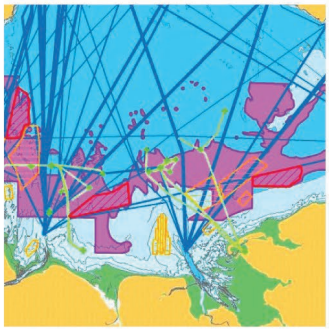
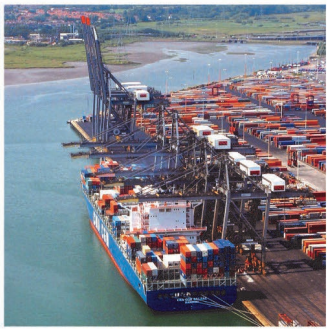
EDF Energy

Torness Seaweed Removal

Environmental Appraisal

September 2019



Innovative Thinking - Sustainable Solutions

ABP mer

Page intentionally left blank

Torness Seaweed Removal

Environmental Appraisal

September 2019

Source: Google Maps. Imagery ©2019 Getmapping plc, Maxar Technologies,
Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Map data ©2019

Document Information

Document History and Authorisation		
Title	Torness Seaweed Removal	
	Environmental Appraisal	
Commissioned by	EDF Energy	
Issue date	September 2019	
Document ref	R.3103	
Project no	R/4673/3	
Date	**Version**	**Revision Details**
02/09/2019	1	Issued for client review
16/09/2019	2	Issued for client use

Prepared (PM)	Approved (QM)	Authorised (PD)
David Honey	Natalie Frost	Stephen Hull

[Redacted]

Suggested Citation

ABPmer, (2019). Torness Seaweed Removal, Environmental Appraisal, ABPmer Report No. R.3103. A report produced by ABPmer for EDF Energy, September 2019.

Notice

ABPmer
Quayside Suite, Medina Chambers, Town Quay, Southampton, Hampshire SO14 2AQ
T: +44 (0) 2380 711844 W: http://www.abpmer.co.uk/

Contents

Appendices

Tables

Figures

1 Introduction

Torness Power Station (TOR), owned and operated by EDF Energy, is located on the east coast of Scotland in the outer Firth of Forth near Dunbar, East Lothian (Figure 1). The station utilises seawater as a source of cooling water for plant systems. The cooling water enters the station by passing through coarse screens located at the cooling water intake, used to remove large debris, followed by rotating drum screens to remove finer material.

On several occasions in recent years, typically during and/or following a storm event coinciding with particular environmental conditions (e.g. wind direction, tidal state), large volumes of seaweed have become entrained on the drum screens. This can present operational challenges to the station due to the restriction on rates of cooling water abstraction. Large volumes of seaweed ingress have previously caused physical damage to the drum screens and/or resulted in the reduction in energy generation of one or both reactors. In extreme cases, seaweed ingress has resulted in the complete shut-down of the reactor(s).

As an option to manage its risk from seaweed ingress, TOR is applying for a marine licence to remove seaweed adjacent to its cooling water intake. While it is considered that the proposed works do not require a formal environmental impact assessment (EIA), ABPmer was commissioned by EDF Energy to prepare an environmental appraisal to provide the relevant information on potential environmental issues in support of the marine licence application.

The environmental appraisal has been structured as follows:

Section 2: **Project Description** presents details of the proposed works;

Section 3: **Consenting Framework** outlines the environmental legislation and policy against which the proposed works have been assessed;

Section 4: **Impact Appraisal** reviews the potential effects of the proposed works on relevant environmental receptors; and

Section 5: **Conclusions** presents a summary of the environmental appraisal.

In addition, the following appendices are provided to support the environmental appraisal:

Appendix A: **Habitats Regulations Appraisal (HRA)** to review the potential effects of the proposed works on designated features of European/Ramsar sites;

Appendix B: **Water Framework Directive (WFD) Compliance Assessment** to consider potential impacts to ecological and chemical parameters of nearby water bodies; and

Appendix C: Provides a copy of **Scottish Natural Heritage (SNH) Pre-Application Advice**.

Figure 1. Location of TOR cooling water intake and outfall

2 Project Description

2.1 Project rationale

TOR uses seawater as a source of cooling water for plant systems, discarding waste heat from power generated by the station. The seawater enters the station by passing through coarse screens, located at the cooling water intake within Skateraw Harbour, to remove large marine debris. The cooling water then passes through large rotating drum screens to remove finer material from the seawater. The material entrained by the drum screens is removed and collected in trash baskets for disposal through appropriate waste streams.

The main reason for screening cooling water is to protect the downstream equipment, such as the pump(s) required to move the water through the cooling water system and condenser tubes used to transfer heat to the cooling water (Environment Agency, 2010). Ingress of marine debris (including seaweed) can lead to blockages of these components, resulting in changes to the available hydraulic head, increased pumping energy requirements and, depending on the scale of the blockage, a reduced flow of cooling water requiring the station to reduce energy generation. On a number of occasions, ingress of large volumes of seaweed has resulted in the manual or automatic shutdown of one or both reactors at TOR, most recently in March 2018.

EDF Energy is actively seeking to manage the station's risk, with the aim of protecting the cooling water intake system from significant seaweed ingress events. Therefore, EDF Energy is applying for a marine licence to remove seaweed from the seabed adjacent to the station's cooling water intake as a pragmatic approach to managing operational risk. There is precedent for this type of approach at Hunterston B Power Station (HNB) located on the west coast of Scotland (also owned and operated by EDF Energy). EDF Energy was granted a one-year Marine Licence (06426/17/0; valid from 28 August 2017 to 27 August 2018) by Marine Scotland to remove up to 150 tonnes of seaweed from an area in front of the HNB cooling water intake (ABPmer, 2017). This was recently followed by another one-year Marine Licence (06954/19/0; valid from 17 May 2019 to 16 May 2020). While it is recognised that TOR presents a markedly different setting and array of sensitive receptors and species compared to HNB, the objectives of the proposed activity are the same.

2.2 Proposed activity

EDF Energy is proposing to remove seaweed from an area in the vicinity of the TOR cooling water intake, as shown in Figure 2. Coordinates for the area, referred to as the proposed seaweed management zone, are provided in Table 1, with the landward boundary following the mean low water mark between points A and D. The total area of the proposed seaweed management zone is approximately 1.29 km^2.

Table 1. Coordinates of proposed seaweed management zone at TOR

Point (see Figure 2)	Coordinates (WGS84; Decimal Degrees)	
	Latitude	Longitude
A	55.979810	-2.430195
B	55.985423	-2.421389
C	55.974630	-2.399370
D	55.972042	-2.403405

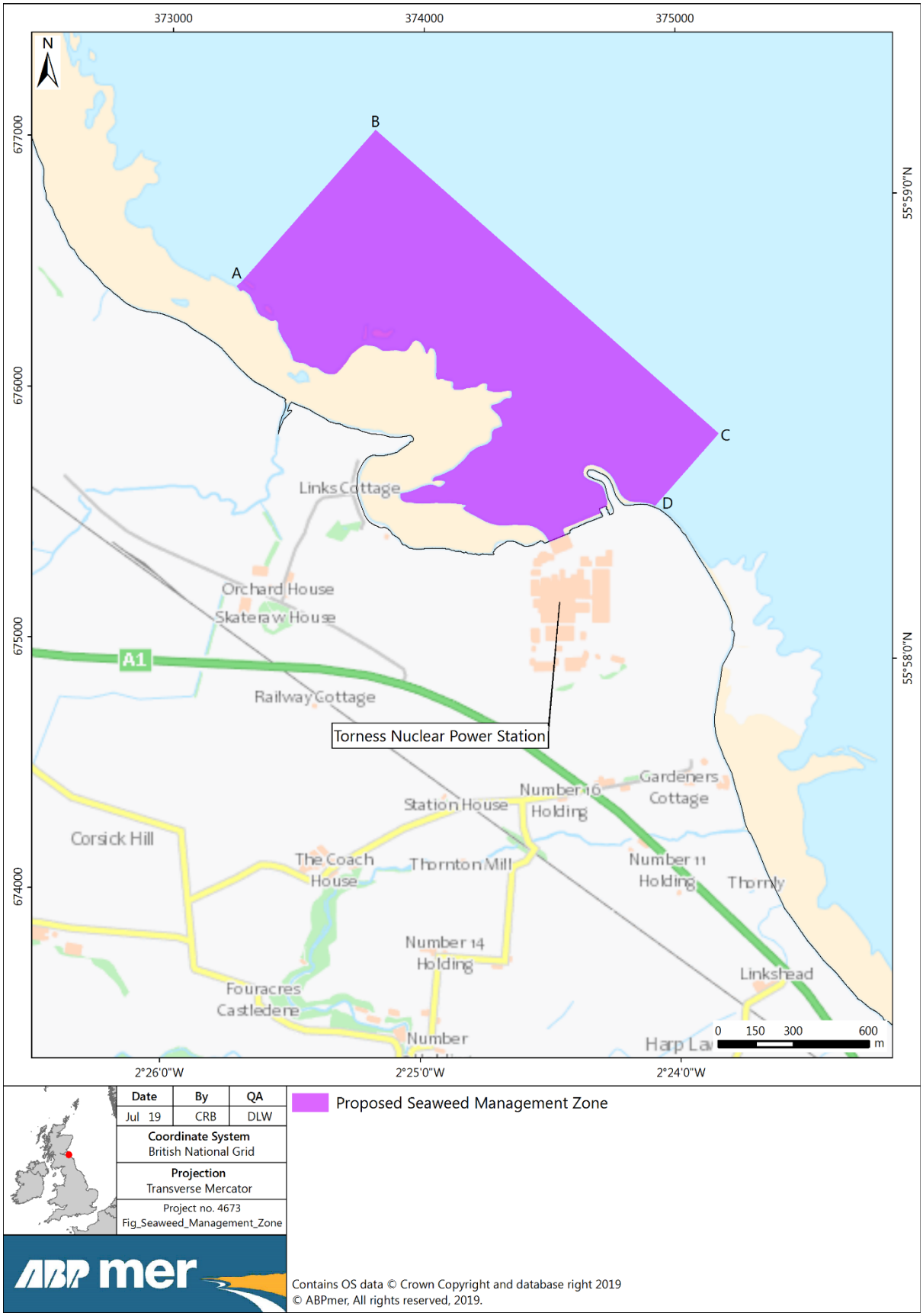
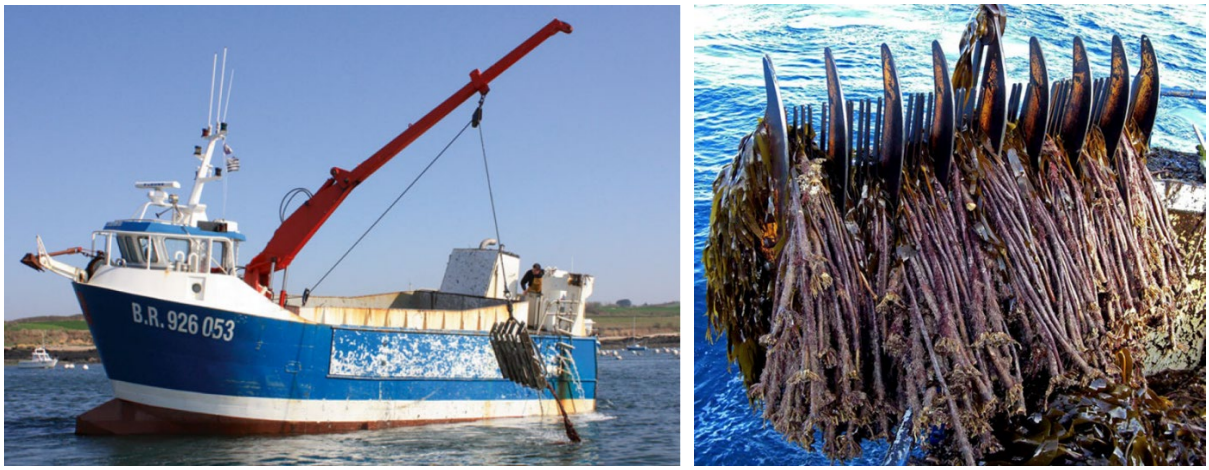


Figure 2. Location of proposed seaweed management zone at TOR

In September 2014, a drop-down video survey found that one of the most common seaweed species in shallow subtidal areas near to the TOR cooling water intake is cuvie kelp (*Laminaria hyperborea*; Envision Mapping, 2014). EDF Energy is proposing to target this species for removal from the proposed seaweed management zone using a Norwegian-style kelp rake (e.g. Figure 3). The Norwegian-style kelp rake comprises a comb-like harvesting head (2 – 4 m wide) that is situated within a curved frame. It is deployed from a vessel and trawled through the kelp bed (approximately 0.5 m above the seabed) at a speed of around 3 knots (1.5 m/s). Trawls are made for approximately 2 minutes, covering a distance of around 200 m before the head is recovered.



Sources: Steen *et al.* 2014; Frangoudes and Garineaud, 2015

Figure 3. Example images of a Norwegian-style kelp rake

Assuming a biomass of between 1 and 5 kg/m^2 throughout the proposed seaweed management zone (e.g. Jupp and Drew, 1974; Beavis and Charlier, 1987; Sjøtun and Fredriksen, 1995; Pehlke and Bartsch, 2008; Burrows *et al*. 2018), it is estimated that over 1,000 tonnes (wet weight) of *L. hyperborea* (among other seaweeds) could be present. However, it is recognised that the distribution of *L. hyperborea* is likely to be patchy. Therefore, the marine licence application is requesting permissions to remove up to 150 tonnes (wet weight) of seaweed per campaign from within the proposed seaweed management zone, with up to two campaigns to be undertaken per annum. EDF Energy is applying for a two-year marine licence period, during which up to four campaigns could be undertaken and thus up to 600 tonnes (wet weight) of seaweed potentially removed from the proposed seaweed management zone.

Previous studies on the efficiency of Norwegian style harvesting rakes indicates that a proportion of the kelp (e.g. small/juvenile plants) will remain *in situ* following passage of the rake. Therefore, the effect of the proposed removal operations at TOR will be to reduce the density of the kelp beds rather than completely remove them. Kelp removal will be undertaken as targeted campaigns, with each removal campaign estimated to last between 2 – 4 weeks depending on the vessel used and the location where material is brought to land for disposal. Campaigns will be undertaken at any time of year during the marine licence period; however, there will be a minimum three-month gap between consecutive campaigns.

The key driver for this removal is to manage the risk from seaweed ingress (see Section 2.1). The aim is not to promote recovery of kelp habitat for ongoing/routine harvesting, but instead to reduce the potential for seaweed material to be dislodged from the seabed and become entrained within the station's cooling water intake. Therefore, following initial removal campaigns, EDF Energy anticipates the need for continued removal campaigns following regrowth of the kelp, although this would be subject to further licensing applications.

Seaweed collected during the proposed removals activity will be stored on the vessel once recovered and taken to land. Depending on the vessel used, material will either be bagged at the point of collection, placed into skips or stored in a hopper. Upon landing, the seaweed will be managed in accordance with waste management legislation and policy. Where feasible, material will be composted or used for energy recovery in preference to landfill. No material will be disposed of at sea, recognising the key objective of the proposed activity to manage the station's risk from seaweed ingress at the cooling water intake.

2.3 Consultation

Scottish Natural Heritage (SNH) was consulted during the pre-application stage to discuss the proposed activity and identify any key areas of concern regarding natural heritage/environmental receptors. The consultation with SNH included early advice by email and a teleconference involving SNH, EDF Energy and ABPmer (31 May 2019), followed by a letter from SNH to formalise its advice (Ref: A297574; 12 June 2019; Appendix C).

During the consultation, an initial removal area of 0.85 km^2 was considered, while a maximum removal of 150 (wet tonnes) was anticipated based on the HNB marine licence. However, as noted in Section 2.2, the proposed seaweed management zone is slightly larger at 1.29 km^2 and up to 300 tonnes (wet weight) of seaweed is proposed for removal per annum (based on two campaigns per annum) over a two-year marine licence period (thus, up to 600 tonnes total). Nevertheless, it is considered that the advice provided by SNH remains applicable, with this appraisal reflecting the anticipated scale of environmental effects.

The SNH advice suggested the main receptors that will need to be assessed in detail are:

- *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp) – a Priority Marine Feature (PMF); and
- Outer Firth of Forth and St Andrews Bay Complex proposed Special Protection Area (pSPA).

In addition, the letter provided further advice on the range of possible receptors, such as invasive non-native species (INNS) and biosecurity, marine mammals, the Barns Ness Coast Site of Special Scientific Interest (SSSI) and the Firth of Forth Banks Complex Nature Conservation Marine Protected Area (MPA). Potential impacts to these receptors are discussed in Section 4.

It is acknowledged that the abundance and distribution of seaweeds within the proposed seaweed management zone, specifically *L. hyperborea*, is based on drop-down video footage collected in September 2014. Several years have elapsed since this baseline survey was completed and the dynamic nature and inter-annual variation of seaweed habitats means that the 2014 data may not be representative of the current seaweed composition, distribution, abundance and density. Therefore, it is proposed to undertake pre- and post-monitoring (drop-down video) surveys for each removal campaign as a condition should this marine licence application be successful. This approach was agreed with SNH and will help to demonstrate the effectiveness of the removal technique used. It will also support targeted removals from areas of increased kelp abundance/density within the proposed seaweed management zone.

3 Consenting Framework

The following sections outline the consenting framework against which the proposed works have been assessed.

3.1 Marine Licence under the Marine (Scotland) Act 2010

Under the Marine (Scotland) Act 2010, Scottish Ministers are responsible for the marine licensing system and enforcement in the Scottish inshore region from 0 – 12 nautical miles (nm)[1]. The licensing regime allows regulation of the deposit and removal of substances and objects in the seas around Scotland. Activities must take place in accordance with licence conditions. The removal of wild seaweed constitutes 'removal of substances/objects from the seabed' and thus the proposed works at TOR would require a marine licence (Marine Scotland, 2015).

In considering an application for a marine licence, the Marine Scotland Licensing Operations Team (MS-LOT) will, as part of the process, take into account Government policy statements and guidance including the United Kingdom (UK) Marine Policy Statement (HM Government, 2011) and Scotland's National Marine Plan (The Scottish Government, 2015). As part of the determination process, Marine Scotland will also take account of and give consideration to the need for the following:

- Environmental Impact Assessment (EIA);
- Habitats Regulations Appraisal (HRA);
- Water Framework Directive (WFD) Assessment;
- Nature Conservation Marine Protected Area (MPA) Assessment; and
- Marine Strategy Framework Directive (MSFD).

The following sections summarise each of the above and considers whether they are likely to be required to support the marine licence application for the proposed works.

3.1.1 Environmental Impact Assessment

The Environmental Impact Assessment Directive (2011/92/EU; as amended) sets out the procedure that must be followed before approval is granted for a range of plans and projects, defined in Annexes I and II of the Directive. Annex I projects are considered to have significant effects on the environment and EIA is mandatory. The potential for significant effects on the environment as a result of Annex II projects, and thus whether an EIA is required, however, is at the discretion of the Competent Authority, in this case Marine Scotland, having regard to criteria set out in Annex III of the Directive.

Wild seaweed removal is not identified under either Annex I or Annex II of the Directive. Therefore, a formal EIA is not required. However, this environmental appraisal has been prepared to provide the relevant information on potential environmental issues in support of the marine licence application.

[1] Inshore waters refer to those waters within 12 nm of the territorial baseline, while offshore waters refer to those waters beyond 12 nm within the seaward limits of the territorial sea adjacent to the UK, in this case both in relation to the "Scottish marine area" as defined by the Marine (Scotland) Act 2010.

3.1.2 Habitats Regulations Appraisal (HRA)

Where a project is located close to, or within, an area designated or proposed under the Birds Directive[2] and/or Habitats Directive[3] (European sites) and/or the Ramsar Convention[4] (Ramsar sites), the requirements of The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the Habitats Regulations) apply. In essence, this requires the lead Competent Authority, in this case Marine Scotland, to determine whether the proposed works are likely to have a significant effect on a European/Ramsar site and, if so, to undertake an Appropriate Assessment (AA) of the implications of the proposals in the light of the site's conservation objectives.

The nearest designated European/Ramsar sites to the proposed works are the Firth of Forth Special Protection Area (SPA) and Ramsar, located approximately 5 km to the northwest, while the boundary of the Outer Firth of Forth and St Andrews Bay Complex proposed SPA (pSPA) directly overlaps the proposed seaweed management zone at TOR. Based on pre-application advice from SNH (see Section 2.3), the kelp habitat within the proposed seaweed management zone may be used to some extent by some protected bird species for foraging. Therefore, the HRA process applies, and the information required to inform an AA has been provided in Appendix A.

3.1.3 Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EEC) establishes a framework for the management and protection of Europe's water resources. It is implemented in Scotland through the Water Environment and Water Services (Scotland) Act 2003 and the Water Environment (Controlled Activities) (Scotland) Regulations 2011, more commonly known as the Controlled Activity Regulations (CAR). The overall objective of the WFD is to achieve "good ecological and good chemical status" in all inland and coastal waters. The initial deadline to meet this objective was 2015; however, in cases where it was not possible to do so due to disproportionate expense, natural conditions or technical feasibility, the deadline to achieve "good ecological and good chemical status" is extended to 2027.

The proposed seaweed management zone is located within the Barns Ness to Wheat Stack coastal water body (ID: 200038). It is necessary to consider whether the proposed works at TOR might compromise achievement of WFD objectives for this and/or adjacent water bodies and, therefore, a WFD compliance assessment is presented in Appendix B.

3.1.4 Nature Conservation Marine Protected Area (MPA) assessment

The Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009 provide for the designation of Nature Conservation Marine Protected Areas (MPAs) in Scottish waters to protect features considered to be of national importance (habitats and species). In 2014, 30 Nature Conservation MPAs were designated covering both Scottish inshore and offshore waters. Under Section 83 of the Marine (Scotland) Act 2010 and Section 126 of the Marine and Coastal Access Act 2009, when considering granting a marine licence, Marine Scotland is required to take account of potential impacts to Nature Conservation MPA protected features.

The Firth of Forth Banks Complex Nature Conservation MPA is located approximately 34 km to the north of the proposed seaweed management zone, designated due to a diversity of habitats and species including ocean quahog aggregations, offshore sands and gravels and shelf banks and mounds (Joint Nature Conservation Committee (JNCC), 2018). Given the location, scale and nature of the proposed

[2] Council Directive 2009/147/EC on the Conservation of Wild Birds.

[3] Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna.

[4] Ramsar Convention on Wetlands – Conservation on Wetlands of International Importance, especially on Waterfowl Habitat.

activity, there are no predicted impacts (direct or indirect) on the features of this MPA and, therefore, a Nature Conservation MPA assessment has not been prepared. However, nature conservation designations are discussed in Section 4.3.

3.1.5 Marine Strategy Framework Directive (MSFD)

The aim of the Marine Strategy Framework Directive (MSFD) (2008/56/EC) is to protect more effectively the marine environment across Europe. It aims to achieve good environmental status of marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The MSFD constitutes the vital environmental component of future maritime policy, designed to achieve the full economic potential of oceans and seas in harmony with the marine environment. It establishes European Marine Regions on the basis of geographical and environmental criteria. Each Member State is required to develop strategies for its marine waters.

The MSFD applies to the landward boundary of coastal waters as defined under the WFD (i.e. from mean high water springs; MHWS) to the outer limit of the UK Exclusive Economic Zone (EEZ), as well as the area of UK continental shelf beyond the EEZ. Reporting against the MSFD is a cyclical process, and updated assessments and Marine Strategy documents are anticipated in due course. The anticipated pressures exerted on the marine environment by the proposed works at TOR are considered to be of such a small magnitude in the context of UK Marine Regions that they are unlikely to be a significant issue. The MSFD is therefore not considered further in this report.

3.2 Site of Special Scientific Interest (SSSI) consent

The Barns Ness Coast Site of Special Scientific Interest (SSSI) includes the intertidal zone and terrestrial semi-natural habitats immediately adjacent to the proposed seaweed management zone (no direct overlap). The intertidal zone is designated for its hard rock geodiversity (Lower Carboniferous). SNH has indicated through pre-application consultation (see Section 2.3) that no adverse effects are anticipated from the proposed seaweed removal activities on any of the designated features of this site. Therefore, it is not considered necessary to apply to SNH for permissions to undertake the proposed activities in relation to the Barns Ness Coast SSSI[5].

3.3 Seabed ownership

The ownership of Scotland's territorial seabed, which extends out to 12 nm from the coastline, is vested in the Crown in Scottish law. Nearly all of this area is owned by the Crown, with limited exceptions to this where the Crown has granted out the ownership historically or, more recently, sold it. These areas include, for example, some statutory harbour authorities which own some or all the seabed within their harbours or areas acquired for infrastructure developments. The Crown also still owns around 50% of Scotland's foreshore, defined in Scottish law as the area of shore between MHWS and Mean Low Water Springs (MLWS) (Scottish Government, 2014). The subtidal seabed within the proposed seaweed management zone is owned by Crown Estate Scotland. Therefore, a lease agreement from Crown Estate Scotland to undertake the proposed seaweed removals activity will be required.

Clause 15 of the Scottish Crown Estate Act 2019 (Restriction on removal of wild kelp from seabed) restricts the ability to harvest wild kelp on any land (seabed) owned by Crown Estate Scotland in specific circumstances. The Clause states:

[5] https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/national-designations/sites-special-scientific-interest (Accessed September 2019).

"(1) The manager of a Scottish Crown Estate asset must not grant a right to remove wild kelp from the seabed (that is, the bed and subsoil of the sea within the Scottish marine area) if either subsection (2) or (3) applies.

(2) This subsection applies if –

(a) removal of the kelp would inhibit the regrowth of the individual plant, and
(b) the kelp removed is intended for commercial use.

(3) This subsection applies if –

(a) removal of the wild kelp is a licensable marine activity, and
(b) the Scottish Ministers have not granted a marine licence for that removal."

In relation to the proposed seaweed removals at TOR (subtidal), it is understood that Clause 15 would not affect or hinder any marine licence application. Subsection (2) would not be triggered as the removal is not intended for '*commercial use*' and, assuming a marine licence is granted by MS-LOT, Subsection (3) would also not be triggered.

Alongside this interpretation of Clause 15, during the Stage 3 amendment debate on the Scottish Crown Estate Bill (now the Scottish Crown Estate Act 2019), Roseanna Cunningham (Cabinet Secretary for Environment, Climate Change and Land Reform in Scotland) noted that the clause was to be included to prevent a restriction on non-commercial but essential maintenance work for safety reasons. This specifically includes the removal of seaweed around cooling water systems at coastal power stations (referring to the recent marine licence acquired by HNB) or from navigation channels in ports. This clarification demonstrates that seaweed removal from within any area of seabed owned by the Crown Estate Scotland to support cooling water operations would not be precluded by Crown Estate Scotland subject to a successful marine licence application.

4 Impact Appraisal

4.1 Scope and assessment methodology

4.1.1 Scope of appraisal

There is limited potential for environmental effects to arise from seaweed removal activity at TOR given the scale and nature of the proposed works. Therefore, only the following environmental receptors have been scoped into the appraisal:

- Physical processes (Section 4.2);
- Water and sediment quality (Section 4.3);
- Nature conservation (Section 4.4); and
- Marine ecology (Section 4.5).

The above environmental receptors are discussed in the following sections (along with potential cumulative/in-combination effects; Section 4.6), while Table 2 summarises environmental receptors which have been scoped out of further consideration, including a justification.

Table 2. Receptors scoped out of the appraisal

Receptor	Justification
Terrestrial ecology	The landward boundary of the proposed seaweed management zone is the mean low water mark (Figure 2) and, therefore, there is no direct overlap with the terrestrial environment. It is recognised that there may be a reduction in beach cast seaweed and associated impacts to strandline communities in the upper foreshore between the intertidal zone and terrestrial environment. However, kelp is only one component of the seaweed assemblage in the vicinity of TOR and thus there will continue to be a supply of seaweed to strandline communities, albeit at a reduced level. Therefore, it is considered unlikely that seaweed removals would result in a significant impact to terrestrial ecology receptors and, therefore, has been scoped out of this appraisal.
Commercial and recreational fisheries	The proposed seaweed management zone is not considered to be a key commercial or recreational fishing ground and the spatial extent of disturbance is negligible in the context of wider fishing grounds in the area. It is recognised that seaweed (kelp) habitat could provide nursery habitat to commercial and recreational fish species, but the proposed activity is over a relatively small spatial extent with large expanses of similar habitat available in the wider Firth of Forth. Potential impacts to fish receptors are considered as part of the marine ecology receptor (Section 4.5) and, therefore, commercial and recreational fisheries has been scoped out of this appraisal.
Commercial and recreational navigation	The proposed activity will involve the movement of a single vessel in the vicinity of TOR, transiting to/from a nearby landing port and completing relatively slow transects within the proposed seaweed management zone over a number of weeks per year. Given the minimal vessel activity currently observed in these waters, the proposed activity is highly unlikely to restrict vessel movements in the context of the wider setting. Nevertheless, a Notice to Mariners will be published through the appropriate authority prior to commencement of the works, if required. Therefore, commercial and recreational navigation has been scoped out of this appraisal.

Receptor	Justification
Cultural heritage and archaeology	There are no known cultural heritage features within the proposed seaweed management zone and the proposed activity is unlikely to result in significant impacts to the coast. Should archaeological features be observed (recovered) during the proposed activity, works will cease immediately, and the appropriate authority contacted. Therefore, cultural heritage has been scoped out of this appraisal.
Landscape, seascape and visual amenity	The proposed activity will effectively result in the presence of a vessel in the vicinity of TOR, with no permanent changes made to the aesthetics of the site (above the waterline). The relatively low number of human receptors in proximity to the site will not result in any significant effects on landscape, seascape and visual amenity and, therefore, this receptor has been scoped out of the appraisal.

4.1.2 Impact assessment methodology

To facilitate the environmental appraisal process, ABPmer has applied a standard analysis methodology. This framework has been developed from a range of sources, including the EIA Directive (2011/92/EU; as amended), EIA Regulations (applicable to Scotland), statutory guidance, consultations and ABPmer's previous (extensive) EIA project experience. Furthermore, reference has been made to the Charted Institute of Ecology and Environmental Management's (CIEEM) latest guidelines for ecological impact assessment in the UK and Ireland (which combines advice for terrestrial, freshwater and coastal environments) (CIEEM, 2018). ABPmer is a registrant of the Institute of Environmental Management and Assessment (IEMA) EIA Quality Mark Scheme.

For this environmental appraisal, all environmental topics are divided into distinct 'receiving environments' or 'receptors' (scope outlined in Section 4.1). The effect of the proposed works on each of these is assessed by describing the baseline environmental conditions of each receptor, the 'impact pathways' by which the receptors could be affected, the significance of the impacts occurring, and the measures proposed to mitigate significant adverse impacts (where these are predicted). This Impact Assessment Framework, which is presented in the following sections, is designed to incorporate the key criteria and considerations without being overly prescriptive.

Stage 1 - Identify receptors and changes

The first stage involves identifying the potential environmental changes resulting from a proposed project and the receptors that are likely to be affected.

Stage 2 - Understand change and sensitivity

The second stage involves understanding the nature of the environmental changes to provide a benchmark against which the changes and levels of exposure can be compared. The scale of the impacts via the impact pathways depends upon a range of factors, including the following:

- Spatial extent (small/large scale);
- Duration (short/intermediate/long-term);
- Frequency (continuous/intermittent/temporary);
- Reversibility;
- Probability of occurrence;
- Confidence, or certainty, in the impact prediction;
- The margins by which set values are exceeded (e.g. water quality standards);

- The importance of the receptor (e.g. designated habitats and protected species);
- The sensitivity of the receptor (resistance/adaptability/recoverability);
- The baseline conditions of the system; and
- Existing long-term trends and natural variability.

Stage 3 - Impact assessment/appraisal

The likelihood of a receptor being vulnerable to an impact pathway is then evaluated as a basis for assessing the level of the impact and its significance. The tables and matrices below (Table 3 to Table 7) are used to help assess significance which is evaluated in the context of the available evidence base and through the application of expert judgement.

The key significance levels for either beneficial or adverse impacts are described as follows:

- **Insignificant**: Neutral change not having a discernible effect;
- **Minor**: Effects that are discernible but tolerable (and not of a significance level that would require mitigation);
- **Moderate**: Effects that are of a local to regional nature, of medium to long-term duration and/or where effects are anticipated to potentially be above accepted guidelines/standards. Where these changes are adverse, they may require mitigation; or
- **Major**: Acute effect on a national or international scale, of long-term or permanent duration, and clearly above accepted guidelines or standards (or indeed against best practice policy, or even illegal in nature). Where these changes are adverse, they will require mitigation.

The matrices in Table 3 to Table 7 are used to help assess significance (see below).

Identification and estimation of exposure to change

Whether a receiving environment can be exposed to an impact or change depends on there being a route or pathway. The first step in order to determine the exposure to change is to consider the magnitude of change and the probability of occurrence.

The magnitude of change and its ability to affect a receptor in the context of the background environmental conditions in the study area depends on the following:

- Spatial extent - the spatial extent of a change is referred to using the terms 'immediate' (i.e. direct project footprint), 'local' and 'wide'; and
- Duration - the length of time a change operates can be described as being either a short or long-term. 'Short-term' changes are more likely to occur as a result of activities during the construction phase (which are temporary in nature), whilst 'long-term' is more likely to be relevant to the operational period.

Table 3 sets out the basic criteria which can be used to help determine the magnitude of an impact for the purposes of an impact assessment. Whilst these are basic criteria, not all changes can be defined. Expert judgement based on an understanding of the overall system is therefore required to moderate the assessment and ensure consistency across receptors.

The probability of occurrence is related to the frequency of the change in the context of the background environmental conditions in the study area. The ability for a change to be repeated is described by the terms 'infrequent', 'frequent' or 'continuous'.

The magnitude and probability of occurrence is combined to arrive at an exposure score which is then used in the next step of the assessment (Table 4). For example, an impact pathway with a medium magnitude of change and a high probability of occurrence would result in a medium exposure to change.

Table 3. Basic criteria for defining magnitude of impact

Magnitude	Definition
Large	Wide spatial extent with scale of change greater than the natural variability with a continuous signal extending into the long-term.
Medium	Local spatial extent with scale of impact within the same order as the natural variability, frequently occurring in the long-term; or Immediate spatial extent (development footprint) with scale of change greater than the natural variability, occurring frequently over a short timescale.
Small	Local spatial extent with scale of impact smaller than the natural variability, frequently occurring over a short/temporary timescale.
Negligible	Immediate spatial extent, with scale of impact smaller than the natural variability, occurring infrequently over a short/temporary timescale.

Table 4. Exposure to change, combining magnitude and probability of occurrence

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

Vulnerability of receptor

Whether a receiving environment is vulnerable to an impact or change depends on the sensitivity of the receptor and the exposure to change (determined in the preceding step). This step essentially provides a benchmark against which the exposure to change can be compared.

An effect can only occur if a receptor is exposed to a change to which it is sensitive. Sensitivity can be described as the intolerance of a receptor to readily accept the levels of predicted environmental change to which they are exposed and essentially considers the response characteristics of the receptor. In this assessment, sensitivity is the degree of perturbation a receptor can tolerate in response to the predicted changes to which they are exposed. Thus, if a single or combination of environmental changes is likely to elicit a response, then the receptor under assessment is considered to be sensitive. In some cases, it may be applicable to compare the anticipated exposure to change against either baseline conditions or other relevant thresholds such as quality criteria (i.e. for water, light or noise). The sensitivity and exposure to change is combined to arrive at a vulnerability score which is then used in the next step of the assessment (Table 5).

Table 5. Estimation of vulnerability based on sensitivity and exposure to change

Sensitivity of Receptor	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

For example, if the impact pathway previously assessed with a medium exposure to change acted on a receptor which had a high sensitivity, this would result in a high vulnerability score. Where the receptor is not sensitive to any given exposure to change, then the vulnerability is scored as none. Similarly, where a negligible exposure is identified, vulnerability will always be none, no matter how sensitive the receptor is.

Significance of impact

The significance of an impact depends on the importance of the receptor and its vulnerability (determined in the preceding step). A receiving environment may have a high or a low vulnerability, but whether the potential effect is 'significant' will depend on its relative 'importance'. The importance of a receptor is based on its value and rarity (e.g. to either ecosystem or economy), such as the levels of protection it is afforded. For this step, Table 6 provides basic definitions for determining the importance of the receptor being assessed.

Table 6. Definition of receptor importance

Receptor Importance	Definition
High	Receptor designated and/or of international importance. Likely to be rare with minimal potential for substitution or unable to tolerate change. May also be of high or very high socio-economic importance.
Moderate	Receptor designated and/or of national importance and/or some ability to tolerate change and recover in the medium term. Likely to be relatively rare. May also be of high socio-economic importance.
Low	Receptor not designated but of local to regional importance and able to tolerate the effect to a large extent, with relatively rapid rate of recovery or not designated/of local importance but not tolerant to change.
Negligible	Receptor only of local importance with a high tolerance to change.

The vulnerability is then combined with the importance of the receptor using Table 7 to determine an initial level of significance. For example, a receptor with a high vulnerability and low importance would have an initial level of significance of minor. Estimating and categorising the significance of an effect, however, can also involve a degree of subjectivity and expert judgement.

Table 7. Estimation of significance based on vulnerability and importance

Importance of Receptor	Vulnerability of Receptor 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

Stage 4 - Impact management

The final stage is to identify any impacts that are found to be of moderate and/or major adverse significance and are considered to require mitigation measures to avoid or reduce residual impacts to environmentally acceptable levels, as far as possible. Within the assessment procedure, the use of mitigation measures will alter the risk of exposure and hence will require significance to be re-assessed and thus the residual impact identified.

4.2 Physical processes

TOR is located on the east coast of Scotland, southeast of Dunbar along the North Sea coast. The station's cooling water intake is located within Skateraw Harbour, while the cooling water outfall is to the east of the station outside of Skateraw Harbour (Figure 1). Water level data at TOR, based on levels at Dunbar (approximately 7 km northwest of TOR), is described on the United Kingdom Hydrographic Office (UKHO) Admiralty Chart 'Fife Ness to Saint Abb's Head' (Chart No. 175). These data are reproduced in Table 8 and show a spring and neap tidal range of 4.5 m and 2.2 m, respectively. The area immediately adjacent to the cooling water intake is relatively shallow, with water depths of 0 – 2 m Chart Datum (CD). This is largely the same throughout Skateraw Harbour, with some deeper waters adjacent to the breakwater and in the middle of the bay (approximately 2 – 8 m). Around the edge of Skateraw Harbour, particularly to the north, there is a large rocky intertidal area, extending in some areas up to 400 m from MHWS.

Table 8. Water level data (Dunbar) to northwest of the proposed seaweed management zone

Tidal Level		Chart Datum (CD) (m)	Ordnance Datum (Newlyn) (ODN) (m)
Mean High Water Springs	(MHWS)	5.2	2.4
Mean High Water Neaps	(MHWN)	4.2	1.4
Mean Low Water Springs	(MLWS)	0.7	-2.1
Mean Low Water Neaps	(MLWN)	2.0	-0.8

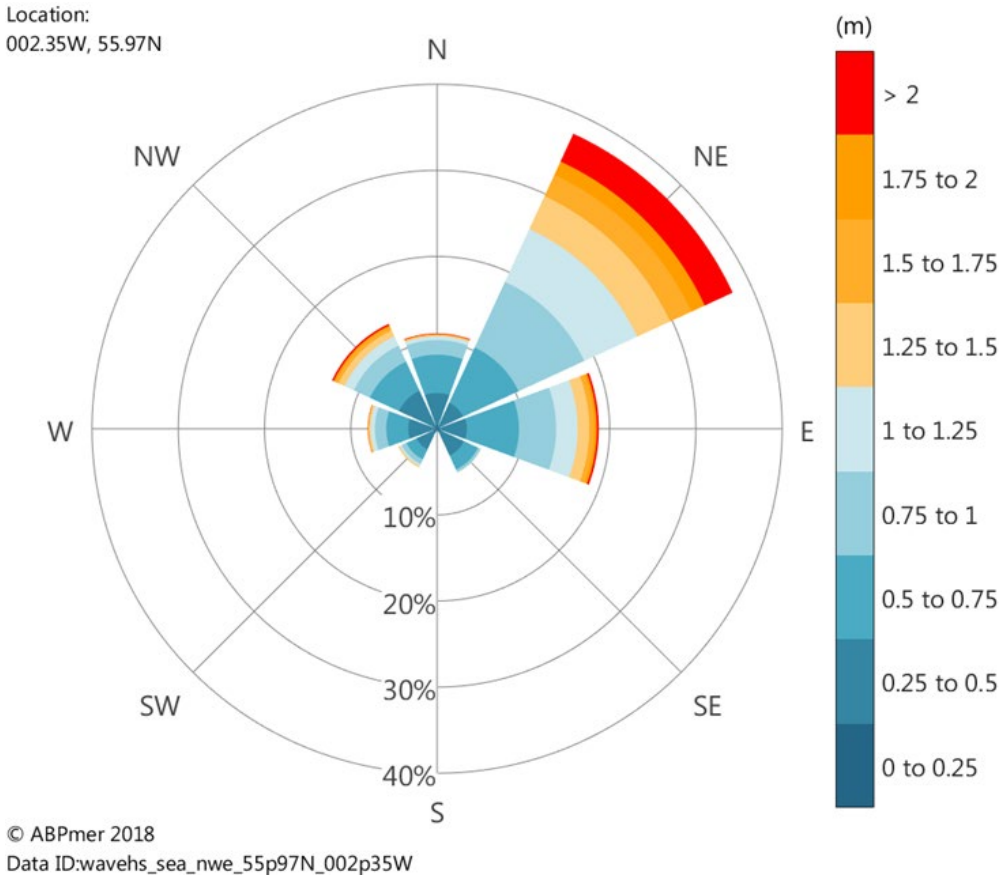
Source: UKHO Chart No. 175

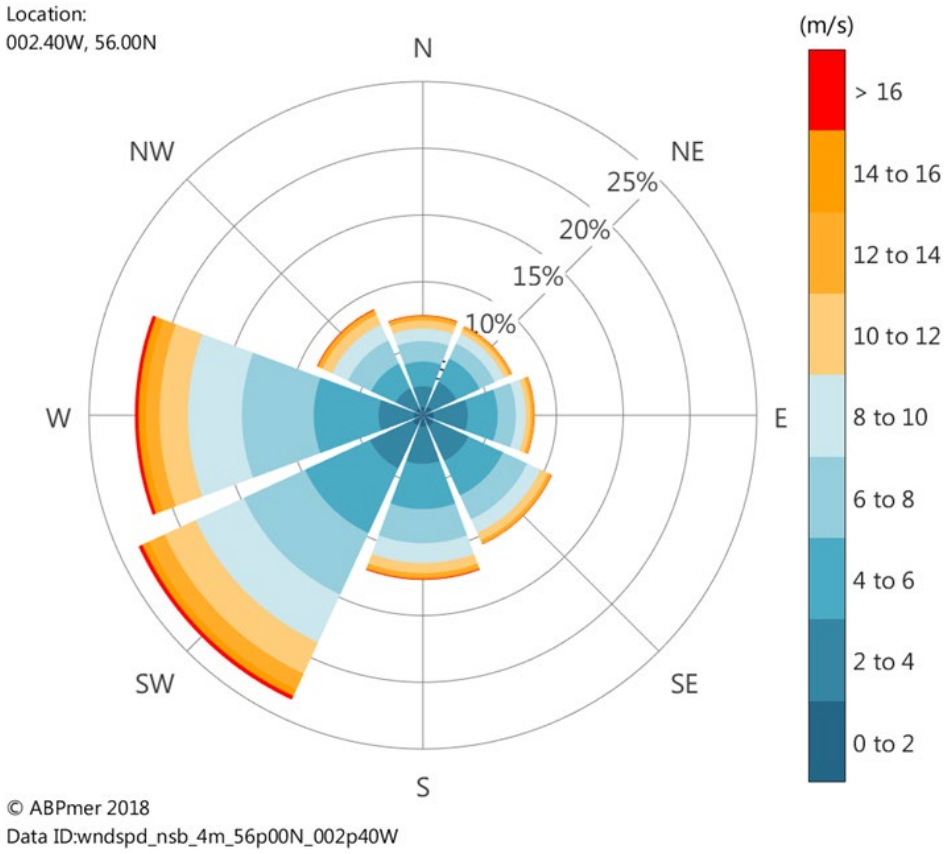
Tidal diamond C, approximately 16 km to the northwest of TOR, and Tidal Diamond G, approximately 17 km to the east of TOR, exhibit an approximate north-westerly flow during the flooding tide and an approximate south-easterly flow during the ebbing tide, following the coastal orientation of this section of the outer Firth of Forth. Maximum flow rates at both tidal diamonds are relatively low (up to 0.36 m/s on spring tides), albeit acknowledging these tidal diamonds are in waters greater than >40 m depth.

SEASTATES[6] is ABPmer's metocean information service which contains a high-resolution hindcast of hourly wave and wind conditions for the period 1979 to 2018 inclusive. Significant wave height and wind speed roses have been exported from SEASTATES from a location representative of the near-shore area to the proposed seaweed management zone at TOR (Figure 4). The mean wave height in the area is 0.9 m, predominantly from a northeast/east direction (>50%), while the mean wind speed is 6.4 m/s, largely blowing offshore from the west/southwest (>40%).

Laminaria hyperborea forests are known to provide a buffer against storm surges through wave dampening and by reducing the velocity of breaking waves (Løvås and Torum, 2001), with such habitats off the coast of Norway found to reduce wave heights by as much as 60%, resulting in wave energy losses of 70 – 80% (Mork, 1996). It is expected that *L. hyperborea* forests around Scotland provide a similar level of protection that is likely to be locally important to coastal communities (Smale *et al.* 2013). Therefore, the removal of seaweed, predominantly *L. hyperborea*, from the proposed seaweed management zone has the potential to increase wave energy reaching the adjacent shoreline. This, in turn, could lead to changes in the morphology of the intertidal area as a result of increased wave energy acting on the shoreline. The extent of wave dampening is strongly influenced by the morphology, and drag co-efficient, and density of the dominant kelp species; thus, the magnitude of protection provided varies with species, and therefore may also vary with location (Gaylord *et al.* 2007).

[6] https://www.seastates.net (Accessed September 2019).





Source: ABPmer Data Explorer https://www.seastates.net (Accessed September 2019)

Figure 4. Significant wave height (m; top) and wind speed (m/s; bottom) distribution by direction from model cell adjacent to TOR coastline

The breakwater to the east of Skateraw Harbour provides an element of sheltering to the bay; however, it is recognised that the prevailing wave direction is from the northeast and thus the TOR cooling water intake remains relatively exposed to the North Sea (hence the operational challenges through seaweed ingress which can develop during storm events). While it is recognised that there may be a small increase in wave action towards the cooling water intake (i.e. reducing wave attenuation through seaweed removals), the key objective of the proposed activity is to reduce seaweed ingress.

It is acknowledged that a proportion of seaweed entrained within the cooling water intake system at TOR is likely to originate from further afield than Skateraw Harbour, or the proposed seaweed management zone, but the proposed activity is considered a pragmatic approach to manage the station's operational risk. The abundance and density of *L. hyperborea* varies seasonally (see Section 4.5), with higher biomass present in the summer months and lower biomass present in winter/early spring due to removal by natural storm events in autumn and winter. Therefore, the wave attenuating effects of *L. hyperborea* would be expected to be reduced during the winter when more extreme and more frequent storm events will occur. It is thus considered that naturally occurring *L. hyperborea* will play a relatively limited role in wave attenuation.

The subtidal area is largely comprised of hard, rocky substrate and, therefore, morphology is unlikely to be impacted by any increased wave action through seaweed removals. In addition, given the rocky nature of the seabed, there will be minimal direct disturbance (abrasion), with the Norwegian-style kelp rake pulled through the water column at approximately 0.5 m above the seabed. Much of the shoreline (intertidal) adjacent to the proposed seaweed management zone comprises rocky shore, sands, boulders, cobbles and shingle habitat. Such shorelines will be relatively insensitive to changes in morphology in response to changes in wave energy and there will be no direct disturbance (abrasion).

Overall, the potential impact of seaweed (kelp) removals within the proposed seaweed management zone at TOR is assessed as **minor adverse**.

4.3 Water and sediment quality

The proposed works are located within the Barns Ness to Wheat Stack coastal water body (ID: 200038), while the North Berwick to Barns Ness coastal water body (ID: 200467) is located immediately to the north of the proposed seaweed management zone (Figure 5). In 2017, both coastal water bodies were classified as achieving good overall status. The WFD compliance assessment, presented in Appendix B, concludes that the proposed works at TOR are not likely to have a permanent (i.e. non-temporary) effect on the status of WFD parameters that are significant at water body level. The proposed works are therefore not predicted to cause either deterioration to the current status of the Barns Ness to Wheat Stack or North Berwick to Barns Ness coastal water bodies, nor prevent these water bodies from achieving future WFD objectives.

The revised Bathing Water Directive (rBWD) (2006/7/EC) was adopted in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (BWD) (76/160/EEC) and the process used to measure/monitor water quality at identified bathing waters. The rBWD focuses on fewer microbiological indicators, whilst setting higher standards, compared to those of the BWD. Bathing waters under the rBWD are classified as excellent, good, sufficient or poor according to the levels of certain types of bacteria (intestinal enterococci and *Escherichia coli*) in samples obtained during the bathing season (May to September). The BWD was repealed at the end of 2014 and monitoring of bathing water quality has been reported against rBWD indicators since 2015. The new classification system considers all samples obtained during the previous four years and, therefore, data has been collected for rBWD indicators since 2012.

There are five designated bathing waters within 10 km of the proposed seaweed management zone, with Thorntonloch located approximately 1.5 km to the southeast and immediately south of the TOR cooling water outfall (Figure 5). Table 9 presents the bathing water classifications over the last four seasons, with all five currently at good or excellent bathing water quality. The proposed activity will not result in the introduction or disturbance of microbial coliforms (intestinal enterococci and *E. coli*) and thus will not affect bathing water quality. In addition, the aim of the proposed activity is to collect seaweed (kelp) during the removals process and dispose of the material to land. Therefore, it is not anticipated that there would be an increase in washed-up seaweed at nearby bathing waters, as this would conflict with the overarching objective of the proposed works (with material instead potentially entering the cooling water intake).

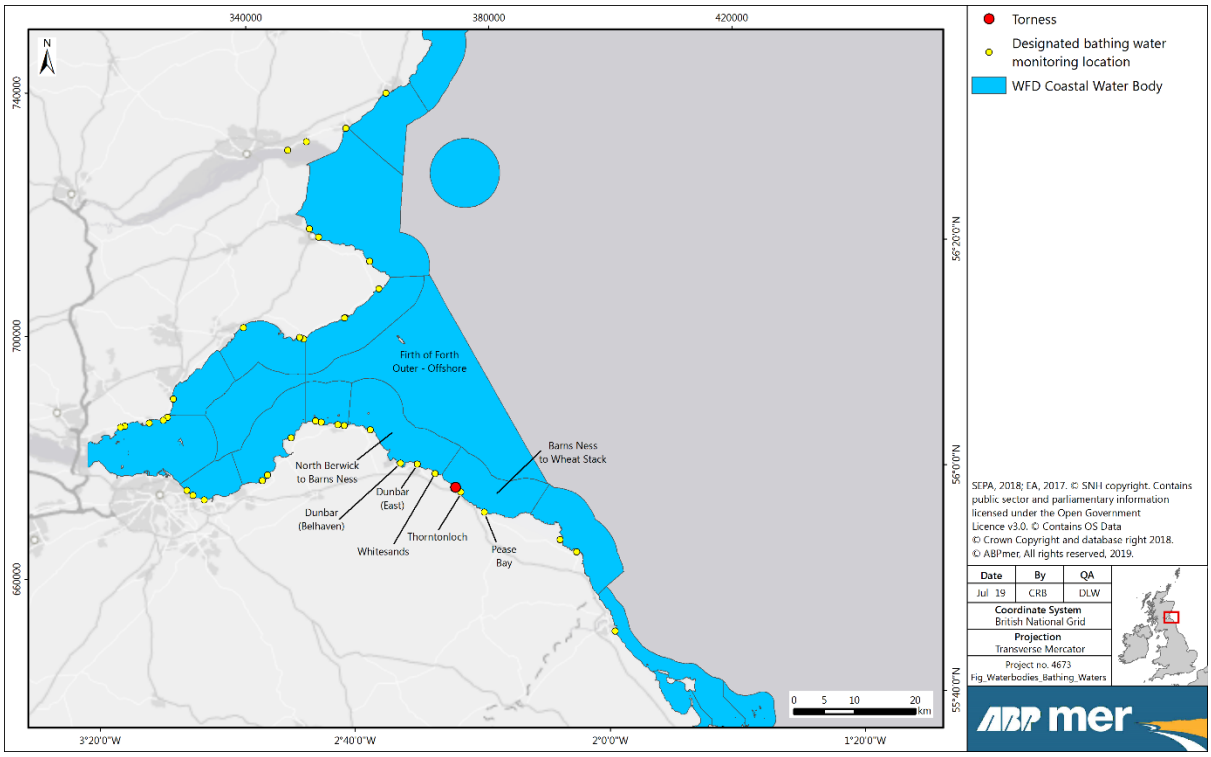


Figure 5. Coastal water bodies and designated bathing waters in the vicinity of the proposed seaweed management zone

Table 9. Bathing waters in the vicinity of the proposed seaweed management zone

Bathing Water	Distance* / Direction	Classification (Season)			
		2015/16	2016/17	2017/18	2018/19
Thorntonloch	1.5 km / southeast	Good	Excellent	Good	Excellent
Pease Bay	6 km / southeast	Excellent	Excellent	Excellent	Excellent
Whitesands	2 km / west	Sufficient	Good	Good	Good
Dunbar (East)	5 km / west	Sufficient	Good	Good	Excellent
Dunbar (Belhaven)	8 km / west	Good	Good	Good	Good
* Approximate distance from proposed seaweed management zone.					

The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. In Scotland, it has been replaced by the Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013 which came into force on 22 December 2013, and subsequently updated in 2016. The Order identifies 85 coastal areas as Shellfish Water Protected Areas, which are

identified on a series of maps[7]. These sites are located mostly on west coast of Scotland, with two located in the Moray Firth (Dornock Firth and Cromarty Bay). The nearest Shellfish Water Protected Area is greater than 200 km to the northwest of the proposed seaweed management zone and, therefore, no further consideration has been made in this appraisal.

The Nitrates Directive (91/676/EEC) aims to reduce water pollution from agricultural sources and to prevent such pollution occurring in the future (nitrogen is one of the nutrients that can affect plant growth). Under the Nitrates Directive, surface waters are identified if concentrations of nitrate in water exceed, or are likely to exceed, the levels set in the Directive; these are designated as Nitrate Vulnerable Zones (NVZs) under the Nitrate Vulnerable Zones (Scotland) Regulations 2015. The (Edinburgh) East Lothian and Borders NVZ includes the coastline adjacent to TOR and the proposed seaweed management zone[8]. However, the proposed activity (seaweed removal from subtidal areas in the vicinity of TOR) will not introduce nitrates to the adjacent Lothian and Borders NVZ and, therefore, no effects are anticipated.

The Urban Waste Water Treatment Directive (91/271/EEC) aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban waste water. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive requires that collected waste water is treated to at least secondary treatment standards for significant discharges. Secondary treatment is a biological treatment process where bacteria are used to break down the biodegradable matter (already much reduced by primary treatment) in waste water. Sensitive areas under the Urban Waste Water Treatment Directive are water bodies affected by eutrophication of elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients. The nearest sensitive areas to the proposed seaweed management zone are related to specific bathing waters, namely Pease Bay, Dunbar (East) and Dunbar (Belhaven)[9]. The proposed activity (seaweed removal from subtidal areas in the vicinity of TOR) will not introduce nutrients to the marine environment and, therefore, no effects are anticipated on the sensitive areas designated under the Urban Waste Water Treatment Directive.

The proposed activity could lead to small quantities of sediment being raised into suspension through contact with the seabed, although it is planned for the Norwegian-style kelp rake to be pulled through the water column at approximately 0.5 m above the seabed (particularly given the rocky nature of the seabed). Any disturbance will be small-scale and temporary, with any sediment raised into suspension quickly dispersed. High contaminant concentrations in marine sediments are largely associated with fine material (e.g. silt and mud), with relatively low concentrations associated with coarser/rocky material. Therefore, it is considered unlikely that the proposed activity will result in the disturbance and dispersal of contaminants (no chemical substances will be intentionally introduced to the marine environment).

Toxic contamination (spillage) has the potential to result from the operation of the vessel during the proposed works (e.g. accidental collision). However, as noted in Table 2, it is considered unlikely that a single vessel working in the vicinity of TOR would present a significant risk to navigation. The works will be undertaken in accordance with standard best practice measures, including (for example) adherence to relevant Guidance for Pollution Prevention (e.g. Works and maintenance in or near water: GPP5)[10].

Overall, given the nature and small scale of the proposed works, potential impacts to water and sediment quality receptors is assessed as **insignificant**.

7 https://www.gov.scot/publications/shellfish-water-protected-areas-maps/ (Accessed September 2019).
8 https://www.gov.scot/publications/nitrate-vulnerable-zones-maps/ (Accessed September 2019).
9 https://www.gov.scot/publications/urban-waste-water-treatment-sensitive-areas-map/ (Accessed September 2019).
10 http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017 (Accessed September 2019).

4.4 Nature conservation

This section reviews the effects of the proposed works on nature conservation receptors (i.e. designated habitats and species). Further discussion on marine ecology receptors (e.g. benthic habitats and species, birds and marine mammals) is provided in Section 4.5.

Article 3 of the Habitats Directive (92/43/EEC as amended) requires the establishment of a European network of important high-quality conservation sites known as Special Areas of Conservation (SACs) that will contribute to conserving habitats and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). In accordance with Article 4 of the Birds Directive (2009/147/EC), Special Protection Areas (SPAs) are strictly protected sites classified for rare and vulnerable birds (Annex I of the Directive), and for regularly occurring migratory species. Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

The following international nature conservation designated sites (with marine components) are located within approximately 30 km of the proposed seaweed management zone (see Figure 6 for locations):

- Berwickshire and North Northumberland Coast SAC;
- St Abb's Head to Fast Castle SAC;
- Isle of May SAC;
- St Abb's Head to Fast Castle SPA;
- Firth of Forth SPA;
- Forth Islands SPA;
- Outer Firth of Forth and St Andrews Bay Complex proposed SPA (pSPA); and
- Firth of Forth Ramsar.

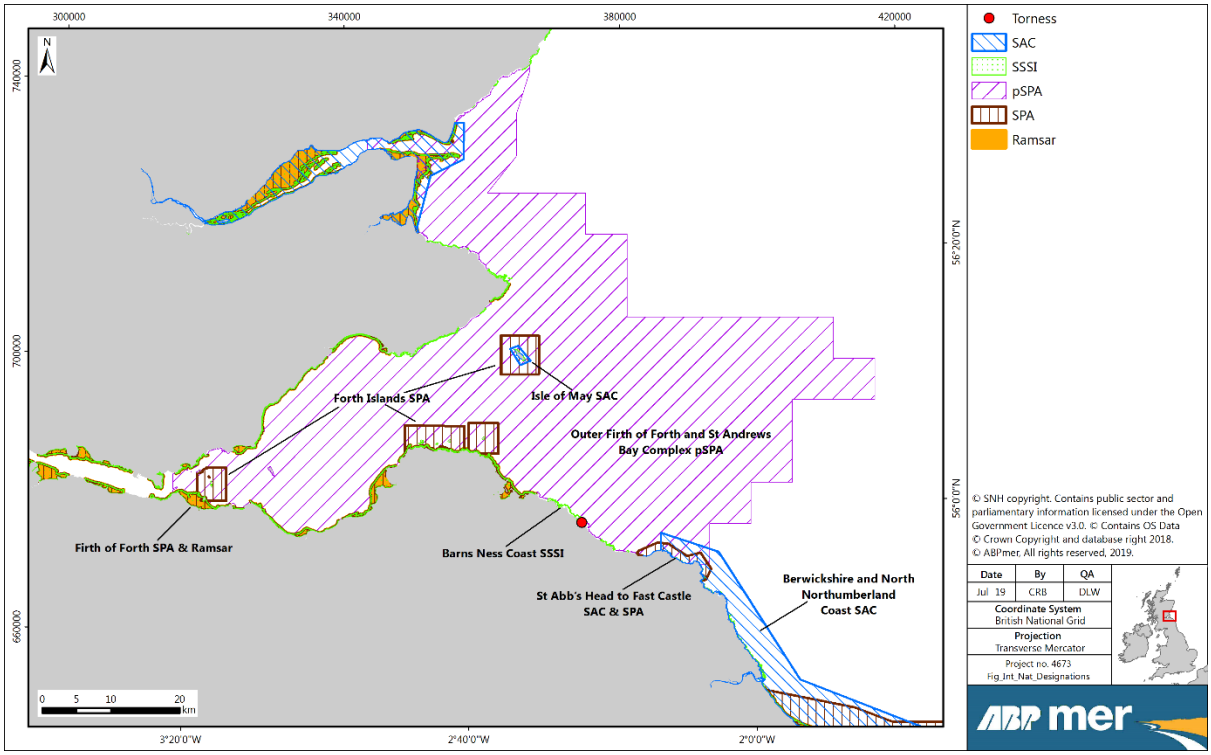


Figure 6. International and national nature conservation designations (with marine components) within 30 km of the proposed seaweed management zone at TOR

Table 10 presents a summary of the respective qualifying features for the above sites. The proposed seaweed management zone directly overlaps with the Outer Firth of Forth and St Andrews Bay Complex pSPA, with the remaining designated sites greater than 5 km away. It is recognised that the Outer Firth of Forth and St Andrews Bay Complex pSPA is afforded the same level of protection as a designated SPA via policy GEN 9 (Natural heritage) of Scotland's National Marine Plan (The Scottish Government, 2015).

Consultation documents for the Outer Firth of Forth and St Andrews Bay Complex pSPA indicate the spatial extent of the site would be 2,720.68 km^2 (272,068 hectares)[11]. The proposed seaweed management zone is located within the boundary of this site, and the kelp habitat currently present may be used by some of the respective bird species for foraging. At this stage, it cannot be excluded that there may be a 'likely significant effect' (LSE) upon the pSPA due to the proposed activity at TOR and the HRA process applies (see Section 3.1.2). Therefore, information to inform an AA (to be completed by Marine Scotland) is provided in Appendix A.

The proposed activity will result in the disturbance/loss of up to 1.29 km^2 of seaweed (kelp) habitat (equating to less than 0.05% of the area of the Outer Firth of Forth and St Andrews Bay Complex pSPA). Within the Firth of Forth region, there is an estimated (modelled) 88 km^2 of *L. hyperborea* habitat with a biomass greater than 2 kg/m^2, of which 10 km^2 is estimated (modelled) to have a biomass of greater than 5 kg/m^2 (Burrows *et al.* 2018). As noted in Section 2.2, it is recognised that seaweed coverage within the proposed seaweed management zone is likely to include areas of dense kelp habitat (e.g. 5 kg/m^2). However, such densities are likely to be patchy across the area with much lower densities elsewhere (i.e. less than 2 kg/m^2). Therefore, the proposed seaweed management zone is estimated to represent a small proportion of the aforementioned *L. hyperborea* habitat within the Firth of Forth region (less than 1%). Furthermore, the Norwegian-style rake is anticipated to only remove a proportion of the kelp biomass during each pass of the rake and, therefore, the activity will serve to reduce the density of the kelp beds rather than remove them completely. Disturbance/loss of this habitat type is considered unlikely to significantly affect designated bird features foraging in the area, particularly in the context of available foraging grounds in the wider Firth of Forth.

Other existing SACs, SPAs and Ramsar sites are greater than 5 km from the proposed seaweed management zone and it is considered unlikely that any significant effects on these sites would arise from the proposed activity.

In addition, on a national basis, Sites of Special Scientific Interest (SSSIs) are statutory designations made by SNH under the Nature Conservation (Scotland) Act 2004 for areas considered for their special interest flora or fauna, geology or geomorphology. The following SSSIs are located within 30 km of the proposed seaweed management zone at TOR:

- Barns Ness Coast SSSI;
- Pease Bat Coast SSSI;
- Siccar Point SSSI;
- Berwickshire Coast (Intertidal) SSSI;
- St Abb's Head to Fast Castle SSSI;
- Firth of Forth SSSI;
- Bass Rock SSSI;
- Forth Islands SSSI; and
- Isle of May SSSI.

[11] https://www.nature.scot/outer-firth-forth-and-st-andrews-bay-complex-proposed-marine-spa-supporting-documents (Accessed September 2019).

Table 10. Nature conservation designated sites within 30 km of the proposed seaweed management zone

Site (Code)	Distance (km)*	Qualifying (Notified) Features
Barns Ness Coast SSSI (135160)	<1	▪ Lower Carboniferous [Dinantian-Namurian (part)] ▪ Saltmarsh ▪ Sand dune ▪ Shingle
Outer Firth of Forth and St Andrews Bay Complex pSPA (UK9020316)	0	Under Article 4.1 of the Birds Directive (Annex I species) (non-breeding): ▪ Red-throated diver (*Gavia stellata*) (A001); Slavonian grebe (*Podiceps auritus*) (A007); Little gull (*Larus minutus*) (A177); Common tern (*Sterna hirundo*) (A193); Arctic tern (*Sterna paradisaea*) (A194) Under Article 4.2 of the Birds Directive (migratory waterfowl): ▪ Common eider (*Somateria mollissima*) (A063) ▪ In excess of 20,000 individual waterfowl, including Long-tailed duck (*Clangula hyemalis*) (A064); Common scoter (*Melanitta nigra*) (A065); Velvet scoter (*Melanitta fusca*) (A066); Common goldeneye (*Bucephala clangula*) (A067); Red-breasted merganser (*Mergus serrator*) (A069) Under Article 4.2 of the Birds Directive (migratory seabirds): ▪ European shag (*Phalacrocorax aristotelis*) (A018); Northern gannet (*Morus bassanus*) (A016) Under Article 4.2 of the Birds Directive (breeding seabirds): ▪ In excess of 20,000 individual seabirds, including Atlantic puffin (*Fratercula arctica*) (A204); Black-legged kittiwake (*Rissa tridactyla*) (A188); Manx shearwater (*Puffinus puffinus*) (A013); Common guillemot (*Uria aalge*) (A199); Herring gull (*Larus argentatus*) (A184) Under Article 4.2 of the Birds Directive (non-breeding seabirds): ▪ In excess of 20,000 individual seabirds, including Black-headed gull (*Chroicocephalus ridibundus*) (A179); Common gull (*Larus canus*) (A182); Herring gull (*Larus argentatus*) (A184); Common guillemot (*Uria aalge*) (A199); European shag (*Phalacrocorax aristotelis*) (A018); Black-legged kittiwake (*Rissa tridactyla*) (A188); Razorbill (*Alca torda*) (A200)
Firth of Forth SPA (UK9004411)	6	Under Article 4.1 of the Birds Directive (Annex I species): ▪ Red-throated diver (*Gavia stellata*) (A001); Slavonian grebe (*Podiceps auratus*) (A007); Golden plover (*Pluvialis apricaria*) (A140); Bar-tailed godwit (*Limosa lapponica*) (A157)

Site (Code)	Distance (km)*	Qualifying (Notified) Features
		Under Article 4.1 of the Birds Directive (Annex I species) (during passage period): ▪ Sandwich tern (*Sterna sandvicensis*) (A191) Under Article 4.2 of the Birds Directive (migratory): ▪ Pink-footed goose (*Anser brachyrhynchus*) (A040); Shelduck (*Tadorna tadorna*) (A048); Knot (*Calidris canutus*) (A143); Redshank (*Tringa totanus*) (A162); Turnstone (*Arenaria interpres*) (A169) Under Article 4.2 of the Birds Directive: ▪ In excess of 20,000 individual waterfowl, including Scaup (*Aythya marila*) (A062); Slavonian grebe (*Podiceps auratus*) (A007); Golden plover (*Pluvialis apricaria*) (A140); Bar-tailed godwit (*Limosa lapponica*) (A157); Pink-footed goose (*Anser brachyrhynchus*) (A040); Shelduck (*Tadorna tadorna*) (A048); Knot (*Calidris canutus*) (A143); Redshank (*Tringa totanus*) (A162); Turnstone (*Arenaria interpres*) (A169); Great crested grebe (*Podiceps cristatus*) (A005); Cormorant (*Phalacrocorax carbo*) (A017); Curlew (*Numenius arquata*) (A160); Eider (*Somateria mollissima*) (A063); Long-tailed duck (*Clangula hyemalis*) (A064); Common scoter (*Melanitta nigra*) (A065); Velvet scoter (*Melanitta fusca*) (A066); Goldeneye (*Bucephala clangula*) (A067); Red-breasted merganser (*Mergus serrator*) (A069); Oystercatcher (*Haematopus ostralegus*) (A130); Ringed plover (*Charadrius hiaticula*) (A137); Grey plover (*Pluvialis squatarola*) (A141); Dunlin (*Calidris alpina alpina*) (A672) ▪ Assemblage additionally includes Mallard (*Anas platyrhynchos*) (A053); Lapwing (*Vanellus vanellus*) (A142); Wigeon (*Anas penelope*) (A050)
Firth of Forth Ramsar (UK13017)	6	Ramsar criterion 5 – Assemblages of international importance ▪ Species with peak counts in winter: 72,281 waterfowl Ramsar criterion 6 – species/populations occurring at levels of international importance ▪ Species with peak counts in spring/autumn: Pink-footed goose (*Anser brachyrhynchus*); Common redshank (*Tringa totanus totanus*) ▪ Species with peak counts in winter: Slavonian grebe (*Podiceps auritus*); Red knot (*Calidris canutus islandica*); Bar-tailed godwit (*Limosa lapponica lapponica*)
St Abb's Head to Fast Castle SPA (UK9004271)	9	Under Article 4.2 of the Birds Directive: ▪ In excess of 20,000 individual seabirds, including Razorbill (*Alca torda*) (A200); Common guillemot (*Uria aalge*) (A199); Black-legged kittiwake (*Rissa tridactyla*) (A188); Herring gull (*Larus argentatus*) (A184); European shag (*Phalacrocorax aristotelis*) (A018)

Site (Code)	Distance (km)*	Qualifying (Notified) Features
St Abb's Head to Fast Castle SAC (UK0030281)	10	▪ Vegetated sea cliffs of the Atlantic and Baltic Coasts (1230)
Berwickshire and North Northumberland Coast SAC (UK0017072)	11	▪ Mudflats and sandflats not covered by seawater at low tide (1140) ▪ Large shallow inlets and bays (1160) ▪ Reefs (1170) ▪ Submerged or partially submerged sea caves (8330) ▪ Grey seal (*Halichoerus grypus*) (1364)
Forth Islands SPA (UK9004171)	14	Under Article 4.1 of the Birds Directive (Annex I species) ▪ Arctic tern (*Sterna paradisaea*) (A194); Roseate tern (*Sterna dougallii*) (A192); Common tern (*Sterna hirundo*) (A193); Sandwich tern (*Sterna sandvicensis*) (A191) Under Article 4.2 of the Birds Directive (migratory): ▪ Northern gannet (*Morus bassanus*) (A016); European shag (*Phalacrocorax aristotelis*) (A018); Lesser black-backed gull (*Larus fuscus*) (A183); Atlantic puffin (*Fratercula arctica*) (A204) Under Article 4.2 of the Birds Directive: ▪ In excess of 20,000 individual seabirds, including Razorbill (*Alca torda*) (A200); Common guillemot (*Uria aalge*) (A199); Black-legged kittiwake (*Rissa tridactyla*) (A188); Herring gull (*Larus argentatus*) (A184); Great cormorant (*Phalacrocorax carbo*) (A017); Northern gannet (*Morus bassanus*) (A016); Lesser black-backed gull (*Larus fuscus*) (A183); European shag (*Phalacrocorax aristotelis*) (A018); Atlantic puffin (*Fratercula arctica*) (A204); Arctic tern (*Sterna paradisaea*) (A194); Common tern (*Sterna hirundo*) (A193); Roseate tern (*Sterna dougallii*) (A192); Sandwich tern (*Sterna sandvicensis*) (A191)
Isle of May SAC (UK0030172)	23	▪ Reefs (1170) ▪ Grey seal (*Halichoerus grypus*) (1364)

* Approximate distance from proposed seaweed management zone.

The proposed seaweed management zone directly overlaps the Barns Ness Coast SSSI (see Table 10 for notified features). This site includes the intertidal zone and terrestrial semi-natural habitats adjacent to the proposed seaweed management zone. The intertidal zone is designated for its hard rock geodiversity (Lower Carboniferous) and, through consultation with SNH (see Section 2.3), it is anticipated that there will be no adverse effects from the proposed works on any of the designated features of this site. Other existing SSSIs are greater than 3 km from the proposed seaweed management zone and it is considered unlikely that any significant effects on these sites would arise from the proposed activity.

The nearest Nature Conservation MPA is located greater than 30 km from the proposed seaweed management zone, namely the Firth of Forth Banks Complex Nature Conservation MPA. Given the distance from this site and the scale and nature of the proposed works at TOR, there are no predicted impacts (direct or indirect) on the features of this Nature Conservation MPA (as suggested through consultation with SNH; see Section 2.3). Therefore, no further consideration has been made regarding the Firth of Forth Banks Complex Nature Conservation MPA.

In summary, the impacts of the proposed seaweed removals at TOR on nature conservation designated sites are considered to be **insignificant**.

4.5 Marine ecology

This section presents the assessment of potential impacts of the proposed activity at TOR on marine ecology receptors. The following marine ecology receptors have been considered as part of the assessment:

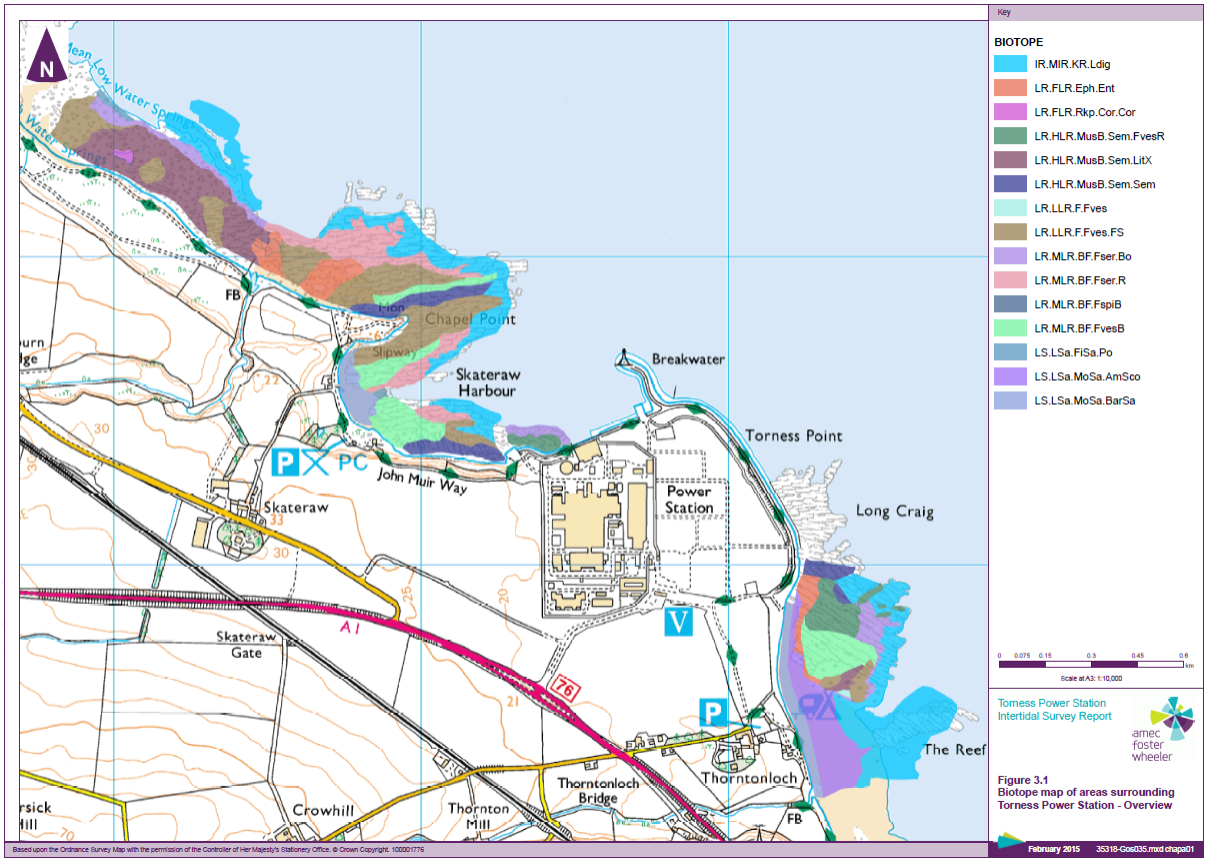
- Benthic habitats and species, including Priority Marine Features (PMFs);
- Fish and shellfish;
- Marine mammals;
- Ornithology; and
- Invasive non-native species (INNS).

4.5.1 Benthic habitats and species

The main habitats and associated species of interest for the appraisal are the subtidal kelp habitats that will be affected by the proposed works and adjacent intertidal areas that could be exposed to indirect impacts as a result of subtidal seaweed removal. Therefore, intertidal and subtidal habitats are discussed in the following sections, followed by consideration of kelp habitat as a PMF in the context of local and national distributions.

Intertidal habitats

An intertidal biotope mapping and infauna sampling survey in the vicinity of TOR conducted in September 2014 and January 2015 found 12 hard substrate biotopes and three sedimentary biotopes (AMEC, 2015; see Figure 7 and Table 11). In the northern extent of the survey area, the intertidal consisted mainly of exposed, high energy rock, but also included characteristic species indicative of sheltered, low energy coastlines, such as the egg wrack (*Ascophyllum nodosum*). *Fucus vesiculosus* observed on the more exposed aspects of the bedrock lacked twin air bladders, which is indicative of a more exposed, high energy environment.



Source: AMEC, 2015

Figure 7. Biotopes observed from intertidal surveys in the vicinity of TOR in 2014/2015

A steeply angled shore was present in Skateraw Harbour, with barren, well-drained sands in the upper and mid-shore areas, and polychaete dominated sediments lower on the shore. To the south of TOR, *F. vesiculosus* dominated the bedrock with varying degrees of abundance, with an underlying layer of barnacles and limpets. On the more exposed and larger sedimentary shore at Thorntonloch, the shore was less steep in profile, and as such had a smaller area of mobile free draining sands, located on the upper shore only. The mid and lower shore areas were dominated by burrowing amphipod communities. Within the intertidal areas, there was evidence of the kelp oarweed (*Laminaria digitata*); this species typically occurs on the fringes between intertidal and subtidal habitats, and follows the standard rocky shore zonation (AMEC, 2015).

In addition, as part of a separate EDF Research and Development Centre project with Cranfield University, TOR arranged for high resolution imagery to be captured using an Unmanned Aerial Vehicle (UAV), also referred to as a drone, in coastal waters adjacent to the station specifically targeting seaweed distribution. Two drone surveys were undertaken in June/August 2018. The first drone survey (26 June 2018) captured an area of approximately 0.5 km^2, primarily focusing on the immediate vicinity of the cooling water intake and outfall, undertaken at low water. The second survey (07 August 2018) captured footage from the same locations as the first survey, but also extended the survey area further along the coast to the southeast and northwest of the station. However, the second survey captured aerial imagery during a mid-tide state, thus reduced exposure of the intertidal zone.

Table 11. Description of the intertidal biotopes observed in the vicinity of TOR in 2014/2015

Biotope (see Figure 7)	Description
IR.MIR.KR.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe rock
LR.FLR.Eph.Ent	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock
LR.FLR.Rkp.Cor.Cor	Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools
LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock
LR.HLR.MusB.Sem.LitX	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles
LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
LR.LLR.F.Fves	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock
LR.LLR.F.Fves.FS	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock
LR.MLR.BF.Fser.Bo	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders
LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
LR.MLR.BF.FspiB	*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock
LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
LS.LSa.FiSa.Po	Polychaetes in littoral fine sand
LS.LSa.MoSa.AmSco	Amphipods and *Scolelepis* spp. in littoral medium-fine sand
LS.LSa.MoSa.BarSa	Barren littoral coarse sand

To review the footage captured during the drone surveys, a 100 x 100 m fishnet gird was placed over the geometrically corrected orthoimage (Figure 8). Within each analysed grid square, the coverage of macroalgae species (including kelp) was recorded based on the Marine Nature Conservation Review (MNCR) SACFOR abundance scale (Table 12), as shown in Figure 9. Of the approximate 1.7 km^2 of drone footage that was analysed during this review, around 0.85 km^2 was subtidal habitat, 0.55 km^2 was intertidal habitat and 0.30 km^2 was terrestrial habitat (including sand dunes).

Table 12. SACFOR abundance scale

Code	Description	Coverage (%)
S	Super-abundant	>80
A	Abundant	40-79
C	Common	20-39
F	Frequent	10-19
O	Occasional	5-9
R	Rare	1-5
L	Less than rare but still has some presence (indicated by extrapolation)	<1
None	No algae present	0

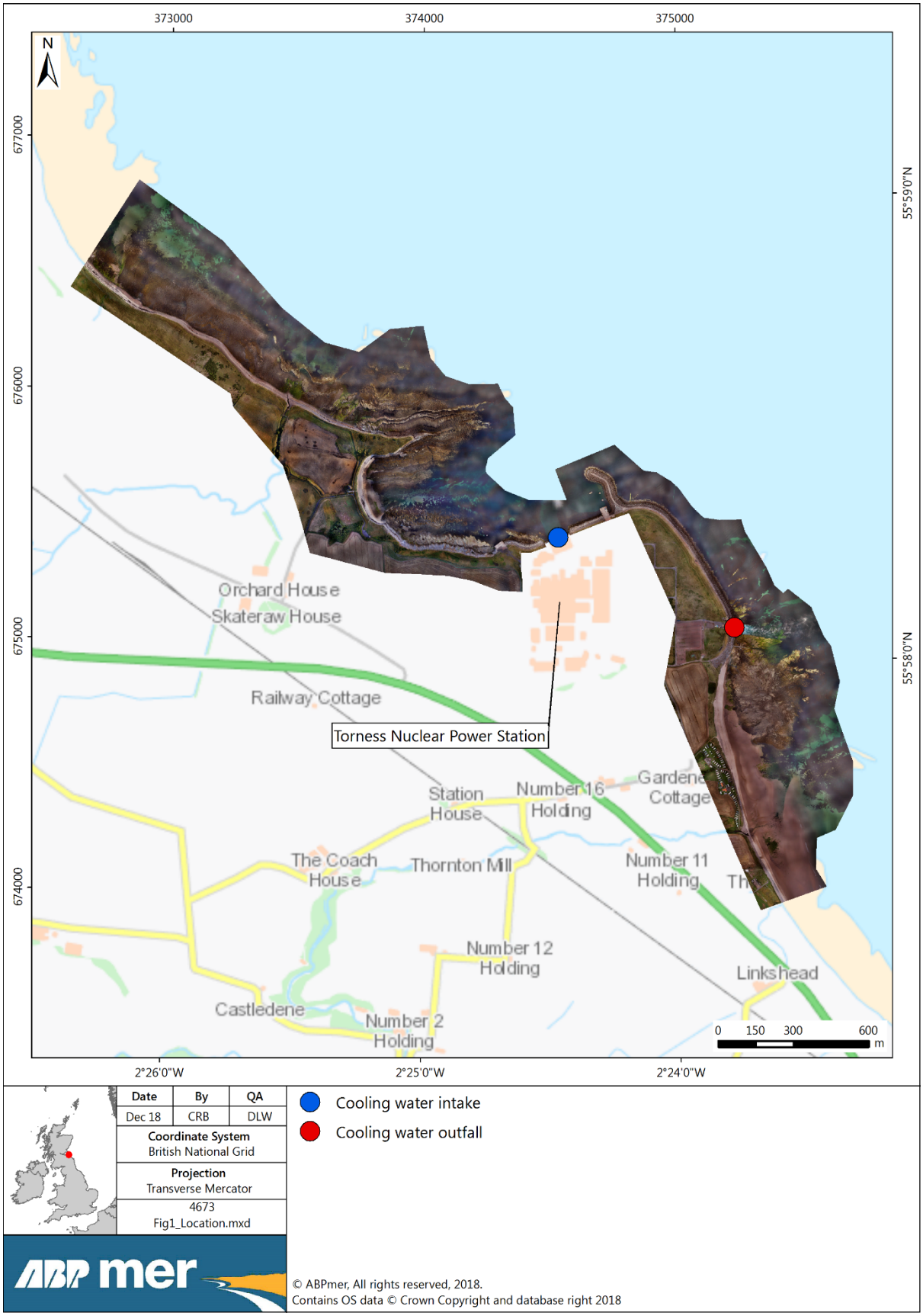


Figure 8. Aerial imagery captured in the vicinity of TOR during drone surveys in 2018

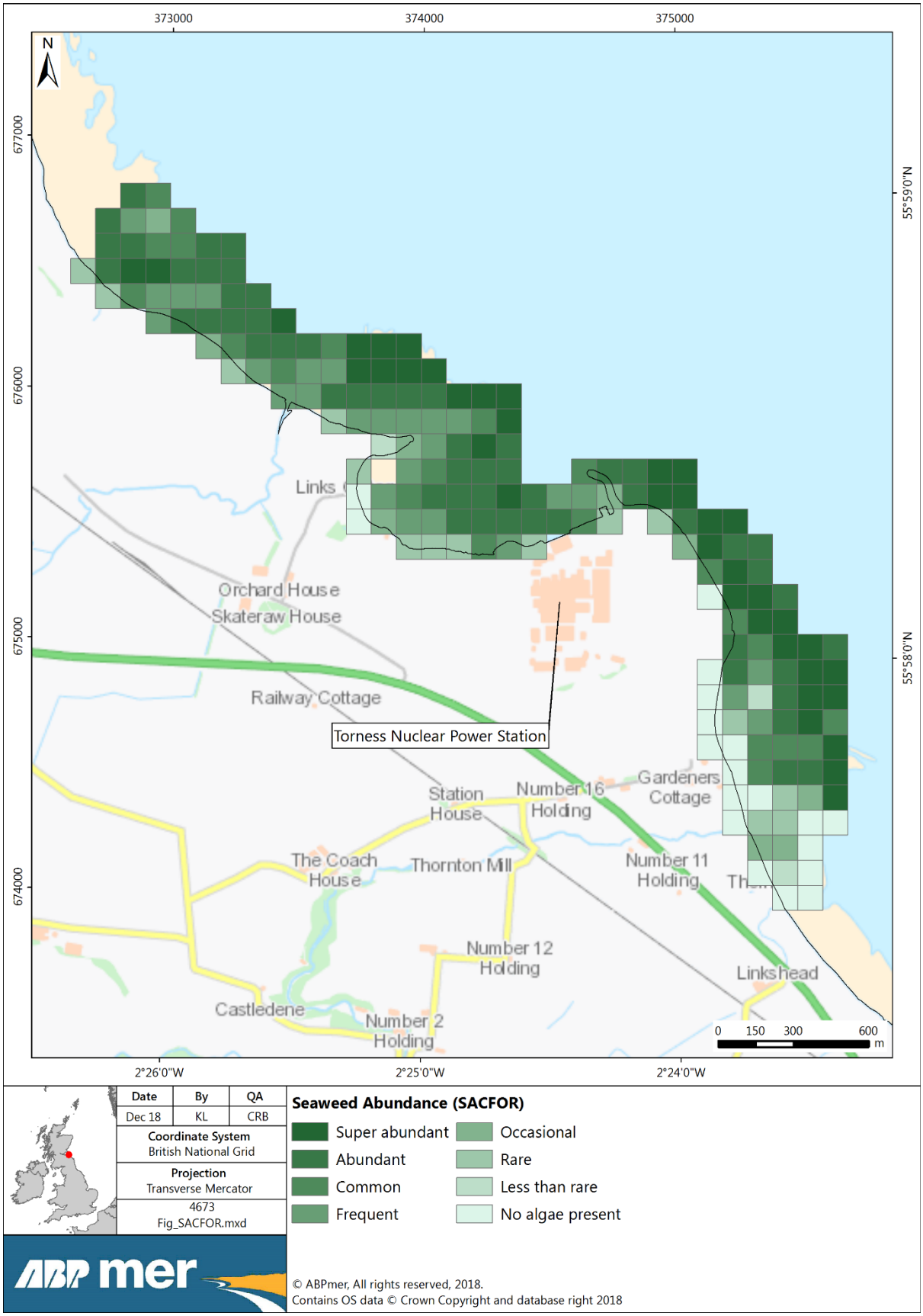


Figure 9. **SACFOR abundance of seaweed within each grid square (100 x 100 m) based on aerial imagery collected in 2018**

The most common intertidal habitat type was intertidal rock, often covered by patchy/dense areas of brown or green algae. Comparison of the intertidal habitat mapping survey (Envision Mapping, 2014) and intertidal areas identified from the drone survey appeared to suggest similarities. When reviewing the drone imagery, it was not possible to identify individual algal species, although typical algal species are likely to include wracks/fucoids such as bladder wrack (*F. vesiculosus*), toothed/serrated wrack (*F. serratus*), spiral wrack (*F. spiralis*), channelled wrack (*Pelvetia canaliculata*) and egg wrack/rockweed (*A. nodosum*) and green seaweeds such as sea lettuce species (*Ulva intestinarlis*, *U. lactuca* and *U. prolifera*).

There will be no direct overlap between the proposed seaweed management zone and intertidal habitats and, as suggested in Section 4.2, it is anticipated that there will be negligible changes in intertidal morphology in response to changes in wave energy (due to reduced wave attenuation). It is recognised that intertidal seaweeds, such as fucoids, are contributing to seaweed ingress at TOR, but these species are not being targeted by this marine licence application.

In summary, the impacts of the proposed seaweed removals at TOR on intertidal habitats and species are considered to be **insignificant**.

Subtidal habitats

The European Marine Observation and Data Network (EMODnet) habitat map indicates that the proposed seaweed management zone is within a high/moderate energy environment, including the following high-level biotopes[12]:

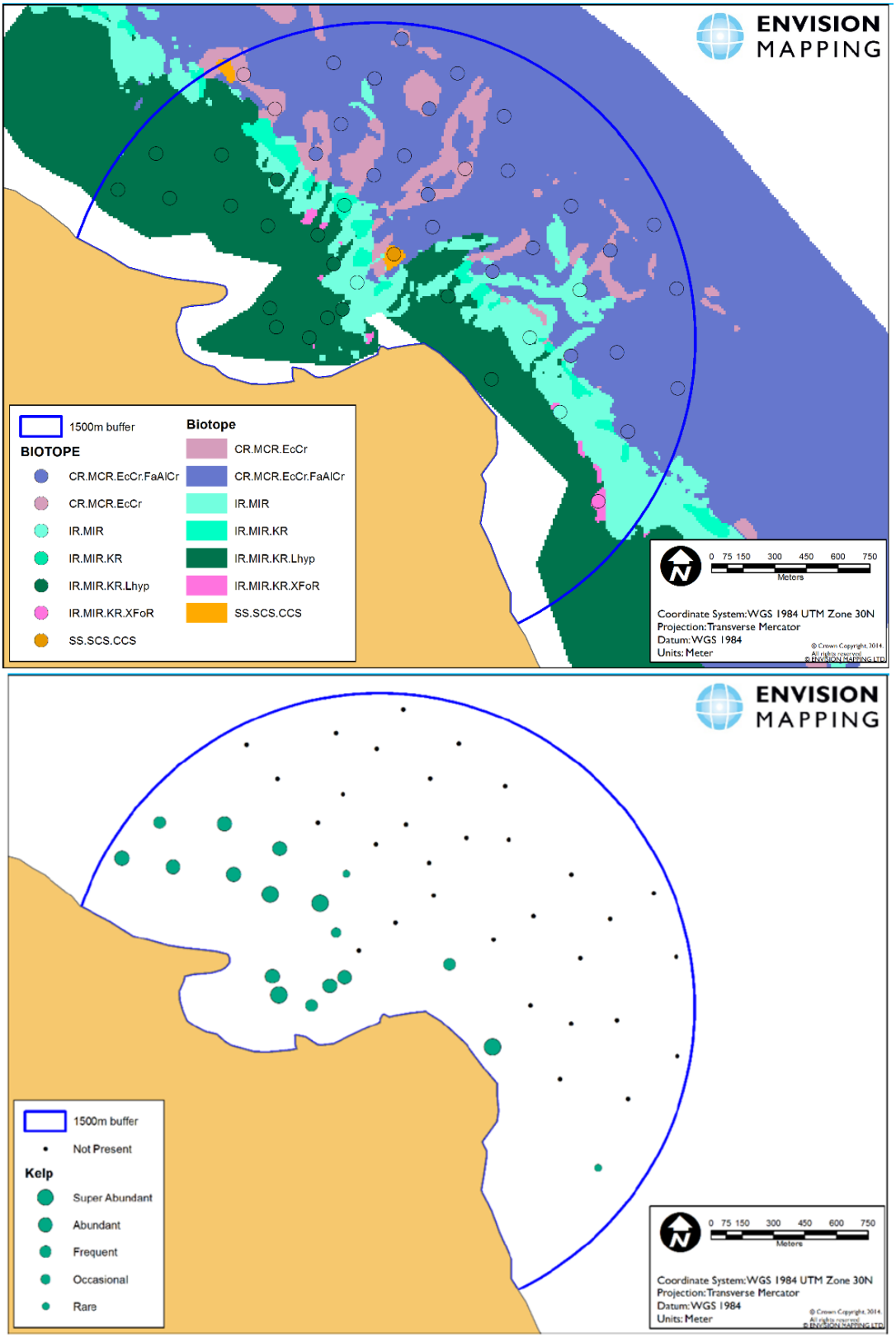
- Atlantic and Mediterranean high energy infralittoral rock (A3.1);
- Atlantic and Mediterranean moderate energy infralittoral rock (A3.2);
- Atlantic and Mediterranean high energy circalittoral rock (A4.1);
- Atlantic and Mediterranean moderate energy circalittoral rock (A4.2);
- Sublittoral sediment (A5); and
- High energy infralittoral seabed (n/a).

A subtidal drop-down video survey was conducted in September 2014, including a total of 49 sites within a 1,500 m buffer of the station's cooling water intake (Envision Mapping, 2014). The survey identified seven biotopes (classified to European Nature Information System (EUNIS) level 4) in the subtidal area surrounding TOR. The drop-down video footage indicated that the shallow subtidal was dominated by the biotope *L. hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp). As water depth increased, the coverage of kelp reduced and red seaweeds increased (IR.MIR.KR). An area of rock, occasionally covered by a veneer of coarse sand, and with patches of macroalgae attached could be seen marking the lower boundary of the infralittoral rock (IR.MIR). Below this region, the deeper circalittoral bedrock was dominated by pink faunal crusts, *Spirobranchus triqueter* and the urchin, *Echinus esculentus* (CR.MCR.EcCr.FaAlCr), interspersed with areas of rock with a sparse appearance due to increasing grazing by echinoderms (CR.MCR.EcCr).

Data analysis combined the drop-down footage with geophysical (remote sensing) information to model the distribution of biotopes in the area, as shown in Figure 10 (see Table 13 for biotope descriptions). In terms of kelp abundance, Figure 10 also shows an area of Abundant (A) or Superabundant (S) kelp in Skateraw Harbour and extending to the west, largely captured within the proposed seaweed management zone. *Laminaria hyperborea* is distributed from the Arctic south to

[12] Derived from data that is made available under the EMODnet Seabed Habitats project, funded by the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE). It is recognised that the Data Owner and EMODnet Seabed Habitats consortium accept no liability for the use of this data or for any further analysis or interpretation of the data. Available at: www.emodnet-seabedhabitats.eu (Accessed September 2019).

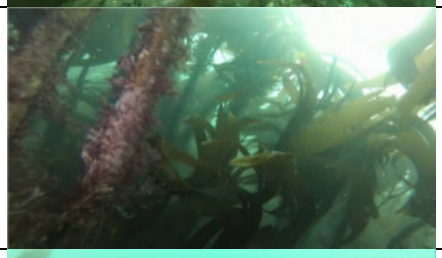
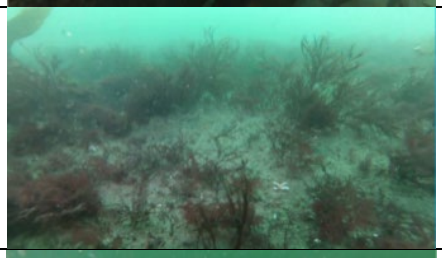
northern Portugal, and in the UK, it persists on all but the most wave-exposed or turbid rocky reefs. It tends to occur from the low water mark down to the limit of photic depth (up to 30 m in clear waters), with lifespans in UK/Irish waters of 5 – 18 years (Smale *et al.* 2013).



Source: Envision Mapping, 2014

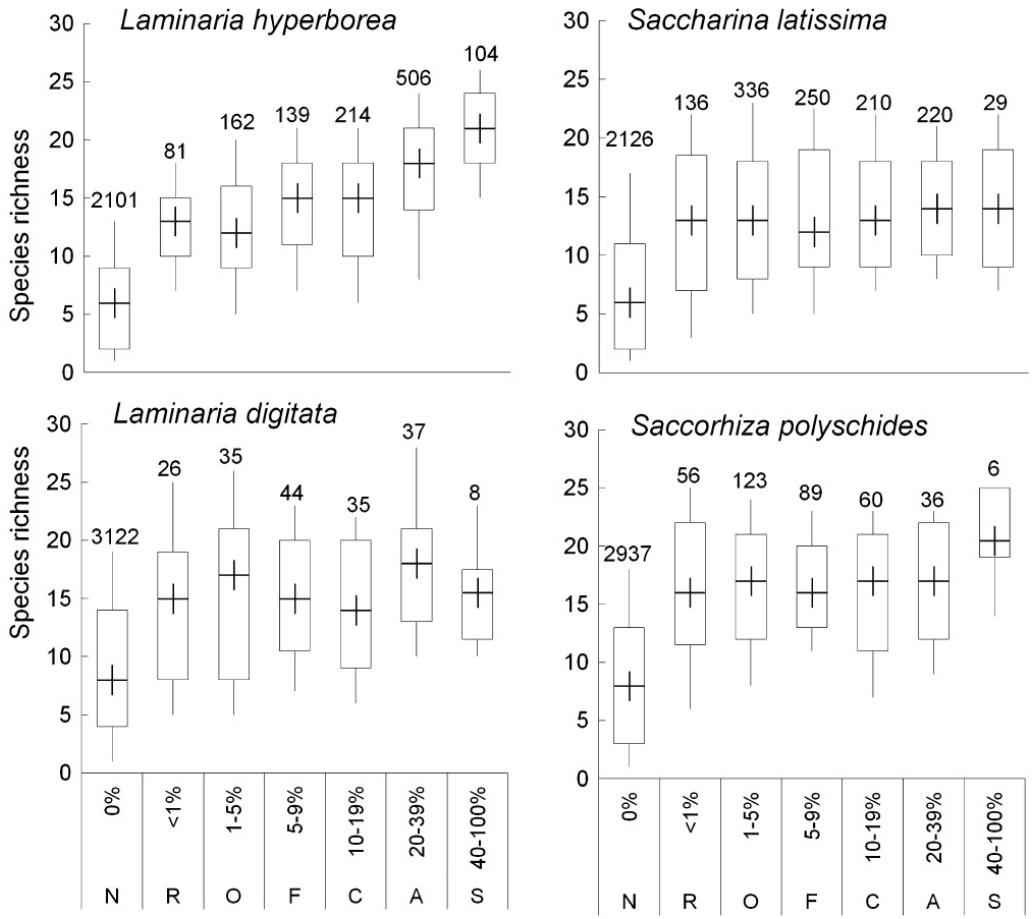
Figure 10. Modelled distribution of subtidal biotopes (top) and kelp abundance based on the SACFOR scale (bottom) in the vicinity of TOR from drop-down video survey in 2014

Table 13. Images of subtidal biotopes observed in the vicinity of TOR from drop-down video survey in 2014

Biotope (see Figure 10)	Description	Example Image (Envision Mapping, 2014)
CR.MCR.EcCr	Echinoderms and crustose communities on circalittoral rock	
CR.MCR.EcCr.FaAlCr	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	
IR.MIR	Moderate energy infralittoral rock	
IR.MIR.KR	Kelps and red seaweeds (moderate energy infralittoral rock)	
IR.MIR.KR.Lhyp	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock	
IR.MIR.KR.XFoR	Dense foliose red seaweeds on silty moderately exposed infralittoral rock	
SS.SCS.CCS	Circalittoral coarse sediment	

Laminaria hyperborea is a large, conspicuous kelp which can grow up to 3.5 m in length (Tyler-Walters, 2007). The proposed activity at TOR aims to remove this dominant species from the proposed seaweed management zone, locally reducing the density of kelp within this biotope within the direct footprint. Seaweed harvesting using the Norwegian-style rake typically removes entire kelp plants, including holdfasts, although juvenile plants are largely left *in situ* to promote more rapid recovery. Removal of whole kelp plants creates bare rock which can be re-colonized by kelp sporelings. While recovery of kelp habitat within the proposed seaweed management zone conflicts with the objective and rationale to manage seaweed ingress at TOR, this partial retention of kelp plants and potential for regrowth may offset some of the lost function of the affected habitat.

Kelps such as *L. hyperborea* play an important role in coastal marine ecosystems. Kelp species support notable biodiversity, with higher levels of biodiversity observed in kelp beds than equivalent comparable areas. A roughly linear decline in local species richness is observed as the abundance of *L. hyperborea* is reduced (see Figure 11; Smale *et al.* 2013). In addition, kelp beds contribute high levels of primary production through carbon (C) assimilation. A range of primary production rates for *L. hyperborea* are reported in scientific literature, with values typically up to 1.3 kg C/m^2/year (e.g. Dayton, 1985; Kelly, 2005; Smale *et al.* 2013; Burrows m^3. 2018), and much of this production enters the carbon cycle as detritus or dissolved organic matter.



Source: Smale *et al.* 2013

Figure 11. Kelp species abundance and local species richness using the SACFOR scale

Based on this primary production rate and the spatial extent of the proposed seaweed management zone at TOR (1.29 km^2), the *L. hyperborea* beds present could provide a sink for up to 1,677 tonnes C/year. In Scotland, the main producer of carbon entering long-term storage in sediments is phytoplankton at 3.9 million tonnes C/year, with coastal plants (predominantly kelp) potentially

contributing a further 1.8 million tonnes C/year (Burrows *et al*. 2014). Therefore, primary production within the proposed seaweed management zone represents less than 0.1% of the contribution made by coastal plants in Scotland. However, it is likely that the primary production rate applied above (1.3 kg C/m^2/year) exceeds the capacity within the proposed seaweed management zone, while it should also be recognised that only a proportion of the *L. hyperborea* present will be removed per campaign (with up to 300 tonnes (wet weight) per annum). Therefore, the loss as a result of the proposed activity is considered minimal in the wider context of kelp primary production in Scotland (and other seaweed productivity), as well overall primary productivity in the marine environment, including phytoplankton.

The proposed activity will reduce kelp density over a subtidal area of up to 1.29 km^2, targeted towards those areas of densest kelp coverage based on the findings of a pre-campaign drop-down video survey. The spatial extent of the proposed seaweed management zone is small relative to the overall extent of kelp resources in the wider Firth of Forth region. The proposed activity will remove the majority, but not all of the kelp and some residual function as a nursery/feeding area will remain following the activity, while regrowth of kelp will be expected to occur over time.

Overall, given the relatively small area affected by the removal activity, wider available (similar) kelp habitat and potential for long-term recovery, the impacts of the proposed seaweed removals at TOR on subtidal habitats and species are considered to be **minor adverse**.

Priority Marine Features (PMFs)

As part of the General Policies of Scotland's National Marine Plan (The Scottish Government, 2015), specifically relating to 'Living within environmental limits', GEN 9 Natural heritage states:

"*Development and use of the marine environment must:*

(a) Comply with legal requirements for protected areas and protected species.
(b) Not result in significant impact on the national status of Priority Marine Features.
(c) Protect and, where appropriate, enhance the health of the marine area".

Priority Marine Features (PMFs) are species and habitats which have been identified by SNH and JNCC, and formally adopted by Scottish Ministers in July 2014, as being of conservation importance (Tyler-Walters *et al*. 2016). In pre-application advice provided by SNH (see Section 2.3), it was suggested that any forthcoming Marine Licence application should be supported by an assessment of impacts on natural heritage receptors, specifically referring to PMFs (see Section 2.3 and Appendix C).

Of relevance to this appraisal, 'Kelp beds' are identified as a PMF, including the following five biotopes recorded in Scottish territorial waters (Figure 12 shows the distribution of these biotopes in the vicinity of TOR)[13]:

- *Laminaria hyperborea* forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed upper infralittoral rock (IR.HIR.KFaR.LhypFa);
- *Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock (IR.HIR.KFaR.LhypR);
- *Laminaria hyperborea* on tide-swept, infralittoral rock (IR.MIR.KR.LhypT);
- *Laminaria hyperborea* on tide-swept infralittoral mixed substrata (IR.MIR.KR.LhypTX); and
- *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp).

[13] https://www.nature.scot/sites/default/files/2018-05/Priority%20Marine%20Features%20in%20Scotlands%20seas.pdf (Accessed September 2019).

The biotope 'IR.MIR.KR.Lhyp' includes four sub-component biotopes, namely:

- *Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock (IR.MIR.KR.Lhyp.Ft);
- *Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock (IR.MIR.KR.Lhyp.Pk);
- Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock (IR.MIR.KR.Lhyp.GzFt); and
- Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock IR.MIR.KR.Lhyp.GzPk.

As previously shown in Figure 10, the biotope 'IR.MIR.KR.Lhyp' was identified within the proposed seaweed management zone during the 2014 drop-down video survey, while the survey report also noted the presence of the 'IR.MIR.KR.Lhyp.Ft' and 'IR.MIR.KR.Lhyp.Pk' sub-component biotopes (Envision Mapping, 2014). In assessing the potential impacts of the proposed activity at TOR, seaweed removals (predominantly targeting *L. hyperborea*) will clearly have a direct effect on this PMF/biotope. Guidance on how to consider potential impacts to PMFs suggests determining the magnitude of change and significance of these impacts to the PMF, acknowledging aspects of policy, spatial context and other factors that influence how the relative conservation importance of different features is regarded (SNH, 2016). In particular, it should be assessed whether any impacts on kelp beds would constitute a 'significant impact on the national status' of the PMF, in line with policy GEN 9 in Scotland's National Marine Plan.

At a local scale, Burrows *et al*. (2018) estimated (modelled) that 88 km^2 of *L. hyperborea* habitat with a biomass greater than 2 kg/m^2 can be found in the Firth of Forth region; the spatial extent of the proposed seaweed management zone (1.29 km^2) equates to less than 1.5% of this habitat type. However, Scottish records of the biotope 'IR.MIR.KR.Lhyp' are of national importance, as a high proportion of the UK records of this biotope are within Scotland. It is widely recorded around all coasts of the Scottish mainland and islands, but particularly off the west coast, around the Hebrides and Northern Isles (Tyler-Walters *et al*. 2016; see Figure 13). It is predicted (modelled) that 3,747 km^2 of *L. hyperborea* habitat with a biomass greater than 2 kg/m^2 is found across Scotland (Burrows *et al*. 2018). At this national scale (noting there will be a further significant distribution at densities less than 2 kg/m^2), the spatial extent of the proposed seaweed management zone at TOR equates to less than 0.05%.

Overall, it is acknowledged that the reduction in kelp density within the proposed seaweed management zone adjacent to TOR is likely to constitute a **minor adverse** impact to the PMF habitat on a **local scale** (given the direct removal/targeting of *L. hyperborea*). However, the impact is considered **insignificant** in terms of the **national status** of the kelp beds PMF.

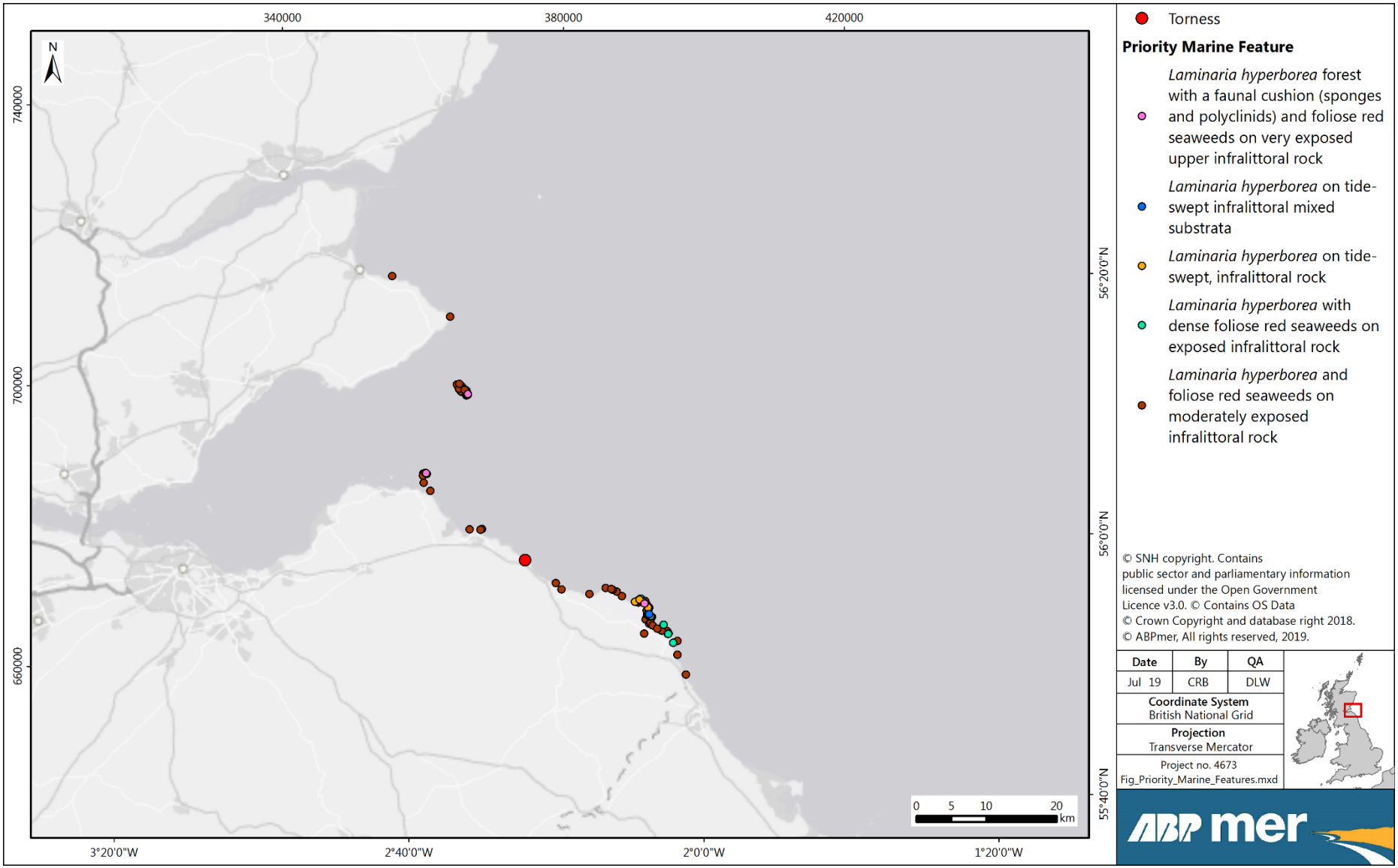


Figure 12. **Priority Marine Feature (PMF) habitats which include the kelp Laminaria hyperborea in the vicinity of TOR**

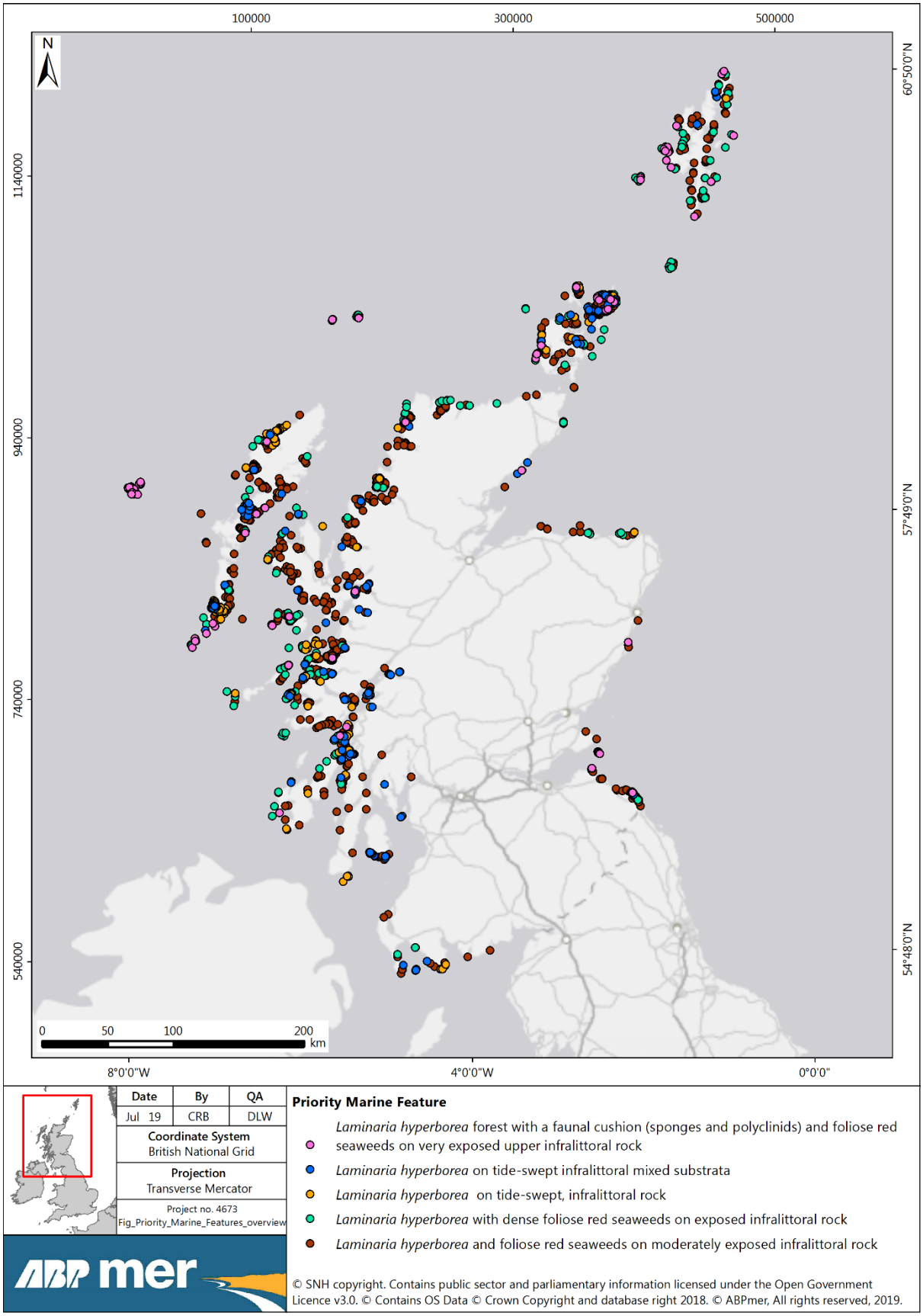


Figure 13. **Priority Marine Feature (PMF) habitats which include the kelp Laminaria hyperborea in Scotland**

4.5.2 Fish and shellfish

Kelp beds have been identified as providing important nursery and feeding functions for certain fish and shellfish species. For example, Smale *et al*. (2013) indicated that kelp forest habitats are vital for the European lobster (*Homarus gammarus*) where it preys on a variety of molluscs and crustaceans. Kelp forests also serve as a nursery for many fish species, including Atlantic Cod (*Gadus morhua*) and pollack (*Pollachius pollachius*) (Smale *et al*. 2013). They are also feeding grounds for fish species such as ballan wrasse (*Labrus bergylta*) and Goldsinny wrasse (*Ctenolabrus rupestris*), which prey on kelp associated invertebrates (Norderhaug *et al*. 2005), as well as attracting commercially important species such as pollack, European sea bass (*Dicentrarchus labrax*) and conger eels (*Conger conger*) (Smale *et al*. 2013). In turn, elevated fish densities in kelp forests attract large piscivores, such as large fish, seals and otters.

It is likely that the kelp beds within the proposed seaweed management zone are of functional value to juvenile fish (and shellfish), as well as important feeding areas. Therefore, reduction in the density of kelp beds within the proposed seaweed management zone could reduce the functional value of the area for juvenile and adult fish and shellfish. As noted in Section 4.5.1 in relation to PMFs ('Kelp beds'), the spatial extent of the proposed seaweed management zone is small relative to the overall extent of kelp resources in the Firth of Forth region (less than 1.5%), and negligible in the national context (less than 0.05%). Given the mobile nature of fish and shellfish, as well as the extensive (similar) habitat type in the wider area, it is considered unlikely that the proposed activity would significantly impact these receptors. The potential loss in terms of primary production as a result of the proposed activity is considered minimal in the wider context of kelp primary production in Scotland (and other seaweed productivity), as well overall primary productivity in the marine environment, including phytoplankton. Consequential impacts to fish and shellfish through disruption to trophic links of species using benthic habitat, including prey resources, within the proposed seaweed management is considered negligible.

In summary, the impacts of the proposed seaweed removals at TOR on fish and shellfish are considered to be **minor adverse**.

4.5.3 Marine mammals

The proposed seaweed management zone does not directly overlap with any national or international nature conservation designated sites with marine mammal qualifying features. The nearest relevant site is the Berwickshire and North Northumberland Coast SAC, designated for Grey seal (*Halichoerus grypus*), at greater than 10 km to the southeast (see Section 4.4; Figure 6). There are no known seal haul-out sites located in the vicinity of TOR. Nevertheless, it is recognised that marine mammals are likely to migrate through and forage in the waters surrounding TOR.

Pre-application advice from SNH recognised that the proposed activity will see 'one small vessel in the water around TOR, in a limited area, for a limited period of time' (see Section 2.3) and, therefore, vessel movements are considered highly unlikely to present a significant disturbance to marine mammals. In terms of disturbance of foraging habitat for marine mammals, the spatial extent of the proposed seaweed management zone is considered negligible in wider context of kelp habitat in the region. Given the mobile nature of marine mammals, as well as the extensive (similar) habitat type in the wider area, it is considered unlikely that the proposed activity would significantly impact these receptors.

As discussed in Section 4.5.1, the potential loss in terms of primary production as a result of the proposed activity is considered minimal in the wider context of kelp primary production in Scotland (and other seaweed productivity), as well overall primary productivity in the marine environment, including phytoplankton. Consequential impacts to marine mammals through disruption to trophic links of species using benthic habitat (e.g. prey resources) within the proposed seaweed management is considered negligible.

In summary, the impacts of the proposed seaweed removals at TOR on marine mammals are considered to be **insignificant**.

4.5.4 Ornithology

The waters of the Firth of Forth and St Andrews Bay attract one of the largest and most diverse Scottish marine bird concentrations. The Outer Firth of Forth and St Andrews Bay pSPA stretches from Arbroath to St Abb's Head, encompassing the Firth of Forth, the outer Firth of Tay and St Andrews Bay (see Section 4.4), and the proposed seaweed management zone at TOR overlaps this large nature conservation designated site (Figure 6). The site supports important populations of 21 species of marine bird (see Table 10). Many of these species feed by surfacing diving, while others dive from flight. Pre-application advice from SNH highlighted that kelp habitat may be used by some of the pSPA bird species for foraging (see Section 2.3). Therefore, given the HRA process was suggested to apply, information to inform an AA under the Habitat Regulations has been provided in Appendix A.

The proposed seaweed management zone is approximately 1.29 km^2, assumed to largely comprise kelp habitat. Disturbance to this habitat type could reduce the functionality as a feeding resource for birds. However, as noted in Section 4.5.1 in relation to PMFs ('Kelp beds'), the spatial extent of the proposed seaweed management zone is small relative to the overall extent of kelp resources in the Firth of Forth region (less than 1.5%). Furthermore, it should be noted that kelp beds will only contribute one habitat type used by foraging marine birds. Given the mobile nature of marine birds and the typically large foraging areas used, as well as the extensive (similar) habitat type in the wider area, it is considered unlikely that the proposed activity would significantly impact these receptors. It is also considered unlikely that a single vessel working in the vicinity of TOR would present a significant visual disturbance to marine birds foraging in the area. The potential loss in terms of primary production as a result of the proposed activity is considered minimal in the wider context of kelp primary production in Scotland (and other seaweed productivity), as well overall primary productivity in the marine environment, including phytoplankton. Consequential impacts to (sea) birds through disruption to trophic links of species using benthic habitat (e.g. prey resources) within the proposed seaweed management is considered negligible.

In summary, the impacts of the proposed seaweed removals at TOR on marine birds are considered to be **insignificant**.

4.5.5 Invasive non-native species (INNS)

There is a potential risk that seaweed removals at TOR could result in the introduction or spread of INNS. The removal of kelp (predominantly *L. hyperborea*) within the proposed seaweed management zone may create colonising space for the recruitment of INNS. The area is approximately 1.29 km^2 and is naturally disturbed by wave activity during storms on a regular basis. It is recognised that the proposed activity is likely to be more intensive in removing seaweed (kelp), given this is the desired result, compared to the episodic dislodgement of seaweeds during storm events (which can also result in significant clearance of kelp habitat). However, kelp habitats recover over time from storm damage, at which point it could be considered to present a similar opportunity for colonisation by INNS. The proposed activity will primarily remove kelp and will cause very little impact to the seabed (Norwegian-style kelp rake pulled through the water column at approximately 0.5 m above the seabed). While the proposed technique typically removes entire kelp plants, including holdfasts, juvenile plants are largely left *in situ*.

As part of a monitoring plan, it is proposed to undertake drop-down video surveys before and after each seaweed removal campaign, hereafter referred to as pre- and post-monitoring surveys, respectively. The aims of these monitoring surveys are as follows:

- **Pre-monitoring survey**: To collect information on the density and distribution of kelp and other algal species prior to the campaign. The pre-monitoring survey would also produce a current broad-scale map of subtidal habitats, used to establish/confirm baseline conditions for impact verification purposes, and also identify key areas for seaweed removal in the vicinity of the TOR cooling water intake; and
- **Post-monitoring survey**: To understand changes in kelp density and subtidal habitat distribution following each campaign. This information will be valuable to understanding any potential environmental effects of the licensed activity, as well as understanding whether a campaign has successfully reduced seaweed coverage.

Through pre-application advice from SNH (see Section 2.3), it was noted that the INNS Japanese kelp (*Undaria pinnatifida*) has been recorded at Port Edgar marina in the Firth of Forth (approximately 60 km to the west of TOR). This species may compete for space and resources with native species of kelp and other brown seaweeds. To minimise the potential risk, it was suggested to consider the principles of marine biosecurity planning guidance (Payne *et al.* 2014) and best practice advice (Cook *et al.* 2014). Through the pre- and post-monitoring surveys outlined above, it will be possible to monitor and respond should the invasive *U. pinnatifida* become established within the proposed seaweed management area. During these surveys, alongside the review of kelp distribution and abundance, the presence of *U. pinnatifida* will be recorded using the SACFOR scale (see Section 4.5.1). On this basis, while there remains a potential risk of non-native species colonising the newly exposed rocky habitat at TOR, these measures are considered to inform how to proceed should such species be identified.

The use of a vessel and equipment to remove seaweed at TOR could pose a risk of introduction of non-native species through, for example, discharge of ballast water, biofouling of the vessel's hull and transfer through use of equipment in differing water bodies. It is likely that a relatively local vessel will be chartered to undertake the proposed activity and thus the risk of transfer of non-native species from further afield is low. The seaweed removal equipment (Norwegian-style kelp rake) will be cleaned before and after commencing the proposed works. Seaweed removed from the proposed seaweed management zone will be landed to the vessel and disposed of to land (as opposed to disposal at sea).

Overall, the risk of introduction or spread of non-native species as a result of the proposed seaweed removal activity is considered to be low and, assuming the above measures are in place, the impact is assessed as **minor adverse**.

4.6 Cumulative and in-combination effects

There are no specific projects or plans known to be taking place in the immediate vicinity of the proposed seaweed management zone at TOR (i.e. less than 10 km). It is also noted that there are no other known seaweed removal/harvesting proposals in the Firth of Forth. However, there are a number of offshore wind farm developments, either consented or currently in the planning system (including revised designs), which could potentially affect the Outer Firth of Forth and St Andrews Bay Complex pSPA[14]. Therefore, it is recognised that cumulative/in-combination effects could arise as a result of the proposed seaweed removals at TOR on this designated site.

In terms of spatial extent, the size of Neart na Gaoithe (approximately 105 km^2)[15], Inch Cape (approximately 150 km^2)[16] and Seagreen Phase One (Alpha and Bravo; approximately 400 km^2)[17] offshore wind farms in the Outer Firth of Forth are several orders of magnitude larger than the proposed

[14] https://www2.gov.scot/Topics/marine/Licensing/marine/scoping (Accessed September 2019).
[15] https://nngoffshorewind.com/ (Accessed September 2019).
[16] http://www.inchcapewind.com/home (Accessed September 2019).
[17] https://www.seagreenwindenergy.com/ (Accessed September 2019).

seaweed management zone (1.29 km^2). Given the offshore location of these wind farms, they are unlikely to overlap kelp beds and, therefore, the proposed activity at TOR would not present an additive loss of such habitat. Instead, the offshore wind farms are thought to largely overlap sandy habitat which supports a different food resource to designated bird features.

As noted in Section 4.4, disturbance to designated bird features from seaweed removals within the proposed seaweed management zone at TOR equates to an area less than 0.05% of the extent of the Outer Firth of Forth and St Andrews Bay Complex pSPA, with disturbance occurring over a very short period each year. At this scale, any disturbance or loss of kelp habitat is considered unlikely to significantly affect birds foraging in the area, particularly in the context of available foraging grounds in the wider Firth of Forth. The reduction in available foraging habitat in combination with the offshore wind farms is considered negligible.

The potential effects that can be attributed to the proposed works are small-scale, localised and considered to be minor at worst for environmental receptors (see Sections 4.2 to 4.5). Therefore, the proposed works are **not predicted to contribute in any significant way to adverse cumulative/in-combination effects**.

5 Conclusions

Torness Power Station (TOR), owned and operated by EDF Energy, is seeking a two-year marine licence to remove up to a maximum of 300 tonnes (wet weight) per annum of seaweed (based on two campaigns per annum, each removing up to 150 tonnes), primarily comprising *Laminaria hyperborea*, from within a proposed seaweed management zone (approximately 1.29 km^2) in the vicinity of its cooling water intake.

The potential effects that can be attributed to the proposed works are localised and, with the application of mitigation measures, are considered to be minor adverse or insignificant for all receptors, both alone and cumulatively/in-combination with other projects. A summary of how the proposed activity is compliant with the respective legislative requirements is provided below:

- **Environmental Impact Assessment**: The scale of the proposed works at TOR is such that an EIA is not considered necessary. Nevertheless, the marine licence application is supported by the review of potential impact pathways provided in Section 4 of this environmental appraisal;
- **Habitats Regulations Appraisal**: Through pre-application consultation with SNH, it was suggested that that there may be 'likely significant effects' (LSE) upon the Outer Firth of Forth and St Andrews Bay Complex pSPA due to the removal of habitat that may be used for foraging birds. Therefore, to support the HRA process, the information required to inform an appropriate assessment (AA) has been provided in Appendix A. Based on the information provided, it is considered that the proposed works at TOR will not have an adverse effect on site integrity; and
- **Water Framework Directive**: The scale and nature of the proposed works are relatively small in scale and unlikely to cause a deterioration or failure of the Barns Ness to Wheat Stack coastal water body, or other nearby coastal water bodies, to meet future WFD objectives. A WFD compliance assessment has been prepared in order to comply with the requirements of the WFD and is provided in Appendix B.

6 References

ABPmer. (2017). Hunterston B Seaweed Removal, Environmental Appraisal. ABPmer Report No. R.2827. A report produced by ABPmer for EDF Energy, June 2017.

ABPmer SEASTATES: https://www.seastates.net (Accessed September 2019).

AMEC. (2015). Torness Cooling Water Protection Works, Intertidal Survey Report. Report by Amec Foster Wheeler for EDF Energy Nuclear Generation Ltd.

Beavis, A. and Charlier, R.H. (1987). An economic appraisal for the onshore cultivation of *Laminaria* spp. Hydrobiologia 151/152: 387-398.

Burrows, M.T., Fox, C.J., Moore, P., Smale, D., Sotheran, I., Benson, A., Greenhill, L., Martino, S., Parker, A., Thompson, E. and Allen, C.J. (2018). Wild seaweed harvesting as a diversification opportunity for fishermen. A report by SRSL for HIE, pp. 171. Available online at: http://www.hie.co.uk/common/handlers/download-document.ashx?id=0336008d-db41-4b61-a9bd-6bfcbd31c876 (Accessed September 2019).

Burrows, M.T., Kamenos, N.A., Hughes, D.J., Stahl, H., Howe, J.A. and Tett, P. (2014). Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment. Scottish Natural Heritage Commissioned Report No. 761. Available online at: https://www.nature.scot/sites/default/files/Publication%202014%20-%20SNH%20Commissioned%20Report%20761%20-%20Assessment%20of%20carbon%20budgets%20and%20potential%20blue%20carbon%20stores%20in%20Scotland%27s%20coastal%20and%20marine%20environment.pdf (Accessed September 2019).

Chartered Institute of Ecology and Environmental Management (CIEEM). (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. September 2018. Available online at: https://cieem.net/wp-content/uploads/2019/02/Combined-EclA-guidelines-2018-compressed.pdf (Accessed September 2019).

Cook, E.J., Payne, R.D. and Macleod, A. (2014). Marine biosecurity planning – Identification of best practice: A review. Scottish Natural Heritage Commissioned Report No. 748. Available online at: https://www.nature.scot/snh-commissioned-report-748-marine-biosecurity-planning-identification-best-practice-review (Accessed September 2019).

Dayton, P.K. (1985). Ecology of kelp communities. Annual Review of Ecology and Systematics 16: 215-245.

Environment Agency. (2010). Cooling water options for the New Generation of Nuclear Power Stations in the UK. SC070015/SR3. Author(s): Turnpenny, A.W.H., Coughlan, J., Ng, B., Crews, P., Bamber, R.N. and Rowles, P. June 2010. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291077/scho0610bsot-e-e.pdf (Accessed September 2019).

Envision Mapping. (2014). Torness benthic survey and habitat mapping, analysis and interpretation of drop down video survey. October 2014.

Gaylord, B., Rosman, J.H., Reed, D.C., Koseff, J.R., Fram, J., MacIntyre, S., Arkema, K., McDonald, C., Brzezinski, M.A., Largier, J.L. and Monismith, S.G. (2007). Spatial patterns of flow and their modification within and around a giant kelp forest. Limnology and Oceanography 52(5): 1838-1852.

HM Government. (2011). UK Marine Policy Statement. HM Government, Northern Ireland Executive, Scottish Government, Welsh Assembly Government. March 2011 London: The Stationery Office. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf (Accessed September 2019).

Joint Nature Conservation Committee (JNCC). (2018). Supplementary advice on conservation objectives for Firth of Forth Banks Complex Nature Conservation MPA. February 2018. Available online at: http://archive.jncc.gov.uk/pdf/FFBC_SACO_v1.0.pdf (Accessed September 2019).

Jupp, B.P. and Drew, E.A. (1974). Studies on the growth of *Laminaria hyperborea* (Gunn.) Fosl. I. Biomass and productivity. Journal of Experimental Marine Biology and Ecology 15(2): 185-196.

Kelly, E. (2005). The role of kelp in the marine environment. Irish Wildlife Manuals, No. 17. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Løvås, S.M. and Tørum, A. (2001). Effect of the kelp *Laminaria hyperborea* upon sand dune erosion and water particle velocities. Coastal Engineering 44(1): 37-63.

Marine Scotland. (2015). Guidance for Marine Licence Applicants. Version 2 - June 2015. Available online at: https://www2.gov.scot/Resource/0052/00524064.pdf (Accessed September 2019).

Mork, M. (1996). The effect of kelp in wave damping. Sarsia 80(4): 323-327.

Norderhaug, K.M., Christensen, J.D., Fossa, J.H. and Fredriksen, S. (2005). Fish-macrofauna interactions in a kelp (*Laminaria hyperborea*) forest. Journal of the Marine Biological Association of the United Kingdom 85: 1279-1286.

Pehlke, C. and Bartsch, I. (2008). Changes in depth distribution and biomass of sublittoral seaweeds at Helgoland (North Sea) between 1970 and 2005. Climate Research 37: 135-147.

Payne, R.D., Cook, E.J. and Macleod, A. (2014). Marine Biosecurity Planning – Guidance for producing site and operation-based plans for preventing the introduction of non-native species. Report by SRSL Ltd. in conjunction with Robin Payne to the Firth of Clyde Forum and Scottish Natural Heritage 39 pp. Available online at: https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/marine-non-native-species (Accessed September 2019).

Scottish Natural Heritage (SNH). (2016). SNH Priority Marine Features Guidance. Document ID: A2086517. Available online at: https://www.nature.scot/priority-marine-features-guidance (Accessed September 2019).

Sjøtun, K. and Fredriksen, S. (1995). Growth allocation in *Laminaria hyperborea* (Laminariales, Phaeophyceae) in relation to age and wave exposure. Marine Ecology Progress Series 126: 213-222.

Smale, D.A., Burrows, M.T., Moore, P., O'Connor, N. and Hawkins, S.J. (2013). Threats and knowledge gaps for ecosystem services provided by kelp forests: a northeast Atlantic perspective. Ecology and Evolution 3(11): 4016-4038.

The Scottish Government. (2014). The Land of Scotland and the Common Good. Report of the Land Reform Review Group. Presented to Scottish Ministers by the Members of the Land Reform Review Group, Elliot, A., Watt, J., Cooke, I. and Tabor, P. (May 2014). Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/progress-report/2014/05/land-reform-review-group-final-report-land-scotland-common-good/documents/00451087-pdf/00451087-pdf/govscot%3Adocument/00451087.pdf (Accessed September 2019).

The Scottish Government. (2015). Scotland's National Marine Plan. A Single Framework for Managing Our Seas. Marine Scotland. March 2015. Available online at: http://www.gov.scot/Resource/0047/00475466.pdf (Accessed September 2019).

Tyler-Walters, H. (2007). *Laminaria hyperborea* Tangle or cuvie. In: Tyler-Walters, H. and Hiscock, K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available online at: https://www.marlin.ac.uk/species/detail/1309 (Accessed September 2019).

Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. and Crawford-Avis, O.T. (2016). Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406. Available online at: https://www.nature.scot/snh-commissioned-report-406-descriptions-scottish-priority-marine-features-pmfs (Accessed September 2019).

7 Abbreviations

AA	Appropriate Assessment
AMEC	Amec Foster Wheeler
AWB	Artificial Water Body
BWD	Bathing Water Directive
CAR	Controlled Activity Regulations
CD	Chart Datum
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Charted Institute of Ecology and Environmental Management
EC	European Commission
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EQS	Environmental Quality Standard
EQSD	Environmental Quality Standards Directive
EU	European Union
EUNIS	European Nature Information System
GCS	Good Chemical Status
GEN	General Policy
GEP	Good Ecological Potential
GES	Good Ecological Status
GPP	Guidance for Pollution Prevention
GS	Good Status
HIE	Highlands and Islands Enterprise
HM	Her Majesty's
HMWB	Heavily Modified Water Body
HNB	Hunterston B Power Station
HRA	Habitats Regulations Appraisal
ID	Identity
IEMA	Institute of Environmental Management and Assessment
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MS-LOT	Marine Scotland Licensing Operations Team
NVZ	Nitrate Vulnerable Zone
ODN	Ordnance Datum Newlyn
PMF	Priority Marine Feature
PSD	Priority Substances Directive
pSPA	Proposed Special Protection Area

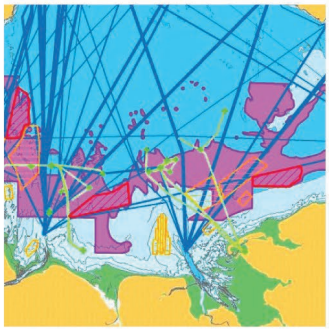
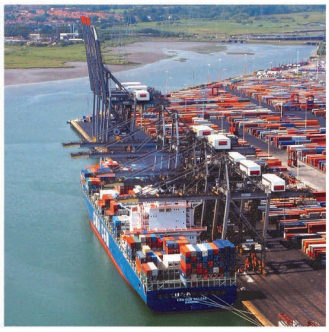
Ramsar	Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)
RBMP	River Basin Management Plan
rBWD	Revised Bathing Water Directive
SAC	Special Area of Conservation
SACFOR	Super-abundant (S); Abundant (A); Common (C); Frequent (F); Occasional (O); Rare (R); Less than rare (L)
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SRSL	SAMS Research Services Ltd
SSSI	Site of Special Scientific Interest
TOR	Torness Power Station
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
WFD	Water Framework Directive
WGS84	World Geodetic System (1984)

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices



Innovative Thinking - Sustainable Solutions

ABP mer

A Habitats Regulations Appraisal (HRA)

A.1 Need for an Appropriate Assessment

Torness Power Station (TOR), owned and operated by EDF Energy, is proposing to undertake seaweed removals from an area adjacent to the station's cooling water intake, referred to as the proposed seaweed management zone. The proposed works will involve the use of a Norwegian-style kelp rake to remove up to 150 tonnes (wet weight) of seaweed per campaign from within the proposed seaweed management zone (predominantly *Laminaria hyperborea*), with up to two campaigns to be undertaken per annum. EDF Energy is applying for a two-year marine licence period, during which up to four campaigns could be undertaken. Therefore, up to 600 tonnes (wet weight) of seaweed could potentially be removed from the proposed seaweed management zone during this period. More detailed information on the scheme can be found in Section 2 of this environmental appraisal (see main report). The proposed works are considered a pragmatic approach to managing the station's risk from seaweed ingress and no viable alternative solution is available.

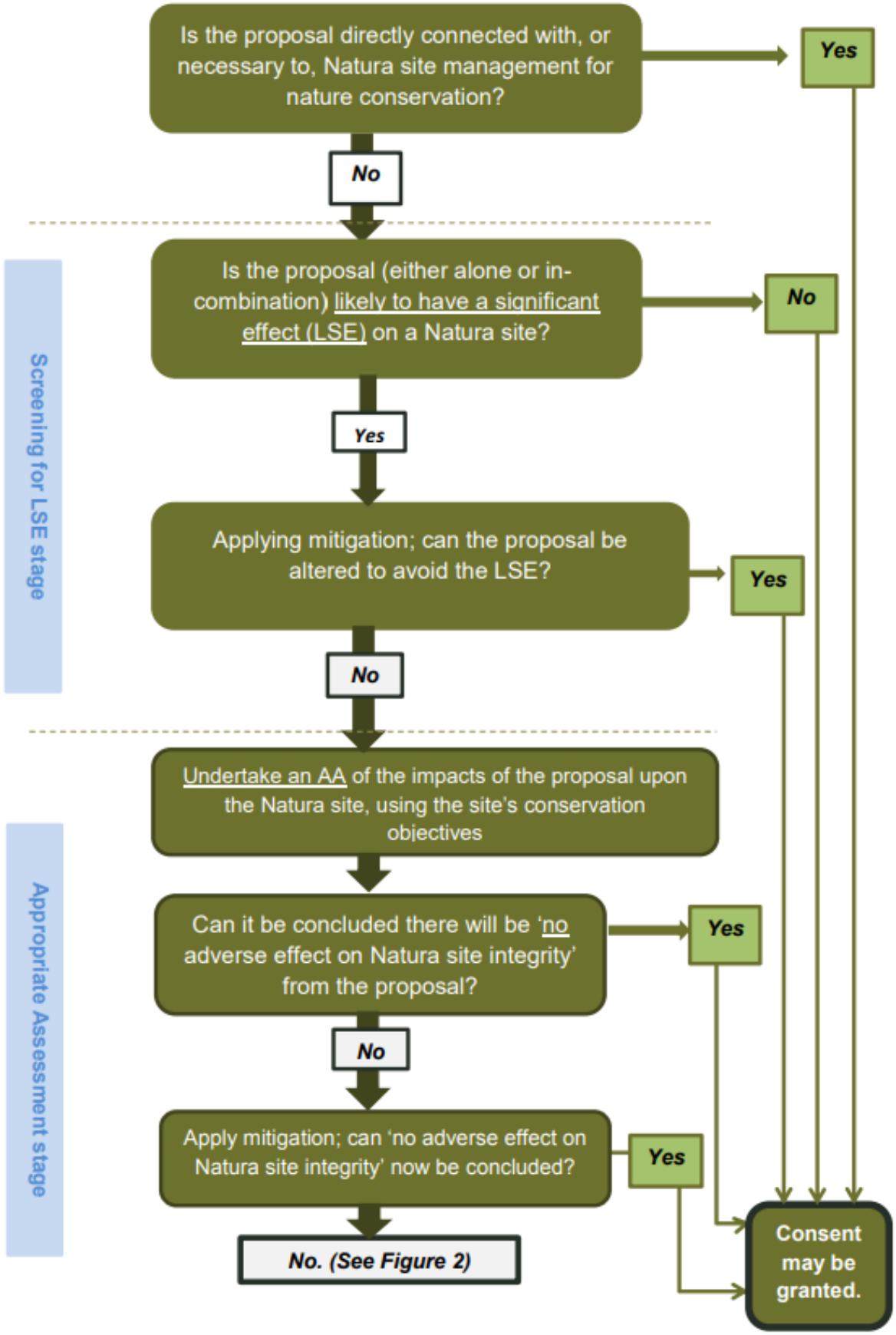
Where a project is located close to, or within, an area designated or proposed under the Birds (2009/147/EC) and/or Habitats Directives (92/43/EEC; European sites) and/or the Ramsar Convention (Ramsar sites), the requirements of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), commonly referred to as the Habitats Regulations in Scotland, apply. The proposed works at TOR directly overlap with the Outer Firth of Forth and St Andrews Bay Complex proposed Special Protection Area (pSPA), with other European/Ramsar sites greater than 5 km away. It is recognised that the Outer Firth of Forth and St Andrews Bay Complex pSPA is afforded the same level of protection as a designated Special Protection Area (SPA) via policy GEN 9 (Natural heritage) of Scotland's National Marine Plan (The Scottish Government, 2015).

An Appropriate Assessment (AA) under Regulation 48(1) of the Habitat Regulations will be required if there is likely to be a significant effect on a European site. Regulation 48(1) states that:

> *"A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which–*
>
> *(a) is likely to have significant effect on a European site in Great Britain (either alone or in combination with other plans or projects); and*
> *(b) is not directly connected with or necessary to the management of the site*
>
> *shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives".*

The decision as to whether an AA is required or not is based upon an assessment of 'Likely Significant Effect' (LSE), which is recognised as being a statement that the anticipated effects of the proposal will be more than trivial, i.e. that the anticipated changes resulting from the proposal have the potential to impact on a receptor designated, or proposed to be designated, as a feature of a European/Ramsar site. It does not automatically follow that an impact will occur, or that the impact would be significant, with a decision of LSE being purely an indication of the need for an AA.

Figure A.1 presents a simple schematic of the Habitats Regulations Appraisal (HRA) process (up to and including AA), published by Scottish Natural Heritage (SNH) as a guide for developers and regulators preparing applications in the Firth of Forth (SNH, 2016).



Source: Scottish Natural Heritage (SNH), 2016

Figure A.1. The Habitats Regulations Appraisal (HRA) process, up to and including appropriate assessment (AA)

A.2 Impacts to relevant interest features of designated sites

The proposed works at TOR are located within the boundaries of the Outer Firth of Forth and St Andrews Bay Complex pSPA (see Figure A.2). Table A.1 presents the qualifying interest features and conservation objectives of this (proposed) designated site. Based on the overlap with the Outer Firth of Forth and St Andrews Bay Complex pSPA, it is acknowledged that a potential LSE cannot be ruled out. This was also informed by pre-application advice from SNH (Ref: A297574; 12 June 2019) which stated:

> "*At this stage we suggest that there may be 'likely significant effects' upon the pSPA due to the removal of habitat that may be used for foraging, and therefore an appropriate assessment may be required*".

Therefore, on a precautionary basis, information has been provided to allow Marine Scotland (in consultation with SNH) to determine whether the proposed works are likely to have an adverse effect on the integrity of this European site and to undertake an AA (if deemed necessary). Table A.2 outlines the potential effects of the proposed works on the relevant features for the Outer Firth of Forth and St Andrews Bay Complex pSPA.

A.3 In-combination effects

The potential effects on the Outer Firth of Forth and St Andrews Bay Complex pSPA and its features that can be attributed to the proposed works in TOR are temporary, very localised and negligible/minor at worst. There are no specific projects or plans known to be taking place in the immediate vicinity of the proposed seaweed management zone at TOR (i.e. less than 10 km). It is also noted that there are no other known seaweed removal/harvesting proposals in the Firth of Forth. However, there are a number of offshore wind farm developments, either consented or currently in the planning system (including revised designs), which could potentially affect the Outer Firth of Forth and St Andrews Bay Complex pSPA[18]. Therefore, it is recognised that cumulative/in-combination effects could arise as a result of the proposed seaweed removals at TOR on this designated site.

In terms of spatial extent, the size of Neart na Gaoithe (approximately 105 km^2)[19], Inch Cape (approximately 150 km^2)[20] and Seagreen Phase One (Alpha and Bravo; approximately 400 km^2)[21] offshore wind farms in the Outer Firth of Forth are several orders of magnitude larger than the proposed seaweed management zone (1.29 km^2). Given the offshore location of these wind farms, they are unlikely to overlap kelp beds and, therefore, the proposed activity at TOR would not present an additive loss of such habitat. Instead, the offshore wind farms are thought to largely overlap sandy habitat which supports a different food resource to designated bird features.

As noted in Section 4.4 of the environmental appraisal (see main report), disturbance to designated bird features from seaweed removals within the proposed seaweed management zone at TOR equates to an area less than 0.05% of the extent of the Outer Firth of Forth and St Andrews Bay Complex pSPA, with disturbance occurring over a very short period each year. At this scale, any disturbance or loss of kelp habitat is considered unlikely to significantly affect birds foraging in the area, particularly in the context of available foraging grounds in the wider Firth of Forth. The reduction in available foraging habitat in combination with the offshore wind farms is considered negligible.

18 https://www2.gov.scot/Topics/marine/Licensing/marine/scoping (Accessed September 2019).
19 https://nngoffshorewind.com/ (Accessed September 2019).
20 http://www.inchcapewind.com/home (Accessed September 2019).
21 https://www.seagreenwindenergy.com/ (Accessed September 2019).

The potential effects that can be attributed to the proposed works are small-scale, localised and considered to be minor at worst for environmental receptors (see Sections 4.2 to 4.5 of the main report). Therefore, the proposed works are not predicted to contribute in any significant way to adverse cumulative/in-combination effects.

A.4 Conclusion

The proposed works at TOR are not expected to lead to any adverse effects to the integrity of the Outer Firth of Forth and St Andrews Bay Complex pSPA, or any other European/Ramsar sites in the vicinity. No ongoing activities, plans and projects are considered to result in in-combination effects of a scale that would change the existing condition status of the features recognised within the European/Ramsar sites. It is considered that the proposed works can commence in accordance with the requirements of the Habitat Regulations.

A.5 References

Burrows, M.T., Fox, C.J., Moore, P., Smale, D., Sotheran, I., Benson, A., Greenhill, L., Martino, S., Parker, A., Thompson, E. and Allen, C.J. (2018). Wild seaweed harvesting as a diversification opportunity for fishermen. A report by SRSL for HIE, pp. 171. Available online at: http://www.hie.co.uk/common/handlers/download-document.ashx?id=0336008d-db41-4b61-a9bd-6bfcbd31c876 (Accessed September 2019).

The Scottish Government. (2015). Scotland's National Marine Plan. A Single Framework for Managing Our Seas. Marine Scotland. March 2015. Available online at: http://www.gov.scot/Resource/0047/00475466.pdf (Accessed September 2019).

Scottish Natural Heritage (SNH). (2016). Habitats Regulations Appraisal (HRA) on the Firth of Forth. A Guide for developers and regulators. Available online at: https://www.nature.scot/habitats-regulations-appraisal-hra-firth-forth-guide-developers-and-regulators (Accessed September 2019).

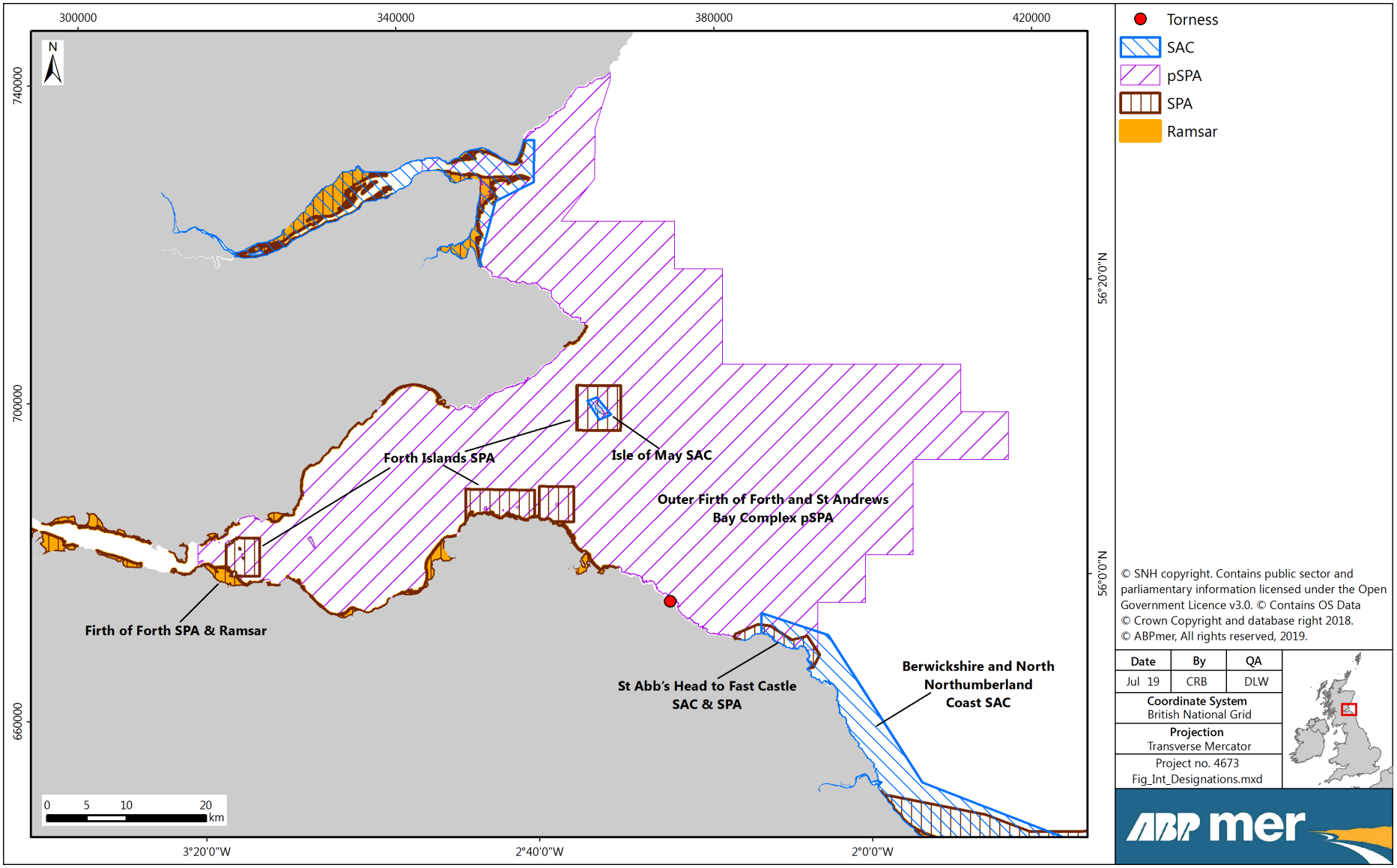


Figure A.2. Nature conservation designated sites in the vicinity of the proposed seaweed management zone at TOR

Table A.1. Internationally designated sites overlapping with proposed works at TOR

Site	Area	Site Description	Qualifying Interest Features	Conservation Objectives
Outer Firth of Forth and St Andrews Bay Complex pSPA	272,068 hectares	The Outer Firth of Forth and St Andrews Bay Complex pSPA is a large estuarine/marine site on south-east coast of Scotland consisting of the two closely adjacent Firths of Forth and Tay. In the mid Firth of Forth a belt of mud-rich sediments lies between areas of sandy gravels and shell material on either side along the shore. As the estuary widens towards the outer firth, there are extensive areas of sandy and gravelly muds and fine sediments. In contrast St Andrews Bay contains clean sands and gravel with only small areas of muddy sediments. Water depth is variable but large areas, in both the Firth of Forth and St Andrews Bay, are shallow and less than 10 m deep. The area supports a wide variety of both pelagic and demersal fish, including sandeels, and crustaceans, molluscs and marine worms, all of which, especially sandeels, comprise the prey of the waterfowl species.	Under Article 4.1 of the Birds Directive (Annex I species) (non-breeding): ▪ Red-throated diver (*Gavia stellata*) (A001); Slavonian grebe (*Podiceps auritus*) (A007); Little gull (*Larus minutus*) (A177); Common tern (*Sterna hirundo*) (A193); Arctic tern (*Sterna paradisaea*) (A194) Under Article 4.2 of the Birds Directive (migratory waterfowl): ▪ Common eider (*Somateria mollissima*) (A063) ▪ In excess of 20,000 individual waterfowl, including Long-tailed duck (*Clangula hyemalis*) (A064); Common scoter (*Melanitta nigra*) (A065); Velvet scoter (*Melanitta fusca*) (A066); Common goldeneye (*Bucephala clangula*) (A067); Red-breasted merganser (*Mergus serrator*) (A069) Under Article 4.2 of the Birds Directive (migratory seabirds): ▪ European shag (*Phalacrocorax aristotelis*) (A018); Northern gannet (*Morus bassanus*) (A016) Under Article 4.2 of the Birds Directive (breeding seabirds): ▪ In excess of 20,000 individual seabirds, including Atlantic puffin (*Fratercula arctica*) (A204); Black-legged kittiwake (*Rissa tridactyla*) (A188); Manx shearwater (*Puffinus puffinus*) (A013); Common guillemot (*Uria aalge*) (A199); Herring gull (*Larus argentatus*) (A184) Under Article 4.2 of the Birds Directive (non-breeding seabirds): ▪ In excess of 20,000 individual seabirds, including Black-headed gull (*Chroicocephalus ridibundus*) (A179); Common gull (*Larus canus*) (A182); Herring gull (*Larus argentatus*) (A184); Common guillemot (*Uria aalge*) (A199); European shag (*Phalacrocorax aristotelis*) (A018); Black-legged kittiwake (*Rissa tridactyla*) (A188); Razorbill (*Alca torda*) (A200)	The (draft) conservation objectives are: ▪ To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long-term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species. ▪ This contribution will be achieved through delivering the following objectives for each of the site's qualifying features: a) Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term; and b) To maintain the habitats and food resources of the qualifying features in favourable condition.

Source: Outer Firth of Forth and St Andrews Bay Complex Proposed marine SPA - supporting documents, available online at: https://www.nature.scot/outer-firth-forth-and-st-andrews-bay-complex-proposed-marine-spa-supporting-documents (Accessed September 2019).

Table A.2. Potential environmental effects to internationally designated sites

Site	Potential Impact	Potential Effect	Justification
Outer Firth of Forth and St Andrews Bay Complex pSPA	Loss or disturbance to subtidal feeding habitats for waterbirds	No adverse effect on site conservation objectives and integrity expected.	It is acknowledged that the kelp bed habitat within the proposed seaweed management zone may be used by some of the SPA bird species for foraging. However, the proposed activity will result in the disturbance/loss of up to 1.29 km^2 of seaweed (kelp) habitat. This equates to less than 0.05% of the area of the Outer Firth of Forth and St Andrews Bay Complex pSPA. Within the Firth of Forth region, there is an estimated (modelled) 88 km^2 of *L. hyperborea* habitat with a biomass greater than 2 kg/m^2, of which 10 km^2 is estimated (modelled) to have a biomass of greater than 5 kg/m^2 (Burrows *et al.* 2018). As noted in Section 2.2 (see main report), it is recognised that seaweed coverage within the proposed seaweed management zone is likely to include areas of dense kelp habitat (e.g. 5 kg/m^2). However, such densities are likely to be patchy across the area with much lower densities elsewhere (i.e. less than 2 kg/m^2). Therefore, the proposed seaweed management zone is estimated to represent a small proportion of the aforementioned *L. hyperborea* habitat within the Firth of Forth region (less than 1%). Furthermore, the Norwegian-style rake is anticipated to only remove a proportion of the kelp biomass during each pass of the rake and, therefore, the activity will serve to reduce the density of the kelp beds rather than remove them completely. Disturbance/loss of this habitat type is considered unlikely to significantly affect designated bird features foraging in the area, particularly in the context of available foraging grounds in the wider Firth of Forth. Therefore, no changes to qualifying species populations or the overall distribution of qualifying features within the site are expected.
	Disturbance to waterbirds during operation	No adverse effect on site conservation objectives and integrity expected.	The proposed activity will involve a single vessel operating within the proposed seaweed management zone in the vicinity of TOR. Noise and visual disturbance stimuli as a result of the works will be temporary, localised and will not cause any permanent displacement of birds from the area. Therefore, no changes to qualifying species populations or the overall distribution of qualifying features within the site are expected.

B Water Framework Directive (WFD) Compliance Assessment

B.1 Introduction

B.1.1 Project overview

Torness Power Station (TOR), owned and operated by EDF Energy, is located on the east coast of Scotland in the outer Firth of Forth near Dunbar, East Lothian (Figure B.1). The station utilises the sea as a source of cooling water for plant systems. The cooling water enters the station by passing through coarse screens located at the cooling water intake, used to remove large debris, followed by rotating drum screens to remove finer material. On several occasions in recent years, large volumes of seaweed have become entrained on the drum screens. This can present operational challenges to the station due to the restriction on rates of cooling water abstraction. Large volumes of seaweed ingress have previously caused physical damage to the drum screens and/or resulted in the reduction in energy generation of one or both reactors. In extreme cases, seaweed ingress has resulted in the complete shut-down of the reactor(s).

As an option to manage its risk, TOR is applying for a marine licence to remove seaweed adjacent to its cooling water intake. ABPmer has been commissioned by TOR to undertake an environmental appraisal to support the marine licence application (see main report). As part of this process, a Water Framework Directive (WFD) compliance assessment has been undertaken to determine whether the proposed works at TOR complies with the objectives of the WFD. This information together with the environmental appraisal will be submitted to Marine Scotland as part of the marine licensing process.

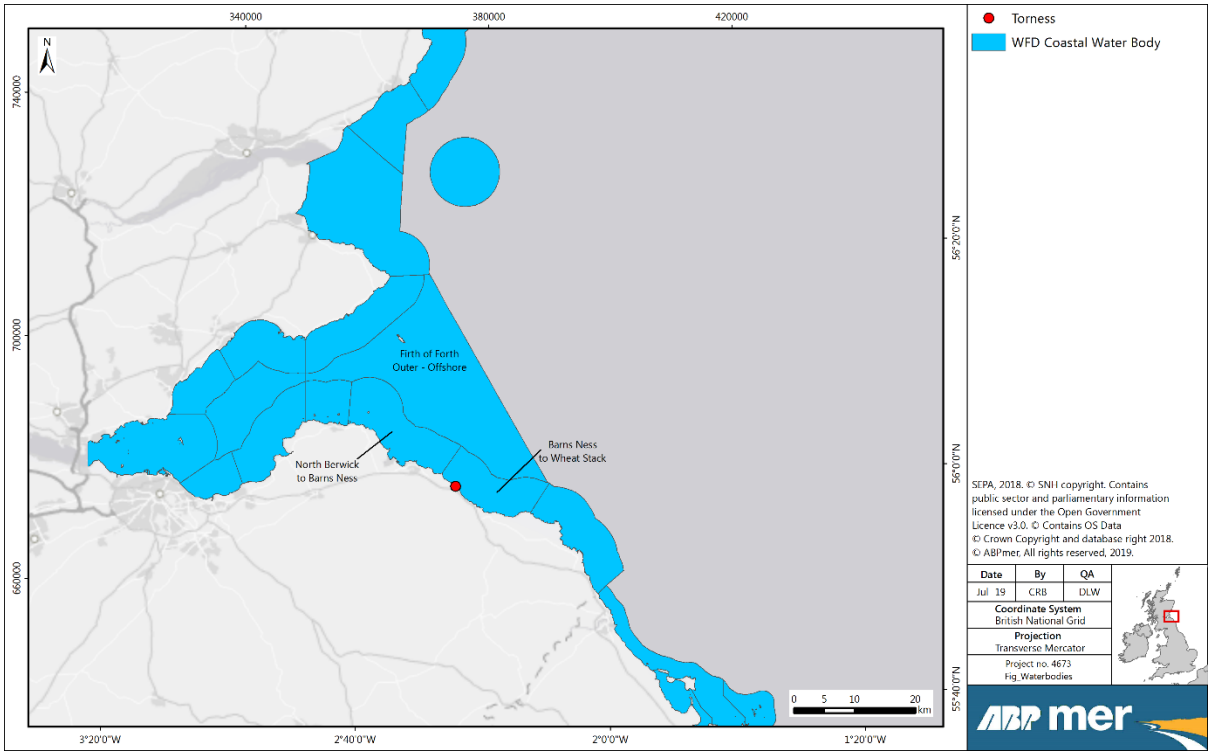


Figure B.1. Coastal water bodies in the vicinity of the proposed seaweed management zone at TOR

B.1.2 Water Framework Directive (WFD)

The WFD (2000/60/EC) came into force in 2000 and establishes a framework for the management and protection of Europe's water resources. It is implemented in Scotland through the Water Environment Water Services (Scotland) Act 2003 and the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), more commonly known as the Controlled Activity Regulations (CAR). The overall objective of the WFD is to achieve good status (GS) in all inland, transitional, coastal and ground waters by 2015, unless alternative objectives are set and there are appropriate reasons for time limited derogation.

The WFD divides rivers, lakes, lagoons, estuaries, coastal waters (out to one nautical mile from the low water mark), man-made docks and canals into a series of discrete surface water bodies. It sets ecological as well as chemical targets (objectives) for each surface water body. For a surface water body to be at overall GS, the water body must be achieving good ecological status (GES) and good chemical status (GCS). Ecological status is measured on a scale of high, good, moderate, poor or bad, while chemical status is measured as good or fail (i.e. failing to achieve good).

Each surface water body has a hydromorphological designation that describes how modified a water body is from its natural state. Water bodies are either undesignated (i.e. natural, unchanged), designated as a heavily modified water body (HMWB) or designated as an artificial water body (AWB). HMWBs are defined as bodies of water which, as a result of physical alteration by human use activities (such as flood protection and navigation) are substantially changed in character and cannot therefore meet GES. AWBs are artificially created through human activity. The default target for HMWBs and AWBs under the WFD is to achieve good ecological potential (GEP), a status recognising the importance of their human use while ensuring ecology is protected as far as possible.

The ecological status of surface waters is classified using information on the biological (e.g. fish, benthic invertebrates, phytoplankton, angiosperms and macroalgae), physico-chemical (e.g. dissolved oxygen and dissolved inorganic nitrogen) and hydromorphological (e.g. hydrological regime) quality of the water body, as well as several specific pollutants (e.g. copper and zinc). Compliance with chemical status objectives is assessed in relation to environmental quality standards (EQS) for a specified list of 'priority' and 'priority hazardous' substances. These substances were first established by the Priority Substances Directive (PSD) (2008/105/EC) which entered into force in 2009.

The PSD sets objectives, amongst other things, for the reduction of these substances through the cessation of discharges or emissions. As required by the WFD and PSD, a proposal to revise the list of priority (hazardous) substances was submitted in 2012. Subsequently, an updated PSD (2013/39/EU) was published in 2013, identifying new priority substances, setting EQSs for those newly identified substances, revising the EQS for some existing substances in line with scientific progress and setting biota EQSs for some existing and newly identified priority substances. The updated PSD is explained in the Scotland River Basin District (Standards) Directions 2014 (as amended) and the Solway Tweed River Basin District (Standards) (Scotland) Directions 2014 for the respective river basin districts.

In addition to surface water bodies, the WFD also incorporates groundwater water bodies. Groundwaters are assessed against different criteria compared to surface water bodies since they do not support ecological communities (i.e. it is not appropriate to consider ecological status of a groundwater). Therefore, groundwater water bodies are classified as good or poor quantitative status in terms of their quantity (groundwater levels and flow directions) and quality (pollutant concentrations and conductivity), along with chemical (groundwater) status.

River Basin Management Plans (RBMPs) are a requirement of the WFD, setting out measures for each river basin district to maintain and improve quality in surface and groundwater water bodies where necessary. In 2009, the Scottish Environment Protection Agency (SEPA) published the first cycle (2009 to 2015) of RBMPs for Scotland, reporting the status and objectives of each individual water body. SEPA subsequently published updated RBMPs for Scotland as part of the second cycle (2015 to 2021). The proposed works at TOR are located within the Barns Ness to Wheat Stack coastal water body (Figure B.1) in the Scotland river basin district which is reported in the Scotland RBMP (SEPA, 2015).

Consideration of WFD requirements is necessary for developments which have the potential to cause deterioration in ecological, quantitative and/or chemical status of a water body or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. Therefore, it is necessary to consider the potential for the proposed works at TOR to impact WFD water bodies, specifically referring to the following environmental objectives of the WFD:

- Prevent deterioration in status of all surface water bodies (Article 4.1 (a)(i));
- Protect, enhance and restore all surface water bodies with the aim of achieving good surface water status by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(ii));
- Protect and enhance all HMWBs/AWBs, with the aim of achieving GEP and GCS by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(iii));
- Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1 (a)(iv));
- Prevent or limit the input of pollutants into groundwater and prevent deterioration of the status of all groundwater water bodies (Article 4.1 (b)(i));
- Protect, enhance and restore all groundwater water bodies and ensure a balance between abstraction and recharge of groundwater (Article 4.1 (b)(ii));
- Ensure the achievement of objectives in other water bodies is not compromised (Article 4.8); and
- Ensure compliance with other community environmental legislation (Article 4.9).

In the absence of formal guidance for the preparation of WFD compliance assessments in Scotland, the Environment Agency's "Clearing the Waters for All" process has been used as a template for the assessment[22]. This guidance outlines how to assess the impact(s) of activities in transitional and coastal waters in relation to WFD objectives, setting out the following three stages:

- **Screening**: excludes any activities that do not need to go through the scoping or impact assessment stages (Section B.2);
- **Scoping**: identifies the receptors and quality elements that are potentially at risk from an activity and need further detailed assessment (Section B.3); and
- **Assessment**: considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and indicates if an activity may cause deterioration or jeopardise the water body achieving GS (Section B.4).

[22] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters (Accessed September 2019).

B.2 Screening

B.2.1 Project description

EDF Energy is proposing to remove seaweed from an area in the vicinity of the TOR cooling water intake, as shown in Figure B.2. Coordinates for the area, referred to as the proposed seaweed management zone, are provided in Table B.1, with the landward boundary following the mean low water mark between points A and D. The total area of the proposed seaweed management zone is approximately 1.29 km^2.

Table B.1. Coordinates of proposed seaweed management zone at TOR

Point (see Figure 2)	Coordinates (WGS84; decimal degrees)	
	Latitude	Longitude
A	55.979810	-2.430195
B	55.985423	-2.421389
C	55.974630	-2.399370
D	55.972042	-2.403405

In September 2014, a drop-down video survey found that one of the most common seaweed species in shallow subtidal areas near to the TOR cooling water intake is cuvie kelp (*Laminaria hyperborea*; Envision Mapping, 2014). EDF Energy is proposing to target cuvie kelp (*Laminaria hyperborea*) for removal from the proposed seaweed management zone using a Norwegian-style kelp rake. The Norwegian-style kelp rake comprises a comb-like harvesting head (2 – 4 m wide) that is situated within a curved frame. It is deployed from a vessel and trawled through the kelp bed at approximately 0.5 m above the rock substrate at a speed of around 3 knots (1.5 m/s). Trawls are made for approximately 2 minutes (covering a distance of around 200 m) before the head is recovered.

It is estimated that over 1,000 tonnes (wet weight) of *L. hyperborea* (among other seaweeds) could be present within the proposed seaweed management zone. The marine licence application is requesting permissions to remove up to 150 tonnes (wet weight) of seaweed per campaign from within the proposed seaweed management zone, with up to two campaigns to be undertaken per annum. EDF Energy is applying for a two-year marine licence period, during which up to four campaigns could be undertaken. Therefore, up to 600 tonnes (wet weight) of seaweed could potentially be removed from the proposed seaweed management zone during this period. Kelp removal will be undertaken as targeted campaigns, with each removal campaign estimated to last between 2 – 4 weeks depending on the vessel used and the location where material is brought to land for disposal. Campaigns will be undertaken at any time of year during the marine licence period; however, there will be a minimum three-month gap between consecutive campaigns.

Seaweed collected during the proposed removals activity will be stored on the vessel once recovered and taken to land. Depending on the vessel used, material will either be bagged at the point of collection, placed into skips or stored in a hopper for subsequent removal by grab bucket. Upon landing, the seaweed will be managed in accordance with waste management legislation and policy. Where feasible, material will be composted or used for energy recovery in preference to landfill. No material will be disposed of at sea, recognising the key objective of the proposed activity to manage the station's risk from seaweed ingress at the cooling water intake.

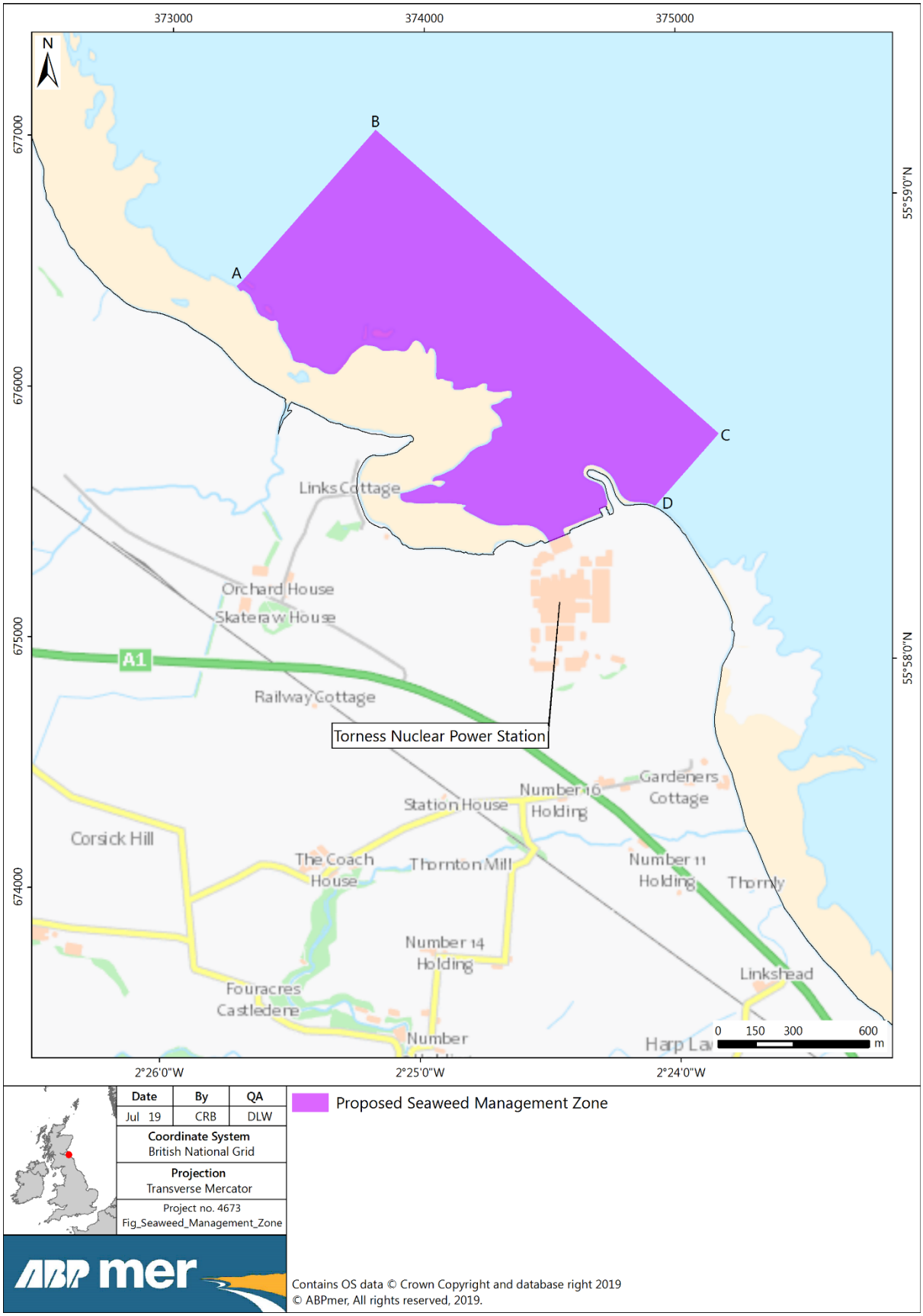


Figure B.2. Location of proposed seaweed management zone at TOR

B.2.2 Potentially affected water bodies

To determine which water bodies would potentially be affected by the proposed works, all surface and groundwater water bodies located within 10 km of the proposed seaweed management zone were recorded. The following water bodies were initially screened in:

- Barns Ness to Wheat Stack coastal water body (ID: 200038);
- North Berwick to Barns Ness coastal water body (ID: 200467);
- Firth of Forth Outer – Offshore coastal water body (ID: 200055);
- Tyne Estuary transitional water body (ID: 200033);
- Torness Coastal groundwater water body (ID: 150730);
- Torness groundwater water body (ID: 150568); and
- Dunbar groundwater water body (ID: 150494).

Based on the location and scale of the proposed works at TOR, it is considered unlikely to cause a significant non-temporary effect on the Tyne Estuary transitional water body (ID: 200033), or the Torness Coastal (ID: 150730), Torness (ID: 150568) and Dunbar (ID: 150494) groundwater water bodies, or cause deterioration in status at the water body level. Therefore, these four water bodies have been screened out of the assessment and will not be discussed further.

Table B.2, Table B.3 and Table B.4 provide a summary of the Barns Ness to Wheat Stack (ID: 200038), North Berwick to Barns Ness (ID: 200467) and Firth of Forth Outer – Offshore (ID: 200055) coastal water bodies respectively, including current water body status (overall, ecological and chemical). The proposed works at TOR are located within the Barns Ness to Wheat Stack coastal water body, with the North Berwick to Barns Ness coastal water body approximately 1.5 km to the northwest and the Firth of Forth Outer – Offshore coastal water body approximately 5 km to the northeast (Figure B.1). Each of these coastal water bodies is currently (2017) achieving overall GS, based on good ecological status (chemical status not assessed). The overall, ecological and chemical status/potential is determined by the "one-out, all-out" principle, whereby the poorest individual parameter classification defines the assessment level. Therefore, if any parameter is assessed as less than good (e.g. moderate), then the status for that water body is reported at that level. Overall GS indicates that no individual parameters are currently failing to achieve good for these three coastal water bodies in the vicinity of TOR.

Table B.2. Barns Ness to Wheat Stack coastal water body summary

Water Body Area	98.3 km^2
Hydromorphological Designation	None (i.e. natural)
Overall Status	Good
Ecological Status/Potential	Good
Chemical Status	Not assessed
Parameters Not at Good Status	N/A

Table B.3. North Berwick to Barns Ness coastal water body summary

Water Body Area	134.5 km^2
Hydromorphological Designation	None (i.e. natural)
Overall Status	Good
Ecological Status/Potential	Good
Chemical Status	Not assessed
Parameters Not at Good Status	N/A

Table B.4. Firth of Forth Outer – Offshore coastal water body summary

Water Body Area	448.2 km^2
Hydromorphological Designation	None (i.e. natural)
Overall Status	Good
Ecological Status/Potential	Good
Chemical Status	Not assessed
Parameters Not at Good Status	N/A

B.2.3 Protected areas

The WFD requires that activities are also in compliance with other relevant legislation, such as the Habitats Directive (92/43/EEC as amended), Birds Directive (2009/147/EC), Ramsar Convention, Bathing Water Directive (2006/7/EC), Nitrates Directive (91/676/EEC), Urban Waste Water Treatment Directive (91/271/EEC) and the provisions of the Shellfish Waters Directive (2006/113/EC).

Nature conservation designations

Article 3 of the Habitats Directive (92/43/EEC as amended) requires the establishment of a European network of important high-quality conservation sites known as Special Areas of Conservation (SAC) that will contribute to conserving habitats and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). In accordance with Article 4 of the Birds Directive (2009/147/EC), Special Protection Areas (SPA) are strictly protected sites classified for rare and vulnerable birds (Annex I of the Directive), and for regularly occurring migratory species. Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

The following international nature conservation designated sites (with marine components) are located within approximately 30 km of the proposed seaweed management zone (see Figure B.3 for locations):

- Berwickshire and North Northumberland Coast SAC;
- St Abb's Head to Fast Castle SAC;
- Isle of May SAC;
- St Abb's Head to Fast Castle SPA;
- Firth of Forth SPA;
- Forth Islands SPA;
- Outer Firth of Forth and St Andrews Bay Complex proposed SPA (pSPA); and
- Firth of Forth Ramsar.

The proposed seaweed management zone directly overlaps with the Outer Firth of Forth and St Andrews Bay Complex pSPA, with the remaining designated sites greater than 5 km away. It is recognised that the Outer Firth of Forth and St Andrews Bay Complex pSPA is afforded the same level of protection as a designated SPA via policy GEN 9 (Natural heritage) of Scotland's National Marine Plan (The Scottish Government, 2015).

Bathing Water Directive

The revised Bathing Water Directive (rBWD) (2006/7/EC) was adopted in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (BWD) (76/160/EEC) and the process used to measure/monitor water quality at identified bathing waters. The rBWD focuses on fewer microbiological indicators, whilst setting higher standards, compared to those

of the BWD. Bathing waters under the rBWD are classified as excellent, good, sufficient or poor according to the levels of certain types of bacteria (intestinal enterococci and *Escherichia coli*) in samples obtained during the bathing season (May to September).

The BWD was repealed at the end of 2014 and monitoring of bathing water quality has been reported against rBWD indicators since 2015. The new classification system considers all samples obtained during the previous four years and, therefore, data has been collected for rBWD indicators since 2012. The UK Government's target under the rBWD is to achieve 'sufficient' for all bathing waters by 2015, as described under the Bathing Water Regulations 2013 which transposes the rBWD into UK law.

There are five designated bathing waters within 10 km of the proposed seaweed management zone, with Thorntonloch located approximately 1.5 km to the southeast and immediately south of the TOR cooling water outfall (Figure B.3). Table B.5 presents the bathing water classifications over the last four seasons, with all five currently at Good or Excellent bathing water quality.

Table B.5. Bathing waters in the vicinity of the proposed seaweed management zone

Bathing Water	Distance* / Direction	Classification (Season)			
		2015/16	2016/17	2017/18	2018/19
Thorntonloch	1.5 km / southeast	Good	Excellent	Good	Excellent
Pease Bay	6 km / southeast	Excellent	Excellent	Excellent	Excellent
Whitesands	2 km / west	Sufficient	Good	Good	Good
Dunbar (East)	5 km / west	Sufficient	Good	Good	Excellent
Dunbar (Belhaven)	8 km / west	Good	Good	Good	Good
* Approximate distance from proposed seaweed management zone at TOR.					

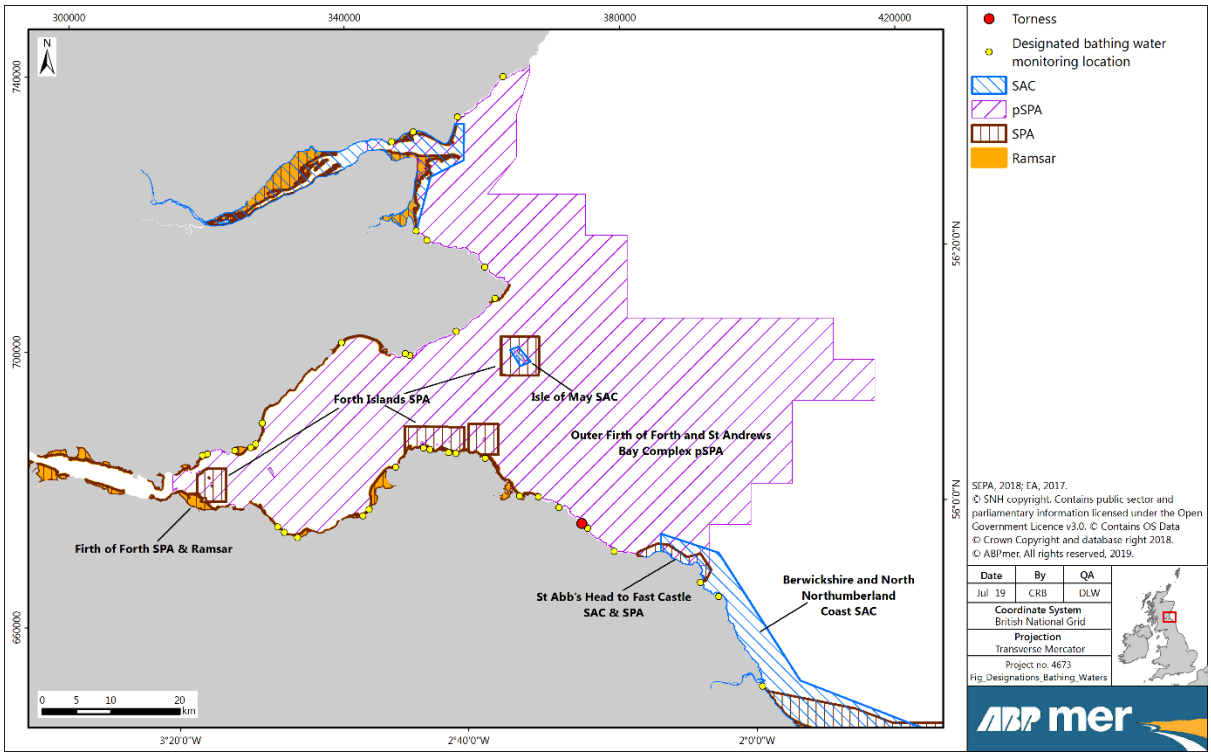


Figure B.3. European and international nature conservation designated sites and bathing waters in the vicinity of TOR

Shellfish Waters Directive

The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. In Scotland, it has been replaced by the Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013 which came into force on 22 December 2013, and subsequently updated in 2016. The Order identifies 85 coastal areas as Shellfish Water Protected Areas, identified on a series of maps[23].

There are no Shellfish Water Protected Areas in the vicinity of TOR, with the closest site on the east coast of Scotland over 200 km away in the Moray Firth (Dornock Firth and Cromarty Bay).

Nitrates Directive

The Nitrates Directive (91/676/EEC) aims to reduce water pollution from agricultural sources and to prevent such pollution occurring in the future (nitrogen is one of the nutrients that can affect plant growth). Under the Nitrates Directive, surface waters are identified if concentrations of nitrate in water exceed, or are likely to exceed, the levels set in the Directive; these are designated as Nitrate Vulnerable Zones (NVZs) under the Nitrate Vulnerable Zones (Scotland) Regulations 2015.

The (Edinburgh) East Lothian and Borders NVZ includes the coastline adjacent to TOR and the proposed seaweed management zone[24].

Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive (91/271/EEC) aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban waste water. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive requires that collected waste water is treated to at least secondary treatment standards for significant discharges. Secondary treatment is a biological treatment process where bacteria are used to break down the biodegradable matter (already much reduced by primary treatment) in waste water. Sensitive areas under the Urban Waste Water Treatment Directive are water bodies affected by eutrophication of elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

The nearest sensitive areas to the proposed seaweed management zone are related to specific bathing waters, namely Pease Bay, Dunbar (East) and Dunbar (Belhaven)[25].

23 https://www.gov.scot/publications/shellfish-water-protected-areas-maps/ (Accessed September 2019)
24 https://www.gov.scot/publications/nitrate-vulnerable-zones-maps/ (Accessed September 2019).
25 https://www.gov.scot/publications/urban-waste-water-treatment-sensitive-areas-map/ (Accessed September 2019).

B.3 Scoping

The Environment Agency's "Clearing the Water for All" guidance provides a scoping template to record findings and consider potential risks for several key receptors, specifically:

- Hydromorphology;
- Biology;
  - Habitats;
  - Fish;
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

Each receptor is considered in the following sections for the three water bodies potentially affected by the proposed works (i.e. Barns Ness to Wheat Stack, North Berwick to Barns Ness and Firth of Forth Outer – Offshore coastal water bodies; see Section B.2.2). Potential risks that have been scoped into the assessment are highlighted in green and considered within the impact assessment stage (Section B.4), while those scoped out of the assessment are highlighted in red.

B.3.1 Hydromorphology

Hydromorphology is the physical characteristics of estuaries and coasts, including the size, shape and structure of the water body and the flow and quantity of water and sediment. Table B.6 presents a summary of hydromorphological considerations and associated risk issues for the proposed works at TOR. As at least one hydromorphological consideration indicates that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.6. Hydromorphology scoping summary

Hydromorphology Considerations	Hydromorphology Risk Issue(s)
Consider if your activity could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status?	Yes (hydromorphology at high status for all three coastal water bodies). Requires impact assessment.
Consider if your activity could significantly impact the hydromorphology of any water body?	Yes (potential changes to hydromorphology as a result of proposed works). Requires impact assessment.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	No (water bodies are not heavily modified). Impact assessment not required.

B.3.2 Biology

Habitats

It is necessary to consider the impact of the physical footprint of an activity on nearby marine and coastal habitats. This specifically refers to habitats of higher sensitivity (e.g. intertidal seagrass, maerl and saltmarsh) and lower sensitivity (e.g. cobbles, gravel and shingle, subtidal rock reef and intertidal soft sediments like sand and mud). Table B.7 presents a summary of biology (habitat) considerations

and associated risk issues for the proposed works at TOR. As at least one biology (habitats) consideration indicates that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.7. Biology (habitats) scoping summary

Biology (Habitats) Considerations	Biology (Habitats) Risk Issue(s)
Is the footprint of the activity 0.5 km^2 or larger?	Yes (1.29 km^2). Requires impact assessment.
Is the footprint of the activity 1% or more of the water body's area?	Yes (1.3% of the Barns Ness to Wheat Stack coastal water body within which the proposed works are located). Requires impact assessment.
Is the footprint of the activity within 500 m of any higher sensitivity habitat?	Yes (saltmarsh habitat within 500 m). Requires impact assessment.
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	Yes (unknown extent of lower sensitivity habitats, but potentially more than 1%; cobbles, gravel and shingle, intertidal soft sediments like sand and mud, rocky shore and subtidal soft sediments). Requires impact assessment.

Fish

Activities occurring within an estuary could impact on normal fish behaviour such as movement, migration or spawning. Table B.8 presents a summary of biology (fish) considerations and associated risk issues for the proposed works at TOR. As at least one biology (fish) consideration indicates that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.8. Biology (fish) scoping summary

Biology (Fish) Considerations	Biology (Fish) Risk Issue(s)
Consider if your activity is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary?	Yes. "Continue with questions".
Consider if your activity could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)?	Yes (disturbance/loss of potential nursery habitat for fish). Requires impact assessment.
Consider if your activity could cause entrainment or impingement of fish?	No (not applicable). Impact assessment not required.

B.3.3 Water quality

Consideration should be made regarding whether phytoplankton status and harmful algae could be affected by the proposed works, as well as identifying the potential risks of using, releasing or disturbing chemicals. Table B.9 presents a summary of water quality considerations and associated risk issues of the proposed works at TOR. As at least one water quality consideration indicates that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.9. Water quality scoping summary

Water Quality Considerations	Water Quality Risk Issue(s)
Consider if your activity could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)?	No (temporary and minor effects on water quality anticipated). Impact assessment not required.
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	No (phytoplankton status is good/high for the three coastal water bodies). Impact assessment not required.
Consider if your activity is in a water body with a history of harmful algae?	No (there is no known history of harmful algae). Impact assessment not required.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if the chemicals are on the Environmental Quality Standards Directive (EQSD) list?	Yes (potential for sediments to be disturbed). Requires impact assessment.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if it disturbs sediment with contaminants above Cefas Action Level 1?	
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the Environmental Quality Standards Directive (EQSD) list?	No (not applicable). Impact assessment not required.

B.3.4 Protected areas

Consideration should be made regarding whether WFD protected areas are at risk from an proposed activity, including SACs and SPAs (Natura 2000 sites), as well as bathing waters, shellfish water protected areas and nutrient sensitive areas. Table B.10 presents a summary of protected area considerations and associated risk issues of the proposed works at TOR. As the protected areas considerations indicate that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.10. Protected areas scoping summary

Protected Areas Considerations	Protected Areas Risk Issue(s)
Consider if your activity is within 2 km of any WFD protected area?	Yes (Outer Firth of Forth and St Andrews Bay Complex pSPA, Thorntonloch bathing water and (Edinburgh) East Lothian and Borders NVZ are within 2 km of the proposed works). Requires impact assessment.

B.3.5 Invasive non-native species (INNS)

Consideration should be made regarding whether there is a risk the activity could introduce or spread INNS. Risks of introducing or spreading INNS include materials or equipment that have come from, had use in or travelled through other water bodies, as well as activities that help spread existing INNS, either within the immediate water body or other water bodies. Table B.11 presents a summary of INNS considerations and associated risk issues of the proposed works at TOR. As the INNS considerations indicate that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (Section B.4).

Table B.11. Invasive non-native species (INNS) scoping summary

INNS Considerations	INNS Risk Issue(s)
Consider if your activity could introduce or spread INNS?	Yes (potential for introduction or spread of INNS). Requires impact assessment.

B.4 Impact assessment

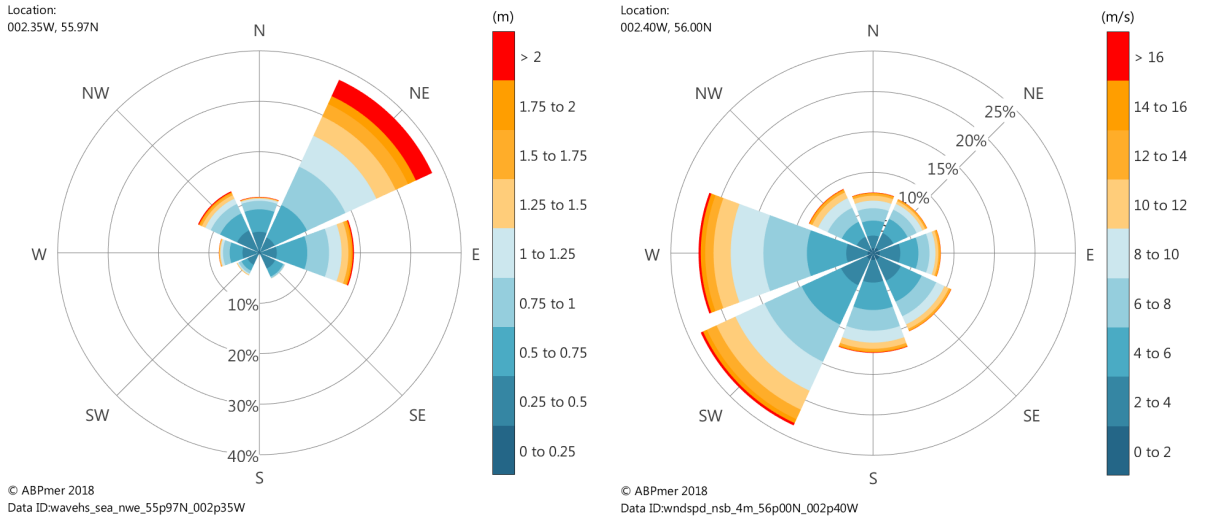
An assessment should be conducted for each receptor identified during the scoping stage as being at risk from the proposed activity. As highlighted in Section B.3, the following receptors have been scoped into the assessment:

- Hydromorphology;
- Biology;
  - Habitats;
  - Fish;
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

Each of these receptors has been evaluated in order to determine whether the proposed seaweed removals activity at TOR might cause deterioration in the status of the Barns Ness to Wheat Stack, North Berwick to Barns Ness and Firth of Forth Outer – Offshore coastal water bodies (defined as a non-temporary effect on status at water body level), or an effect that prevents these water bodies from meeting their WFD objectives.

B.4.1 Hydromorphology

The breakwater to the east of Skateraw Harbour provides an element of sheltering to the bay. However, it is recognised that the prevailing wave direction is from the northeast (Figure B.4) and thus the TOR cooling water intake remains relatively exposed to the North Sea (hence the operational challenges through seaweed ingress which can develop during storm events).



Source: ABPmer Data Explorer https://www.seastates.net (Accessed September 2019)

Figure B.4. Significant wave height (m; left) and wind speed (m/s; right) distribution by direction from model cell adjacent to TOR coastline

The presence of seaweed within the proposed seaweed management zone, predominantly *L. hyperborea*, is partially seasonal in nature and thus highest densities are likely to occur during the spring and summer months. In contrast, somewhat reduced densities of seaweed are likely to be present during winter storm events. Therefore, it is unlikely that the presence of seaweed within the proposed seaweed management zone has a major attenuation effect on wave action against the adjacent coastline. As removal of seaweed from within the proposed seaweed management zone is unlikely to change the prevailing wave conditions and given the rocky/hard coastline at TOR which is highly resistant to wave impact, the impact on kelp removal is therefore assessed as minor (see Section 4.2 of the main report).

The subtidal area is largely comprised of hard, rocky substrate and, therefore, morphology is unlikely to be impacted by any minor changes in wave action through seaweed removals. In addition, given the rocky nature of the seabed, there will be minimal direct disturbance (abrasion), with the Norwegian-style kelp rake pulled through the water column at approximately 0.5 m above the seabed. Much of the shoreline (intertidal) adjacent to the proposed seaweed management zone comprises rocky shore, sands, boulders, cobbles and shingle habitat. Such shorelines will be relatively insensitive to changes in morphology in response to changes in wave energy and there will be no direct disturbance (abrasion).

In conclusion, the proposed works at TOR are not expected to lead to a deterioration of the assessed hydromorphological elements within the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies, nor prevent these water bodies from meeting future WFD objectives

B.4.2 Biology

Habitats

The proposed works at TOR will remove some but not all of the kelp from within the proposed seaweed management zone. Immediately following the removal, the habitat will support less kelp/less dense kelp than prior to the activity, but the habitat type will not change. Rather some of the ecological functioning of the area could be reduced. *Laminaria hyperborea* is a large, conspicuous kelp which can grow up to 3.5 m in length (Tyler-Walters, 2007). Seaweed harvesting using the Norwegian-style rake

typically removes entire kelp plants, including holdfasts, although juvenile plants are largely left *in situ* to promote more rapid recovery. Removal of whole kelp plants creates bare rock which can be re-colonized by kelp sporelings. While recovery of kelp habitat within the proposed seaweed management zone conflicts with the objective and rationale to manage seaweed ingress at TOR, this partial retention of kelp plants and potential for regrowth may offset some of the lost function of the affected habitat.

Kelps such as *L. hyperborea* play an important role in coastal marine ecosystems. Kelp species support notable biodiversity, with higher levels of biodiversity observed in kelp beds than equivalent comparable areas. The biological element 'Benthic invertebrates' is currently (2017) at GS for all three coastal water bodies (based on the infaunal quality index). It is anticipated that there will be a small-scale reduction in the abundance of benthic invertebrate within the proposed seaweed management zone as a result of the seaweed removals activity, but this is considered negligible at the water body level. The proposed seaweed management zone will be frequently exposed to disturbance from storm events and the annual degradation of kelp plants. Therefore, it is considered highly unlikely that a deterioration of this parameter would result in the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies.

Kelp beds also contribute high levels of primary production through carbon (C) assimilation. A range of primary production rates for *L. hyperborea* are reported in scientific literature, with values typically up to 1.3 kg C/m^2/year (e.g. Dayton, 1985; Kelly, 2005; Smale *et al*. 2013; Burrows *et al*. 2018), and much of this production enters the carbon cycle as detritus or dissolved organic matter. Based on this primary production rate and the spatial extent of the proposed seaweed management zone at TOR (1.29 km^2), the *L. hyperborea* beds present could provide a sink for up to 1,677 tonnes C/year. In Scotland, the main producer of carbon entering long-term storage in sediments is phytoplankton at 3.9 million tonnes C/year, with coastal plants (predominantly kelp) potentially contributing a further 1.8 million tonnes C/year (Burrows *et al*. 2014). Therefore, primary production within the proposed seaweed management zone represents less than 0.1% of the contribution made by coastal plants in Scotland. However, it is likely that the primary production rate applied above (1.3 kg C/m^2/year) exceeds the capacity within the proposed seaweed management zone, while it should also be recognised that only a proportion of the *L. hyperborea* present will be removed per campaign (up to 300 tonnes (wet weight) per annum). Therefore, the loss as a result of the proposed activity is considered minimal in the wider context of kelp primary production in Scotland (and other seaweed productivity), as well overall primary productivity in the marine environment, including phytoplankton.

The proposed activity will reduce kelp density over a subtidal area of up to 1.29 km^2, targeted towards those areas of densest kelp coverage based on the findings of a pre-campaign drop-down video survey. The spatial extent of the proposed seaweed management zone is small relative to the overall extent of kelp resources in the wider Firth of Forth region. The proposed activity will remove the majority, but not all of the kelp and some residual function as a nursery/feeding area will remain following the activity, while regrowth of kelp will be expected to occur over time.

The nearest saltmarsh habitat is adjacent to the proposed seaweed management zone along the Torness coastline. However, the saltmarsh habitat is unlikely to be indirectly affected by the proposed works as wave action will not be significantly altered by seaweed removal (see Section B.4.1). Furthermore, all seaweed removed from within the proposed seaweed reduction area will be collected and disposed to land (as opposed to disposal at sea). This mitigation measure avoids potential adverse impact pathways between the disposed material and other marine habitats (e.g. smothering of saltmarsh).

In conclusion, the proposed works at TOR are not expected to lead to a deterioration of seabed habitats (or associated species) within the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies, nor prevent these water bodies from meeting future WFD objectives.

Fish

Kelp forests also serve as a nursery for many fish species, including Atlantic Cod (*Gadus morhua*) and pollack (*Pollachius pollachius*). They are also feeding grounds for fish species such as ballan wrasse (*Labrus bergylta*) and Goldsinny wrasse (*Ctenolabrus rupestris*), which prey on kelp associated invertebrates (Norderhaug *et al.* 2005), as well as attracting commercially important species such as European sea bass (*Dicentrarchus labrax*), pollack (*P. pollachius*) and conger eels (*Conger conger*) (Smale *et al.* 2013). In turn, elevated fish densities in kelp forests attract large piscivores, such as large fish, seals and otters.

As highlighted above (Habitats), the proposed works at TOR will remove some but not all of the kelp from the areas within the proposed seaweed management zone. Immediately following the removal, the habitat will support less kelp/less dense kelp than prior to the activity, but the habitat type will not change. Rather some of the ecological functioning of the area could be reduced. Smale *et al.* (2013) noted that the biodiversity of *L. hyperborea* beds generally increases with increasing kelp abundance (across the SACFOR scale; see Table B.12), but indicates that some aspects of ecological functioning may not be significantly impaired until complete clearance of the kelp occurs. Given the relatively small area over which the activity may occur in relation to the overall scale of the resource within the Firth of Forth, the limited impact on ecological structure/functioning and the scope for recovery, the impact on kelp habitat is therefore assessed as minor (see 4.5.1 of the main report).

Table B.12. SACFOR abundance scale

Code	Description	Coverage (%)
S	Super-abundant	>80
A	Abundant	40-79
C	Common	20-39
F	Frequent	10-19
O	Occasional	5-9
R	Rare	1-5
L	Less than rare but still has some presence (indicated by extrapolation)	<1
None	No algae present	0

In conclusion, the proposed works at TOR are not expected to lead to a deterioration of fish within the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies, nor prevent these water bodies from meeting future WFD objectives (noting, the parameter 'fish' is not assessed for any of the coastal water bodies identified).

B.4.3 Water quality

The proposed seaweed removal activity at TOR could lead to small quantities of sediment being raised into suspension through contact with the seabed, although any disturbance will be temporary and sediment will quickly disperse. Furthermore, the subtidal area is largely comprised of hard, rocky substrate and the Norwegian-style kelp rake will be pulled through the water column at approximately 0.5 m above the seabed. High contaminant concentrations in marine sediments are largely associated with fine material (e.g. silt and mud), with relatively low concentrations associated with coarser/rocky material. Therefore, it is considered unlikely that the proposed activity will result in the disturbance and dispersal of contaminants (no chemical substances will be intentionally introduced to the marine environment).

Toxic contamination (spillage) has the potential to result from the operation of the vessel during the proposed works (e.g. accidental collision). However, it is considered unlikely that a single vessel working in the vicinity of TOR would present a significant risk to navigation. The works will be undertaken in accordance with standard best practice measures, including (for example) adherence to relevant Guidance for Pollution Prevention (e.g. Works and maintenance in or near water: GPP5+)[26].

In conclusion, the proposed works at TOR are not expected to lead to a deterioration of fish within the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies, nor prevent these water bodies from meeting future WFD objectives (noting, the chemical status is not assessed for any of the coastal water bodies identified).

B.4.4 Protected areas

The proposed seaweed management zone directly overlaps with the Outer Firth of Forth and St Andrews Bay Complex pSPA. Consultation documents for the Outer Firth of Forth and St Andrews Bay Complex pSPA indicate the spatial extent of the site would be 2,720.68 km^2 (272,068 hectares)[27]. The proposed seaweed management zone is located within the boundary of this site, and the kelp habitat currently present may be used by some of the respective bird species for foraging. The proposed activity at TOR will result in the disturbance/loss of up to 1.29 km^2 of seaweed (kelp) habitat, equating to less than 0.05% of the area of the Outer Firth of Forth and St Andrews Bay Complex pSPA.

Within the Firth of Forth region, there is an estimated (modelled) 88 km^2 of *L. hyperborea* habitat with a biomass greater than 2 kg/m^2, of which 10 km^2 is estimated (modelled) to have a biomass of greater than 5 kg/m^2 (Burrows *et al*. 2018). It is recognised that seaweed coverage within the proposed seaweed management zone is likely to include areas of dense kelp habitat (e.g. 5 kg/m^2). However, such densities are likely to be patchy across the area with much lower densities elsewhere (i.e. less than 2 kg/m^2). Therefore, the proposed seaweed management zone is estimated to represent a small proportion of the aforementioned *L. hyperborea* habitat within the Firth of Forth region (less than 1%). Furthermore, the Norwegian-style kelp rake is anticipated to only remove a proportion of the kelp biomass during each pass and, therefore, the activity will serve to reduce the density of the kelp beds rather than remove them completely. Disturbance/loss of this habitat type is considered unlikely to significantly affect designated bird features foraging in the area, particularly in the context of available foraging grounds in the wider Firth of Forth.

Other existing SACs, SPAs and Ramsar sites are greater than 5 km from the proposed seaweed management zone and it is considered unlikely that any significant effects on these sites would arise from the proposed activity.

The Thorntonloch bathing is located approximately 1.5 km to the southeast of the proposed seaweed management zone, and immediately south of the TOR cooling water outfall (Figure B.3). Thorntonloch is currently (2018/19) classified as having 'Excellent' bathing water quality[28]. The proposed activity will not result in the introduction or disturbance of microbial coliforms (intestinal enterococci and *E. coli*) and thus will not affect bathing water quality. In addition, the aim of the proposed activity is to collect seaweed (kelp) during the removals process and dispose of the material to land. Therefore, it is not anticipated that there would be an increase in washed-up seaweed at nearby bathing waters, as this

26 http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017 (Accessed September 2019).

27 https://www.nature.scot/outer-firth-forth-and-st-andrews-bay-complex-proposed-marine-spa-supporting-documents (Accessed September 2019).

28 https://apps.sepa.org.uk/bathingwaters/Classifications.aspx (Accessed September 2019).

would conflict with the overarching objective of the proposed works (with material instead potentially entering the cooling water intake).

The (Edinburgh) East Lothian and Borders NVZ includes the coastline adjacent to TOR and the proposed seaweed management zone[29]. However, the proposed activity (seaweed removal from subtidal areas in the vicinity of TOR) will not introduce nitrates to the adjacent Lothian and Borders NVZ and, therefore, no effects are anticipated.

In conclusion, the proposed activities at TOR are not expected to lead to a deterioration of the assessed protected area designations, nor prevent the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies from meeting their WFD objectives.

B.4.5 Invasive non-native species

There is a potential risk that seaweed removals at TOR could result in the introduction or spread of INNS. The removal of kelp (predominantly *L. hyperborea*) within the proposed seaweed management zone may create colonising space for the recruitment of INNS. The area is approximately 1.29 km^2 and is naturally disturbed by wave activity during storms on a regular basis. It is recognised that the proposed activity is likely to be more intensive in removing seaweed (kelp), given this is the desired result, compared to the episodic dislodgement of seaweeds during storm events (which can also result in significant clearance of kelp habitat). However, kelp habitats recover over time from storm damage, at which point it could be considered to present a similar opportunity for colonisation by INNS. The proposed activity will primarily remove kelp and will cause very little impact to the seabed (Norwegian-style kelp rake pulled through the water column at approximately 0.5 m above the seabed). While the proposed technique typically removes entire kelp plants, including holdfasts, juvenile plants are largely left *in situ*.

As part of a monitoring plan, it is proposed to undertake drop-down video surveys before and after each seaweed removal campaign, hereafter referred to as pre- and post-monitoring surveys, respectively. The aims of these monitoring surveys are as follows:

- **Pre-monitoring survey**: To collect information on the density and distribution of kelp and other algal species prior to the campaign. The pre-monitoring survey would also produce a current broad-scale map of subtidal habitats, used to establish/confirm baseline conditions for impact verification purposes, and also identify key areas for seaweed removal in the vicinity of the TOR cooling water intake; and
- **Post-monitoring survey**: To understand changes in kelp density and subtidal habitat distribution following each campaign. This information will be valuable to understanding any potential environmental effects of the licensed activity, as well as understanding whether a campaign has successfully reduced seaweed coverage.

Through pre-application advice from SNH (see Section 2.3 of the main report and Appendix C), it was noted that the INNS Japanese kelp (*Undaria pinnatifida*) has been recorded at Port Edgar marina in the Firth of Forth (approximately 60 km to the west of TOR). This species may compete for space and resources with native species of kelp and other brown seaweeds. To minimise the potential risk, it was suggested to consider the principles of marine biosecurity planning guidance (Payne *et al*. 2014) and best practice advice (Cook *et al*. 2014). Through the pre- and post-monitoring surveys outlined above, it will be possible to monitor and respond should the invasive *U. pinnatifida* become established within the proposed seaweed management area. During these surveys, alongside the review of kelp distribution and abundance, the presence of *U. pinnatifida* will be recorded using the SACFOR scale

[29] https://www.gov.scot/publications/nitrate-vulnerable-zones-maps/ (Accessed September 2019).

(Table B.12). On this basis, while there remains a potential risk of non-native species colonising the newly exposed rocky habitat at TOR, these measures are considered to inform how to proceed should such species be identified.

The use of a vessel and equipment to remove seaweed at TOR could pose a risk of introduction of non-native species through, for example, discharge of ballast water, biofouling of the vessel's hull and transfer through use of equipment in differing water bodies. It is likely that a relatively local vessel will be chartered to undertake the proposed activity and thus the risk of transfer of non-native species from further afield is low. The seaweed removal equipment (Norwegian-style kelp rake) will be cleaned before and after commencing the proposed works. Seaweed removed from the proposed seaweed management zone will be landed to the vessel and disposed of to land (as opposed to disposal at sea).

In conclusion, the proposed works at TOR are not expected to lead to a deterioration of nearby water bodies in terms of INNS, specifically the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies (noting that this parameter is not currently assessed), nor prevent these water bodies from meeting future WFD objectives.

B.5 Conclusion

Based upon the information presented within this WFD compliance assessment, and considering the additional information presented in the environmental appraisal (see main report), it is concluded that the proposed works at TOR are not likely to have a permanent (i.e. non-temporary) effect on the status of WFD parameters that are significant at water body level. The proposed works are therefore not predicted to cause either deterioration to the current status of the Barns Ness to Wheat Stack, North Berwick to Barns Ness or Firth of Forth Outer – Offshore coastal water bodies, nor prevent these water bodies from achieving future WFD objectives.

B.6 References

Burrows, M.T., Fox, C.J., Moore, P., Smale, D., Sotheran, I., Benson, A., Greenhill, L., Martino, S., Parker, A., Thompson, E. and Allen, C.J. (2018). Wild seaweed harvesting as a diversification opportunity for fishermen. A report by SRSL for HIE, pp. 171. Available online at: http://www.hie.co.uk/common/handlers/download-document.ashx?id=0336008d-db41-4b61-a9bd-6bfcbd31c876 (Accessed September 2019).

Burrows, M.T., Kamenos, N.A., Hughes, D.J., Stahl, H., Howe, J.A. and Tett, P. (2014). Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment. Scottish Natural Heritage Commissioned Report No. 761. Available online at: https://www.nature.scot/sites/default/files/Publication%202014%20-%20SNH%20Commissioned%20Report%20761%20-%20Assessment%20of%20carbon%20budgets%20and%20potential%20blue%20carbon%20stores%20in%20Scotland%27s%20coastal%20and%20marine%20environment.pdf (Accessed September 2019).

Cook, E.J., Payne, R.D. and Macleod, A. (2014). Marine biosecurity planning – Identification of best practice: A review. Scottish Natural Heritage Commissioned Report No. 748. Available online at: https://www.nature.scot/snh-commissioned-report-748-marine-biosecurity-planning-identification-best-practice-review (Accessed September 2019).

Dayton, P.K. (1985). Ecology of kelp communities. Annual Review of Ecology and Systematics 16: 215-245.

Envision Mapping. (2014). Torness benthic survey and habitat mapping, analysis and interpretation of drop down video survey. October 2014.

Kelly, E. (2005). The role of kelp in the marine environment. Irish Wildlife Manuals, No. 17. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Norderhaug, K.M., Christensen, J.D., Fossa, J.H. and Fredriksen, S. (2005). Fish-macrofauna interactions in a kelp (*Laminaria hyperborea*) forest. Journal of the Marine Biological Association of the United Kingdom 85: 1279-1286.

Payne, R.D., Cook, E.J. and Macleod, A. (2014). Marine Biosecurity Planning – Guidance for producing site and operation-based plans for preventing the introduction of non-native species. Report by SRSL Ltd. in conjunction with Robin Payne to the Firth of Clyde Forum and Scottish Natural Heritage 39 pp. Available online at:
https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/marine-non-native-species (Accessed September 2019).

Scottish Environment Protection Agency (SEPA). (2015). The river basin management plan for the Scotland river basin district: 2015–2027. 21 December 2015. Available online at:
http://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf (Accessed September 2019).

Smale, D.A., Burrows, M.T., Moore, P., O'Connor, N. and Hawkins, S.J. (2013). Threats and knowledge gaps for ecosystem services provided by kelp forests: a northeast Atlantic perspective. Ecology and Evolution 3(11): 4016-4038.

The Scottish Government. (2015). Scotland's National Marine Plan. A Single Framework for Managing Our Seas. Marine Scotland. March 2015. Available online at:
http://www.gov.scot/Resource/0047/00475466.pdf (Accessed September 2019).

Tyler-Walters, H. (2007). *Laminaria hyperborea* Tangle or cuvie. In: Tyler-Walters, H. and Hiscock, K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available online at:
https://www.marlin.ac.uk/species/detail/1309 (Accessed September 2019).

C Scottish Natural Heritage (SNH) Pre-Application Advice

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
nature.scot

Angus Bloomfield
Environment Officer (Marine Specialist)
EDF Energy

Date: 12 June 2019
Our ref: A2975745

Email: angus.bloomfield@edf-energy.com

Dear Mr Bloomfield

TORNESS POWER STATION – SEAWEED REMOVAL – PRE-APPLICATION ADVICE

Thank you for contacting SNH at the pre-application stage of this proposal to remove seaweed at Torness power station, with the aim of protecting its cooling water intake system. We recognise the important economic and security of energy supply drivers for this project.

Background
Our understanding is that the current proposal is to remove c. 0.85 km^2 of seaweed (primarily *Laminaria hyperborea*) from the seabed in the vicinity of the power station, using a Norwegian kelp rake. It is intended that this will be carried out in one campaign although, depending on timings, this may span two years. A maximum removal of 150 wet tonnes is anticipated.

We have provided early advice by email and by phone discussion, this letter aims to formalise that earlier advice.

SNH Advice
Any forthcoming Marine Licence application should be supported by an assessment of impacts on natural heritage receptors. The main receptors that will need to be assessed in detail are:

- *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp) – a Priority Marine Feature (PMF); and
- Outer Firth of Forth and St Andrews Bay Complex proposed Special Protection Area (pSPA).

Annex 1 of this letter provides further advice on the range of possible receptors. I hope these comments are useful, if you would like to discuss them further you can contact me on 0131 316 2629 / malcolm.fraser@snh.gov.uk

Yours sincerely

[by email]

Malcolm Fraser
Operations Officer
Forth

Annex 1 – further advice on natural heritage receptors

1. Priority Marine Feature (PMF) – *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp)

PMFs require specific consideration within any forthcoming Marine Licence application. The habitat 'Kelp beds' is one of 81 features considered to be marine nature conservation priorities in Scottish waters. PMFs receive policy protection through the National Marine Plan.

The baseline benthic survey report (*Envision - Torness Benthic Survey & Habitat Mapping Oct 2014*) was published in 2014 and precedes the inclusion of kelp beds on the PMF list. The report therefore does not assess impacts on component PMF kelp biotopes identified in the report.

The Kelp PMF component biotope *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock (IR.MIR.KR.Lhyp) was recorded during the survey as well as associated sub-component biotopes including:

- *Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock (IR.MIR.KR.Lhyp.Ft); and
- *Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock (IR.MIR.KR.Lhyp.Pk).

The Marine Licence application should assess whether any impacts on kelp beds would constitute a 'significant impact on the national status' ('SINS') of the PMF, in line with policy GEN 9 in the National Marine Plan.

Information on the presence, abundance and / or extent of PMFs may be drawn from various publicly accessible sources including PMF list[1] and a report with descriptions of Scottish PMFs[2] are on our website. PMF guidance can also be found on our website[3].

When we discussed this receptor I suggested that you could use a line of reasoning based on the geographical extent of the kelp to be removed. This area to be removed could be put into context of:

- local resource of kelp (potentially using the habitat modelling work described on page 14 of the 2014 report); and
- national resource of kelp.

At this stage we advise that the proposed removal of seaweed is likely to constitute a significant environmental impact on a local scale, but is it not likely to have significant impact on the national status of the PMF.

2. Outer Firth of Forth and St Andrews Bay Complex proposed Special Protection Area (pSPA)

As a 'proposed SPA' this site gains the same level of protection as a fully designated SPA via policy GEN 9 in the National Marine Plan.

---

[1] https://www.nature.scot/sites/default/files/2018-05/Priority%20Marine%20Features%20in%20Scotlands%20seas.pdf
[2] https://www.nature.scot/snh-commissioned-report-406-descriptions-scottish-priority-marine-features-pmfs
[3] https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/priority-marine-features-scotlands-seas

The proposal location is within this pSPA, and the kelp bed habitat may be used by some of the SPA bird species for foraging. Therefore the Habitats Regulations Appraisal (HRA) process applies, and any forthcoming Marine Licence application should be supported with information to enable Marine Scotland to complete an HRA.

Information on the proposed SPA, the bird species it seeks to protect, and their distributions can be found on our website[4]. We have also published a range of HRA guidance documents[5]. More specifically we have published guidance on 'HRA on the Firth of Forth'[6] as well as a literature review[7] on bird populations/ trends which will also be relevant to this proposal.

At this stage we suggest that there may be 'likely significant effects' upon the pSPA due to the removal of habitat that may be used for foraging, and therefore an appropriate assessment may be required.

3. Invasive non-native species (INNS) and biosecurity

Any forthcoming Marine Licence application should include an assessment of the risk of introduction of invasive non-native species (INNS) and present a method statement which takes account of the biosecurity plans for managing INNS in Scotland.

Marine biosecurity planning guidance[8] and best practice advice[9] is available on our website The invasive non-native seaweed *Undaria pinnatifida*[10] has been recorded at Port Edgar marina in the Firth of Forth. *U. pinnatifida* may compete for space and resources with native species of kelp and other brown seaweeds. Following biosecurity principles outlined in the guidance will help to minimise the spread of INNS, including *U. pinnatifida*.

4. Other natural heritage receptors

We suggest that the following receptors may not require full assessment in any forthcoming Marine Licence application:

a. marine mammals (cetaceans, seals, otter) – in effect the proposal will see one small vessel in the water around Torness, in a limited area, for a limited period of time. It is therefore not clear whether there is an impact pathway from the proposal to these receptors. Your assessment should clarify whether any impact pathway exists.

b. Barns Ness Coast SSSI – this site includes the intertidal zone and terrestrial semi-natural habitats. The intertidal zone is designated for its hard rock geodiversity (Lower Carboniferous). We anticipate no adverse effects from this proposal on any of the designated features of this site.

---

[4] https://www.nature.scot/outer-firth-forth-and-st-andrews-bay-complex-proposed-marine-spa-supporting-documents
[5] https://www.nature.scot/professional-advice/planning-and-development/environmental-assessment/habitats-regulations-appraisal-hra/habitats-regulations-appraisal-hra-help-and
[6] https://www.nature.scot/habitats-regulations-appraisal-hra-firth-forth-guide-developers-and-regulators
[7] https://www.nature.scot/snh-commissioned-report-804-review-literature-qualifying-interest-species-special-protection-areas
[8] https://www.nature.scot/sites/default/files/2019-02/Marine%20Biosecurity%20Planning.pdf
[9] https://www.nature.scot/snh-commissioned-report-748-marine-biosecurity-planning-identification-best-practice-review
[10] http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=3643

c. Firth of Forth Banks Complex MPA – the proposal is 34 km south west of this site. Due to the location, scale and nature of the proposal, there are no predicted impacts (direct or indirect) on the features of this MPA.

5. Survey and monitoring

We recommend that surveys are carried out pre- and post-removal to assess the effectiveness of this removal technique. Several years have passed since the baseline survey and the dynamic nature and inter-annual variation of seaweed habitats means that the 2014 data may not be representative of the current seaweed abundance and density. This would provide a current and realistic estimate of the maximum biomass in wet tonnes to be removed under licence.

The effectiveness of kelp removal will depend on the regenerative ability of the kelp forest and the removal frequency. Frequency and timing of removal of kelp should be described in any forthcoming Marine Licence application. Post-removal monitoring will also be required to determine if the proposed removal method will be effective in subsequent years, given that the remaining plants may be smaller and of a higher density.

Contact Us

ABPmer

Quayside Suite,
Medina Chambers
Town Quay, Southampton
SO14 2AQ

T +44 (0) 23 8071 1840
F +44 (0) 23 8071 1841
E enquiries@abpmer.co.uk

www.abpmer.co.uk