DO NOT PRINT THIS PAGE

6 Water Quality

6.1 Introduction

This section deals with the potential impact of marine renewables on sediment and water quality. The baseline environment is described using data provided for the Bailiwick of Guernsey from Health and Social Services and the Environment departments.

6.2 Baseline Environment

6.2.1 Legislation

There are a number laws and legislation that apply to Guernsey, and these are generally adapted from UK and EU legislation. The following legislation relates to water quality and pollution at sea, placing of objects on the seabed and the harvesting of food from the marine environment.

- Environmental Pollution (Guernsey) Law 2004 (Part 6 relates to water pollution. There is currently no ordinance in place, but this is shortly to go to the Sates of Guernsey to be enacted.)
- EC environmental Legislation 1991 (currently in force, there are plans to update it but they are not imminent.)
- The London convention (Convention on the Prevention of Marine Pollution by dumping of Wastes and other matters)
- The Oslo Convention (Convention for the Prevention of Marine Pollution by dumping from Ships and Aircraft)
- Prevention of Pollution (Guernsey) Law 1989
- Food and Environment Protection (Guernsey) Act 1987
- European Union Directive 91/492/EEC
- EC Shellfish Waters Directive (79/923/EEC)
- European Union Bathing Water Directive – 76/160/EEC.
- European Union Directive 91/492/EEC

The last two directives are not being legally enforced; they are used purely for reporting and analysis purposes, the other laws and legislation are enforced in the Bailiwick of Guernsey.

6.2.2 Water Quality

Beach Sampling – There is regular sampling of the beaches around Guernsey, with special focus on "Blue Flag" beaches. These are sampled weekly through the summer and the results classified as Guide pass, Mandatory pass or fail. Other sites are tested monthly over the winter and randomly at other times. The overwinter testing are noted but not classified as they fall outside the "Blue Flag" definition. Table 6.2.1 below shows the number of samples taken in 2009 at the various beaches and the results for "Blue Flag" beaches. The samples are tested by the States Analyst's Laboratory against the mandatory and guideline values as specified in the European Union Bathing Water Directive – 76/160/EEC.

As can be seen in Table 6.2.1 there are very few reported failures, only 9, and any failures are retested as soon as they are identified. This is because of the identification of water quality is based on the number of Coliforms, Faecal Coliforms and Faecal Streptococci per 100ml. This means that the sample could be contaminated by an event such as a large amount of bird faeces in the area or run off from agricultural land after heavy rainfall, which would not be there when the area is retested. Several beaches on Guernsey have been awarded the Encams Seaside Award. One of the criteria for receiving this prestigious award is the quality of the seawater. Encams specify that in order to qualify for this award the seawater must comply with the mandatory standards.

"Blue Flag" beaches, with regards to Guernsey, are those which are of significant importance to bathing and the tourism industry. Guernsey's beaches cannot qualify for the UK Blue Flag standard as there is the stipulation that there are certain sewage treatment and effluent quality levels that Guernsey, without a sewage treatment works, does not comply with. However, the second level of the UK Blue Flag scheme is the ENCAMS Quality Coast Award, previously the ENCAMS Seaside Award, and Guernsey beaches do qualify for this. Both Blue Flag and Quality Coast Awards require the same stringent levels of testing of water quality against bacterial contamination as outlined in the EU Bathing Water Directive. This requires at least 20 water samples to be taken throughout the bathing season (May to September) with no more than 17 days between samples. There are also limitations on the number of times a beach can fail a water sample test in order that it retains its status. Guernsey aims to fulfil the requirements for Blue Flag beaches, however as mentioned previously, Guernsey does not qualify due to the sewage releases.

Aside from water quality issues in order to obtain the Blue Flag or Quality Coast Award there are many other criteria required ranging from education, to health and safety to beach management. However these additional requirements do not relate to sediment or water quality and so are not covered here. If you wish to read more regarding the standards please refer to http://www.blueflag.org.uk/blue2more.asp for blue flag information and

http://www.qualitycoastapplication.org/resources_and_guidance.aspx?style= for quality coast information.

Table 6.2.1 – Seawater Quality results 2009

Site	No. of Samples	Guide Pass	Mandatory Pass	Fail
Bordeaux	27	14	5	0
Chouet	7	0	0	0
Cobo (North)	7	0	0	0
Cobo (South)	32	16	3	2
Fermain	29	15	3	0
Grand Havre (Houmet)	7	0	0	0
Grand Havre (Vale Pond)	7	0	0	0
Grandes Rocques	28	17	1	1
Halfway	8	0	0	0
Havelet Bay	27	17	1	0
Ladies Bay	28	15	6	1
Lancresse	7	0	0	0
L'Eree Bay	27	17	1	0
Longstore	7	0	0	0
Moulin Huet	7	0	0	0
Pembroke	31	12	6	3
Perelle Bay	7	0	0	0
Petit Bot	28	12	6	0
Port Grat	7	0	0	0
Port Soif	28	18	0	1
Portelet	27	18	0	0
Red Lion	7	0	0	0
Richmond Corner	7	0	0	0
Saints Bay	27	16	2	0
Salerie Corner	6	0	0	0
Southside 1	7	0	0	0
Southside 3	7	0	0	0
Southside 6	7	0	0	0
Southside 7	7	0	0	0
Vazon(North)	28	16	2	1
Vazon (South)	7	0	0	0
Les Banques	7	0	0	0
Ladies Pool	7	3	0	0

Shellfish Farms – As well as beach sampling, the Bailiwick has a number of shellfish farming areas, as identified in the Fisheries and Mariculture Chapter, which are also monitored for water quality. There are four possible levels of quality, A, B, C, or D, with A being the highest quality, and D the lowest. The classification and subsequent required treatment of the levels of quality is outlined in Table 6.2.2 below. The sites are sampled on a monthly basis and all are commercial oyster and mussel beds. In the Bailiwick there are only "A" and "B" quality areas, and the way sites are graded is again dependant on faecal coliforms and specifically E. coli. The European Union Directive 91/492/EEC sets out the health conditions for the production and placing of live bivalve molluscs on the market.

The EC Shellfish Waters Directive (79/923/EEC) aims to protect or improve shellfish waters in order to support shellfish life and growth, therefore contributing to the high quality of shellfish products directly edible by man. The directive sets physical, chemical and microbiological water quality requirements that designated shellfish waters must comply with ('mandatory' standards) or endeavour to meet ('guideline' standards).

The Shellfish Waters Directive is designed to protect the aquatic habitat of bivalve and gastropod molluscs, including oysters, mussels, cockles, scallops and claws. The directive does not cover shellfish crustaceans such as crabs, crayfish and lobsters.

Table 6.2.2 – Classification of Shellfish sites (taken from HSSD website)

Classification	Permitted level	Outcome
Class A	Less than 230 E.coli per 100g of flesh or Less than 300 faecal coliforms per 100g flesh	Molluscs can be harvested for direct human consumption i.e. without cooking
Class B	Less than 4,600 E.coli per 100g of flesh (in 90% samples) or Less than 6000 faecal coliforms per 100g flesh (in 90% samples)	Molluscs can be used for human consumption after purification in an approved processing plant or after relaying in an approved relaying area or after an EC approved heat treatment process.
Class C	Less than 4600 E.coli per 100g of flesh	Molluscs can go for human consumption only after relaying for at least two months in an approved relaying area, whether or not combined with purification, or after an EC approved heat treatment process
Class D	Greater than 4600 E.coli per 100g of flesh	Prohibited or unclassified shellfish beds. Molluscs must not be used for human consumption

Radioactivity Sampling – There are samples taken from Guernsey of seaweed and marine animals. There are two sampling methodologies that run concurrently, one run by the IRSN in France that samples once a year and issues the results to Guernsey, the other is from CEFAS and the samples are collected by Sea Fisheries and sent to the UK 3 times a year.

6.2.3 Suspended Sediments

Particulate matter suspended in the marine environment has three main constituent parts; living organic material, organic detritus and inorganic material. The inorganic material can either have been transported from land into the marine environment or have originated in the marine environment.

Living organic material is comprised of plankton, and information on photo and zooplankton in the REA area can be found in the Pelagic Ecology chapter. Concentrations of suspended inorganic material depend on a number of processes. Generally distributions of suspended sediment are found in highest concentrations around coastal areas, due to sediment re-suspension from the seabed, discharge from land based sources such as river mouths and coastal erosion. There is more information on sediment in the REA area in the Geology Chapter.

6.2.4 Potential Contamination

There are potentially already sources of contamination to both the sediment and water quality. This is potentially important not only to outline what may already be present, but also because any disturbance of contaminants already around could have environmental effects. Unfortunately other than the beach water quality surveys and the radioactivity sampling there are no water or sediment quality checks. The beach sampling also only looks at coliform levels, and so does not include other contaminants that may be there. In addition to this there are no studies of water quality away from the shore. This makes identifying potentially present contaminants hard to specify, however they will generally come from:

- Marine Inputs, carried from other areas
- Terrestrial Inputs
- Atmospheric inputs, such as dust mixing with the water
- Disposal sites. There is a disposal site located to the north of the study area
- Radioactive Contamination

6.3 Potential Effects

There is a potential for a number of effects to occur from the installation, operation and decommissioning of marine renewable energy devices. But it is equally important to note that due to the dynamic nature of the marine environment, especially in areas where there is the potential to harvest energy, there is the likelihood that the possible contaminants could be dispersed. This would dilute any potentially harmful pollutants, thereby reducing the effect.

6.3.1 Installation Effects

Disturbance of natural sediments – It is highly likely that for any work carried out in the area on the seabed there will be re-suspension of sediments. In the REA area and specifically where there are likely to be deployments there is likely to only be sand sized particles (see Geology Chapter). This could be easily disturbed during cable laying throughout the area and by device deployment. Courser sized particles would quickly redeposit on the sea bed near to the area of disturbance. Finer particles may well be distributed over large areas before being re-deposited.

Release of additional sediment during construction – There is likely to be additional sediment produced during the installation of all devices, save if they use gravity bases only, due to drilling and piling. There is further potential for this if there is trenching for cable laying activities.

Release of contaminants during construction – There is the possibility of installation operations may release hazardous or toxic materials, thereby temporarily reducing water quality in the area. Use of chemicals and discharge of all material will be covered under the Renewable Energy Law and under licences issued to developers. Under the terms of any licence given, the use of chemicals and discharges will be enforced by the Director of the Health and Social Services Department (HSSD), who will be a statutory consultee on any application.

Currently the is the FEPA Guernsey Act 1987 is in force in the Bailiwick of Guernsey, which would cover the release of contaminants. However, the Director of the HSSD is working on replacing the FEPA legislation with the Environmental Pollution Guernsey Law 2004. An exemption to FEPA is planned for offshore renewable energy within the Renewable Energy (RE) Law, with all relevant FEPA legislation to be covered in the RE Law.

Disturbance of contaminated sediments – There is the potential to disturb contaminated sediments during both device and cable installation, as there could be contamination in the sediment from the sewage outlet on the east coast of Guernsey. Disturbance of these sediments is likely to reduce water quality locally and may increase dispersion of contamination, thereby reducing water quality over a wider area than the development area.

Accidental release of contaminants – There is the possibility of the accidental release of contaminants such as fuels, lubricating oils, paints, antifouling chemicals and paints amongst other things. The release of contaminants could come from multiple sources during the installation, ranging from the devices themselves if damaged to the boats installing them. The release of any contaminant would reduce the water quality levels and release of contaminants such as litter or other polluting discharges could affect bathing waters and beaches as well as the health of wildlife. However there is the possibility of larger scale releases, such as damaged ships releasing large amounts of oils. This would not only reduce water quality on a large scale and prevent bathing on affected beaches for an unknown

period, but could also have large negative effects on wildlife and the range of the effects could be large due to the high energy waters in the Bailiwick. However it is impossible to predict the probability of accidental contaminant releases due to the unknown nature of installation. To this end there would be specific mitigation methods for each installation method once details are known.

6.3.2 Operational Effects

It is highly unlikely that, once installed, cables will have any effect on water quality, except should any unplanned maintenance be required, so the effects listed below are only for the devices.

Accidental release of contaminants – There are two potential sources of accidental contamination, firstly that of the devices themselves where they use lubricating oils and hydraulics and secondly from vessels during maintenance. From devices it is hard to predict the levels of leakage at this stage as it is not know whether the devices that will be installed will use hydraulics and lubricants or, as appears to be the favoured way forward, they will use sea water lubrication. Leakage of hydraulic fluid or other contaminants could cause reduced water quality in the area around the devices and, with the high energy nature of the waters in the Bailiwick, could also cause widespread problems to water quality, beach quality and be damaging to wildlife. There is also the possibility that there could be multiple releases, if for example something is found to be faulty with the devices, which could in turn lead to cumulative effects of release, thereby increasing the potential for larger scale contamination and damage. During maintenance there is the same possibility of accidental release of contaminants as mentioned for installation.

Erosion of sacrificial anodes – Sacrificial anodes are designed to corrode in preference to operational and constructional materials such as steel. They are commonly used in the marine industry and do not have any noted adverse effects. However the most commonly used materials are potentially toxic to marine organisms, although anode dissolution rates should be sufficiently slow that contamination levels should not reach dangerous levels.

Antifouling compounds – Most antifouling coatings now do not contain toxic materials. Assuming that these are used, in combination with them only being used on moving parts, it is unlikely that there will be any reduction in water quality. It is also possible to prevent the use of toxic chemicals in the antifoulants used through conditions on the licences.

Changes in sediment dynamics – Removal of energy around arrays may increase sedimentation in the vicinity, which may in turn have effects on other areas (see marine processes chapter).

Collisions between boats and devices – By placing devices in the water and implementing exclusion zones there is the possibility of two effects. Firstly that there will be a funnelling of ships which could lead to boat collisions and secondly

that there could be collisions between boats and devices if exclusion zones are not sufficiently marked or are ignored. Any collision could cause a number of releases, ranging from the relatively undamaging releases of metal and wood from collision, to the far more damaging release of heavy fuel oils. There is also the possibility that should a boat collide with a device (or multiple devices) then there could be multiple pollutants released and dispersed around the Bailiwick.

6.4 Sensitivity of receptors

The main primary receptors identified are the levels of water quality and sediment contamination. However, leading on from these, there are numerous potential secondary receptors to changes in water and sediment quality. These include effects on wildlife (including marine flora and fauna, littoral flora and fauna and sea birds), human health, the human environment (such as effects on property and aesthetics) and the operation of other devices.

From the information collected on the beaches around Guernsey the water quality generally appears to be of a high standard. There is however the potential for water and sediment quality to be reduced in the vicinity of the sewage outlet. This general high water quality means that the waters and sediments are likely to be sensitive to decreases in quality. For bathing and the shellfish farms, there is a high sensitivity to fuel and oil (hydrocarbon). They are also sensitive to coliform increases, and so any disturbance near the sewage outlet may have significant effects.

Due to the energetic nature of the areas where deployment of arrays will take place it is likely that dissolved and suspended substances would be expected to disperse or dilute rapidly. However slick forming hydrocarbons and litter are less easily dispersed and can become a persistent problem. This means that on the secondary receptors the release of suspended and dissolved substances would have only very little effects, however the release of litter would have a far greater effect, with the possibility that marine fauna and sea birds could get caught up in or damage by litter and the human environment would be adversely affected as well. Should hydrocarbons be released then all of the secondary receptors would be highly sensitive, with animal and plant species facing severe damage and mortality and damage to property such as marinas and boats also being a possibility.

Additionally, due to the tidal dynamics and the proximity of the Bailiwick to both Jersey and to France, spills of hydrocarbons and other pollutants have the potential to affect not only the local environment, but also the regional and International environments.

6.5 Potential Significance and Likelihood of Effects

Table 6.5.1 below illustrates both the potential significance on the receptors of the different possible effects listed above and the probability of an event occuring. There are 4 categories the effect can fall into; Major, Moderate, Minor or None. This relates to the impact that the effect would have on the given receptor(s) and is calculated by working out the value of the receptor – based on how far reaching the effects are: local, regional or international – and the perceived magnitude of the impact (the severity of the impact on the receptor).

The likelihood of occurrence is the currently understood probability of an event occurring under current guidelines and legislation.

Table 6.5.1 – Significance of Effects and Likelihood of Effect Occurrence

Potential Effect	Device Characteristic	Development phase	Receptor	Significance of effects	Likelihood of occurrence
Disturbance of natural sediments	All devices and cables	Installation Operation Decommissioning	Water Quality, Shellfishing waters	Minor	High
Release of additional sediment during construction	Fixing of devices to the seabed and cabling	Installation Operation Decommissioning	Water Quality, Shellfishing waters	Minor	Dependent on methods of installation and cabling – Moderate to high
Release of contaminants during construction	Devices, cables and Boats	Installation Decommissioning	Water Quality Human Health Flora and Fauna Human Environment	None – Moderate (depending on release)	Low
Disturbance of contaminated sediments	Fixing of devices to the seabed and cabling	Installation, Operation, Decommissioning	Water Quality, Shellfishing waters, Bathing waters	Moderate	Dependent on where devices and cables are deployed – Low to high

Potential Effect	Device Characteristic	Development phase	Receptor	Significance of effects	Likelihood of occurrence
Accidental release of contaminants during operation	Devices, cables and Boats	Operation Maintenance Decommissioning	Water Quality, Shellfishing waters, Bathing waters Human Health Flora and Fauna Human Environment Operation of other devices	Moderate	Low
Erosion of sacrificial anodes	Devices using sacrificial anodes	Operation	Water Quality	None	High
Anti fouling compound release	Devices using Biocidal antifouling	Operation	Water Quality Flora and Fauna	Minor	Dependent on device characteristics
Changes in sediment dynamics	All devices	Operation	Water Quality	Unknown	Unknown (see Marine Processes Chapter for more information)
Collisions between boats and devices	Devices and Boats	Operation Maintenance Decommissioning	Water Quality, Shellfishing waters, Bathing waters Human Health Flora and Fauna Human Environment Operation of other devices	Moderate	Low

6.6 Mitigation Measures

Where potential effects have been identified the following mitigation methods can be implemented to reduce the effect.

Disturbance of Natural Sediments

- Minimise dredging
- Use cable and devices installation methods that minimise sediment disturbance
- Carry out work in appropriate tidal conditions

Release of Additional Sediment

- Minimise depth of piling/drilling
- Avoid trenching for cabling where possible

Release of Contaminants

- Use low/non toxic materials
- Minimise contact of toxic materials with water
- Minimise quantity of toxic materials used

Disturbance of contaminated sediments

- Avoid infrastructure within areas of known or suspected sediment contamination
- Carry out pre-installation surveys
- Use cable and devices installation methods that minimise sediment disturbance
- Undertake in depth risk assessments and contingency planning

Accidental Release of Contaminants

- Carry out potentially hazardous operations in appropriate conditions
- Use low toxicity and biodegradable materials
- Design devices for minimum maintenance
- Undertake in depth risk assessments and contingency planning
- Utilise device specific mitigation once devices are known

- Have cleanup plans in place for release of all forms of contaminants ranging from wood to hydrocarbons.

Erosion of Sacrificial Anodes

- Minimise use of sacrificial anodes

Release of Antifouling Compounds

- Use non-biocide based antifoulants (enforceable through the licence)
- Minimise use of antifoulants

Changes in Sediment Dynamics

- Position deployments in areas of low sediment loads
- Undertake in depth hydrodynamic studies prior to installation

Collisions between Boats and devices

- Good navigational aids around arrays
- Ensure charts are fully updated with locations prior to beginning of work
- Identify shipping lanes

6.7 Confidence and Knowledge Gaps

Baseline water quality in the REA area have only be studied at beach level for quality based on coliform presence and for radioactive particles. This means that there is not sufficient data on the quality of water with regards to chemical constituents of the water. There is also no offshore readings taken at any point for water quality and this is creates a large data gap.

There are also no sediment samples taken and the naturally occurring seabed types have not been identified since the 1970's at the most recent. The location of the sewage outfall is of course well known and the dispersion is thought to be well known. This should enable reasonable confidence on where contaminated sediments would be, however this would only be from sewage contamination. Overall the confidence in the offshore baseline environment would be low.

There are also uncertainties relating to the potential of release of contaminants as that depends on the methods and materials to be used, and so is highly project specific. The potential for changes in sediment dynamics and increased sedimentation around devices would also be project specific, due to the different effects the different devices may have.

6.8 Residual Effects

Table 6.9.1 – Potential residual effects following mitigation

Potential Effect	Device Characteristic	Development phase	Receptor	Significance of effects	Mitigation	Likelihood of Occurrence	Residual Significance	Confidence
Disturbance of natural sediments	All devices and cables	Installation Operation Decommissioning	Water Quality, Shellfishing waters	Minor	Minimise dredging Use Cable and devices installation methods that minimise sediment disturbance Carry out work in appropriate tidal conditions	Moderate	Minor to None	High
Release of additional sediment during construction	Fixing of devices to the seabed and cabling	Installation Operation Decommissioning	Water Quality, Shellfishing waters	Minor	Minimise depth of piling/drilling Avoid trenching for cabling where possible	Moderate	Minor to None	High
Release of contaminants during construction	Fixing of devices to the seabed and cabling	Installation Decommissioning	Water Quality Human Health Flora and Fauna Human Environment	None – Moderate (depending on release)	Use low/non toxic materials Minimise contact of toxic materials with water Minimise quantity of toxic materials used Have cleanup plans in place	Low	None – Major (depending on contaminant)	Moderate

Potential Effect	Device Characteristic	Development phase	Receptor	Significance of effects	Mitigation	Likelihood of Occurrence	Residual Significance	Confidence
Disturbance of contaminated sediments	Fixing of devices to the seabed and cabling	Installation, Operation, Decommissioning	Water Quality, Shellfishing waters, Bathing waters	Moderate	Avoid infrastructure within areas of known or suspected sediment contamination Use Cable and devices installation methods that minimise sediment disturbance	Low	Moderate	Moderate
Accidental release of contaminants	Devices and cables	Installation Operation Decommissioning	Water Quality, Shellfishing waters, Bathing waters Human Health Flora and Fauna Human Environment Operation of other devices	Moderate	Design devices for minimum risk. Carry out activities in appropriate conditions	Moderate	None – Major (depending on contaminant)	Low
Erosion of sacrificial anodes	Devices using sacrificial anodes	Operation	Water Quality	None	Minimise use of sacrificial anodes	High	None	High
Anti fouling compound release	Devices using Biocidal antifouling	Operation	Water Quality Flora and Fauna	Minor	Use low/non toxic materials as part of licence	Low	None	High
Changes in sediment dynamics	All devices	Operation	Water Quality	Unknown	Modelling and Surveying of areas to inform site selection	Unknown	Unknown	Low
Collisions between boats and devices	Devices and Boats	Operation Maintenance Decommissioning	Water Quality, Shellfishing waters, Bathing waters Human Health Flora and Fauna Human Environment Operation of other devices	Moderate	Good navigation Aids Updated charts	Low	Moderate	Moderate

6.9 Recommendations for Survey and Monitoring

Generally there is little understanding of the effects of wave and tidal device deployment on water and sediment quality, especially on array scale. Therefore when possible there needs to be monitoring of specific devices and their effects on sediment dynamics. This would fall to the developers to undertake as part of their ongoing assessments of how their devices work and would form part of their environmental impact assessment when applying for a licence.

In order to inform the baseline environment there needs to be monitoring of sediment and waters away from the beaches. This needs to be performed prior to developments being given consent and should fall to GREC to undertake in order to get an overarching view of the environment. As well as this baseline monitoring there needs to be operational monitoring in order to ensure that there are no adverse effects occurring, and to respond when they do arise. This would be undertaken by the developer both during and post deployment as part of their licence.