, cuvie L. hypberborea and furbelows Saccorhiza polyschides.	Notable at this site were scour tolerant anemones, daisy anemone, Cereus pedunculatus and gem anemone, Aulactinia verrucosa.	
		Vertical and overhanging rock faces	Encrusting coralline algae and a short animal turf consisting mainly of bryozoans and sea squirts.		

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
2c	Les Boufresses	Sloping rock surfaces (3-15m)	Kelp forest of Laminaria hyperborea with an understorey of sponges and red seaweeds	7 species of sponge and 41 seaweeds. Amongst the seaweeds of note was the presence of one plant of Schmitzia neapolitana on a pebble and an unidentified small Cryptonemiales species	IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock IR.MIR.KR.LhypTX.Pk Laminaria hyperborea park and foliose red seaweeds on tide-swept lower infralittoral mixed substrata
		Flatter surfaces with boulders and pebbles (15-18m)	Kelp park		
3c	Longis Bay	Eelgrass bed	Eelgrass is present right up to the rocky edges of Raz Island and extends south in line with the southern rocky promontory to a depth of 11m	A few epiphytic seaweeds with only a filamentous brown, vindeterminate, species recorded. A limited range of small animals, including 4 anemones, of which Peachia cylindrica is relatively uncommon. In the rocky areas 25 species of seaweeds were recorded, including two kelps, Laminaria hyperborea and L. ochroleuca, and the dominant foliose red seaweeds were Chordaria flagelliformis, Brogniartella byssoides, Ahnfeltia plicata, Caliophyllis laciniata and Rhodothamniella floridula. Of note was the presence of Gracilaria bursa-pastoris, a nationally scarce species.	IR.LIR Low energy infralittoral rock IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock SS.SMp.SSgr.Zmar Zostera marina/angustifolia beds on lower shore or infralittoral clean or muddy sand SS.SSa.IMuSa.AreISa Arenicola marina in infralittoral fine sand or muddy sand
4c and 5c	Queslingue and Frying Pan Bay	Rock wall	Dense kelp forest containing both Laminaria hyperborean and L. ochroleuca. In the sublittoral fringe there was a dense covering of foliose red seaweeds.	45 species of seaweeds were recorded from the face of Queslingue alone and there was a good range of animal species on the submerged rocks to the south. The boulder bed is an unusual feature in Alderney and was covered exclusively in the southern golden kelp, Laminaria ochroleuca. The eelgrass bed would be a priority habitat in the UK and the crumpled duster sponge, Axinella damicornis, which is nationally scarce in the UK, was also present.	LR.HLR.FR. Robust fucoid and/or red seaweed communities IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock IR.MIR.KR.Lhyp.Ft Laminaria hyperborea forest and foliose red seaweeds on moderately exposed upper infralittoral rock IR.MIR.KR.LhypT Laminaria hyperborea park and foliose red seaweeds on tide-swept lower infralittoral mixed substrata SS.SMp.SSgr.Zmar Zostera marina/angustifolia beds on lower shore or infralittoral clean or muddy sand
		Submerged rocky outcrops	The tops and sides were covered in kelps with the vertical and overhanging surfaces contained a greater range of sessile animals, including 13 species of sponge, as well as soft corals, cup- corals, jewel and white striped anemones, a single pink sea fan, bryozoans, sea cucumbers and sea squirts.		
		Sandy seabed	Tide-swept patchy eelgrass bed, with common filamentous brown seaweeds on the eelgrass.		
		Small boulders	Kelp forest of Laminaria ochroleuca with an understorey of foliose red and brown seaweeds		
6c	Rousset, below Hanging Rock	Steep outer face	Dominated by a mixed kelp forest of Laminaria hyperborea and L. ochroleuca with an understorey of red foliose seaweeds, sponges and sea squirts	47 species of seaweeds in this habitat most of which were foliose reds. The majority of the animal life was on the vertical wall of the rock and included 16 species of sponges, as well as a range	IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock IR.HIR.KFaR.LhypRVt

Site	Area	Habitat	Community Types	Features of Interest	Main Biotopes
		Tide-swept boulders and consolidated pebbles	Kelp forest, dominant species Laminaria ochroleuca.	of cnidarians, bryozoans and sea squirts. Species of interest included small pink sea fans, Eunicella verrucosa (nationally scarce and Biodiversity Action Plan species in the UK), Parazoanthus axinellae (yellow cluster anemones), which are nationally scarce in the UK, Codium vermilaria, previous records from Jersey and southern England cited as doubtful, and the black faced blenny, Tripterygion deleasi, which has a southerly distribution and is only seen in a few places in southern England. There was relatively little animal turf on the flat seabed, largely due to the scouring effect of the mobile sand.	Laminaria hyperborea and red seaweeds on exposed vertical rock IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock
7c	La Tchue	Rock surfaces and boulder habitats	Kelp forest of Laminaria hyperborea and L. ochroleuca. Beneath the kelp the surfaces were dominated by foliose red seaweeds	43 seaweeds, 15 sponges, 13 cnidarians, and a variety of crustaceans, molluscs, bryozoans, echinoderms, sea squirts and fishes. Of particular interest was the presence of the, rarely recorded, yellow sponge Endectyon delaubenfelsi and the scarlet and gold cup-coral, Balanophyllia regia, which is nationally scarce in England. The black face blenny, Tripterygion deleasi, was also present. Amongst the brown seaweeds recorded was the nationally scarce Carpomitra costata.	IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna
8c	South of Rubbish Tip	Shallow fringing rock	Mixed kelp forest with an understorey of red foliose seaweeds	Considerable evidence of impact from the rubbish tip with much rubbish caught around the boulders and part buried in the sand, including plastics, metal, cabling, tyres and netting. This was not a diverse or interesting site from the point of view of marine life and habitats.	IR.LIR.K.LhypLoch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on moderately exposed or sheltered infralittoral rock SS.SSa.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna
		Sand	Largely barren with a few brittlestars and sand mason worms		
9c	The Sisters, Telegraph Bay	Wave exposed and tide-swept area	Kelp forest, predominantly Saccorhiza polyschides	The number and variety of animal species was limited. Two seaweeds were seen which are only rarely recorded in southern Britain, Haliptilon squamatum and Gelidum corneum.	IR.FIR.SG Infralittoral surge gullies and caves IR.HIR.KFaR.LhypR.Loch Mixed Laminaria hyperborea and Laminaria ochroleuca forest on exposed infralittoral rock
		Gullies	Young kelp plants and filamentous brown seaweeds		

Table B2. Seastar Survey Ltd biotopes and features of interest recorded around Alderney

Station	Main Substrata	Main fauna	Main Biotopes
Cam01	Rocky outcrops interspersed and, in part, covered in coarse sand. Some cobbles and small boulders.	Sponges (e.g. Pachymatisma johnstonia), anemones (Urticina spp.), sea squirts, Tubularia indivisa and bryozoans.	CR.HCR.FaT.CTub CR.HCR.XFa.FluCoAs.Paur CR.HCR.XFa.Flu
Cam02	Coarse sand and sand waves with little visible fauna or flora, interspersed by rocky outcrops	Red and brown seaweed (e.g. Halidrys siliquosa). Hydroids and some sponges are also present on the rocky outcrops.	SS.SCS.CCS IR.HIR.KSed.XKHal IR.HIR.KSed CR.HCR.FaT.CTub IR.HIR.KSed.XKScrR
Cam03	Bedrock, boulders and cobbles interspersed and covered by coarse sand.	Red and brown (Halidrys siliquosa and Laminaria sp.) seaweed. Sponges, barnacles, bryozoans and sea squirts.	IR.HIR.KSed.XKScrR IR.HIR.KSed.XKHal CR.HCR.XFa.ByErSp CR.HCR.XFa.Flu
Cam04	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam05	Small boulders, cobbles and gravel interspersed / covered by coarse sand.	Some sponges, hydroids and barnacles dominate the fauna	SS.SCS.CCS SS.SCS.CCS.(PomB) CR.HCR.XFa
Cam06	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam07	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam08	Boulders, cobbles and gravel interspersed and covered by coarse sand.	Sponges, anemones, barnacles, bryozoans and sea squirts dominate.	CR.HCR.XFa.ByErSp CR.HCR.XFa.FluCoAs.SmAs CR.HCR.XFa.ByErSp.DysAct
Cam09	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam10	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam11	Boulders, cobbles and gravel interspersed and covered by coarse sand.	Sponges, barnacles, bryozoans and sea squirts dominate the fauna.	CR.HCR.FaT.BalTub CR.HCR.XFa.FluCoAs.Paur CR.HCR.FaT.CTub CR.HCR.XFa.FluCoAs.SmAs
Cam12	Boulders, cobbles and gravel interspersed and covered by coarse sand.	Sponges, barnacles, bryozoans (e.g. Flustra) and sea squirts dominate the fauna.	CR.HCR.XFa CR.HCR.XFa.FluCoAs.Paur SS.SCS.CCS.PomB CR.HCR.XFa.FluCoAs.SmAs
Cam14	Boulders, cobbles and gravel interspersed / covered by coarse sand. Bedrock outcrops present.	Sponges, hydroids, barnacles and sea squirts dominate the fauna.	SS.SCS.CCS.PomB CR.HCR.XFa.ByErSp CR.HCR.XFa.FluCoAs.SmAs
Cam15	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam16	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam17	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam19	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam20	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam21	Coarse sand (sand ripples and waves) with gravel / rocky outcrops.	Fauna on rocks dominated by hydroids, barnacles, bryozoans and sea squirts.	SS.SCS.CCS CR.HCR.FaT.CTub CR.HCR.XFa.FluCoAs.Paur
Cam23	Coarse sand with some large shells and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam24	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam25	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam26	Coarse sand and sand waves.	No visible fauna or flora.	SS.SCS.CCS
Cam28	Coarse sand and gravel with shell material.	No visible fauna or flora.	SS.SCS.CCS
Cam30	Shell gravel and gravel.	No visible fauna or flora.	SS.SCS.CCS
Cam31	Shell gravel and gravel.	No visible fauna or flora.	SS.SCS.CCS
Cam32	Shell gravel and gravel.	No visible fauna or flora.	SS.SCS.CCS

Table B3. Intertidal biotopes recorded around Alderney

Biotope Type	Biotope Code	Description	Ecological Significance	Location
High energy	LR.HLR.FR.Coff.Coff	C. officinalis and M. stellatus on exposed to moderately exposed lower eulittoral rock	Moderate	HB, LB, BL, HH
High energy	LR.HLR.FR.Him	H. elongata and red seaweeds on exposed to moderately exposed lower eulittoral rock	Low	HB, SC, LB, BL, HH
High energy	LR.HLR.FR.Osm	O. pinnatifida on moderately exposed mid eulittoral rock	Low	HB, LB, HH
High energy	LR.HLR.FR.Pal	P. palmata on very exposed to moderately exposed lower eulittoral rock	Low	HB, SC, LB, BL, HH
High energy	LR.HLR.MusB.Cht	Chthamalus spp. on exposed eulittoral rock	Low	HB, SC, LB, BL, HH
High energy	LR.HLR.MusB.Cht.Lpyg	Chthamalus spp. and L. pygmaea on steep exposed upper eulittoral rock	Moderate	HB, SC, LB, HH
High energy	LR.HLR.MusB.Sem.Fves.R	S. balanoides, F. vesiculosus and red seaweeds on exposed to moderately exposed eulittoral rock	Low	HB, LB, BL, HH
High energy	LR.HLR.MusB.SemSem	S. balanoides, P. vulgata, Littorina spp. On exposed/moderately exposed/vertical sheltered eulittoral rock	Low	HB, SC, LB, BL
High energy	LR.HLR.MusB.Sem.Litx	Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles	Low	HB, SC
High energy	LR.HLR.FR.Mas	M. stellatus and C. crispus on very exposed to moderately exposed lower eulittoral rock	Low	SC, LB, HH
High energy	LR.HLR.FT.FserTX	F. serratus with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata	Moderate	SC, LB
Moderate Energy	LR.MLR.BF.Fser.R	F. serratus and red seaweeds on moderately exposed lower eulittoral rock	Moderate	HB, SC, LB, BL, HH
Moderate Energy	LR.MLR.BF.Fser.Bo	F. serratus and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	Moderate	SC, LB, HH
Moderate Energy	LR.MLR.BF.FspiB	F. spiralis on exposed to moderately exposed upper eulittoral rock	Moderate	HB, LB, HH
Moderate Energy	LR.MLR.BF.FvesB	F. vesiculosus and barnacle mosaics on moderately exposed mid eulittoral rock	Low	HB, SC, LB, BL, HH
Moderate Energy	LR.MLR.BF.PelB	P. canaliculata and barnacles on moderately exposed littoral fringe rock	Low	HB, SC, LB, HH
Moderate Energy	LR.MLR.BF.Rho	R. floridula on sand scoured lower eulittoral rock	Low	HB, LB, HH
Low energy	LR.LLR.F.Fves.X	F. vesiculosus on mid eulittoral mixed substrata	Low	SC, LB, HH
Low energy	LR.LLR.F.Asc.FS	A. nodosum on full salinity mid eulittoral rock	Low	LB
Low energy	LR.LLR.F.Asc.X	A. nodosum on full salinity mid eulittoral mixed substrata	Low	LB
Low energy	LR.LLR.F.Fserr.X	F. serratus on full salinity lower eulittoral mixed substrata	Moderate	LB, HH
Low energy	LR.LLR.F.Fspi.X	F. spiralis on full salinity upper eulittoral mixed substrata	Low	LB
Features of littoral rock	LR.FLR.Lic.Ver	V. maura on very exposed to very sheltered upper littoral fringe rock	Low	HB, SC, LB, HH
Features of littoral rock	LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock	Low	HB, SC, LB, HH
Features of littoral rock	LR.FLR.Rkp.Cor.Bif	B. bifurcate in shallow eulittoralrock-pools	Low	HB, LB, BL, HH
Features of littoral rock	LR.FLR.Rkp.Cor.Cor	Corallina crusts and Corallina officinalis in shallow eulittoral rockpools	Low	BL, HH
Features of littoral rock	LR.FLR.Rkp.FK.Sar	S. muticum in eulittoral rock-pools	Low	HB, LB, HH
Features of littoral rock	LR.FLR.Rkp.G	Green seaweeds (Enteromorpha spp. and Cladophora spp.) in shallow upper shore rock-pools	Low	HB, LB, HH
High energy infra-littoral rock	IR.HIR.KSed.Sac	S. polyschides and other opportunistic kelps on disturbed sublittoral fringe rock	Low	SC, LB, BL, HH
High energy infra-littoral rock	IR.HIR.KFaR.LhypR	L. hyperborea with dense foliose red seaweeds on exposed infralittoral rock	Moderate	LB
High energy infra-littoral rock	IR.HIR.KSed.XKScrR	Mixed kelps with scour tolerant and opportunistic foliose red seaweeds on scoured or sand covered infra-littoral rock	Low	HH
Features of infralittoral rock	IR.FIR.SG.CRSpAsAn	Anemones, including Corynactis viridis, crustose sponges and colonial ascidians on very exposed or wave surged vertical infra-littoral rock.	Moderate	BL

Biotope Type	Biotope Code	Description	Ecological Significance	Location
Littoral caves/ overhangs	LR.FLR.CvOv.AudCla	A. purpurea and C. rupestris on upper to midshore cave walls	Moderate	SC, LB
Littoral caves/ overhangs	LR.FLR.CVOV.FaCr	Faunal crusts on wave-surged littoral cave walls.	Moderate	SC, LB
Ephemeral Communities	LR.FLR.Eph.Ent	Enteromorpha spp. on freshwater influenced and/or unstable upper eulittoral rock	Low	HB, SC, LB, HH
Ephemeral Communities	LR.FLR.Eph.EntPor	P. purpurea and Enteromorpha spp. on sand scoured mid or lower eulittoral rock	Low	HB, LB, HH
Ephemeral Communities	LR.FLR.Eph.EphX	Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata	Low	SC, LB, BL, HH
Littoral sediment	LS.LCS.Sh.Barsh	Barren littoral shingle	Low	HB, SC, LB, HH
Littoral sediment	LS.LCS.Sa.MoSa.BarSa	Barren littoral coarse sand	Low	SC, LB
Littoral sediment	LS.LSa.St.Tal	Talidris on the uppershore and strand line	Low	HB, LB, HH
Littoral sediment	LS.LSA.MuSa.MacAre	M. balthica and A. marina in littoral muddy sand	Moderate	LB
Littoral sediment	SS.SMp.SSgr.Zmar	Z. marina/angustifolia beds on lower shore or infralittoral clean or muddy sand	Moderate	LB

HB Hanaine Bay
SC South coast of Alderney
LB Longis Bay
BL Brinchetais Ledge
HH Houmet Herbé

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