Vattenfall

HT1 Hydrogen Demonstrator Project

EIA Screening Opinion Request Report

80925

NOVEMBER 2021

VATTENFALL

RSK

RSK GENERAL NOTES

Project No.: 80925

Title: HT1 Hydrogen Demonstrator Project | Aberdeen Offshore Windfarm – (The European Offshore Wind Deployment Centre – EOWDC) – EIA Screening Opinion Request

Client: Vattenfall

Date: 05 November 2021

Office: Helsby

Status: Final *(Figure Corrections 17.11.2021)*

Lead Author & Project Manager	Paul Parker	**Technical reviewer**	Kathy Bradshaw
	[Redacted]		[Redacted]
Signature		Signature	
Date:	05.11.2021	Date:	05.11.2021

Quality reviewer	James Brocklehurst
	[Redacted]
Signature	
Date:	05.11.2021

CONTENTS

TABLES

FIGURES

1 DEFINITIONS & ACRONYMS

1.1 Definitions

Word	Definition
Aberdeen Harbour	Includes the original Aberdeen Harbour at the mouth of the River Dee and the New South Harbour in Nigg Bay.
Aberdeen South Harbour	Refers to the New Aberdeen Harbour/Port in Nigg Bay. Originally called the 'Aberdeen Harbour Extension'.
Aircraft	The remains of any aircraft.
Corridor	Refers to the flowline corridor, within which the flowline can be micro-routed once the results of more detailed studies are available.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Findspot	The place where an archaeological object has been found.
Front-end engineering and design (FEED)	The work required to produce process and engineering documentation to define the project requirements for detailed engineering, procurement and facilities construction, (and develop a project cost estimate (±15%)).
Heritage assets	Elements of the historic environment – buildings, monuments, sites or landscapes – that have been positively identified as holding a degree of significance due to their historic, archaeological, architectural or artistic interest.
Live wreck	A wreck that has been detected, by recent surveys, in its recorded location is recorded by the UKHO as 'live'.
Marine Protected Areas	Areas of the ocean set aside for long-term conservation aims. MPAs involve the protective management of natural areas according to pre-defined management objectives. MPAs can be conserved for a number of reasons including economic resources, biodiversity conservation, and species protection.

Monument	A locally, regionally or nationally important archaeological site or historic building.
MS-LOT – Marine Scotland – Licensing Operations Team	The regulator on behalf of Scottish Ministers for marine licence applications in the Scottish inshore region (between 0 and 12 nm) under the Marine (Scotland) Act 2010 and in the Scottish offshore region (between 12 and 200 nm) under the Marine and Coastal Access Act 2009.
Obstruction	An object that may constitute danger for surface navigation or an area (foul ground) over which it is safe to navigate but which should be avoided for anchoring.
Pipeline Pigs	Pipeline pigs are devices that are inserted into and travel throughout the length of a pipeline driven by a product flow.
The Applicant	Refers to the applicant of the Screening Request who is Vattenfall Wind Power Ltd.
Wreck	The remains of any shipwreck.

1.2 Acronyms

Abbreviation	Definition
AOWF	Aberdeen Offshore Wind Farm (also known as the European Offshore Wind Deployment Centre (EOWDC))
AOWFL	Aberdeen Offshore Wind Farm Ltd.
CAR	Controlled Activity Regulations
CTV	Crew Transfer Vessel
EIA	Environmental Impact Assessment
EOWDC	European Offshore Wind Deployment Centre (also known as AOWF)
EPS	European Protected Species
ESs	Environmental Statement(s)
FEED	Front-end Engineering Design
HDD	Horizontal Directional Drilling
HT1	Hydrogen Turbine 1
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LLA	Local Landscape Area
MCA	Maritime and Coastguard Agency
MEG	Mono-ethylene glycol
MHWS	Mean High Water Springs
MMO	Marine Mammal Observer

Abbreviation	Definition
MS-LOT	Marine Scotland Licensing Operations Team
NLB	Northern Lighthouse Board
OGA	Oil and Gas Authority
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbon
PEL	Probable Effects Level
PWA	Pipeline Works Authorisation
SAC	Special Area of Conservation
SBP	Sub-bottom Profiler
SEPA	Scottish Environmental Protection Agency
SLA	Special Landscape Area
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
UXO	Unexploded ordnance
WTG	Wind Turbine Generator
Units	
Bar	Metric unit of pressure.
E	east
Ft	Foot
Hs	Mean annual significant wave height
Hz	hertz
H_{max}	Maximum wave heights
Kg/hr	Kilogram per hour
kHz	kilohertz
km	kilometre
kV	kilovolt
m	meters
N	north
m^3/day	cubic meter per day
m^3/h	cubic meter per hour
MW	Megawatt
nm	nautical mile
S	south
W	west
“	inch

2 INTRODUCTION

2.1 Background

Aberdeen Offshore Wind Farm (AOWF), also known as the European Offshore Wind Deployment Centre (EOWDC), is located 2-5 km off the Aberdeenshire coast, in an area of 7 km² in water depths from 20-30 m. The offshore wind farm demonstration project was a joint venture between Vattenfall, Technip and AREG and is now solely owned by Vattenfall. The offshore wind farm (OWF) has an installed energy capacity of 96.8 MW consisting of 11 x 8.8 MW turbines supported by three-legged suction bucket jacket foundations, an industry first, with a 13 km long array cable connecting to an offshore transformer which transmits the energy from the turbines to the onshore substation at Blackdog. Offshore site investigation was completed in April 2016, and construction of the facility began in October 2016, with first power generated on 1st July 2018.

As well as the suction bucket jackets, other innovative techniques were adopted during project development including higher voltage inter-array cables of 66 kV which reduce transmission losses. As part of the continuous innovative approach to the demonstration site, Vattenfall are now looking to demonstrate the feasibility of offshore hydrogen production by installing hydrogen generating equipment (as defined in section 4.1) on an extended transition piece platform at one of the Aberdeen turbines. The hydrogen generating equipment would be connected to land via an 8" internal diameter (maximum) buried flowline, where the hydrogen would be stored for offtake.

2.1.1 Need for the Project

The project offers a unique opportunity to test the viability of offshore production of green hydrogen and help move towards commercial scale operations and the associated positive environmental benefits that come from this. This would be associated predominantly with the decrease in greenhouse gas emissions, the increased efficiency of energy generation from green hydrogen and the resultant contribution to global carbon reduction and reaching the Scottish target of being net zero by 2045 and the UK target of being net zero by 2050.

Due to its geography, infrastructure and industry expertise, Scotland and the UK are well placed to lead global developments in low carbon hydrogen production. Scotland has a stated ambition of at least 5 GW of renewable and low-carbon hydrogen production by 2030 (Scottish Hydrogen Policy Statement, 2020) whilst the UK has also set a target of 5 GW of low carbon hydrogen production capacity by 2030 (UK Hydrogen Strategy, 2021). The demonstrator project will put Scotland at the forefront of low-carbon hydrogen production and positively contribute to the European Union's Green Deal and strategic approach to reach 40 GW of renewable hydrogen by 2030 (European Commission, A hydrogen strategy for a climate-neutral Europe, 2020).

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, which amends the Climate Change (Scotland) Act 2009, sets targets to reduce Scotland's emissions of all greenhouse gases to net-zero by 2045 at the latest, with interim targets for reductions of at least 56% by 2020, 75% by 2030 and 90% by 2040. The Scottish Government's Climate Change Plan update demonstrates a pathway to meeting Scotland's emissions reduction targets over the period to 2032.

The UK Government's 'Ten Point Plan for a Green Industrial Revolution' (November 2020), establishes a framework for achieving net-zero, which prominently identifies hydrogen as a key part of the solution. This is manifested in a target of 5 GW of low-carbon hydrogen (a mix of blue and green) production by 2030 (UK Hydrogen Strategy, 2021, Scottish Government Hydrogen Policy Statement 2020). The commercialisation of offshore hydrogen production in the UK will help to meet these targets and broader targets within the UK government's sixth Carbon Budget and commitments within the Climate Change Act 2008, Energy Act 2013 and the 2015 Paris Agreement.

Vattenfall have commitment to continue to take an innovative approach and develop innovative technologies at the AOWF demonstration site. The development of an offshore hydrogen production turbine at AOWF will not only help the future commercialisation of this technology but will provide benefits to the local environment and economy in terms of the availability of green hydrogen which could be utilised by various users, including local transportation networks and marine operators.

2.2 Purpose of this Screening Opinion Request Report

The purpose of this Screening Opinion Request Report is to present the required information under Section 10 of the Marine Works (Environmental Impact Assessment (EIA)) (Scotland) Regulations 2017 (EIA Regulations) to support MS-LOT in their determination of whether an EIA is required for the proposed HT1 hydrogen demonstration project. This report presents details of the characteristics and location of the proposed works and identifies known sensitivities along with the characteristics of any potential impacts to support a screening decision.

The onshore flowline, associated onshore infrastructure and hydrogen storage for HT1 will be consented under the Town and Country Planning Act (Scotland) 1997. These elements are therefore not considered in detail within this report. However, an overview of the expected onshore elements of the project are included in section 4.1.4 to support the consideration of a screening opinion under the EIA Regulations.

This report provides all information requested under Regulation 10 of the EIA regulations to inform the requested screening opinion. Table 2.1 outlines the required information and where this can be found within the following report.

Table 2.1: EIA Screening Checklist based on information requirements set out under Regulation 10(2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Information required under Regulation 10(2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017	Covered within the following Screening Opinion Request Report (Chapter reference)
A description of the location of the proposed works, including a plan sufficient to identify the area in which the works are proposed to be sited.	Chapter 3 and Figure 3-3.
A description of the proposed works, including in particular: • a list of all of the proposed regulated activities	Chapter 2.3.8

Information required under Regulation 10(2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017	Covered within the following Screening Opinion Request Report (Chapter reference)
• a description of the physical characteristics of the proposed works and works to be decommissioned • a description of the location of the proposed works, with particular regard to the environmental sensitivity of geographical areas likely to be affected.	Chapter 4 Chapter 3 and Chapter 5.1
A description of the aspects of the environment likely to be significantly affected by the proposed works	Chapter 6 (Table 6.1 and Table 6.2)
A description of any likely significant effects, to the extent of the information available on such effects, of the proposed works on the environment resulting from either, or both, of the following: • the expected residues and emissions and the production of waste, where relevant • the use of natural resources, in particular soil, land, water and biodiversity	Chapter 6 (Table 6.1 and Table 6.2)
A description of any features of the proposed works or proposed measures envisaged to avoid or prevent significant adverse effects on the environment (mitigation measures).	Chapter 6 Characterisation of potential impacts and associated mitigation
The information referred to above is to be compiled taking into account, where relevant: • the selection criteria set out in schedule 3 • the available results of any relevant assessment.	The following report has been prepared taking into account the selection criteria within schedule 3 of the EIA regs and number of existing assessments including: • AOWFL (Aberdeen Offshore Wind Farm Limited) (2011) 'European Offshore Wind Deployment Centre Environmental Statement'. • Aberdeen Harbour (2015), 'Aberdeen Harbour Expansion Project Environmental Statement.' • Vattenfall HT1 Hydrogen Demonstration Project (2021) EPS Risk Assessment.

A formal Screening Opinion is requested from Marine Scotland under Regulation 10(1) of the EIA Regulations, to determine whether an EIA will be required to support the Marine Licence application for the proposed hydrogen production equipment, works to WTG B06 and the installation and operation of the flowline and associated landfall.

2.3 Consent Requirements / Legislative Framework

2.3.1 Consenting to date

The consent application and Environmental Statement for construction and operation of the AOWF was originally submitted to Scottish Ministers on 1st August 2011, under Section 36 Consent (S.36). This application was subsequently revised to build a demonstration power project, with research and testing facilities. An addendum to the consent was submitted in July 2012 with a Supplementary Environmental Information Statement submitted by the Company to the Scottish Ministers on 06/08/2012. A Marine License was also applied for under Section 20 (1) of the Marine (Scotland) Act 2010 under Part 4 of the same Act for construction works and deposits of substances or objects in the Scottish Marine Area in relation to the Offshore Wind Farm and Export Cable Corridor. An addendum was submitted by the Company on 6th August 2012 to increase maximum turbine height and rotor diameter.

A planning application for onshore works, including the cable route and substation, was submitted to Aberdeenshire Council in January 2013 and granted on appeal. (Aberdeenshire Council (2011) Onshore Consent Planning Application No. APP/2011/2815).

Scottish Minsters granted S.36 consent for the wind farm on 26/03/2013. The Marine License was granted on 15 August 2014 under Section 25 of the Marine (Scotland) Act 2010 (reference 04309/16/0) and varied on 18 March 2019 (reference 04309/19/0), and subsequently, with the latest in September 2020 (which was a variation to licences 04309/13/0, 04309/16/0, 04309/16/1, 04309/17/0, 04309/17/1, 04309/17/2, 04309/18/0, 04309/18/1, 04309/18/2, 04309/18/3, 04309/18/4, 04309/19/0, 04309/20/0 and 04309/20/1). The current licence is valid until 25 July 2043.

Aberdeen Offshore Wind Farm Limited (AOWFL) is a company wholly owned by Vattenfall and was established to develop, finance, construct, operate, maintain, and decommission the AOWF.

The primary purpose of this Screening Opinion Request Report is to determine whether an EIA is required. However, following informal discussions with Marine Scotland and the Oil and Gas Authority, clarity is also sought regarding the key pathways to consent. These are discussed in the following subsections of this chapter.

2.3.2 Environmental Impact Assessment

Assuming the project is consented via a Marine Licence (see sections 2.3.3 and 2.3.4) an EIA could be required to support the Marine Licence application for the installation of the flowline and any associated marine works under Part 4 of the Marine (Scotland) Act 2010. This EIA may be required under Schedule 1 or 2 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017. All works listed under Schedule 1 require a mandatory EIA while Schedule 2 works require an EIA if they meet or exceed the applicable thresholds and criteria set out in column 2 of the table in Schedule 2 of the Marine Works (EIA) Regulations or if they are wholly or partly in a sensitive area as defined in Regulation 2 (1). Schedule 2 works (which exceed the threshold or are in a sensitive area) must be screened to determine if they are likely to have significant effects on the environment by virtue of factors such as their nature, size or location and thus require an EIA. If neither apply, an EIA would not be required but a

Marine License and probable non statutory environmental assessment would be required.

Based on the project description, we believe that the proposed works could fall under Schedule 1.6 or 2.3, 2.6, 2.10 or 2.13 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 as summarised below.

Table 2.2: Summary of potentially relevant Schedule 1 and Schedule 2 projects (taken from Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017)

Descriptions of projects (*Options)*	Applicable thresholds and criteria
Schedule 1.6 Integrated chemical installations Integrated chemical installations, that is to say, installations for the manufacture on an industrial scale of substances using chemical conversion processes, in which several units are juxtaposed and are functionally linked to one another and which are— (a) for the production of basic organic chemicals (b) for the production of basic inorganic chemicals.	All schedule 1 developments require EIA
Schedule 2.3 Energy b) Industrial installations for **carrying gas**, steam and hot water	The area of the work exceeds 1 hectare.
Schedule 2.6 Chemical industry (unless included in schedule 1) (a) Treatment of intermediate products and production of chemicals;	The area of the works exceeds 1,000 square meters.
Schedule 2.10 Infrastructure Projects (k) Oil and **gas pipeline installations** and pipelines for the transport of carbon dioxide streams for the purposes of geological storage (unless included in schedule 1)	(i) The area of the work exceeds 1 hectare; or (ii) In the case of a gas pipeline, the installation has a design operating pressure exceeding 7 bar gauge.
Schedule 2.13 Any change to or extension of works of a description mentioned in paragraphs 1 to 12 of Column 1 of this table where those works are already authorised, executed or in the process of being executed.	

If the HT1 hydrogen demonstration project constitutes a schedule 1 development, then an EIA will be automatically required. However, if the project is not deemed a schedule 1

development but is classified as a Schedule 2 development it may require an EIA, subject to an assessment against Schedule 3 of the EIA Regulations.

It is Vattenfall's opinion that the proposed HT1 hydrogen demonstration project should not be classed as a Schedule 1 development (under 1.6 integrated chemical installations) as the project is not of a "industrial scale". As discussed throughout this Screening Opinion Request Report, the project is a pre-commercial demonstrator which will support proof of concept and would only be viable due to financial support relating to its demonstrator status. As outlined in section 4.3, the project comprises the retrofitting of a single turbine, leading to a maximum hydrogen production flow rate of up to 0.18 m^3/h, (assuming maximum generated power of 8.8 MW). The use of an existing turbine reduces to the bare minimum the development required in order to test this infrastructure in the marine environment.

As illustrated in Table 2.2 the project has potential to fall under 4 Schedule 2 project descriptions (2.3, 2.6, 2.10 and 2.13). However, as evidenced through the development of this Screening Opinion Request Report, Vattenfall believe that the project would have no significant effect on the environment and thus are of the opinion that the proposed project should not be classified as an EIA development.

MS-LOT are therefore asked to confirm if they agree with Vattenfall's assessment of the project and determine whether an EIA would be required under either Schedule 1 or Schedule 2 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

2.3.3 Section 36 Consent:

Under the Electricity Act 1989 a Section 36 Consent is required if a generating station is situated in the:

- Scottish territorial sea (out to 12 nm from the shore), with a generating capacity in excess of 1 MW; or
- Scottish Offshore Region (12 to 200 nm), with a generating capacity in excess of 50 MW.

Following discussions with MS-LOT (via conference call on the 05.02.2021, 15.07.2021, 06.08.2021, 27.08.2021 and 19.10.2021), it is our understanding that an electrolyser and associated infrastructure is not considered an energy generating station and thus does not fall under the Electricity Act 1989. We also understand that MS-LOT consider that the proposed works are unlikely to require a variation to the AOWF existing section 36 as the proposed change would not result in development which would be fundamentally or substantially different in terms of scale and/or nature from that authorised by the existing consent. This is backed up by the criteria within the variation guidance - 17-18 (a) and b -19 which states that a variation is required where:

- The construction of either a generating station or of an extension to a generating station in a different manner or using different components to that set out in the existing consent; or
- The operation of a generating station (whether or not it is already operational) in a manner, or for a period of time, that is different from that specified in the existing consent

Can MS-LOT (in conjunction with the Energy Unit) confirm that they do not class the installation of hydrogen production equipment on an existing offshore wind

turbine as an energy generating station and therefore a new section 36 consent is not required?

Can MS-LOT (in conjunction with the Energy Unit) also confirm that a variation to the existing AOWF Section 36 consent is not required?

2.3.4 Marine Licence

Offshore generating stations and associated marine works also require a marine licence under the Marine (Scotland) Act 2010 (between 0 and 12 nm from shore) or under the Marine and Coastal Access Act 2009 (between 12 and 200 nm). In addition, a marine licence is also required to carry out any of the following activities in Scottish Waters:

- Deposit any substance or object in the sea or on or under the seabed;
- Deposit any substance or object in the sea or on or under the seabed from a vehicle, vessel, aircraft or marine structure loaded with the substance or object in Scotland or in the Scottish Waters;
- Construct, alter or improve works on or over the sea or on or under the seabed from a vehicle, vessel, aircraft or marine structure;
- Remove substances or objects from the seabed; Dredging (including plough, agitation, side-casting and water injection dredging);
- Deposit and/or use explosives; and
- Incinerate substances or objects.

It is therefore considered that a marine licence will be required from MS-LOT for the following aspects of the proposed project:

- Construction of an extended transition piece platform on the existing WTG B06
- Installation of the hydrogen production equipment as defined in section 4.1, anticipated to be housed in up to seven 40ft containers on the aforementioned extended transition piece
- Abstraction of seawater and discharge of brine (approx. 50% more concentrated than the abstracted water) and associated infrastructure at the existing wind turbine B06
- Construction (including trench and burial) and operation of an 8” maximum internal diameter flowline from WTG B06 to shore (see 2.3.5 below).

2.3.5 Pipeline Works Authorisation

The Oil and Gas Authority (OGA) are a government body with responsibility for regulating and influencing the oil and gas industry within the UK. Vattenfall have discussed the potential need for a Pipeline Works Authorisation (PWA), under the Petroleum Act 1998, the Pipeline Safety Regulations 1996 and the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, with the OGA. The OGA informed Vattenfall (via a conference call on the 29.03.2021 and a follow up email on the 20.05.2021) that a PWA is not required for this project and the proposed hydrogen flowline as hydrogen is not included within the Petroleum Act. Vattenfall’s legal opinion has also concluded that a pipeline works authorisation is not required for the following reasons:

- It is not considered that the hydrogen pipeline would constitute a pipeline for the purposes of Part III of the Petroleum Act 1998

- Section 34(a) of the Marine (Scotland) Act 2010 - marine licensing regime does not apply to any activity which relates to a matter which is a reserved matter. The exclusion is however restricted to activities which are outside controlled waters in terms of the Control of Pollution Act 1974
- Marine (Scotland) Act does therefore apply to such matters to the extent which they occur within 3 nautical miles of the territorial sea adjacent to Scotland
- As all proposed works are within 3 nm it is our current understanding that a Marine Licence would be the appropriate consenting regime.

We are however aware that Marine Scotland are discussing the regulatory responsibilities with regards to the flowline. Clarity is therefore requested as to whether the project falls under the Petroleum Act or not and subsequent confirmation of the associated pathway to consent.

Could MS-LOT, please clarify if all proposed activities within section 2.3.4 will be consented via a marine licence and thus there will be no requirement for a Pipeline Works Authorisation?

2.3.6 Controlled Activities Regulations

An abstraction is defined by the Scottish Environment Protection Agency (SEPA) as *"the removal or diversion of water from the natural water environment, by a variety of means, including pumps, pipes, boreholes and wells[1]".* These abstractions are regulated in Scotland via the Water Environment (Controlled Activities) (Scotland) Regulations 2011, known commonly as the Controlled Activity Regulations (CAR). They define that all coastal and transitional water abstractions ≥10m^3/day require registration. The regulations define Coastal waters as waters between the three-mile limit and the limit of the highest tide, or the seaward limit of transitional water. As the proposed abstraction for the hydrogen production equipment is proposed to take place c. 2.4 nm offshore, registration under the CAR will be required.

Similarly, discharge to coastal waters is regulated by the Water Environment and Water Services (Scotland) Act 2003 and the CAR regulations. It is likely that a registration or licence will be required for the discharge of saline effluent from the electrolyser process, but this will be discussed with SEPA and MS-LOT during the application process.

2.3.7 Other legislative / consent requirements

We are aware that several other consents/considerations will be required alongside a marine licence regardless of whether a formal EIA is required. These may include the following:

- European Protected Species Licence (on and offshore)
- A Marine Protected Area Assessment
- A Habitat Regulation Assessment
- A Water Framework Directive Assessment
- A Harbour Works Licence from Aberdeen Harbour Board
- A Crown Estate Scotland Lease
- Permits and permissions associated with survey work including a marine works licence from Crown Estate Scotland

[1] https://www.sepa.org.uk/regulations/water/abstractions/

- Planning permission for onshore works under the Town and Country Planning Act (Scotland) 1997
- Production of Hydrogen Activity Permit – currently in development by SEPA under (Pollution Prevention and Control (Scotland) Regulations 2012 (PPC 2012))
- Hazardous Substances consent and lower tier COMAH regulations for onshore hydrogen storage of c. 7 T.

In addition to the above, Scotland have recently developed a national marine plan, which covers Scotland's marine waters out to 12nm, under the Marine (Scotland) Act 2010 and from 12-200nm under the Marine and Coastal Access Act 2009.The Scottish national marine plan was published in March 2015 and subsequently reviewed in 2019 and sets out strategic policies for the sustainable use of Scotland's marine resources. The Plan supports development and activity in Scotland's seas while incorporating environmental protection into marine decision making to achieve sustainable management of marine resources. The policies and objectives of the Plan are also being reflected at a more local scale through the development of regional marine plans. All decisions within the marine area should be made in accordance with the national marine plan (and emerging regional marine plans) and thus the National marine plan and North East regional marine plan will be taken into consideration when developing the HT1 hydrogen demonstration project and associated consent applications.

Additionally, the Marine Licensing (Pre-application Consultation) (Scotland) Regulations 2013, requires applicants for certain activities within the Scottish Inshore Region to carry out a public pre-application consultation. This involves at least one public event, where various stakeholders, including members of the public, are given the opportunity to comment on the prospective licensable activity that is being applied for. Vattenfall will consult with MS-LOT regarding the requirement for pre-application consultation prior to submission of a marine licence application.

2.3.8 Proposed Regulated Activities

Regulation 10(2) of the EIA Regulations states that a request for a screening opinion must include a list of all of the regulated activities which are proposed. In addition to the information provided in section 2.3.4 and chapters 3 and 4. Table 2.3 summarises the proposed regulated activities, giving a brief description of the activity, the consent required and the relevant regulator(s).

Table 2.3: Summary of proposed regulated activities in the marine environment

Regulated Activity	Brief Description	Consent	Regulator(s)
Geophysical and environmental surveys as required	Geophysical and environmental surveys of the study area and proposed flowline route to inform siting and construction	European Protected Species Licence Marine Works Licence Marine licence exemption	MS-LOT Crown Estate MS-LOT

Regulated Activity	Brief Description	Consent	Regulator(s)
Offshore construction works	Construction of an extended transition piece platform and new j-tube and riser(s) on existing wind turbine B06 using a Vessel or Jack-up-Barge. Construction of abstraction and discharge infrastructure at the existing wind turbine B06.	Marine Licence	MS-LOT
Installation of infrastructure and equipment	Placement of the hydrogen production equipment within seven 40ft containers on the extended transition piece platform	Marine Licence	MS-LOT
Operation of hydrogen electrolyser	Abstraction of seawater and discharge of saline effluent (approx. 50% more concentrated than the abstracted water)	Marine Licence Registration / licence under the Controlled Activities Regulations	MS-LOT SEPA
Flowline construction and operation	Construction (including trenching and burial) and operation of an up-to 8" internal diameter flowline from WTG B06 to shore	Marine Licence	MS-LOT
Maintenance and operational activities	Maintenance and operation of the electrolyser equipment, associated infrastructure and flowline as required.	Marine Licence	MS-LOT

3 LOCATION

This Screening Opinion Request Report focuses on the projects marine area from MHWS seaward. However, an overview of the expected onshore elements of the project are included in section 4.1.4 to support the consideration of a Screening Opinion.

3.1 Aberdeen Offshore Wind Farm

The proposed hydrogen demonstrator project (HT1) is located at Vattenfall's AOWF in Aberdeen Bay (Figure 3-1). The wind farm is located approximately 2 km east of Blackdog, Aberdeenshire with the windfarm lease area being at:

57° 14.723' N 002° 00.911' W 57° 15.240' N 001° 56.865' W

57° 12.360' N 001° 58.680' W 57° 11.842' N 002° 02.721' W

Hydrogen production equipment will be installed on an extended transition piece platform on the existing B06 turbine (previously known as WTG 10 in the marine licence 04309/13/0) located at 57° 13.809' N 001° 58.450' W. No additional wind turbines will be constructed as part of this demonstrator project.

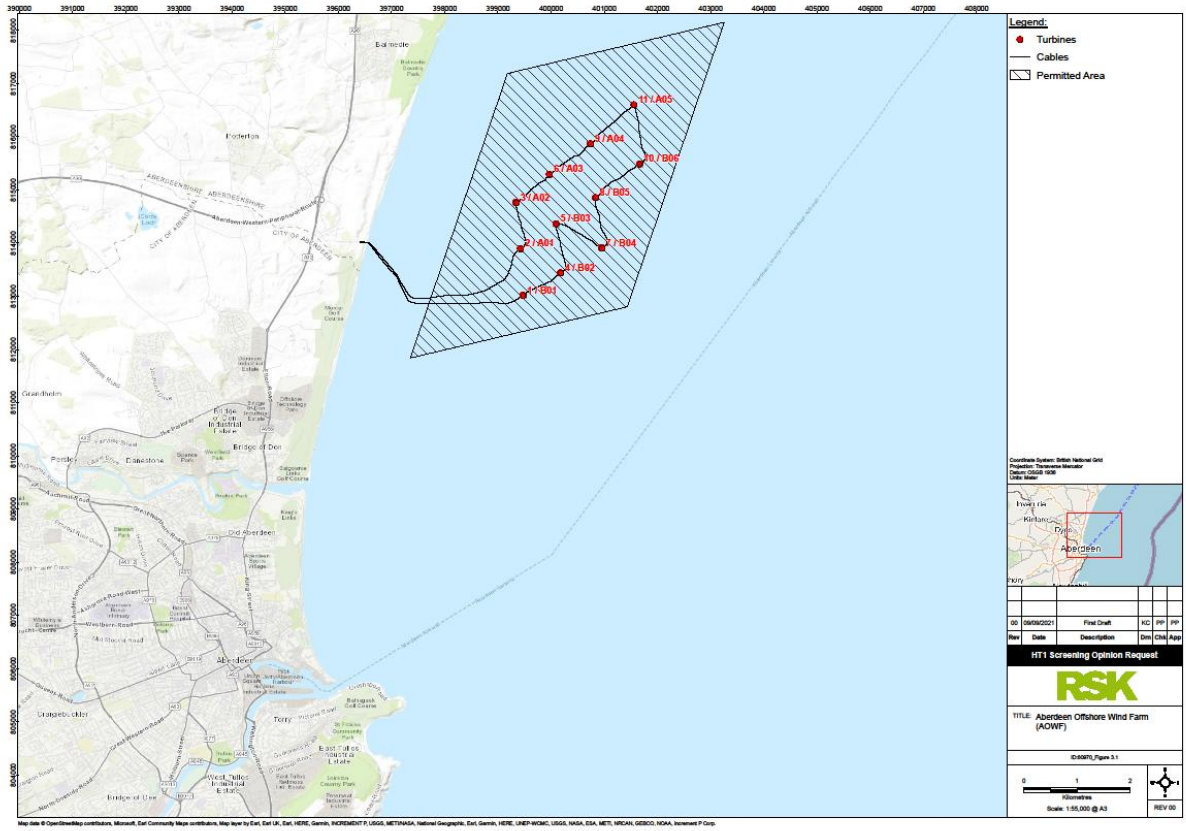

Figure 3-1: Aberdeen Offshore Wind Farm (AOWF) - Lease Area, turbines and cables

3.2 Flowline Route Options

From the WTG B06 a hydrogen flowline will be constructed to bring the hydrogen to shore. The exact route of the flowline is still to be finalised. The route is being informed by a recently concluded internal offshore routing assessment study which considered routing options with a length range of 6.5 - 14.3 km and a recently commissioned onshore site selection study. The study area of the routing assessment covers an area of 96.5 km² from MHWS along the coast from Aberdeen to Balmedie, to a distance of c. 5-8 km offshore (Figure 3-2).

The study area is defined on the west side by the coast, extending to MHWS.

To the east it goes directly south from the north-east tip of the windfarm lease area. One of the flowline location principals is that a 'flowline should follow the shortest route to shore.' The longer the route to shore the more expensive and the more constraints likely to be encountered. Therefore, extending further east (away from the shore) into deeper water, where it is likely to be more difficult to bury the cable has not been further investigated within the offshore routing study.

To the south, following the same principal, the study area goes slightly south of Aberdeen south Harbour. This allows landfall options to include the harbour and industrial areas around it. However, no viable reason can be found to extend the study area further south, resulting in a longer route to shore.

To the north, the study area goes from the north-east lease point of the existing windfarm and follows the lease area to shore. A primary market and location for off-takers for the hydrogen produced is considered to be in and around Aberdeen city therefore going further north will lead to longer transport routes onshore. Therefore, a more northerly route was not considered within the offshore routing study.

The routing study identified five potential landfall sites with six flowline corridor options. Figure 3-3 provides a plan that identifies the area in which the proposed works will be sited.

The six flowline route options that have been identified (Figure 3-3) can be summarised as below, with Option 3a and 4 being the current favoured options.

Option 1:

This option heads east from WTG B06 (0.4 km) outside of the turbine buffer zone before heading north for 1.5 km skirting round the AOWF cables and turbine A05. The proposed route then proceeds east directly to shore (4.6 km), staying within the AOWF permitted area until the last 1.6 km. When it arrives at shore the route is 0.6 km wide at Landfall A to ensure options for landfall locations. Option 1 has a total distance of 6.5 km.

Option 2:

This option heads south from WTG B06 within the AOWF permitted area and outside of the cable and turbine buffer zones until it exits the AOWF at 2.8 km. It then heads south-west skirting the anchorage area to the east for 4.7 km. Then heads 4.3 km north-east, to the south of the anchorage area towards the shore and directly towards the Bridge of Don industrial estate. The Landfall area B is a 4.1 km across with an 800 m no go area of the Don Local Nature Reserve. Option 2 has a total distance of 11.8 km.

Option 3:

This option is the same as Option 2, however the last section heads directly to shore towards the centre of the recreational area at Kings Links 3.8 km within Landfall area B as above. Option 3 has a total distance of 11.3 km.

Option 3a:

This option is the same as Option 3 however it starts slightly further north and heads directly south-west towards Aberdeen (original) Harbour and Landfall E. Option 3a has a total distance of 11.6 km.

Option 4:

This option heads further south than Option 2 and 3 for 4.4 km towards the Aberdeen south Harbour until it reaches the main Aberdeen Harbour shipping route. This option then heads south-west for 4.6 km towards Nigg Bay northern headland. The potential Landfall area C surrounds the headland and is 0.9 km long. Option 4 has a total distance of 11.8 km

Option 5:

Option 5 is similar to Option 4 offshore but heads to the south headland of Nigg bay skirting the discharge pipeline to the south. Option 5 has a total distance of 14.3 km.

Vattenfall have identified Options 3a and 4 as preferred options due to the avoidance of major constraints and environmental sensitivities, opportunities for onward distribution of hydrogen and the availability of suitable industrial sites. However, the final decision will be made through discussion with stakeholders and ongoing assessment. This screening opinion request is therefore being submitted with all the above route and landfall options for consideration with the exception of route Option 1 and Landfall A which will not be considered any further. This is because route Option 1 and the associated Landfall A has significant potential to impact on the sensitive dune environment at Balmedie, would likely require an additional onshore flowline route to reach a suitable onshore location and is a significant distance north of the potential centre of demand. Therefore, the potential length and associated impact of the required onshore pipeline and associated infrastructure could be significant in the context of this demonstrator project resulting in the decision to discount route Option 1 and Landfall A at this early stage.

The finalised offshore flowline corridor is envisaged to be 250 m wide (125 m either side) during construction to allow for micro-siting, with an installation corridor of 30 m (15 m either side) and with a 25 m separation from any other adjacent flowline/pipeline. The flowline depth of cover will be a minimum of 0.6 m, with possible greater depth below the breaking wave position. It is noted that the Crown Estate recommends a minimum of 1m depth, in areas of little/no navigation traffic (inside AOWF), 2m in areas of navigation traffic and 3m in areas of shipping channels and anchorage zones for export transmission cables, which is akin to the installation methodology for the proposed flowline (The Crown Estate (2012)). The final recommended flowline burial depth will be determined by a burial depth assessment.

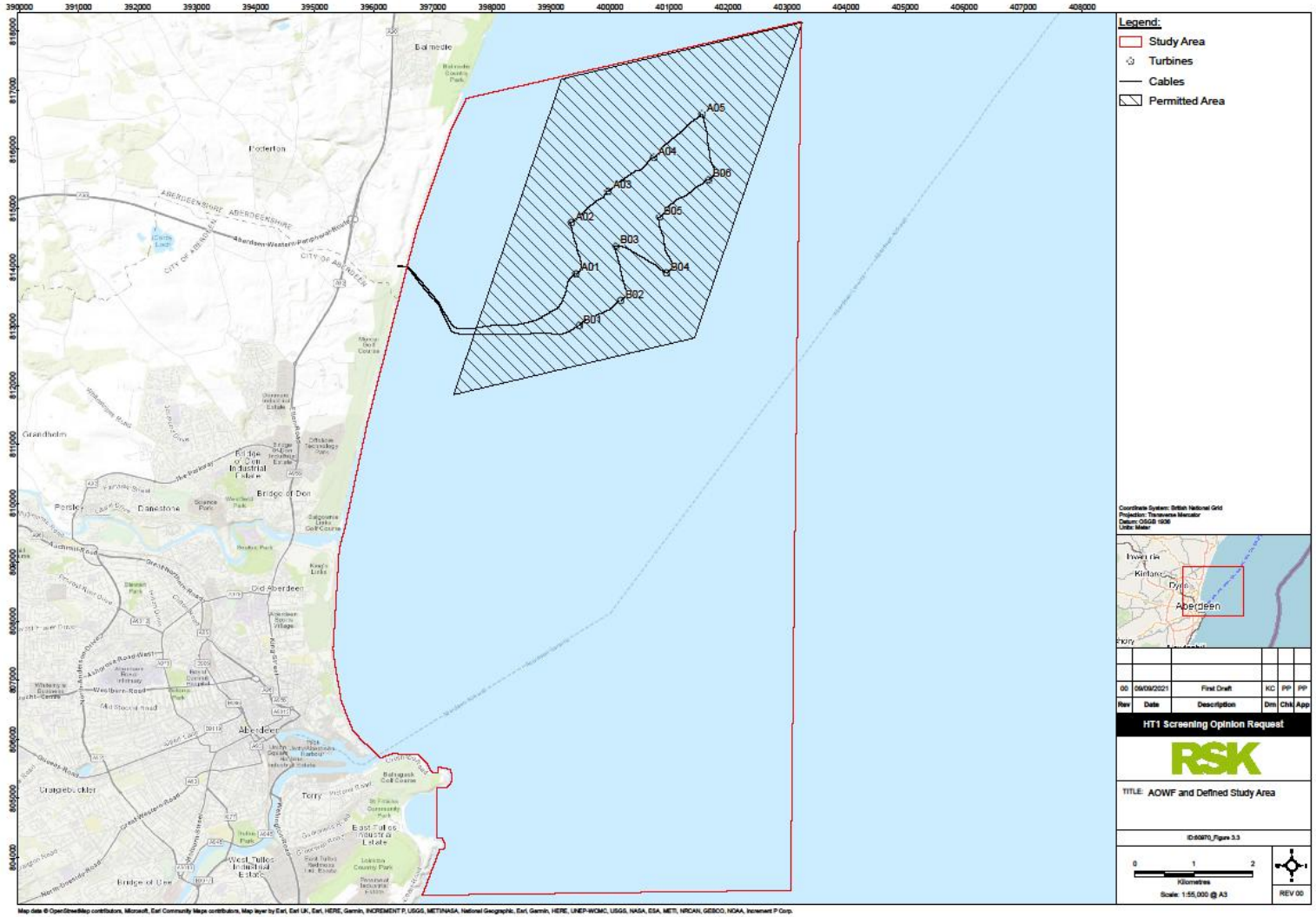

Figure 3-2: Vattenfall HT1 flowline routing assessment study area

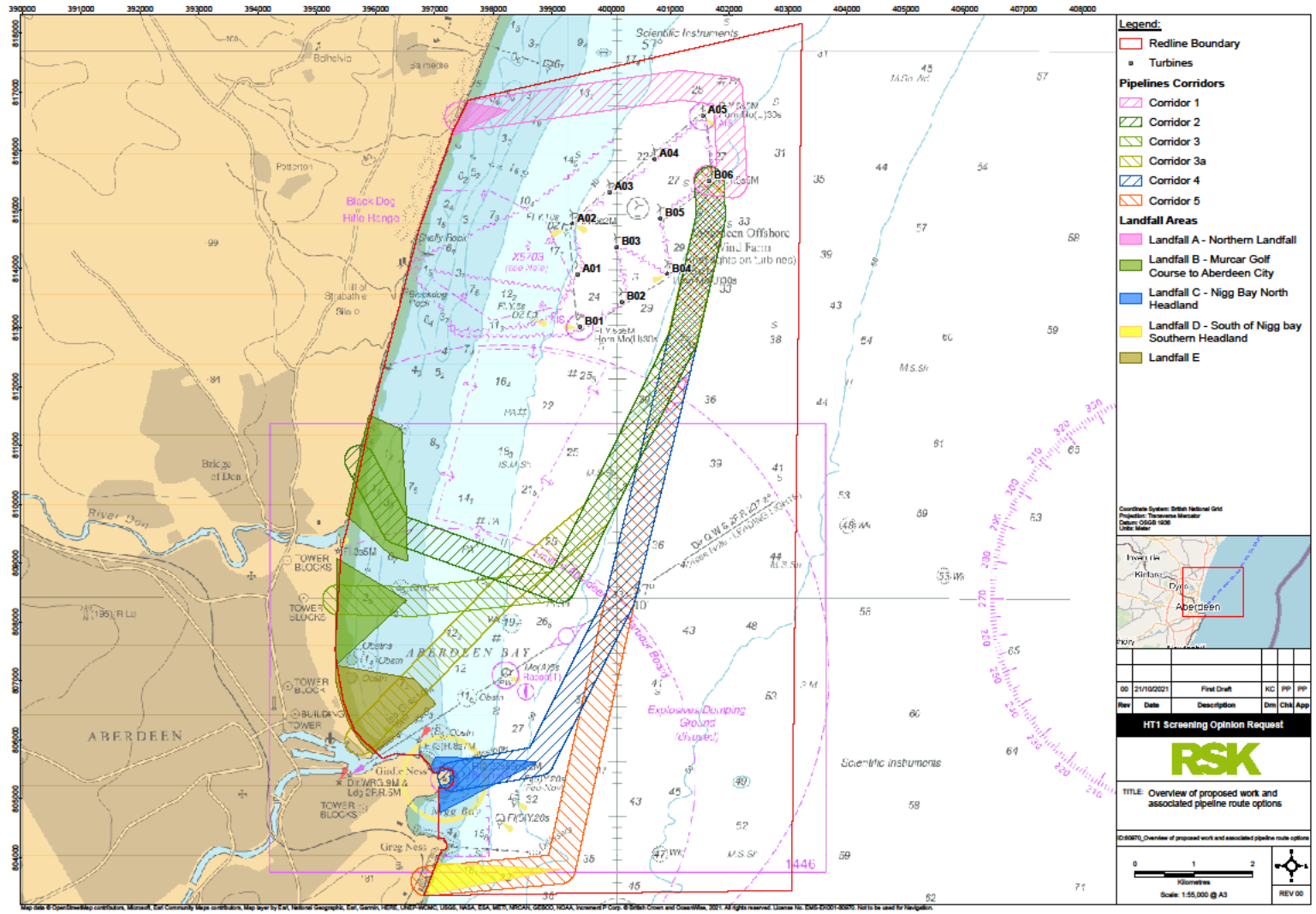

Figure 3-3: Overview of proposed work and associated flowline route options

4 CHARACTERISATION OF WORKS

4.1 Description of proposed works

The HT1 Hydrogen demonstration project will utilise electrical power generated from the existing WTG B06 to produce hydrogen which will be transferred to shore via an 8" maximum internal diameter flexible flowline (Figure 4-1).

Seawater will be abstracted from the immediate vicinity of the WTG and desalinated. The desalinated water will then be electrolysed using electricity from the WTG to produce hydrogen and oxygen. The oxygen will be released to the atmosphere and the hydrogen transported to shore by a buried flowline. Wastewater from the seawater abstraction and desalination process will be discharged back to the sea via a discharge pipe in the water column in the vicinity of WTG B06. Additional abstraction and discharge infrastructure may be required for cooling purposes (see section 6.2.2). After achieving landfall, the hydrogen will be received, processed and stored at an onshore facility, ready for offtake. Various opportunities for offtake, including transportation, industrial uses and marine operations are currently being considered.

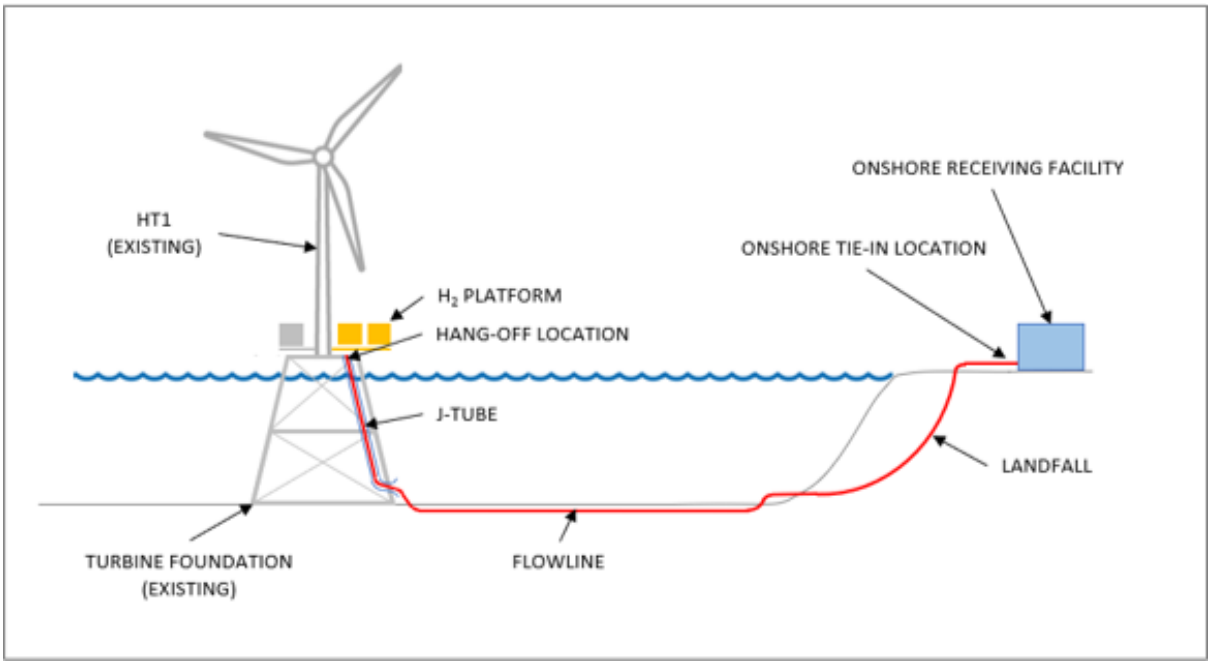

Figure 4-1: Outline of the hydrogen demonstrator project

4.1.1 Wind Turbine Generator (WTG)

The hydrogen equipment installed on the turbine will comprise the electrolyser, desalination equipment and compressors. These will be housed in separate 40 ft (12.19 m) shipping containers with additional cooling where required. The platform to support this new infrastructure will be installed on the transition piece of the turbine, extending the current platform to provide sufficient area. A new j-tube will be installed to route the

flowline from the transition piece to the seabed, and extraction and discharge pipes will extend from the equipment into the water column. The additional equipment is not expected to be beyond 8 m from the current footprint of the WTG girder. The footprint of the platform surrounding the turbine tower base is estimated to be contained within a triangular bounding box of side length 25 m with a total area of 271 m^2. The structure is likely to have the following approximate dimensions:

- 16-27 m above LAT
- 47-58 m above seabed.

The platform will consist of up to seven, 40 ft containers, of steel (80 tons) and concrete for the containerised modules, plus equipment (150 tons). Emergency lighting will be installed on the platform for maintenance purposes. Figure 4-2 and Figure 4-3 provides an overview of the likely look of WTG B06 after installation of the hydrogen production equipment.

The HT1 Hydrogen Demonstrator project comprises of the following offshore components:

- Construction of an extension platform on turbine B06
- Additional J-tube to be added to house the flowline riser
- Installation and operation of hydrogen production equipment within seven 40 ft shipping containers on the turbine platform. Hydrogen production equipment includes:
    - Seawater Inlet and Filter
    - Seawater Intake Pump
    - Water Buffer Tank
    - Circulating Water Pump
    - Desalination Unit
    - Water Treatment Unit (De-ionization)
    - PEM Electrolyser
    - Separator
    - Oxygen Vent
    - Condenser and Trap
    - Dryer Bed
    - Hydrogen Vent
    - Accumulator
    - Brine Outfall
    - Piping, Valves, Monitors, Regulators etc.
- The installation and operation of water abstraction and discharge infrastructure adjacent to the platform
- Construction of a buried hydrogen production flowline from turbine B06 to shore.

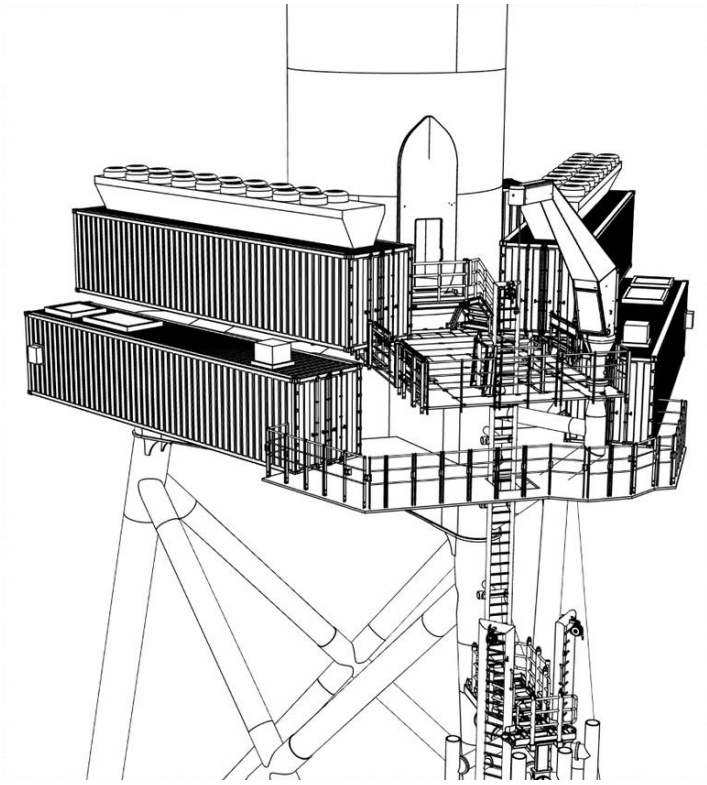

Figure 4-2: Illustration of likely additional infrastructure on WTG B06

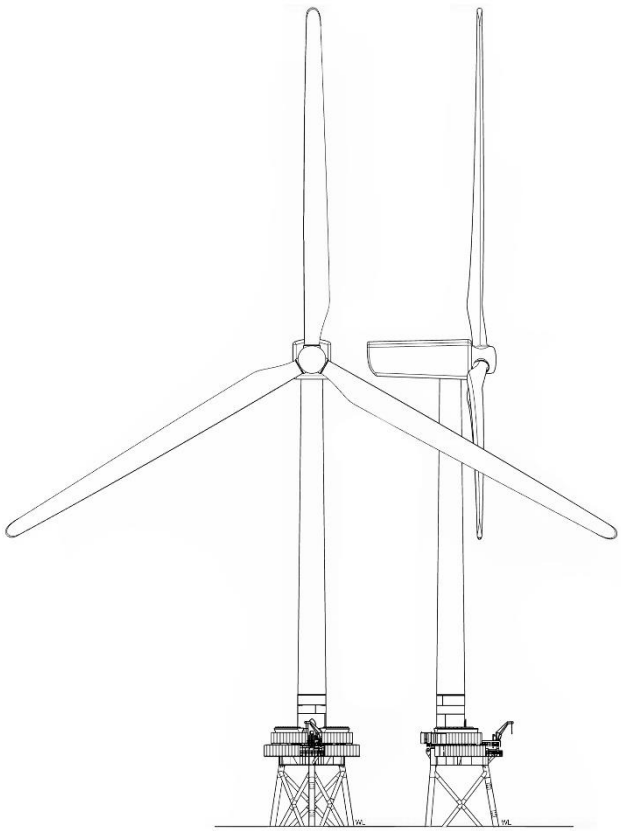

Figure 4-3: Overview of WTG B06 with additional Hydrogen Production Equipment

4.1.2 Hydrogen flowline

The hydrogen transmission system from the WTG to the onshore storage facility is expected to consist of a single flexible flowline, from the hang-off location on the turbine foundation to the onshore tie-in location. The flowline is anticipated to be a maximum of 8” internal diameter.

4.1.3 Transport

It is likely that local ports will be utilised as base locations for construction, operation and maintenance works. A jack-up vessel and support vessels will be used for construction and commissioning, with equipment delivered by barges where applicable.

4.1.4 Onshore facility

The location of the onshore infrastructure for HT1 is yet to be finalised and is subject to ongoing site selection. Irrespective of location, the site will be up to a maximum of 0.5 ha in size, in close proximity (no more than 1 km) from the landfalls identified in Figure 3-3.

Due to the nature of the project as a demonstrator, onshore works including any onshore flowline will be kept to a minimum to limit potential effects as well as time and cost. If an onshore flowline route is required (i.e. the flowline is not installed via HDD directly from the onshore site), this could be installed in roads, verges, or through agricultural land.

A temporary construction compound of up to 0.5 ha may also be used, where space allows adjacent to the site.

The onshore infrastructure for HT1 is expected to include:

- Hydrogen storage containers (up to 4 tonnes, compressed to approximately 200 bar)
- Compression
- Utilities e.g. cooling, el. cabinet, instrument air, …
- Safety systems (including isolation, alarm, vent, …) and valves
- Tanker refuelling facilities for up to four trailers (up to 1 tonne of hydrogen each, compressed at up to 500 bar)
- Parking
- Landscaping
- Lighting
- Drainage
- Receiving facilities; valve station, pig receiver, buffer vessel

Total site storage (containers + trailers) may exceed 5 tonnes and in that instance would fall under the COMAH regulations. The exact maximum volume will be confirmed following site selection and prior to any planning application.

HGV movements during operation are expected to be low (up to 4 per day), however filling may occur at any time of the day. Identifying suitable transport routes will be a key component of site selection.

4.2 Construction Phase

4.2.1 WTG

Construction works at the WTG will include construction of the extended transition piece platform to house up to seven 40 ft shipping containers and the associated installation of the hydrogen production equipment. The required equipment will be pre-installed as a containerised solution to accommodate optimised installation cycles. Construction of water intakes and outtakes within the water column in the vicinity of the WTG B06 will also take place at this time. The construction and installation work at the WTG will include welding, drilling and cutting activities but no piling works are foreseen. Directly after the installation activities are completed, commissioning of the new equipment will commence to connect the equipment with the power supply of the WTG.

It is envisaged that small jack-up vessel with crane, a crew transfer vessel (CTV) and an anchor handling tug (AHT) with a crane will be utilised for the installation works at the WTG.

4.2.2 Flowline

The flowline, which is anticipated to be an unbonded flexible flowline, will be pre-fabricated onshore and installed from a carousel or reel drive system on an appropriate vessel. The flowline will be initiated from the landfall location, where it will be terminated at a connection point onshore. The vessel will lay the flowline along the route corridor to WTG B06 where the second end of the flowline will be pulled through the new J-tube to the turbine foundation where it will be terminated and connected to the hydrogen production system. Prior to flowline installation a pre-lay grapnel run or other seabed preparation may be required, depending on seabed conditions.

Following flowline installation, appropriate pre-commissioning activities will be performed to confirm the integrity of the system prior to burial. Pre-commissioning of the flowline is anticipated to be completed by standard procedures using typical pre-commissioning fluids such as:

- Fresh water (flooding pre-lay)
- Filtered and treated seawater (cleaning, gauging, strength test)
- MEG (dewatering)
- Nitrogen (dewatering).

It is anticipated that the flowline will be protected by post-lay jetting, however this is subject to a geotechnical route survey. Ploughing and backfilling, or the use of a hybrid jetting and cutting tool may be specified if geotechnical conditions are unsuitable for jetting alone. A trenching assessment will be completed to determine the required depth of cover. This is expected to be a minimum of 0.6 m, but may be greater in line with Crown Estate recommendations, especially in areas inside the breaking wave point.

Trench transitions, end zones and areas along the route where the required depth of cover is not achieved will be protected by remedial rock-dumping and/or concrete mattresses.

For the purposes of this screening report, a highly conservative estimate of up to 15% of the route requiring protection is consider, however this would be reduced as far as practicable, and this figure will be refined following seabed surveys.

In this regard, it should be noted that no sensitive benthic features have been identified that would be affected by any flowline protection (section 5.1), and the location and extent of any protection would be discussed with the relevant maritime authorities to ensure it poses no hazard to shipping.

4.2.3 Landfall

The landfall construction will depend greatly on the final location and associated geological material (rock and/or sand). There are several potential methods being considered;

- Horizontal Directional Drilling (HDD)
- Open cut
- Flowline protection e.g. rock placement/mattressing; or
- a combination thereof.

The landfall site itself would be as small as possible, consisting of a small construction site which would potentially include;

- Road access
- Winch and winch platform
- Jointing bay
- Small site office

Horizontal Directional Drilling (HDD)

The primary installation method of choice would be Horizontal Directional Drilling (HDD). With the current geological information, HDD is considered suitable at all landfalls. The base case would be HDD drilled from onshore to offshore seawards of any sensitive coastal or intertidal features and coastal protection assets.

The horizontal distance of the HDD would be kept to a minimum, taking into account the local geological, bathymetric and environmental conditions. HDD drilling time will vary depending on the underlying geology, and the length of drilling works. Where possible, drilling may be undertaken 24 hours a day subject to the agreement of relevant regulators.

Open Cut

The cable for AOWF was brought ashore via an open cut landfall and this remains an option for the HT1 flowline, where there is suitable coastal topography and geology. For this approach a trench would be excavated in the intertidal zone, in which the flowline would be laid and then subsequently backfilled.

Open cut is sometimes quicker, more economical and less technically challenging than HDD, and may also be required as a back-up option even where HDD is proposed as the primary installation method.

Rock placement

It is feasible but highly unlikely that the flowline could be surface laid to shore and then covered with rocks and/or mattresses. This form of flowline protection could allow installation over hard geology, however this would only be considered where HDD and open cut methods were technically unfeasible.

Auxiliary Works

In addition to the aforementioned installation methods, ancillary works may be required at the landfall including:

- Temporary access construction
- Transition joint bay (buried chamber where the offshore and onshore flowline are joined)
- Site facilitates and laydown area (including welfare, office, storage).
- Fencing

4.3 Operations phase

4.3.1 WTG

The WTG and OWF is expected to operate in exactly the same manner after installation of the hydrogen equipment with exception of nominally reduced power to shore output. This is due to the power consumed by hydrogen production (c. 8.8 MW max) which is subsequently converted from AC to DC (the turbine will therefore no longer export electricity). Hydrogen production is expected whenever the turbine power output and onshore storage capacity allows.

The following key operational inputs and outputs are expected when the hydrogen production equipment is in full operation (assuming the max generated power of 8.8 MW).

- Maximum hydrogen production flow rate 0.18 m^3/h
- Maximum seawater abstraction rate of 3.52 m^3/h for desalination
- Maximum wastewater brine discharge (at c. 50% increased salinity) at a rate of 1.76 m^3/h.

Regular maintenance and testing of the equipment on the WTG will be done in the first year by a CTV vessel (or similar), estimated maximum of twice per month. Frequency of visits to the Hydrogen equipment will likely decline after the first year.

No significant waste is expected from day to operations.

4.3.2 Flowline

The Flowline will be sized to accommodate maximum hydrogen production capacity (envisaged to maximum internal diameter of 8”), with an anticipated maximum operating pressure of 40 bar and a flowrate of 200 kg/hr.

4.4 Decommissioning Phase

The HT1 facility is envisaged to be operational by 2024/5. The lifetime of the project is likely to be between 8-10 years, which is the lifetime of the electrolyser system. The current OWF is licenced until July 2043.

The hydrogen equipment and flowline will be decommissioned in line with relevant guidance and in consultation with statutory bodies and Crown Estate Scotland. The decommissioning plan will set out the methodology and timing of decommissioning. At this stage it is not confirmed whether the hydrogen infrastructure will be decommissioned at the end of its operational life or at the same time as the wind farm and this will be subject to further discussions with regulators. A comparative assessment will be completed as part of planning the decommissioning programme for the works.

5 KNOWN SENSITIVITY

5.1 Biodiversity

5.1.1 Designated Sites

There are several coastal or marine protected areas in or within 20 km of the study area boundary. Table 5.1 describes these and the designated sites onshore within Aberdeenshire and the adjacent offshore area are illustrated in Figure 5-1. Sites included here are both within and outwith the marine study area defined in Section 3.

Table 5.1: Designated sites within 20 km of the study area

Site name	Distance* / direction	Reason designated
Special Protection Area (SPA)		
Ythan Estuary, Sands of Forvie and Meikle Lock	0 km Marine area of the SPA overlaps with study area	Supports populations of European importance of the migratory pink-footed goose (*Anser brachyrhynchus*), populations of European importance of sandwich tern (*Thalasseus sandvicensis*), common tern (*Sterna hirundo*), little tern (*Sternula albifrons*), and a wintering waterbird assemblage, which includes nationally important populations of pink-footed goose, eider (*Somateria mollissima*), redshank (*Tringa tetanus*) and lapwing (*Vanellus vanellus*).
Buchan Ness to Collieston Coast	7.6 km N	Supports a breeding seabird assemblage, which includes nationally important populations of fulmar (*Fulmarus glacialis*), guillemot (*Uria aalge*), herring gull (*Larus argentatus*), black-legged kittiwake (*Rissa tridactyla*) and European shag (*Phalacrocorax aristotelis*).
Special Area of Conservation (SAC)		
River Dee	0 km Area of the SAC at the River Dee estuary mouth overlaps with study area	[Redacted] a significant proportion of the Scottish Atlantic salmon (*Salmo salar*) resource and a strong, high quality population of otters (*Lutra lutra*).
Garron Point	16.2 km S	Supports the only remaining population of narrow-mouthed whorl snail (*Vertigo angustior*) in Scotland.
Sands of Forvie	6 km N	Supports dune habitats: shifting dunes, shifting dunes with marram, lime-deficient dune heathland with crowberry and humid dune slacks.

Site name	Distance* / direction	Reason designated
Buchan Ness to Collieston	10.4 km N	Supports vegetated sea cliffs of the Atlantic and Baltic coasts.
Site of Scientific Special Interest (SSSI)		
Nigg Bay	0.3 km W	Designated for geological interest: quaternary of Scotland.
Cove Bay	2.5 km S	Designated for geological and biological interest: maritime cliff and Dickie's bladder-fern (*Cystopteris dickieana*).
Findon Moor	6 km S	Designated for biological interest: lowland heathland.
Garron Point	16.2 km S	Designated for geological and biological interest: Dalradian geology, maritime cliff, narrow-mouthed whorl snail (*Vertigo angustior*) and the Northern brown argus butterfly (*Aricia artaxerxes*).
Forveran Links	4.8 km N	Designated for geological and biological interest: coastal geomorphology of Scotland and sand dunes.
Sands of Forvie and Ythan Estuary	6 km N	Designated for geological and biological interest: coastal geomorphology of Scotland, sand dune, estuary, saltmarsh, vascular plant assemblage and breeding bird assemblage.
Collieston to Whinnyfold Coast	10.4 km N	Dalradian geology, maritime cliff, cliff-breeding seabird colony, and sea wormwood (*Seriphidium maritimum*).
Bullers of Buchan Coast	18.6 km N	Designated for geological and biological interest: coastal geomorphology of Scotland, maritime cliff, and breeding seabird assemblage.
Local Nature Reserve (LNR)		
Donmouth	0 km Overlap with coastal strip of study area	Designated for the beach, which is of local importance in terms of natural heritage.

*****Distance estimated from closest point of protected area boundary to study area outline

Source: Marine Scotland, 2021; NatureScot, 2021

Not all the sites listed above are of direct relevance to this Project: most of the SSSIs are designated for either geomorphological or terrestrial / coastal features, while the Garron Point, Sands of Forvie, and Buchan Ness to Collieston SACs are all designated for coastal habitats or terrestrial invertebrates, and these are unlikely to be impacted by this project and so can be screened out.

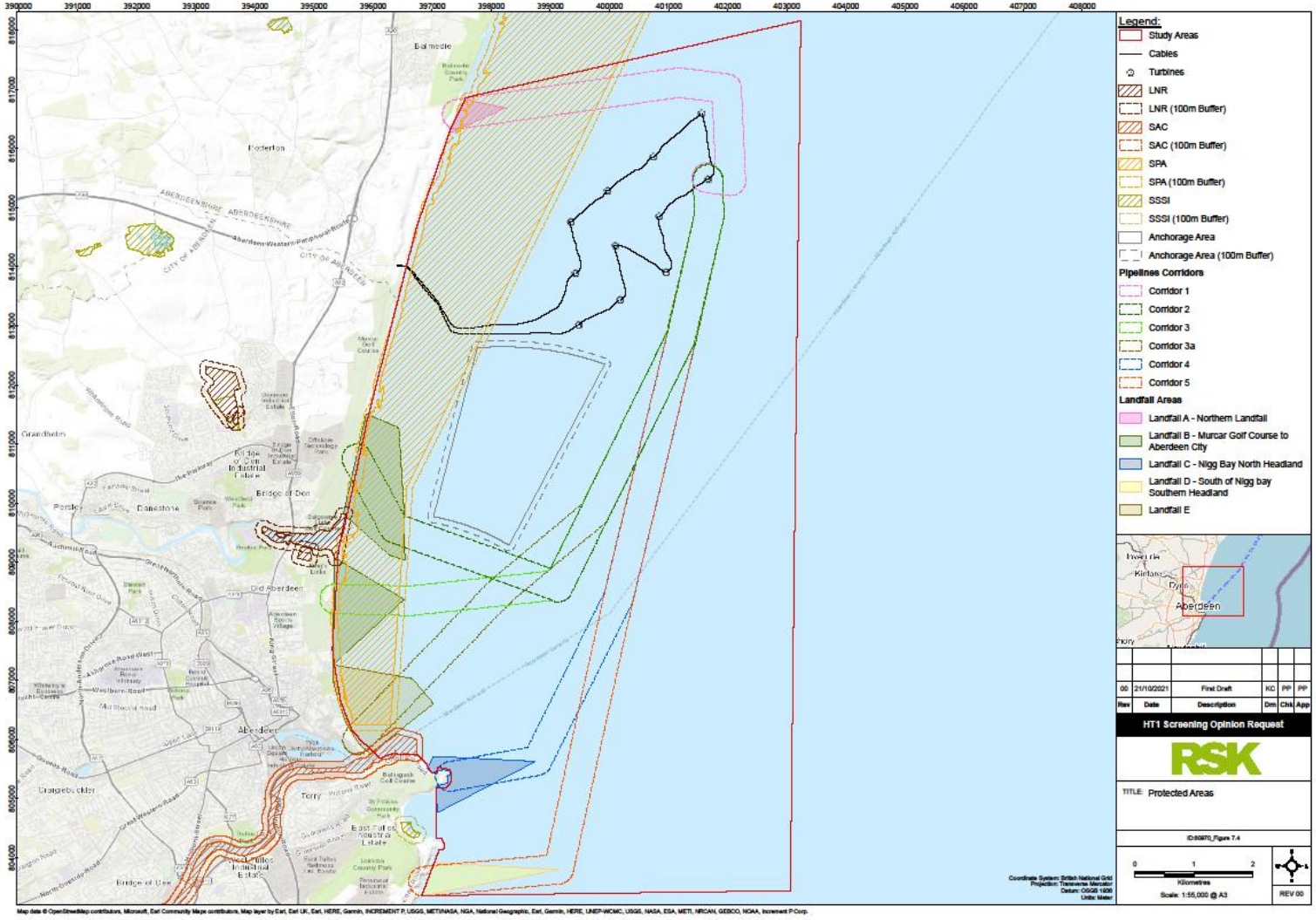

Figure 5-1: Protected areas in proximity to the identified flowline corridor options

5.1.2 Terrestrial

The coastal habitat along the study area includes modified sandy beaches in front of Aberdeen city, but also habitats of regional or national importance that are in some cases protected as qualifying features for the designation of the sites listed in Table 5-1 above. However, the terrestrial habitats and species are not described in further detail here, as they are unlikely to be impacted by the Project other than at the flowline landfall site.

The [Redacted] coastal wading birds, such as those included in the Ythan Estuary, Sands of Forvie and Meikle Lock SPA designations, are referenced in further sections as they interact with the intertidal or marine areas within the study area.

5.1.3 Marine

5.1.3.1 Benthic Ecology

Subtidal

The main subtidal habitat type in the study area is the high energy, shallow circalittoral sands: circalittoral fine sand (A5.25 / SS.SSa.CFiSa) or circalittoral muddy sand (A5.26 / SS.SSa.CMuSa). A small patch of moderate energy mud: circalittoral sandy mud (A5.35 / SS.SMu.CSaMu), is present in the north east corner of the study area, while the area further inshore, in the south west of the study area adjacent to Aberdeen city, is described as infralittoral sands: infralittoral fine sand (A5.23 / SS.SSa.IFiSa) or infralittoral muddy sands (A5.24 / SS.SSa.IMuSa) (JNCC, 2015; EEA, 2020). This means that the subtidal benthic community described at the AOWF site is likely to be similar throughout the majority of the study area.

The offshore subtidal benthic habitat including the dominant community assemblage in the study area is described in the AOWF ES as *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSA.CMuSa.AalbNuc) (AOWFL, 2011; JNCC, 2015). As the circalittoral muddy sand is more stable than the habitats further inshore, the infaunal community is richer. In this community, polychaetes (e.g. *Notomastus latericeus*), bivalves (*Abra alba*, *Nucula nitidosa* and *Fabulina fabula*) and echinoderms (e.g. brittle stars *Ophiura* spp.) dominate. The epifaunal community is relatively sparse due to the high energy environment, and is dominated by brittle stars, brown shrimp (*Crangon crango*n) and flying crab (*Liocarcinus holsatus*) (AOWFL, 2011).

The subtidal benthic habitat including the dominant community assemblage further inshore is described as *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSA.IFiSa.NcirBat) (AOWFL, 2011; JNCC, 2015). Infralittoral fine sand habitats are characterised by robust fauna, such as amphipods (e.g. *Bathyporeia*) and polychaetes (e.g. *Nepthys cirrosa*), which can withstand the high energy environment resulting from wave action along the open coastline around Aberdeen. Similar species to those found offshore will be present in the epifaunal community further inshore.

There are a few additional subtidal habitats in the southern section of the study area, described in the Aberdeen South Harbour Project ES, around Nigg Bay (Aberdeen Harbour, 2015) These are *Laminaria digitata* on moderately exposed sublittoral fringe rock (IR.MIR.KR.Ldig) in the shallow subtidal areas at the peripheries of the bay, *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag), and echinoderms and crustose

communities (CR.MCR.EcCr). The CR.MCR.EcCr habitat may also be combined with the SS.SSA.IFiSa.NcirBat habitat in some places (Aberdeen Harbour, 2015; JNCC, 2015).

Intertidal

The intertidal shorelines of the Aberdeenshire coast generally comprise sandy shores with an intertidal fauna dominated by infaunal mobile crustaceans (such as haustorid amphipods: *Haustorius arenarius* and *Bathyporeia pelagica*). This is the expected habitat along the study area shoreline from Aberdeen city northwards. Sedentary species are expected to be less abundant, as the area is of moderate exposure and relatively high energy (AOWFL, 2011). These habitats are potentially barren or amphipod-dominated mobile sand shores (LS.LSa.MoSa), Talitrids on the upper shore and strand-line (Ls.LSa.St.Tal) and/or barren littoral shingle (LS.LCS.Sh.BarSh) (JNCC, 2015).

The intertidal shoreline in the southern section of the study area, where the Aberdeen South Harbour Project is located, contains some rockier habitats around the headlands of Nigg Bay (Aberdeen Harbour, 2015), although this area will be heavily altered by the construction of the new harbour, with works currently ongoing.

The habitats around the northerly headland include:

- *Mytilus edulis* and barnacles on very exposed eulittoral rock (LR.HLR.MusB.MytB)
- *Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock (LR.HLR.MusB.Sem.Sem)
- *Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock (LR.FLR.Lic.Ver.Ver)
- Yellow and grey lichens on supralittoral rock (LR.FLR.Lic.YG)
- LS.LCS.Sh.BarSh

while at the southerly headland the following are present:

- *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock (LR.MLR.BF.FvesB)
- LR.HLR.MusB.Sem.Sem
- LR.FLR.Lic.Ver.Ver
- LR.FLR.Lic.YG.

5.1.3.2 Fish & Shellfish

There is a large range of teleost (ray-finned) fish, elasmobranchs (e.g. sharks, rays, skates) and shellfish that can be found in the study area, in the waters in and around Aberdeen and Nigg Bay. Species noted as potentially relevant to the study area, such as those species whose spawning and nursery grounds may overlap the study area or those that are migratory and may pass through the study area, are included in Table 5.2, based on information from the AOWF and Aberdeen South Harbour Project ESs.

Table 5.2: Overview of key fish species in the study area.

Common Name Species Name	Spawning / Nursery Grounds in the Study Area	Migratory / Resident
Teleost fish		
Sea trout (*Salmo trutta)*	No	Resident*
Atlantic salmon (*Salmo salar)*	No	Migratory
European eel (*Anguilla Anguilla)*	No	Migratory
River lamprey (*Lampetra fluviatillis)*	No	Migratory
Sea lamprey (*Petromyzon marinus)*	No	Migratory
Herring (*Clupea harengus)*	**Spawning & nursery grounds**	**Seasonal resident**
Cod (*Gadus morhua)*	Low intensity spawning ground & nursery ground	Seasonal resident
Whiting (*Merlangius merlangus)*	Low intensity spawning & high intensity nursery grounds	Seasonal resident
Saithe (*Pollachius virens)*	Nursery ground	Seasonal resident
Sandeel (*Ammodytes marinus)*	**Potential spawning & nursery ground, although more likely further offshore**	**Resident**
Plaice (*Pleuronectes platessa)*	Potential spawning although more likely further offshore & nursery ground	Seasonal residents
Lemon sole (*Microstomus kitt)*	Spawning & nursery grounds	Seasonal residents
Elasmobranchs		
Basking shark (*Cetorhinus maximus)*	No	Migratory
Common skate (*Dipturus batis)*	Nursery ground	Resident
Tope (*Galeorhinus galeus)*	No	Migratory
Small-spotted catshark (*Scyliorhinus canicula)*	**Thought to spawn where it occurs**	**Resident**
Thornback skate (*Raja clavata)*	**Thought to spawn where it occurs**	**Resident**
Spurdog (*Squalus acanthias)*	No	Migratory

*Migrates in/out of Nigg Bay (Aberdeen Harbour, 2015) but is resident in coastal waters (AOWFL, 2011).

Those species in bold above, thought to spawn in the study area have spawning grounds that are benthic or demersal.

Source: Adapted from AOWFL (2011) and Aberdeen Harbour (2015)

Other species potentially present in the study area include gobys (Gobbiidae), blennies (Blenniidae), dragonets (Callionymidae), dab (*Limanda limanda*), hake (*Merluccius merluccius*), ling (*Molva molva*), Norway pout (*Trisopterus esmarkii*), hooknose (*Agonus cataphractus*) and spotted ray (*Raja montagu*i).

Some of the species potentially present in Table 5.2 are also commercially important, while other species of commercial importance in the area are likely to include haddock (*Melanogrammus aeglefinus*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*) and horse mackerel (*Trachurus trachurus*).

The following shellfish species may also be present within the study area (AOWFL (2011) and Aberdeen Harbour (2015):

[Redacted]

- European lobster (*Homarus Gammarus*)
- Norway lobster (*Nephrops norvegicus*)
- Brown crab (*Cancer pagurus*)
- Velvet swimming crab (*Necora puber*)
- Flying crab (*L. holsatus*)
- Harbour crab (*Liocarcinus depurator*)
- Brown shrimp (*C. crangon*)
- King scallop (*Pectin maximus*)
- Common whelk (*Buccinum undatum*)
- Cockle (*Cerastoderma edule*)
- Mussels (*M. edulis*)
- Periwinkles (*Littorina* spp.)

Many of these shellfish species are either commercially important themselves, or important as prey of commercially important species, as are the cephalopod species below.

Cephalopods are relatively diverse and abundant in the northern North Sea, with frequently recorded species including long-finned squid (*Alloteuthis subulata* and *Loligo forbesii*), short-finned squid (*Todaropsis sagittatus*, *Gonatus fabricii*, and *Onychoteuthis banksii*), bobtail squid (*Rossia macrosoma*, *Sepietta atlantica* and *Sepietta oweniana*), the octopus (*Eledone cirrhosa*), and cuttlefish (*Sepiida*).

[Redacted] Atlantic salmon are Annex II species that are a primary reason for the selection of the River Dee SAC (see Table 5.1). Although none of the proposed flowline route corridors directly coincide with the SAC, the migratory pathway of the Atlantic salmon may be intersected by them within the study area.

5.1.3.3 Marine Mammals

Two main groups of marine mammals occur in the study area: cetaceans (dolphins and whales) and pinnipeds (seals).

During the boat surveys carried out for the AOWF development, harbour porpoise (*Phocoena phocoena*) were the most regularly sighted species, with bottlenose dolphins (*Tursiops truncatus*) also regularly sighted (AOWFL, 2011; Genesis, 2012a). Other cetacean species sighted during the surveys were white-beaked and Risso's dolphins

(*Lagenorhynchus albirostris* and *Grampus griseus*), and minke whales (*Balaenoptera acutorostrata)* (AOWFL, 2011; Genesis, 2012a), suggesting they may be present in the study area. Table 5.3 shows the usage of Aberdeen Bay by these species, as well as the seals, and the seasons they are likely to be present.

Table 5.3: Presence of marine mammals in Aberdeen Bay area (study area)

Species	Usage	Winter	Spring	Summer	Autumn
Harbour porpoise *(Phocoena phocoena)*	Resident	Moderate		High	Moderate - High
Bottlenose dolphin (*Tursiops truncatus*)	Resident	Moderate - High	High		Moderate - High
White-beaked dolphin (*Lagenorhynchus albirostris*)	Seasonal	Moderate - absent	Absent - Low	High	Moderate-low
Risso's dolphin *(Grampus griseus)*	Occasional	Absent - low	Low	Low - moderate	Moderate – absent
Minke whale *(Balaenoptera acutorostrata)*	Seasonal	Absent - low	Low-moderate	High	Absent - low
Grey seal *(Halichoerus grypus)*	Resident	Moderate			
Harbour seal (*Phoca vitulina*)	Resident	High	High to moderate		High

Source: Adapted from AOWFL (2011), Genesis (2012a), Aberdeen Harbour (2015) and Hague et al. (2020).

Minke whales, humpback whales (*Megaptera novaeangliae*) and short-beaked common dolphins (*Delphinus delphis*) have all been observed within the study area around Aberdeen Harbour (Hague et al., 2020), although humpback whales and common dolphins are rare visitors to the area. Other species may also be present in north east Scotland / East Grampian region, but this area (including the study area within Aberdeen Bay) is only a marginal part of their habitat, with restricted use by relatively few individuals and most likely further offshore (AOWFL, 2011; Genesis, 2012a; Aberdeen Harbour, 2015; Hague et al., 2020). This includes, but is not limited to:

- White-sided dolphin (*Lagenorhynchus acutus*)
- Long-finned pilot whale (*Globicephala melas*)
- Killer whale (*Orcinus orca*)
- Sperm whale (*Physeter microcephalus*)
- Fin whale (*Balaenoptera physalus*).

Grey and harbour seals (*Halichoerus grypus* and *Phoca vitulina*) also use the area year-round (Hague et al., 2020), with the nearest main haul-out sites of both species at Donmouth (within the study area) and the mouth of the Ythan River (outside the study area). They also use the estuaries of the River Dee and Don as feeding grounds (AOWFL, 2011). The study area is used more consistently by grey seals, with high at-

sea usage in Aberdeen Bay (Hague et al., 2020), although harbour seals are seen regularly along the coast.

All cetaceans in Northern European waters are listed under Annex IV of the EU Habitats Directive as European Protected Species of Community Interest and in need of strict protection. The harbour porpoise, bottlenose dolphin, harbour seal and grey seal have protection under Annex II as species of Community Interest whose conservation requires the designation of Special Areas of Conservation (SACs). There are no SACs in the area designated for marine mammals that overlap with the study area.

However, there are SACs designated for seals that may have foraging and habitat interconnectivity with the study area:

- grey seals:
  - Isle of May SAC (107.5 km S)[2] at the entrance of the Firth of Forth
  - Berwickshire and North Northumberland Coast SAC (132.5 km S)[1]
- harbour seals:
  - Dornoch Firth and Morrich Moore SAC (181.2 km NE)[1] in the Moray Firth
  - Firth of Tay and Eden estuary SAC (81.2 km S)[1].

Animals from the colonies at these SACs may pass through the study area (AOWFL, 2011; Hague et al., 2020).

The Moray Firth SAC (141.5 km NE)[1] is designated for bottlenose dolphins, and individuals from the East Scotland population that utilise Aberdeen Bay are also likely to be part of the resident population the SAC is designated for. The overall East Scotland population of bottlenose dolphins was estimated to be 213 animals in 2019 (Arso Civil et al., 2021). Minke whales observed in Aberdeen Bay are likely to be individuals from the population that utilise the Southern Trench MPA (20.6 km NW)[1] as a feeding ground (Hague et al., 2020; NatureScot, 2019).

[Redacted]

5.1.3.4 Marine Ornithology

Marine birds can be classified as offshore – those that breed along coast but spend the majority of time outside of the breeding season over the open sea – and coastal – those that breed along the coast but may collect food from the open sea (this includes coastal waders, wildfowl and other shorebirds). The study area within Aberdeen Bay is likely to be used as a foraging area for both offshore and coastal birds. Many of these species are included as assemblage species, or species that the coastal SPAs are designated for (see Table 5.1).

A summary of the common offshore birds that may be present in the study area are presented in Table 5.4, and common coastal birds in the study area are summarised in Table 5.5.

[2] Estimated distances from closest point of the SAC boundary to the study area outline.

Table 5.4: Common offshore birds likely to be present in the study area

Species	Seasonality (main)
Black-legged kittiwake (*Rissa tridactyla*)	Spring, summer, autumn
Great black-backed gull (*Larus marinus*)	All year round
Arctic skua (*Stercorarius parasiticus*)	Summer & autumn
Great skua (*Stercorarius skua*)	Summer & autumn
Fulmar (*Fulmarus glacialis*)	Spring, summer, autumn
Manx shearwater (*Puffinus puffinus*)	Spring, summer, autumn
Northern gannet (*Morus bassanus*)	Spring, summer, autumn
Atlantic puffin (*Fratercula arctica*)	Spring, summer
Razorbill (Alca t*orda*)	All year round
Guillemot (*Uria aalge*)	All year round

Source: AOWFL, 2011; Genesis 2012b; Aberdeen Harbour, 2015

Table 5.5: Common coastal birds likely to be present in the study area

Species	Seasonality (main)
Whooper swan (*Cygnus cygnus*)	Winter
Pink-footed goose (*Answer brachyrhynchus*)	Winter
Barnacle goose (*Branta leucopsis*)	Summer & Autumn
Eurasian wigeon (*Anas Penelope*)	Spring & Autumn
Eurasian teal (*Anas crecca*)	Spring & Autumn
Eider (*Somateria mollissima*)	All year round
Long-tailed duck (*Clangula hyemalis)*	Winter & Spring
Common scoter (*Melanitta nigra*)	Spring & Summer
Red-throated diver (*Gavia stellate*)	Spring & Autumn
Common gull (*Larus canus*)	All year round
Sandwich tern (*Thalasseus sandvicensis*)	Spring, Summer & Autumn
Common tern (*Sterna hirundo*)	Spring, Summer & Autumn
Arctic tern (*Sterna paradisaea*)	Spring, Summer & Autumn
Black-headed gull (*Chroicocephalus ridibundus*)	Autumn, Winter & Spring
Lesser black-backed gull (*Larus fuscus*)	All year round
Herring gull (*Larus argentatus*)	All year round
Cormorant (*Phalacrocorax carbo*)	All year round
European shag (*Phalocrocorax auratus*)	All year round

Source: AOWFL, 2011; Genesis, 2012b; Aberdeen Harbour, 2015

As detailed in Table 5.1, the study area overlaps with the marine area of the Ythan Estuary, Sands of Forvie and Meikle Lock SPA, which will be used as a foraging area by the species the SPA is designated for. There are additional SPAs along the coast to those included in Table 5.1 that may have connectivity to the southern Aberdeen Bay area (study area) due to habitat interconnectivity and foraging ranges of the designated species (based on Woodward et al., 2019). These include, but are not limited to:

- Troup Penan and Lion's Heads SPA
- East Caithness Cliffs SPA
- North Caithness Cliffs SPA
- SPAs around the Orkney Isles
- SPAs around the Shetland Isles
- Fowlsheugh SPA
- Outer Firth of Forth and St Andrews Bay Complex SPA
- Forth Islands SPA

5.2 People

5.2.1 Population and Employment

The two local authorities closest to the marine study area are Aberdeen City Council and Aberdeenshire Council. Approximately 9.0% of Scotland's overall population in 2020 lived in these two local authorities. Table 5.6 gives a brief overview of the population estimates and employment rates for the two local authorities in 2020.

Table 5.6: 2020 population estimates and employment rates for the local authorities adjacent to the study area

Local Authority	Population Estimate	Working Age (16-64) Population Estimate	Employment Rate (%)
Aberdeen city	229,100	156,700	71.5
Aberdeenshire	260,800	160,000	79.6

Source: NOMIS, 2021

The overall employment rate (of people of working age, 16-64) in Scotland in 2020 was 73.5%. The economic activity rate (i.e. the percentage of the total population which is either employed or actively seeking employment) in Aberdeen city was 77.0% and in Aberdeenshire 81.7% whereas the average across Scotland was 76.8% (NOMIS, 2021).

The oil and gas industry is hugely important to the economy of Aberdeen with over 10% of the workforce being directly employed by the sector (Scotjobsnet, 2021). The oil and gas sector also has a large support base and supply chain within Aberdeen city and Shire. This is shown in the relatively high proportion of the workforce who were employed in the professional, scientific and technical sector (15.7% in Aberdeen city; 11.1% in Aberdeenshire) and in manufacturing (5.2% in Aberdeen city; 12.1% in Aberdeenshire) (NOMIS, 2021). It is estimated that through indirect and direct employment, the oil and gas sector accounts for 46% of the total jobs in the area (Scotjobsnet, 2021). However, as the traditional oil and gas sector starts to decline with the reduction of fossil fuel use,

Aberdeen city is keen to invest in sustainable jobs for the future. There is a significant opportunity for hydrogen and other green industries to support a transition to a low carbon economy in Aberdeen city and across Aberdeenshire. The HT1 hydrogen demonstration project offers a gateway for this process.

The public sector (health, social work, education and public administration and defence sectors) employed 25.6% of the workforce in Aberdeen city and 22.2% in Aberdeenshire compared to 30.6% across Scotland as a whole in 2019. The human health and social work sector was the largest source of employment in Aberdeen city in 2019 (16.3%; NOMIS, 2021).

Labour demand statistics are not yet available from 2020-2021, and it is anticipated that job changes may have been due to the unprecedented Covid-19 situation.

5.2.1.1 Aberdeen Harbour

The rapid expansion of oil and gas interests in the North Sea in the 1970's saw Aberdeen become the principal service port for the UK's offshore oil and gas industries. While the port's importance to fishing has decreased (only one fish quay remains), it also has an important general maritime trade (in timber and grain, for example) as well as some naval activity.

The Covid-19 pandemic affected activity at Aberdeen Harbour, with a 16% decrease in vessel tonnage and 35% decrease in vessel arrivals. In 2020, 96 people were employed by the port and they handled just over 3.2 million tonnes of cargo, a total of 6,141 vessels and a total tonnage of over 22.4 million gross tonnage (Aberdeen Harbour, 2021). In 2019, Aberdeen Harbour was generating around £1.5 billion GVA and supporting 12,000 indirect jobs for the Scottish economy (Aberdeen Harbour, 2020).

The Aberdeen South Harbour Project is entering its final phase, set to be complete in 2022. The South Harbour expansion is the largest single development in UK Trust Port history and will make Aberdeen the largest port in Scotland in terms of berthage (Aberdeen Harbour, 2020). The proposed HT1 Hydrogen Demonstration Project has had discussions with Aberdeen South Harbour Project to explore the potential for constructing hydrogen shoreside infrastructure within the new harbour complex. These options will be considered further within the onshore siting study.

5.2.2 Tourism

In 2019, overnight trips and spend in Scotland were at their highest over the last decade. This increase is driven largely by the increase in domestic overnight tourism (Visit Scotland, 2020a). However, overnight tourism to the Grampian Region declined in 2019, with a decline of international visitors, as well as those from England and Wales (Visit Scotland, 2020b). Table 5.7 illustrates the 2019 numbers for visits, nights and spend in the Grampian Region (region containing the study area) and Scotland as a whole. 2020 and 2021 statistics are not yet available, but it is likely that tourism will have decreased, particularly international tourism, due to Covid-19.

Overnight trips by Scottish residents to Grampian increased, while the average length of stay by domestic visitors was 3.2 nights and 4.3 nights by international visitors (Visit Scotland, 2020b). Holiday is the main purpose of travel by all visitors.

The 2017-2019 average domestic day visits to Grampian was 14.7 million, with 6.5 million visits to Aberdeen and 5.8 million to Aberdeenshire. There were 1.4 million day trips that included a visit to a beach in the 2016-2018 average annual figures for the Grampian Region (Visit Scotland, 2020b).

Table 5.7: Visit Scotland tourism statistics 2019

Tourist Metric	Grampian Region*		Scotland	
	Domestic Visitors	International Visitors	Domestic Visitors	International Visitors
Visit[1]	1,093,000	230,000	13,810,000	3,460,000
Nights[2]	3,444,000	990,000	46,413,000	27,385,000
Spend[3]	£203 million	£114 million	£3,200 million	£2,538 million

*includes Aberdeen city, Aberdeenshire and Moray

1 Stay of one or more nights away from home for holidays, visits to friends, business and conference or any other purpose other than boarding education of semi-permanent employment.

2 Nights spent away from home using any type of accommodation or in transit on a tourist trip.

3 Spending incurred while away from home on a tourist trip and advance payments for such items as fares and accommodation. For overseas visitor statistics, the cost of travel to the destination is excluded.

Source: Visit Scotland, 2020a,b

5.2.3 Recreation

As stated above, visits to the beach are a popular activity. This can include walking, wildlife watching (whales, dolphins, seals, [Redact birds etc.), swimming or other water sports. Ballroom and Footdee beaches in Aberdeen Bay are popular for wind surfing, jet skiing, sailing, and kayaking, as well as sea angling (UK Beach Guide, 2021), with Ballroom a designated bathing water (Aberdeen). Balmedie Country Park beach, just outside the study area, is also popular for kite surfing and surfing, and is a designated bathing area, while Newbrugh and Collieston further up the coast are predominantly used for walking and wildlife watching (UK Beach Guide, 2021). Further north up the coast, Fraserburgh is a particularly popular surfing location and regularly holds Scottish Surfing Federation events and competitions (e.g. Gathering of the Clans).

5.2.4 Commercial fisheries

Commercial fishing activities in the area surrounding the AOWF are considered to be at relatively low levels. Potting for crab and lobsters (inshore); trawling for whitefish (predominantly offshore); and dredging for scallops (predominantly offshore) accounts for the majority of the activity (AOWFL, 2011).

The predominant fisheries likely to be affected are inshore fishing fleets. Data on inshore fishing activities gathered as part of the ScotMap project (Kafas et al., 2014) suggest that fishing within the study area is for the most part limited to creeling by small local vessels. These vessels have historically concentrated their activity within the study area around a localised nearshore area off Aberdeen. It should be noted, however, that since the ScotMap project data was gathered, the new Aberdeen Harbour extension project has been developed. This may result in reduced creeling activity over these grounds due to

traffic in and out of the harbour, with activity likely moving further south, to grounds outside of the study area.

Vessels engaged in demersal trawling and scallop dredging activities for the most part target offshore grounds and would not be expected to fish within the study area. It is noted, however, that although at very low levels some demersal trawling activity by small vessels targeting flatfish has been historically reported from the study area (Kafas et al, 2014).

From the 2019 Scottish sea fishing statistics, only 12 people were employed in sea fishing in Aberdeen city, and 1,238 people were employed from Aberdeenshire (The Scottish Government, 2020a). In Aberdeen harbour there remains only one fish quay – Commercial Quay (AOWFL, 2011). Total landings in Aberdeen in 2019 were 1,271 tonnage, made up of 2 tonnage of demersal species, 7 tonnage of pelagic species and 1,262 tonnage of shellfish (edible crab, lobster, Nephrops, scallops, velvet crab, plus other shellfish), with a total value of £5.625 million (The Scottish Government, 2020a).

Scottish Atlantic salmon and Sea trout are also fished in the study area, with both species present in the Rivers Dee and Don. As a result of the Salmon Conservation Regulations, no salmon may be retained if caught in coastal waters. Most salmon and sea trout are therefore caught by rod in local rivers and in 2019 92% of the annual salmon catch was released (The Scottish Government, 2020b), as was 87% of the annual sea trout catch (The Scottish Government, 2020c). Heritable Fishing Rights do also exist in the coastal waters of the study area and have been considered during early project design and will be factored into ongoing flowline route selection.

5.2.5 Other marine users and material assets

There are no pipeline routes known in the study area, but there are two potential cables (in addition to the AOWF cables), although both are indicative meaning that the exact location of the cables is unknown. The only known intakes and outfalls in the study area are in Nigg Bay and may have been altered due to the construction of Aberdeen South Harbour including an outfall from a nearby fish processing facility. On the northern headland of Nigg Bay is the Scottish Water storm outfall at Girdle Ness and on southern headland at Greg Ness is the main Wastewater Treatment Outfall approximately 2 km offshore.

There is a Ministry of Defence (MoD) firing range present to the west of the AOWF at Blackdog. There is a safety exclusion zone seaward of this range and the area may contain a significant number of unexploded ordnances (UXO).

There is also an explosives dumping ground in the south east of the study area, with the potential for UXOs.

Various other potential UXO sources in Aberdeen Bay include:

- Military ranges (Royal Navy and British Army)
- munitions dumping grounds
- sea mines (British and German)
- anti-aircraft artillery projectiles
- coastal gun batteries
- unexploded bombs

- wrecks
- convoy routes.

Vattenfall is conducting an UXO survey that will inform any further studies.

5.3 Cultural Heritage

Designated heritage assets are defined in Scottish Planning Policy as:

'World Heritage Sites, Scheduled Monuments, Listed Buildings, historic Marine Protected Areas, Registered Park and Gardens, Registered Battlefields and Conservation Areas designated under the relevant legislation.'

Sites of cultural heritage along the coastline of the study area (section 5.3.1) include a scheduled monument, a listed building and a conservation area) and those marine assets within the study area (section 5.3.2) include live wrecks.

However, the old archaeological adage that absence of evidence is not evidence of absence is pertinent here.

5.3.1 Terrestrial sites of cultural heritage along the coastline of the study area

There are three terrestrial sites of cultural heritage adjacent to the study area that are designated heritage assets (Table 5.8).

Table 5.8: Terrestrial designated sites of cultural heritage interest adjacent to the study area

ID. No.	Designation	Name	Description
SM9215	Scheduled monument	Torry Battery	Remains of a coastal battery built in the mid-19th century; manned through both World Wars; a tangible link to the past providing visible evidence of Britain's response to external threat, Aberdeen's importance as a port and of historic military tactical thinking.
LB20078	Category-A listed building	Girdle Ness Lighthouse	Well-preserved example of a (Robert) Stevenson lighthouse; built in 1833 overlooking Aberdeen Harbour and Nigg Bay, a foghorn know as 'Torry Coo' was added c. 1880-1890 just to the east of the lighthouse; cultural significance rests in its technological importance, its direct relationship with the Stevenson family and the development of Scottish lighthouses; also has aesthetic value as a prominent landmark.
CA453	Conservation area	Footdee	Known to most of the residents as Fittie; developed as a planned village at the beginning of the 19th century; the characteristic north and south squares – Middle Row and Pilot's

ID. No.	Designation	Name	Description
			Square – were added later; cultural significance lies in its unique and regular plan form and layout of a 'model village' designed by architect John Smith in 1809, with strong links and immense social importance to local fishing history.

Source: Historic Environment Scotland; AOWFL, 2011; Aberdeen Harbour, 2015

5.3.2 Sites of cultural heritage interest within the study area

There are 400 records held within the study area, including 3 aircraft, 323 wrecks, 50 obstructions, one findspot and 23 monuments (Table 5.9).

Table 5.9: Sites of cultural heritage interest within the study area.

Type	Total	Live	Dead	Lifted	Reported loss	No status
Aircraft	3	0	0	0	3	0
Wrecks	323	13	1	4	305	0
Obstructions	50	7	0	0	0	43
Findspots	1	0	0	0	0	1
Monuments	23	0	0	0	0	23
Total	**400**	**20**	**1**	**4**	**308**	**67**

Source: Coracle Archaeology, 2021

It is important to emphasise that many of the wrecks identified in the study area are reports of wreck events, and either do not have reliable locational information or should not be seen as indicative of the presence (or otherwise) of physical remains; the same is also true of the aircraft recorded within the study area. These records are included to highlight the potential for encountering wrecks which have been reported in the past, but for which there is currently no material evidence to substantiate their existence.

5.3.2.1 Live wrecks identified within the study area

A total of 12 live wrecks are recorded within the study area (Table 5.10 and Figure 5-3).

Table 5.10: Live wreck details in the study area

CA no.	Name	Type	Date	Notes
CA261	SS James Hall	Wreck	1904	British cargo ship of 366 gross registered tonnage (grt), built in 1870 by Hall, Russell & Co. Ltd., Aberdeen; last detected in 1976 at a depth of c. 1 m lowest astronomical tide (LAT) measuring approximately 53 m x 7 m x 4 m.

CA no.	Name	Type	Date	Notes
CA277	FV Empress	Wreck	23 December 1915	British fishing trawler of 104 grt, built in 1890 by Eltringham J. T. Ltd., South Shields; last detected in 2013 at a depth of 9 m LAT, measuring approximately 28.3 m x 5.6 m x 3.1 m.
CA283	SS Glen Tanar	Wreck*	3 May 1917	British cargo ship of 817 grt, built in 1909 by Hall, Russell & Co. Ltd., Aberdeen; last detected in 2011 at a depth of c. 22 m LAT, measuring approximately 59.4 m x 9.8 m x 3.4 m.
CA284	HMT Yesso	Wreck	9 February 1917	British fishing trawler of 229 grt, built in 1911 by Cochrane & Sons Shipbuilders Ltd., Selby; converted into a minesweeper in 1914; last detected in 2013 at a depth of c. 8 m LAT, measuring approximately 36.3 m x 6.7 m x 3.5 m.
CA305	KMS T6	Wreck	7 November 1940	German torpedo boat of 600 grt; last detected in 1976 at a depth of c. 53 m LAT, measuring approximately 81.4 m x 8.5 m x 1.8 m.
CA307	SS Cairnie	Wreck	3 April 1941	British cargo ship of 250 grt, built in 1891 by Blyth Shipbuilding & Drydock Co. Ltd., Blyth; last detected in 2000; categorised as a wreck showing any portion of the hull or superstructure; measures approximately 36.6 m x 6.2 m x 3m.
CA311	FV Sturdee	Wreck	19 October 1955	British fishing trawler of 202 grt, built in 1919 by Hall, Russell & Co. Ltd., Aberdeen; last detected in 2000 at a depth of c. 2 m LAT, measuring approximately 35 m x 6.7 m x 3.9 m.
CA317	Sheriffmuir	Wreck	1 October 1976	British fishing ship of 180 grt, built in 1952 by Henry Scarr Ltd.; last detected in 1981; categorised as a wreck showing any portion of the hull or superstructure; measures approximately 30.5 m x 6.7 m x 3.3 m.
CA318 / CA319*	MFV Coastal Emperor / Christine	Wreck	6 December 1978	British fishing trawler of 250 grt, built in 1960 by Mitchinson T., Gateshead, Sunderland; last detected in 1983; categorised as a wreck showing any portion of the hull or superstructure;

CA no.	Name	Type	Date	Notes
				measures approximately 34.6 m x 7.6 m x 3.8 m; also identified as the *Christine* although details are identical.
CA320	Xmas Rose	Wreck	12 August 1979	British fishing ship of 49 net tonnage (nrt); last detected in 2011 at a depth of c. 18 m LAT.
CA322	MFV Viking Queen	Wreck	18 February 1993	British fishing ship of 15 grt; last detected in 2009 at a depth of c. 60 m LAT, measuring approximately 12.2 m in length.
CA323	MFV Intrepid	Wreck	8 August 1997	British fishing trawler of 39 grt; categorised as a wreck showing any portion of the hull or superstructure; reported as entirely intact in 1997, measuring approximately 19.2 m x 5.5 m x 2.1 m.

***** These count as two separate wreck records in Table 5.9 but have been combined as one wreck here as they are thought to be the same vessel.

Source: Adapted from Coracle Archaeology (2021)

The remaining 310 wreck records are either dead, lifted or appear to refer to reports of losses in the general area, rather than the definitive location of known wrecks themselves, as mentioned above.

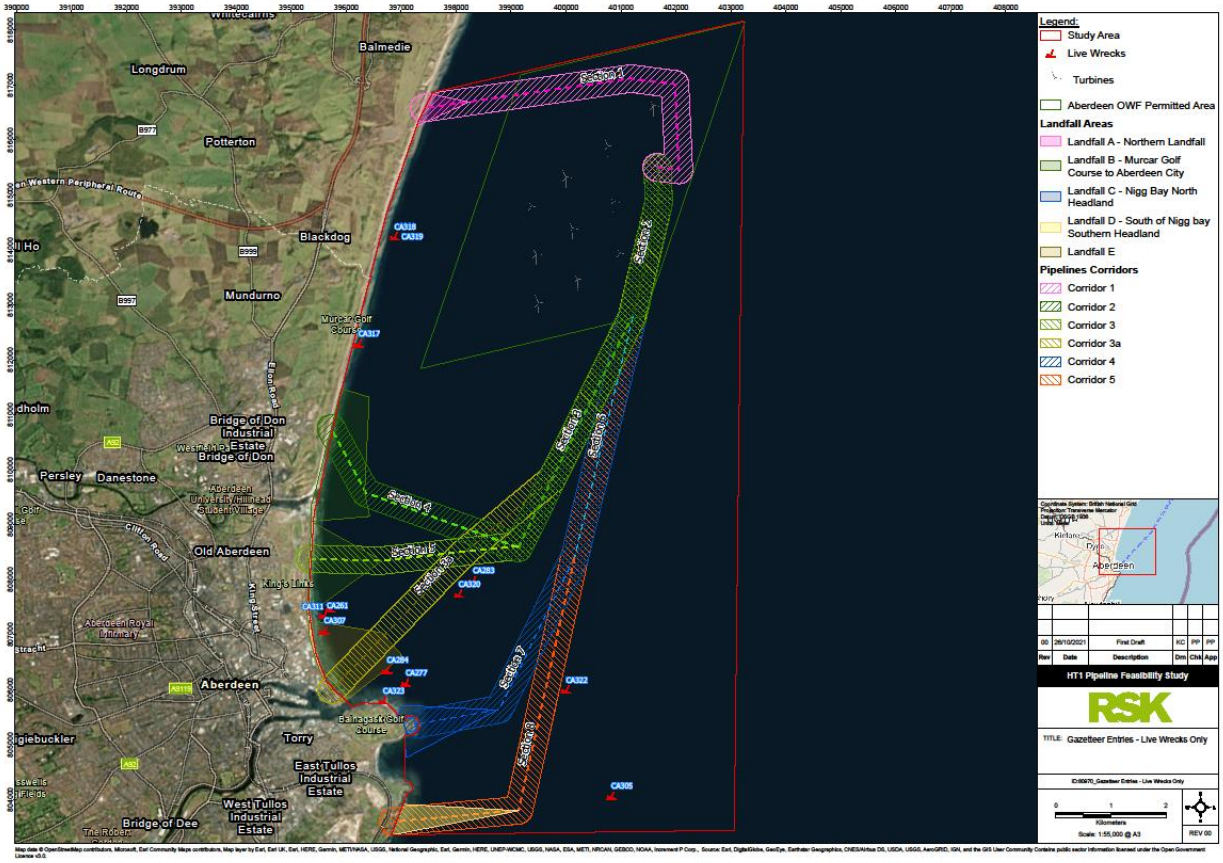

Figure 5-2: Live wrecks within the study area

5.4 Seascape, Landscape and Visual

The study area is within the national seascape unit 'Area 4: Northeast Coast', which comprises two seascape character types 'Mainland Rocky Coastline with Open Sea Views' and 'Deposition Coastline with Open Sea Views'. There are no published seascape units at a regional scale, but the Seascape, Landscape and Visual Impact Assessment conducted for the AOWF ES (2011) characterised six regional seascape units within the 40 km of their study area.

The study area for this project includes a small section at the north of the Stonehaven to Girdle Ness regional seascape unit, and the Aberdeen Beach and Aberdeen Bay regional seascape units (AOWFL, 2011). The north of the Stonehaven to Girdle Ness seascape unit is predominantly urban with a craggy, rocky coast south of the Girdle Ness headlands, and an open shingle beach at Nigg Bay (although alterations may have occurred to this beach due to the Aberdeen South Harbour Project). The Aberdeen Beach seascape unit extends from Girdle Ness to the mouth of the River Don and is a dynamic and busy seascape which is heavily influenced by the city of Aberdeen. Donmouth represents the end of Aberdeen Beach. The Aberdeen Bay regional seascape unit is defined by a large crescent of sandy beaches, dunes and links that lie between the mouths of the rivers Don and Ythan.

Only the landscape receptors adjacent to the study area are considered here. The city of Aberdeen is the main settlement adjacent to the study area. The two relevant landscape character assessment (LCA) areas to the study area include:

- South and Central Aberdeenshire LCA – there is a coastal strip defined in the Aberdeen Bay seascape unit, with the majority of the adjacent area is classified as 'agricultural heartlands'.
- Aberdeen LCA – predominantly urban with a coastal strip of sandy beach.

There is a Special Landscape Area (SLA) and a Local Landscape Area (LLA) north of Aberdeen city, and the study area is adjacent to the southern edges of them. The Northeast Aberdeenshire Coast SLA extends from Blackdog on the outskirts of Aberdeen city, north to Buchan Ness, and then from Peterhead to Fraserburgh (Aberdeenshire Local Development Plan, 2020), while there is a LLA between Balmedie and Longhaven (NatureScot, 2017).

There are multiple viewpoints along the study area coast where residents or visitors are the key visual receptors. Particular points include Aberdeen Beach, the Girdle Ness headlands and the A90, while Balmedie Beach is just north of the study area.

Designated cultural heritage sites and nature designations also action as viewpoints. As mentioned in the terrestrial cultural heritage section (5.3.1), there is a listed building, a scheduled monument and a conservation area along the periphery of the study area. In terms of nature, there are two designated areas within the study area; the Donmouth LNR, and the Nigg Bay SSSI; see section 5.1.1.

There are also many accessible public paths and cycle routes around Aberdeenshire and the coast, which may act as viewpoints. These include the Aberdeen Coastal Trail, which is part of the North Sea Trail (Aberdeen City Council, 2019), and paths from the Aberdeen City Council Core Paths Plan 2009 (Aberdeen City Council, 2009).

5.5 Land, Air and Water

5.5.1 Land

Relevant terrestrial receptors are described in the section above (5.4).

5.5.2 Air

The climate around Aberdeen is temperate, with significant rainfall. Average temperatures at Dyce weather station ranged from an average low temperature of 2°C in January / February to an average high of 16°C in July / August. Average precipitation ranges from 49.5 mm in April to 126.4 mm in July. Over the last ten years average wind speeds have ranged from 3.1 m/s to 8.3 m/s. Wind speeds of up to 15.3 m/s and gust speeds of up to 20.3 m/s have been measured. Winds offshore come from a variety of directions but are predominantly from the southwest.

5.5.3 Water

5.5.3.1 Bathymetry

The bathymetry in the study area ranges from 0-60 m, and the inclination towards the shore is gentle. Around the Nigg Bay headlands there is greater variability in depth and

steeper seabed gradients. The seabed in the study area around the AOWF slopes east-south-east with decreasing gradient between 1 in 110 and 1 in 140 to the 25 m contour, which continues to decrease further offshore at a gradient of 1 in 300.

5.5.3.2 *Tides, currents and waves*

A summary of the tides, currents and waves in the study area based on the information provided in the AOWF and Aberdeen South Harbour Project ESs is presented in Table 5.11.

Table 5.11: Tidal range, peak currents and wave heights and direction in the study area

Hydrological Aspect	AOWF	Aberdeen South Harbour
Mean spring tidal range	3.4 m	3.5 m
Peak currents	1.1 m/s	0.6-1.3 m/s
Mean annual significant wave height (H_S)	0.5-1.0m Hs	0.1-4.0 m
Most common wave direction	south-east	south-east
Maximum wave heights **(H_{max})**	5.5 m	6.7 m

Source: Adapted from AOWFL (2011) and Aberdeen Harbour (2015)

5.5.3.3 *Sediment*

The section of the study area around the AOWF is mostly fine well sorted sands, with fine muddy sands near WTG B06, while the rest of the study area is sandy sediment. No bedrock is exposed in the study area with sediment thickness ranging from 30-50 m at WTG B06 to 5-20 m near the shore. Sediment near the Aberdeen South Harbour is rock at the headlands, with much of the central area mobile sand, with coarse shingle strips (Aberdeen Harbour, 2015). However, there may have been alterations due to the ongoing construction works.

Offshore, there is a gradual net transport of sediment (sand). Longshore drift of material is dominated by waves in a northern direction, although southern drift is also possible. Aberdeen Bay is characterised by beaches that feed sand dunes under normal conditions but can erode during storm events. There is a lack of sediment transport from offshore, so the beaches are eroding over time (AOWFL, 2011).

Average suspended sediment concentrations in the study area vary between 43 mg/L (AOWF) to 35.6 mg/L (Aberdeen Harbour) (AOWFL, 2011; Aberdeen Harbour, 2015).

Sediment contamination in the study area is in line with the background contamination levels reported for the north-east Atlantic Sea.

5.5.3.4 *Water Bodies*

The study area is located within 2 Water Framework Directive (WFD) water bodies: Cruden Bay to Don Estuary coastal water body and the Don Estuary to Souter Head (Aberdeen) coastal water body.

The Cruden Bay to Don Estuary coastal water body has an overall water body status of high, while the Don Estuary to Souter Head (Aberdeen) coastal water body has an overall status of good. This water body is designated as a heavily modified water body due to physical alternations that cannot be addressed without significant impact on navigation and from an increased risk of subsidence or flooding.

5.6 Navigation

A baseline navigation assessment has been undertaken (Anatec Limited, 2021), using one month in summer (June) and one month in winter (December), thus ensuring that any seasonal variations in traffic are not overlooked. Months in 2019 were selected to avoid the COVID-19 pandemic effects, while still being considered up to date.

There is a high-density SW/NE route observed to/from Aberdeen Harbour through the study area, passing to the east of the AOWF, and this was observed during both June and December. The majority of vessels recorded on this route were oil and gas support vessels, followed by passenger vessels (i.e. ferries to/from the Northern Isles).

There was also a high density of vessels in the Aberdeen South Harbour Development zone; mainly tugs, port tender vessels and dredgers.

Oil and gas support vessels were the most abundant vessel type during the two month-long study periods. Dredging activity at the Aberdeen South Harbour was more prevalent during the June period with dredgers making repeated trips to the spoil ground just south of the study area. This is likely to decrease in the next year, once construction of the South Harbour is completed, although it is expected that there will also be an increase in commercial vessels visiting the harbour once it is operational.

Other vessels in the study area include cargo, fishing, search and rescue, recreational, and wind farm support vessels.

There is a designated (charted) anchorage area within the study area, 2 nm north of the entrance to the Aberdeen Harbour, as well as a pilot boarding location. This is illustrated in Figure 5-3 which depicts the key constraints within the study area from a flowline routing perspective. The majority of anchored vessels during June and December 2019 were anchored in the anchorage area, with a number of vessels also anchored to the east of the anchorage area, outside the charted boundary, and a small amount of tanker anchoring activity recorded in the southeast of the study area. Vessels working on the Aberdeen South Harbour Development anchored just south of the area with restricted entry.

Aberdeen Harbour has compulsory pilotage for vessels with a length of 60+ m, and so the pilot boarding location may also be an area of high frequency anchorage.

Navigation buoys are also present in the study area, directing vessels on the approach to Aberdeen Harbour. A fairway buoy (equipped with Radar and Beacon - RACON) is the main navigational aid approximately 1.4 nm north-east from Aberdeen Harbour's South Breakwater.

There are no known maintenance dredged channels, dredging disposal or borrow (sand mining) areas in the study area (Admiralty, 2021).

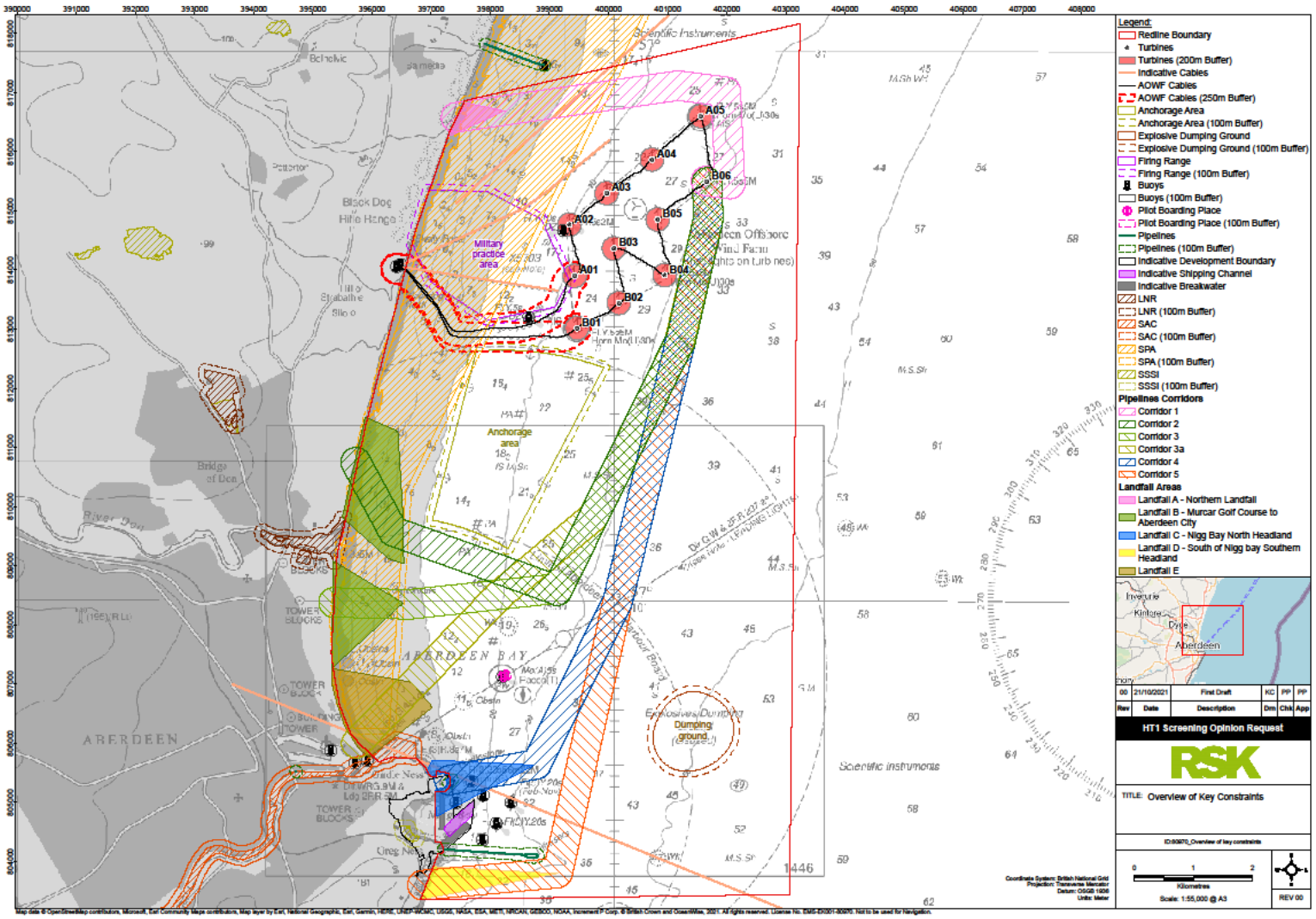

Figure 5-3: Overview of key constraints within study area

6 CHARACTERISATION OF POTENTIAL IMPACTS AND ASSOCIATED MITIGATION

6.1 Construction

Table 6.1 provides a description of the potential environmental impacts resulting from the construction of the proposed HT1 hydrogen demonstration project. The table outlines the potential sensitives as per chapter 5, identities any likely significant effects and proposes mitigation measures (where required) for any likely significant effects that may have a potential impact on the environment. Where potential impacts on known sensitivities and/or likely significant effects have been identified, they have been assessed in further detail below the table.

For the purpose of the characterisation of potential impacts of the construction phase of the proposed works, the following activities have been assessed:

- Geophysical, Geotechnical and Environmental surveys
    - Geophysical, geotechnical and environmental surveys of the study area and proposed flowline route to inform siting and construction
- Offshore construction work
    - Construction of an extended transition piece platform and j-tube on existing WTG B06 using a Vessel or Jack-up-Barge.
    - Construction of abstraction and discharge infrastructure at the existing WTG B06.
- Installation of infrastructure and equipment
    - Placement of the hydrogen electrolyser equipment (as defined in section 4.1) within up to seven 40 ft containers on the extended transition piece platform
- Flowline construction and operation
    - Construction (including trench and burial) and operation of an 8” internal diameter (maximum) flowline from WTG B06 to shore.
    - Landfall of flowline via either HDD, open cut or rock placement or a mixture of the 3 methods.

Table 6.1: Construction effects and sensitivities

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
Use of Natural Resources	Materials	Steel for construction of transition piece platform and containers to house electrolysis equipment. Rock for rock covering/ mattressing if / where required. Concrete for concrete mattresses. Steel and/or polymers for flowline. Drilling mud (non-toxic) (if HDD)	None	No	Efficient use of resources and re-use of materials where appropriate. Corrosion protection to be used on all relevant steel elements to ensure longevity in marine environment Innovative and efficient design for maximum life in marine environment
	Land/Soil	Minimal area of seabed will be utilised for laying and burial of flowline. The flowline is proposed to be between 6.5 - 14.3 km in length with a construction corridor of 125 m either side.	Biodiversity Cultural Heritage People (other marine users and material assets)	Assessed in Section 6.1.1	Known sensitivities will be avoided as far as possible when siting the flowline, following avoidance and reporting protocol. A Construction Environmental Management Plan (CEMP) will be developed, including outlining best practice methodologies.

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
	Water	No significant use of water is proposed during the construction activities, aside from water for drinking, sanitation, cleaning and drilling (if required).	None	No – international, UK and Scottish laws will be complied with.	Nontoxic chemicals to be used for drilling (if required). Sewage to be discharged in line with IMO requirements. To shore or treated onboard. Bilge water to be transported and treated onshore. Marine Warranty survey prior to works starting.
	Biodiversity	Loss of habitat and associated biodiversity through the laying and burial of the proposed flowline and any associated protection.	Biodiversity Commercial Fisheries	Assessed in Section 6.1.2 and 6.1.4	Any known sensitive habitats will be avoided where possible. Indirect impacts will be of short duration and limited in extent A Fisheries Liaison Officer will be assigned to the project.
Pollution & nuisances	Acoustics (Noise & vibrations)	Offshore airborne noise associated with the construction works at the WTG and laying and burial of the flowline, including at landfall. Specific sources include: - Welding	People Biodiversity: Marine Ornithology	Assessed in Section 6.1.5	All works will be within agreed working hours. If rock placement / mattressing is required, an acoustic assessment will be completed. Mitigation measures and/or monitoring implemented if required and upon agreement.

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
		- Drilling - Cutting - Jetting, ploughing, trenching, HDD, - Shipping activity - Rock placement/ mattressing (if required) Sources of vibration envisaged are HDD (e.g. no blasting or piling)			
	Underwater Noise	Vessel movements Flowline laying and burial activities Rock placement/ mattressing (if required) Geophysical Surveys	Biodiversity: Fish and shellfish Marine Mammals, Marine ornithology	Assessed in Section 6.1.6	Implementation of JNCC 2017 guidelines to minimise injury to marine mammals from geophysical surveys and adherence to JNCC statutory protocols for operations (if required) administered by MMOs. Pre-work searches Soft starts (where feasible) Reporting to MS-LOT and JNCC (marine mammal recording forms)

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
	Air Quality (emissions and climate change impacts)	Vessel movements Material imports	People Potential climate change contribution	No – As the majority of works will take place offshore or within the industrial harbour, emission impacts are expected to be negligible. Minor climate change impacts are envisaged from increased marine traffic and material imports, but not considered to be significant.	Plant, vehicles and vessels will be well maintained. Burial of flowline is preferred installation method, minimising bulk import of rock and concrete mattresses.
	Water and seabed quality	Impact on water and seabed quality from the resuspension of sediment associated with flowline laying and burial including via: jetting, ploughing, trenching, HDD.	Biodiversity: Benthic ecology Marine mammals Fish and shellfish	Assessed in Section 6.1.7	Flowline route to avoid the vicinity of the River Dee SAC. all discharges from construction will be in line with MARPOL 73/78 requirements as required.
	Water quality	Impacts associated with accidental release of pollutants e.g.	Biodiversity: Benthic ecology	No	Vessels, plant and machinery will be appropriately

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
		- Vessel/machinery fault - Waste material - Oil/fuel	Marine mammals Fish and shellfish Marine ornithology		maintained and operated in line with the CEMP. Works will also be conducted in line with best practice and existing guidelines including: - Storage and handling - Waste management - Surface water management - Pollution prevention plan and spill management plan
	Water Quality	Pre-commissioning of the flowline is anticipated to be completed by standard procedures using typical pre-commissioning fluids such as: - Fresh water (flooding pre-lay) and discharge to sea - Filtered and treated seawater (cleaning, gauging, strength test) - MEG (dewatering)	Negligible impacts as a result of discharge of hydrotest water. Fresh water of a volume of 200 – 500 m^3 to be discharged to sea. MEG would be collected at the turbine along with pigs and transported to shore	No	Any freshwater or seawater discharged to sea will be of similar temperature to the ambient environment. Unless otherwise agreed with the relevant regulator, any chemicals used in the pre-commissioning of the flowline, will be selected from the List of Notified Chemicals approved for use by the offshore oil and gas industry under the Offshore Chemicals

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
		- Nitrogen (dewatering) - Pipeline Pigs	and treated appropriately. Nitrogen would be vented to the atmosphere following standard procedure.		Regulations 2002 (as amended) and discussed with SEPA accordingly. Freshwater and seawater discharges will be designed to ensure maximum dispersal and minimal environmental impact.
	Light Emissions	Additional lighting associated with construction	Seascape, Landscape and Visual Biodiversity	No – Works unlikely to require significant additional lighting	Works will be carried out in accordance with best practice and in line with guidance notes, Scottish Executive Guidance Note, 'Controlling light pollution and reducing lighting energy consumption' and the 'Safety in Ports (SIP) 009 – Guidance on Lighting.'
Transport, Navigation and Surveys	Navigation	Construction works including the use of a small jack-up vessel with crane and a crew transfer vessel at WTG B06 and an anchor handling tug with a crane for the flowline installation.	People (commercial fisheries) Biodiversity Cultural Heritage Navigation	Assessed in section 6.1.3	Vessel requirements will be kept to a minimum. Full liaison with MCA, NLB and Harbour Authorities will take place prior to additional work vessels being in the area. Notice to mariners will be published as required.

Potential Effect		Activity / Source	Impact on known sensitivity	Potential for Likely Significant Effect (pre- mitigation)	Proposed Mitigation Measures
					Vessel Management Plan(s) and Navigation Safety Plan(s) will be in place as required.
	Surveys	Geophysical, environmental, and geotechnical survey campaign to support the development of the HT1 hydrogen project and the associated siting of a hydrogen flowline.	Biodiversity: Marine Mammals	No	EPS licence (incl. supporting Risk Assessment), marine works licence and marine licence exemption have been applied for to support the proposed survey campaign. EPS licence includes a number of mitigation measures to prevent injury and reduce disturbance to marine mammals.
Landscape and Visual	Visual Impact	Visual impacts associated with the construction works at the WTG and laying of flowline and associated landfall	People	No – works will take place away from known sensitivities in offshore or industrialised (existing Harbour) locations.	Construction activities will be temporary in nature with the flowline being buried and WTG infrastructure situated on the furthest existing WTG from shore.
Employment	Job creation	The construction works will create direct and indirect employment.	People (population and employment)	Yes (positive)	Local employment and supply chains will be actively encouraged.

Table 6.1 identifies seven potentially significant effects arising from the construction stage of the proposed HT1 hydrogen demonstration project. One of these, job creation, has been identified as a potentially positive effect and is not discussed further, however the remaining six are assessed below.

6.1.1 Land/Soil

With the use of natural resources through the construction of the proposed flowline a number of known sensitivities could be impacted by the use of the seabed as illustrated in Table 6.1 and discussed in further detail in the sub-chapters below.

6.1.1.1 Cultural Heritage

With the laying of the flowline and associated landfall, known cultural heritage assets identified in chapter 5.3 could be impacted. The construction and decommissioning would require cut and burial of the flowline and possibly placement of rocks / mattressing if burial was unachievable and thus would impact the seabed and structures present within the immediate vicinity. The same would apply at the landfall.

Chapter 5.3 identifies three terrestrial sites of cultural heritage adjacent to the study area and 400 records within the marine study area, mainly comprising of reported wrecks. A geophysical, environmental and geotechnical survey campaign is schedule for Winter 2021 / Spring 2022 which will further identify potential cultural heritage assets along the proposed flowline route. It is envisaged that impacts on any identified assets can be mitigated through following the avoidance and reporting protocol, including the micro-siting of the flowline and an associated buffer around any identified cultural heritage assets where access will be restricted. A Construction Environmental Management Plan will also be developed, including outlining best practice installation methodologies. This will be the case both offshore and at landfall where cultural heritage assets such as Girdle Ness Lighthouse can be avoided through careful route placement and HDD as required. The following navigational mitigation will also be implemented to reduce any potential impact on cultural heritage assets.

- no anchorage areas and/or,
- no go areas,
- sufficient buffer zones around archaeological sites.

It is therefore considered that with appropriate mitigation the proposed development will not have likely significant effects on cultural heritage in relation to works at the WTG, flowline construction and at the landfall.

6.1.1.2 Other Marine Users (Material Assets)

There are a number of other marine users and material assets within the vicinity of the proposed works as discussed in chapter 5.2.5. These include a MoD firing range, explosive dumping grounds and a number of UXO sources. There are currently known UXO locations near the proposed WTG and across the majority of the study area. Although Aberdeen OWF and Aberdeen South Harbour can be assumed to have been cleared and therefore unlikely to pose significant effects on the project. However, the flowline could potentially pass though or nearby previous firing ranges from WWII and known WWII munitions dumps.

The MoD firing range and explosive dumping ground will be avoided through the routing of the proposed flowline.

Vattenfall are currently undertaking an UXO study and associated geophysical survey to inform the flowline route siting. Following this study, flowline micro-siting will seek to avoid UXOs as far as possible. In the unlikely case that removal of UXO is required using either high or low order detonation, this would be subject to a separate Marine Licence and is not considered further within the scope of this EIA screening request.

6.1.2 Biodiversity

Biodiversity has the potential to be impacted as a known sensitivity during construction by the following potential effects, associated activities and sources as identified in Table 6.1:

- Laying and burial of flowline and associated rock covering/mattressing, (or other protection), if required
- Underwater noise producing activities
- Impact on seawater and seabed sediment and habitat quality from the resuspension of sediment associated with flowline laying and burial (including potential jetting, ploughing, trenching or HDD)
- Navigational impacts (and collision risk), including the use of a small jack-up vessel with crane and a crew transfer vessel at WTG B06 and a flowline installation vessel.

6.1.2.1 Terrestrial

There is potential for impacts on otter and coastal wading birds during the laying of the flowline at the proposed landfall location. However, as mitigation measures will be in place to avoid any disturbance, significant effects are not likely. Mitigation measures may include intertidal surveys to [Redacted] observe birds present,[Redacted]

6.1.2.2 Benthic Ecology

6.1.2.2.1 Subtidal

The Aberdeen OWF site is considered to have ecology with high recoverability (AOWFL, 2011), with the benthic habitat largely consistent across the study area. None of the subtidal benthic habitats observed, or the species associated with them, are Scottish Priority Marine Features, and there are no protected areas designated for subtidal benthic habitats. The primary potential impacts are those associated with the laying and burial of the flowline and associated rock covering/mattressing (or other protection), and the resuspension of sediment. However, as the habitats and species present are expected to recover quickly, no significant effects are identified. In addition, any disturbance of sediments and seabed habitats is expected to be localised and temporary in nature.

6.1.2.2.2 *Intertidal*

None of the intertidal biotopes identified at Aberdeen South Harbour are valued as either Annex I habitats or habitats of principal importance. However, Nigg Bay is highly modified by the construction of the new harbour, which is still ongoing, thus cumulative effects may occur if the selected landfall is located within the same area as the harbour works (see section 6.4.2 on cumulative effects). Nonetheless, due to the recoverability and common nature of the intertidal biotopes present, and the fact that they are not protected features, any effects (cumulative or otherwise) are not expected to be significant.

6.1.2.3 *Fish & Shellfish*

As several fish species have spawning and/or nursery grounds within the Aberdeen OWF area, there is potential for impacts associated with all project activities specified above, if these activities damage or alter spawning/nursery grounds, and/or disturb fish. Shellfish could also be disturbed through sediment resuspension and/or laying of the flowline.

The River Dee SAC is primarily designated for [Redacted] Atlantic salmon (Annex II species), and though the SAC doesn't intersect with any of the proposed flowline routes, there is potential for Atlantic salmon to be migrating across the route. However, given the known limited sensitivity of salmonids to underwater noise (Nedwell et al., 2003; Popper, 2005), significant effects are unlikely. As large, mobile species, salmon are also likely to undertake avoidance behaviour in the case of underwater noise. Soft-start procedures will be included in the mitigation measures overseen by the MMO, in place for marine mammals (see section below), also allowing salmon and other fish in the local area to temporarily move away from the underwater sound sources and minimise the risk of undue disturbance or potential for injury. The route will also be selected to minimise disturbance on the seabed, including sessile shellfish present such as mussel beds, which would be avoided as far as possible. There is the potential for minor impacts on these habitat features from suspended sediments which would be expected to recover quickly following this level of disturbance as release of suspended sediments are expected to be limited in extent and of short duration. Thus, there are no likely significant effects on most fish and shellfish from the works.

[Redacted] of the River Dee SAC will be vulnerable to suspension of sediments. Though the effects are minimal as the route will not directly intersect with the SAC and suspended sediments from the installation of the flowline on the seabed will be limited in both extent and duration.

An environmental survey campaign is currently planned for Winter 2021 / Spring 2022, the results of which will further inform the biodiversity impacts and associated design of the project prior to final consent applications. This would include routing to avoid any sensitive seabed features, including mussel beds, where possible.

6.1.2.4 *Marine Mammals*

During the survey campaign and construction operations, there are risks to marine mammals from underwater noise and the potential for vessel collision. The harbour porpoise and resident bottlenose dolphin are vulnerable to these impacts, and there is a seal haul-out site within one of the potential flowline route corridors, although this is not a favoured option to shore. All marine mammals present are highly protected, with some

species being qualifying interests for nearby SACs. The risks, mitigation measures and resulting effects are as follows:

Underwater noise

There are potential significant effects on marine mammals from the use of some equipment during the geophysical surveys. These effects could include auditory injury and/or disturbance, as sound travels further underwater. Marine mammals typically have large foraging ranges, and therefore animals that are qualifying interest species from nearby SACs could be impacted.

Southall *et al*. (2019) sets out marine mammal exposure criteria for underwater noise. For very high frequency cetaceans, which includes the harbour porpoise, there may be some overlap with some of the survey equipment's frequencies, e.g. the Multi-Beam Echo Sounder (MBES). The use of Sub-Bottom Profilers (SBP) and the Subsea Positioning Ultra Short Baseline (USBL) positioning system and transponder beacons operate at lower frequencies and thus may also be audible to certain cetaceans and seals. The introduction of additional vessels into the Aberdeen Bay area will increase ambient underwater noise levels and the potential for cumulative disturbance as a result of prolonging the durations of exposure for the animals, but this is unlikely to increase peak noise levels which will come from construction activities.

Mitigation measures during the survey campaign will follow the approved JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) to include, but not be limited to pre-watch searches by an MMO, soft-start procedures for equipment (where possible), transit watches and reporting according to required procedures. High frequency sound also attenuates rapidly in water due to natural spherical spreading and absorption during propagation, thus any impacts are highly localised.

Risk is also minimised as marine mammals, and their prey species, are highly mobile and likely to exhibit a behavioural response to increased underwater noise - temporarily leaving the area. Nevertheless, given the potential for significant effects on some marine mammals from underwater noise impacts, underwater noise will be further assessed prior to survey and any subsequent construction work.

To this end a detailed assessment of underwater noise impacts on marine mammals has recently been submitted to MS-LOT (August 2021) in the form of an EPS risk assessment in support of initial survey campaigns (Vattenfall HT1 Hydrogen Demonstration Project (2021) EPS Risk Assessment).

Navigational impacts

There is possible navigational and/or collision risk to marine mammals associated from the introduction of additional vessels to the area for the survey campaign and during construction. Vessels will however be following a pre-defined route and will be operating at low speeds. Marine mammals are therefore likely to be able to avoid the vessels. Slow-moving vessels also present a much reduced risk to marine mammals than high-speed vessels (Bristow & Reeves, 2001; Gregory & Rowden, 2001; Leung Ng & Leung, 2003; Buckstaff, 2004). As the presence of vessels will be temporary, and any effects will be extremely localised, and species that predominate in the study area are relatively small

and mobile, there are no likely significant effects on marine mammals expected with regards to collision risk or disturbance.

There is a possibility that survey and construction vessel activities may cause disturbance to marine mammals. But these additional vessels are expected to cause an insignificant increase in general traffic in the area and due to mitigation measures described above (and outlined within the EPS Risk Assessment) and the associated design of activities to cause minimal disturbance, there are no likely significant effects envisaged.

6.1.2.5 Marine Ornithology

As outlined in chapter 5.1.3.4, several migratory and non-migratory species of European importance including terns are present within the study area. However, as the majority of works will be underwater and of relatively limited extent and duration, the effects on marine ornithology will be minimal, localised and temporary.

Birds are highly mobile so likely to temporarily move out of the area. As the area is busy with shipping and recreational boating, birds are also likely to be habituated to vessel traffic and the addition of construction vessels would have temporary and localised disturbance on birds. Lighting on vessels and at landfall/ WTG B06 during construction may have some effect on birds, but again effects will be very localised and temporary. The construction schedule will be such that particularly sensitive areas at sensitive periods, e.g. during the breeding season (identified during the survey campaign) will be avoided where possible. Resuspension of sediments may present a minor risk for diving birds, but this will be minimal due to installation methods that minimise seabed sediment suspension, and effects will be highly localised and temporary. Some birds may be more vulnerable to underwater noise impacts from geophysical surveys and construction works due to their feeding ecology, e.g. for diving birds, however most will move away from the area following soft-start procedures, and/or exhibit a natural flight response. Therefore, the development is unlikely to have significant effects on marine ornithology.

6.1.3 Navigation

The construction traffic is of a temporary nature and envisaged throughout the duration of 4 months.

Construction activities at Aberdeen OWF will not pose a conflict with many other users, due to the restrictions on navigation within the array area and the low traffic volumes in the wider study area. There will be a period of time between flowline lay and burial, at which time guard vessels will likely be in place to monitor activity as required. Therefore, it is considered that the development is unlikely to have significant effects on shipping during construction at the WTG.

During construction of the flowline across the Aberdeen Harbour shipping channel and the potential landfall at Aberdeen South Harbour, there will be a conflict between the navigation of the vessels into and out of the harbour and the construction works. At the original Aberdeen Harbour there is a lot of space and depth for vessel to manoeuvre around the flowline construction. However, this may not be the case at the Aberdeen South harbour where the entrance to the harbour and shipping channel may intersect during and once operational.

Therefore, it is considered that the development will have potential minor impact on shipping during construction of the flowline and landfall prior to mitigation. To ensure these are not significant the following mitigation measures are proposed;

- full liaison with MCA, NLB and Harbour Authorities will take place prior to additional work vessels being in the area,
- notice to mariners will be published as required,
- Vessel Management Plan(s) and Navigation Safety Plan(s) will be developed as required.

6.1.4 Commercial Fishing

Levels of commercial fishing within the Aberdeen Bay area are relatively low with just four vessels identified as fishing within the boundaries of the Aberdeen OWF prior to construction (AOWFL, 2011). Similarly, there is no fishing at Aberdeen Harbour or in the navigation channels. However, temporary impact on commercial fisheries activities during construction and decommissioning of the flowline, including through the increase in construction vessels is likely. Although this will be for a limited time period and should not be significant as fishing vessels will be able to re-enter the area once the flowline is buried. In addition to the navigation mitigation measures identified in chapter 6.1.3, a Fisheries Liaison Officer will be assigned to the project to ensure clear communication of when and where the works will take place.

With this mitigation in place, it is considered that the development is unlikely to have significant effects on commercial fishing.

6.1.5 Acoustics

Acoustic (airborne noise and vibration) will be created during construction by additional vessels, work on the WTG, flowline construction and HDD drilling. Work at the WTG will be minimised to reduce offshore construction timescales. To do this pre-fabricated sections and modular components will be constructed onshore and brought to the WTG for hook up and auxiliary works. This should reduce the entire project construction time to approximately 4 months weather depending. All offshore works are unlikely to have significant noise impacts on onshore receptors or reach levels where impacts will be above the current anthropogenic and/or natural acoustic levels. To further reduce acoustic impacts of the proposed works, helicopters will not be utilised except in emergencies.

Works at the Landfall such as flowline protection and HDD have the potential to cause audible noise for people and fauna especially birds and nesting birds.

- HDD noise and vibration is likely to be the localised to the construction site and unlikely to be significant. This will be confirmed with the HDD contractor prior to works starting.
- Rock placement or other means of mechanical protection (if required) may result in noise and vibration levels being significant in the local vicinity but an assessment based on locations of nearest sensitive receivers and known noise levels will be undertaken prior to consent application once installation methodologies are finalised. If noise levels may affect sensitive receivers

(people/birds) required rock placement timings and/or additional mitigation measures will be agreed.

In conclusion there are no likely significant impacts from offshore work or HDD. There are likely potential impacts to be assessed from rock placement, or other protection, (if required). However, the extent of these impacts may vary greatly, depending on the final locations of the work in relation to sensitive receivers, work method chosen and timings of the work. Rock placement (or other protection) will be limited as far as possible. With this in mind and associated assessments and implementation of industry best practice mitigation measures as required, it is considered that a likely significant effect on acoustic receptors is unlikely.

6.1.6 Underwater noise

Underwater noise will occur from vessel movements, flowline installation (including HDD), burial activities and rock placement (or other protection) but are unlikely to be significant. Geophysical surveys will be a notable source of underwater noise but have been assessed to date via the EPS risk assessment carried out in support of an EPS licence application for the proposed survey campaign. This assessment included proposed mitigation measures as per the JNCC 2017 guidelines to minimise injury and disturbance to marine mammals, which include, pre-work searches, soft starts (where feasible), reporting to MS-LOT (marine mammal recording forms) and completion of the JNCC Marine Noise Registry process.

With the implementation of this assessment and subsequent mitigation measures, it is considered that underwater noise will not constitute a likely significant impact.

6.1.7 Water and seabed quality

Construction methods will endeavour to ensure that water quality is maintained. Disturbance to seabed sediments and resuspension of sediments will impact on seawater quality during flowline installation operations and during construction of the flowline landfall. However, as contaminants in the sediments within the original AOWF area were all found to be below the Probable Effects Level (PEL) or below detection limits, this risk is unlikely assuming contaminant levels are consistent throughout the study area (AOWFL, 2011). A survey campaign is scheduled for Winter 2021 / Spring 2022 which will further inform knowledge and associated assessment of sediment contamination levels along the preferred flowline corridor. There is a greater risk from sediment re-suspension around the River Dee SAC, as the qualifying species salmon [Redacted] (see section 5.1.3.2) require very good water quality. The closest proposed point from the flowline corridor option to the River Dee SAC is c. 250m to the south (around Girdle Ness). Although the predominant direction of sediment transportation is northerly, it is expected that the sediment will remain offshore of the estuary and SAC with any suspended sediment being limited in extent and temporary in nature and thus, no significant effect is envisaged. However, the scheduled geophysical and seabed environmental survey campaigns will determine the exact composition of the seabed sediments and help to further inform this conclusion.

Routine marine discharges associated with survey and construction vessel use could also result in minor water quality impacts. However, all discharges will be in line with MARPOL 73/78 requirements, and activities will be temporary and limited in duration,

and the open coastal aspect will result in rapid dilution and dispersion of pollutants, such that there are no likely significant residual effects on water quality.

6.2 Operation

This section provides a description of the potential environmental impacts resulting from the operation and maintenance of the proposed HT1 hydrogen demonstration project. Table 6.2 outlines the potential sensitives as per chapter 5, identities any likely significant effects and proposes mitigation measures (where required) for any likely significant effects that may have a potential impact on the environment. Where potential impacts on known sensitivities and/or likely significant effects have been identified, they have been assessed in further detail in the following section.

For the purpose of the characterisation of potential impacts of the operational phase of the proposed project, the following activities have been included:

- Operation of hydrogen electrolyser including abstraction of seawater and discharge of saline effluent (approx. 50% more concentrated than abstracted)
- Maintenance and operation of the electrolyser equipment, associated infrastructure and flowline.

The health and safety aspects relating to the storage of hydrogen onshore will be separately assessed by the Competent Authority in consultation with the Local Planning Authority, Health and Safety Executive and Scottish Environmental Protection Agency, and is generally referred to in section 6.3.

Table 6.2: Operation effects and sensitivities

Potential Effect		Source	Sensitivities	Likely Significant Effect (before mitigation)	Required Mitigation Measures
Use of Natural Resources	Water Abstraction	Seawater will be abstracted at a rate of 3.52 m^3/h (84.48 m^3/day assuming 24-hour operation) via an abstraction pipe in the water column in the vicinity of WTG B06 and desalinated in situ.	Land, Air and Water: Water Biodiversity: Fish and shellfish	Assessed in section 6.2.1	Careful siting and appropriate screening of abstraction infrastructure to minimise entrainment.
	Water Discharge	Saline effluent will be discharged to the sea via a discharge pipeline in the water column in the vicinity of WTG B06 at a rate of 1.76 m^3/h (42.24 m^3/day) with a 50% greater salinity concentration than the water abstracted.	Land, Air and Water: Water Biodiversity: Fish and shellfish	Assessed in section 6.2.2	Modelling will be undertaken of the discharge based on its concentration, volume and rate of discharge to aid with the design of possible diffusers to aid dispersion.
	Cooling-Water	Potential for water-cooling of hydrogen producing equipment requiring additional extraction and discharge of seawater (at an elevated temperature) to that indicated above.	Land, Air and Water: Water Biodiversity: Fish and shellfish	Assessed in section 6.2.2	Necessary modelling Utilisation of best practice methods as employed for oil and gas installations (albeit on a much smaller scale) Only approved chemicals to be used.

Potential Effect		Source	Sensitivities	Likely Significant Effect (before mitigation)	Required Mitigation Measures
Pollution & nuisances	Airborne Noise	Small amounts of airborne noise will be generated by the hydrogen equipment installed on the WTG and equipment at the flowline landfall.	None	No – additional noise levels are expected to be negligible and located within the vicinity of the existing windfarm or within an industrial area onshore.	Noise levels of the hydrogen infrastructure will be minimised as far as possible and located within the OWF and an industrialised area onshore.
	Vibration	No significant vibrations are envisaged from the operation and maintenance of the proposed hydrogen demonstration projects	None	No	
	Underwater Noise	Underwater noise could be generated from abstraction and discharge activities and maintenance vessel movement	Biodiversity: Fish and shellfish Marine Mammals	No – negligible noise will be created from the abstraction and discharge activities and vessel activity will not increase the background vessel movements within the Aberdeen Bay area significantly.	Vessel Management Plan(s) and Navigation Safety Plan(s) will be produced as required.
	Air Quality (emissions and climate change impacts)	Maintenance vessel movements could increase emissions to air whilst the production of green	People	Yes (positive)	

Potential Effect		Source	Sensitivities	Likely Significant Effect (before mitigation)	Required Mitigation Measures
		hydrogen could reduce overall carbon emissions.	Potential positive climate change contribution		
	Water Quality and sediment	Direct impact on water quality from the abstraction of 84.48 m^3/day of sea water and discharge of 42.24 m^3/day of brine at c. 50% greater salinity and potential cooling-water operations.	Biodiversity: Marine Land, Air and Water: Water	Assessed in section 6.2.3	Baseline surveys prior to construction. Modelling of the abstraction and discharge as required to aid with the design of possible diffusers to aid dispersion.
	Light Emission	Small levels of additional lighting at WTG B06 and hydrogen storage location	Seascape, Landscape and Visual Biodiversity	No – levels of additional lighting expected to be minimal	For the protection of birds and to minimise visual impact, there will be no permanent lighting on the WTG during operations, only emergency lighting will be used.
Landscape and Visual	Visual Impact	Additional infrastructure on WTG B06 and infrastructure related to onshore hydrogen storage facility	People	No – additional infrastructure is minimal and installed offshore at WTG B06 or within an already industrialised site. Visual impacts are therefore considered to be negligible.	Infrastructure will be situated on the WTG furthest from shore (B06). Infrastructure will be low lying and situated within an already developed area.

Potential Effect		Source	Sensitivities	Likely Significant Effect (before mitigation)	Required Mitigation Measures
Transport & Navigation	Navigation	Maintenance vessels visiting WTG B06 and surveying flowline as required.	People (commercial fisheries) Biodiversity Navigation	No – increase in vessel activity expected to be negligible.	Vessel requirements will be kept to a minimum. Full liaison with MCA, NLB and Harbour Authorities will take place prior to additional work vessels being in the area. Notice to mariners will be published as required. Vessel Management Plan(s) and Navigation Safety Plan(s) will be in place as required.
	Navigation	Risk of Anchor strike on hydrogen flowline	People Biodiversity Navigation	No – flowline designed to mitigate risk	Flowline buried. If burial is not feasible rock cover (or other protection) will be implemented. Burial assessment will specify depth of cover, taking into account risk of anchor strike. Navigational risk assessment to be carried out. Flowline route designed to avoid anchorage areas.

Potential Effect		Source	Sensitivities	Likely Significant Effect (before mitigation)	Required Mitigation Measures
	Surveys	Maintenance surveys on the flowline and hydrogen equipment.	Biodiversity: Marine Mammals	No	EPS licence (incl. supporting Risk Assessment), marine works licence and marine licence exemption will be sought to support any maintenance survey campaigns and associated works. EPS licence would include a number of mitigation measures to prevent injury and reduce disturbance to marine mammals.

Table 6.2 identifies 4 potentially significant effects arising from the operation and maintenance of the proposed HT1 hydrogen demonstration project. One of these, air quality (emissions and climate change impacts), has been identified as a potentially positive effect and is not discussed further, the remaining 3 are assessed below.

6.2.1 Water Abstraction

Seawater will be abstracted at a rate of up to 3.52 m^3/h (84.48 m^3/day assuming 24-hour operation) via an abstraction pipe in the water column in the vicinity of WTG B06 and desalinated in situ. Prior to electrolysis, the abstracted water will be mechanical filtered and likely supplemented with UV or chemical treatment to ensure suitability for electrolysis. As described in chapter 5.5.3, the seawater environment around WTG B06 where the abstraction will take place, is geographically large, open and well mixed. The abstraction will occur in the vicinity of the Cruden Bay to the Don Estuary coastal water body (ID: 200117), which is 149.3 km^2 in area. The water body is at overall high status and is not classified as heavily modified. Due to the relatively small abstraction proposed in a large, open water body, no significant effect is expected on water quality or availability. However, there are a number of environmental regulations, including the Water Framework Directive and Controlled Activity Regulations, that place obligations on organisations that take water from or return water to the natural environment. As the abstraction is proposed to take place c. 2.4 nm offshore, registration under the Controlled Activity Regulations will be required and will be discussed with SEPA accordingly.

Where required, measures will be put into place to help protect and promote the recovery of the European eel (Anguilla anguilla) population within the project area. This may include appropriate screening of the intake and discharge infrastructure to reduce entrainment and allow escape of eels and other species of fish. Advice will be required to be sought on mesh size/angle as well as intake/discharge velocities that are permitted. These factors will depend on the importance of the area for these species as well as the seasonality and life cycle stages for them.

6.2.2 Water Discharge

Wastewater from the seawater abstraction and desalination process will be discharged back to the sea via a discharge pipe and suitable diffuser structure into the water column in the vicinity of WTG B06 at a rate of up to 1.76 m^3/h (42.24 m^3/day assuming 24-hour operation) with a c. 50% greater salinity concentration than the water abstracted.

Typically, saline discharges to the marine environment can have impacts on benthic fauna, plankton and fish as well as impacts on water quality through increased turbidity, and also potentially limited impacts on primary production within phytoplankton and marine algae / seagrasses.

The impacts of this discharge will be mitigated by the fact that the discharge will not be intertidal and will be below MLWS and into a receiving environment that is of relative high energy, open and exposed coastal aspect and into deep well mixed seawater, with strong ambient tidal currents and wave regime that will facilitate rapid dilution and dispersion. Modelling will be undertaken of the discharge based on its concentration, volume and rate of discharge to aid with the design of possible diffusers. A highly saline discharge will be denser than ambient seawater and as such will have a tendency to sink, consequently the positioning of the outfall diffuser and the rate or pressure that the water

is discharged from it will have implications for the speed and spatial extent within which the discharge will be diluted and dispersed.

The discharge of 42.24 $m^{3/}$day of saline effluent will be relatively minor in the context of the receiving environment, as dilution and dispersion will be rapid in the offshore environment and impacts will be very localised and of limited duration. It is therefore considered that the proposed saline discharge is unlikely to have significant effect on the receiving environment.

As part of ongoing design considerations, it is likely that water-cooling of the hydrogen producing equipment will be required. This technology is commonly used in offshore oil and gas operations and would require additional extraction and discharge of seawater to that indicated above (as this water would be separate from that used in desalination). Seawater discharge would be at an elevated temperature compared to the receiving environment. The rate of abstraction and discharge for water-cooling has a direct relationship on the temperature of the discharged water (i.e. using more water throughput would result in lower discharge temperatures). However, the exact parameters of any water-cooling system are yet to be defined and would be discussed and agreed with the relevant authorities, alongside any necessary modelling. This would inform the water-cooling system and diffuser design to ensure no significant environmental effects.

Both desalination and water-cooling are widely used technologies around the marine environment and the project will use best practice methods as employed for oil and gas installations (albeit on a much smaller scale). Seawater used for cooling will have anti-foaming, biocides and anti-corrosion agents added which, depending on concentrations, will be neutralised prior to discharge.

Unless otherwise agreed with the relevant regulator, all chemicals used in the construction and operation of the project, including any chemical agents used in desalination or water-cooling, will be selected from the List of Notified Chemicals approved for use by the offshore oil and gas industry under the Offshore Chemicals Regulations 2002 (as amended).

Any potential impacts will be discussed with SEPA alongside any requirements for registration or licensing under the Controlled Activity Regulations.

6.2.3 Water Quality and Sediment

The abstraction and discharge of water and saline effluent respectively could result in movements of sediments in the water column, although this is not considered to be significant given the rates of flow and volumes that are envisaged. Baseline surveys to determine the nature of the seabed sediment and seawater quality prior to construction would be undertaken and modelling of the abstraction and discharge streams would also be carried out as required. This would develop understanding of how the projected abstraction and discharge streams might affect local hydrodynamics and provide a guide to the best designs for the abstraction and diffuser structures to minimise the potential for suspension of sediments and/or scour at the seabed. It might be necessary to undertake periodic monitoring of the abstraction and discharge streams during operations.

It is considered that the operation of the proposed HT1 hydrogen demonstration project is unlikely to have significant effects on water quality.

6.3 Major accident and hazards

The UK is an area of low seismicity and the risk to offshore structures is considered to be correspondingly low (AOWFL, 2011). However, the risk of seismic activity is not considered negligible (Aberdeen Harbour 2015). Part of the proposed flowline route runs across the fault line between the two different bedrocks. The flowline will be designed during the FEED study for the level of seismic activity expected in the area and thus no significant risk is foreseen.

As with other gaseous fuels, there is a minor but controllable explosion and fire risk associated with the hydrogen production, flowline and subsequent storage. Due to the safety measures embedded into the design of such facilities, the risk of explosion from hydrogen production, flowline and arrival on shore is considered highly unlikely in all circumstances. There will be an automatic shut off system and manual backup for the hydrogen production equipment and flowline system in case of emergencies. Studies are ongoing to clarify this with further details to be provided at the time of consent application. The project will work with the competent authority to define the scope of assessment under the COMAH regulations and other relevant legislation and to identify the necessary consents and licences required to be in place prior to operation.

Risk of a major shipping accident are not envisaged to increase as a result of the construction and operation of the HT1 hydrogen demonstrator.

6.4 Cumulative effects

Schedule 3 of the Marine Works EIA Regulations includes cumulative effects as part of the criteria for screening schedule 2 works. Cumulative effects are those which are caused by the combined impact of anthropogenic actions and natural process at a certain location and can be divided into two categories:

- **Type 1** cumulative effects are where different environmental impacts are caused by one project acting on one receptor; and
- **Type 2** cumulative effects where there is an environmental impact on a receptor caused by the combination of effects from multiple projects (either in existence or reasonable foreseen).

6.4.1 Type 1 Cumulative Effects

All works associated with the project will be subject to risk assessment, mitigation and monitoring measures, to minimise the risk of potentially significant effects. Furthermore, due to the need to carry out different project activities in consecutive stages, there will be little overlap in activities. As a result, there are no significant cumulative effects anticipated.

6.4.2 Type 2 Cumulative Effects

On review of Marine Scotland's consents public register and the relevant local authorities planning portals, the following active projects were identified within the study area, that have potential to create cumulative effects with this proposed project:

- Aberdeen Harbour Expansion: Includes a European Protected Species (EPS) Licence application (post-consent) for potential effects from dredging on Harbour porpoise, Bottlenose dolphin, White-beaked dolphin, Risso's dolphin and Minke whale in Nigg Bay, and a Marine Licence (post-consent) for the use and deposit of explosives in Nigg Bay. There are active Marine Licences in place for the construction of the new harbour and use of explosive substances, and for capital dredging and sea deposit, in Nigg Bay expiring on 31 December 2021. These works may result in cumulative effects on noise sensitive species, if carried out at the same time as the survey campaign for this project, which involves geophysical surveying methods, and is scheduled to start before the Aberdeen Harbour licences expire in December 2021. However, there will be an EPS licence in place for the survey campaign, which will include a number of mitigation measures to prevent injury and reduce disturbance to marine mammals (which will also aid protection of other noise sensitive species). Furthermore, as the survey campaign will take place over several months, and offshore as well as inshore, activities could be scheduled to take place at a different time to the harbour works, to minimise the risk of cumulative effects.
- AOWF: Ongoing operational and maintenance works (including surveys of transmission cables) may result in cumulative effects. However, as both projects will be run by Vattenfall, alignment of work programmes will take place to ensure any potential cumulative impacts are minimised and where possible resources can be shared to decrease potential environmental impacts (e.g. via sharing of maintenance vessels and ongoing survey campaigns).

7 SUMMARY

The Vattenfall HT1 Hydrogen demonstration project offers a unique opportunity to test the viability of offshore production of green hydrogen and help realise the positive environmental benefits from a reduction in use of fossil fuels. The project requires the construction of an extended transition piece platform on the existing WTG B06, the placement of hydrogen production equipment (defined in chapter 4.1) within up to seven 40 ft containers on the extended transition piece, construction of abstraction and discharge infrastructure at WTG B06 and construction (including trench and burial) of an 8" (maximum internal diameter) flowline to transport the produced hydrogen to shore.

The operation of the project will involve the abstraction of seawater, desalination, electrolysis to produce hydrogen - which will be exported to shore; oxygen – which will be released to the atmosphere and saline effluent – which will be discharged back to the marine environment.

The purpose of this screening opinion request is to determine MS-LOTs opinion regarding whether an EIA is required under the EIA regulations to support a Marine Licence consent application for the proposed project. Vattenfall also request clarity on the consenting regime that these works will be consented under, specifically whether MS-LOT agree that the proposed project and flowline as described in chapter 4, can be consented via a marine licence under the Marine (Scotland) Act 2010 or if a pipeline works authorisation will be required.

Several known sensitivities have been identified throughout chapter 5 and the potential impacts on these in chapter 6 (Table 6.1 and Table 6.2). The known sensitivities at risk of greatest impact from the construction phase of the project are cultural heritage, material assets, biodiversity, navigation, commercial fishing and seawater and seabed sediment quality. Similarly, the known sensitives at greatest risk of impact from an operational perspective are biodiversity and seawater quality caused by the abstraction and discharge activities.

It is considered that the project is likely to be classified as a schedule 2 project under the EIA regulations. However, it is our view that with the implementation of the identified mitigation measures in chapter 6 and utilisation of standard environmental good practice, that likely significant effects can be avoided and that the proposed project does not require a statutory EIA under the EIA regulations and associated schedule 3 selection criteria. Furthermore, all works at the WTG (B06) and for the preferred flowline route options (Option 3a and 4) do not take place within sensitive areas. Where alternative flowline routes may take place within sensitive areas (namely the Ythan Estuary, Sands of Forvie and Meikle Lock SPA), mitigation is readily available to avoid significant effects. It is Vattenfall's intension that a non-statutory environmental appraisal accompanies any subsequent Marine Licence application.

Confirmation of this approach through provision of a screening opinion is kindly requested from MS-LOT.

8 REFERENCES

Aberdeen Harbour (2015), 'Aberdeen Harbour Expansion Project Environmental Statement.' Available at: https://www.aberdeen-harbour.co.uk/south-harbour/environmental-mitigation/2016-documents/ .

Aberdeen Harbour (2020), 'Open to a World of Possibilities: Annual Review 2020-2021'. Available at: https://www.aberdeen-harbour.co.uk/images/uploads/annual-review_(1).pdf .

Aberdeen Harbour (2021), 'A Bright Future Ahead: Annual Review 2021-2022'. Available at: https://www.aberdeen-harbour.co.uk/images/uploads/Aberdeen_Harbour_Annual_Review_2021-2022.pdf .

Aberdeenshire Council (2011) Application for Consent Under Section 36 of the Electricity Act 1989 and a Marine Licence Under Part 4, Section 20 of the Marine (Scotland) Act 2010 to Construct and Operate an Offshore Windfarm and Deployment Centre | Aberdeen Bay Aberdeen Aberdeenshire. Application No. APP/2011/2815. Available at: https://www.aberdeenshire.gov.uk/ .

Aberdeen City Council (2009), 'Core Paths Plan'. Available at: https://www.aberdeencity.gov.uk/services/environment/access-outdoors/core-paths-plan .

Aberdeen City Council (2019), 'Aberdeen Coastal Trail'. Available at: https://www.visitabdn.com/assets/Aberdeen-City-Council-Guide-Coastal-Trail.pdf .

Aberdeenshire Local Development Plan (2020), 'APPENDIX 13 ABERDEENSHIRE SPECIAL LANDSCAPE AREAS'. Available at: https://online.aberdeenshire.gov.uk/ldpmedia/pldp2020/Appendix13AberdeenshireSpecialLandscapeAreas.pdf .

Admiralty 2021. 'Maps' https://www.admiralty.co.uk/ .

AOWFL (Aberdeen Offshore Wind Farm Limited) (2011) 'European Offshore Wind Deployment Centre Environmental Statement'. Available at: http://marine.gov.scot/data/environmental-statement-construction-operation-generating-station-and-transmission-works.

Arso Civil, M., Quick, N., Mews, S., Hague, E. Cheney, B.J., Thompson, P.M. & Hammond, P.S. (2021), 'Improving understanding of bottlenose dolphin movements along the east coast of Scotland.' Final report. Report number SMRUC-VAT-2020-10 provided to European Offshore Wind Deployment Centre (EOWDC), March 2021 (unpublished). Available at: https://group.vattenfall.com/uk/what-we-do/our-projects/european-offshore-wind-deployment-centre.

Bristow, T. & Reeves, E.I.S. (2001), 'Site fidelity and behaviour of bottlenose dolphins (*Tursiops truncatus*) in Cardigan Bay, Wales'. Aquatic Mammals 27: 1-10.

Buckstaff, K.C. (2004), 'Effects of watercraft noise on the acoustic behaviour of bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida'. Marine Mammal Science 20: 709-725.

EEA (2020), 'EUNIS Habitat Classification.' Available at https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification / https://eunis.eea.europa.eu/habitats-code-browser.jsp .

European Commission (2020), A hydrogen strategy for a climate-neutral Europe. Available at: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

Genesis (2012a), 'Aberdeen Offshore Wind Farm Marine Mammals Baseline Addendum'. Available at: http://marine.gov.scot/datafiles/lot/eowdc/ES_Addendum/ .

Genesis (2012b), 'Aberdeen Offshore Wind Farm Environmental Statement Chapter 10 Ornithology (Revised)'. Available at: http://marine.gov.scot/datafiles/lot/eowdc/ES_Addendum/.

Gregory, P.R. & Rowden, A.A. (2001), 'Behaviour patterns of bottlenose dolphins (*Tursiops truncatus*) relative to tidal state, time of day and boat traffic in Cardigan Bay, West Wales'. Aquatic Mammals 27: 105-113.

Hague, E.L, Sinclair, R.R. & Sparling, C.E. (2020), 'Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters.' Scottish Marine and Freshwater Series Vol 11 No 12.

Historic Environment Scotland. 'Portal'. Available at: http://portal.historicenvironment.scot/ .

JNCC (2015), 'The Marine Habitat Classification for Britain and Ireland Version 15.03.' [accessed 12th July 2021]. Available at: https://mhc.jncc.gov.uk/.

Kafas, A., McLay, A., Chimienti, M., Gubbins, M. (2014) ScotMap Inshore Fisheries Mapping in Scotland: Recording Fishermen's use of the Sea. Scottish Marine and Freshwater Science Volume 5 Number 17. Edinburgh: Scottish Government, 32p. DOI: 10.4789/1554-1.

Leung Ng, S. & Leung, S. (2003), 'Behavioural response of Indo-Pacific humpback dolphin (Sousa chinensis) to vessel traffic'. Marine Environmental Research 56: 555-567.

Marine Scotland (2021), 'Marine Protected Areas Map', Available at: https://map.environment.gov.scot/sewebmap/.

Marine Scotland (2020), 'Licence for Marine Renewables construction Works and Deposits of Substances or Objects in the Scottish Marine Area'. Reference FKB/Z242.

Marine Works (2017) 'Schedule 3 Environmental Impact Assessment, Scotland Regulations.'

NatureScot (2017), 'Local Landscape Areas 2017 map'. Available at: https://www.nature.scot/sites/default/files/2017-07/A2218733%20-%2082889_Local_Landscape_Areas_map_24_02_2017.pdf .

NatureScot (2019), 'Southern Trench Possible Marine Protected Area'. Available at: https://www.nature.scot/sites/default/files/2019-06/Southern%20Trench%20possible%20MPA%20-%20Site%20Summary%20Leaflet.pdf .

NatureScot (2020), 'Citation For Special Protection Area (Spa) Ythan Estuary, Sands of Forvie and Meikle Loch (UK9002221) Including Marine Extension.' Available at: https://sitelink.nature.scot/site/8592 .

NatureScot (2021), 'SiteLink'. Available at: https://sitelink.nature.scot/home.

NOMIS (Office of National Statistics) (2021), 'Annual Population Survey'. Available at: http://www.nomisweb.co.uk/.

Popper, A. N., Smith, M. E., Cott, P. A., Hanna, B. W., MacGillivray, A. O., Austin, M. E. and Mann, D. A. (2005). *Effects of exposure to seismic airgun use on hearing of three fish species*. Journal of the Acoustical Society of America. 117. 3958–3971.

Scottish Government Hydrogen Policy Statement, 2020. Available at: https://www.gov.scot/publications/scottish-government-hydrogen-policy-statement/documents/

Scotjobsnet (2021) https://www.scotjobsnet.co.uk/aberdeen-the-scottish-capital-of-growth-and-employment.cms.asp

The Crown Estate (2012), *'Export transmission cables for offshore renewable installations, Principles of cable routing and spacing'.* Available at: https://www.thecrownestate.co.uk/media/1781/ei-km-in-pc-cables-export-transmission-cables-for-offshore-renewable-installations.pdf

The Scottish Government (2020a), 'Scottish Sea Fisheries Statistics 2019'. Available at: https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2019/pages/1/ .

The Scottish Government (2020b), 'Salmon fishery statistics: 2019'. Available at: https://www.gov.scot/publications/salmon-fishery-statistics-2019/ .

The Scottish Government (2020c), 'Sea Trout fishery statistics: 2019'. Available at: https://www.gov.scot/publications/sea-trout-fishery-statistics-2019/ .

UK Beach Guide (2021), 'Grampian Beaches'. Available at: https://www.thebeachguide.co.uk/north-scotland/grampian/.

UK Hydrogen Strategy, 2021. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

Vattenfall HT1 Hydrogen Demonstration Project (2021) EPS Risk Assessment .

Visit Scotland (2020a), 'Insight Department: Key Facts on Tourism in Scotland 2019'. Available at: https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/key-facts-on-tourism-in-scotland-2019.pdf .

Visit Scotland (2020b), 'Insight Department: Grampian Factsheet 2019 (Aberdeen City, Aberdeenshire & Moray)'. Available at: https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/regional-factsheets/grampian-factsheet-2019.pdf .

Woodward, I., Thaxter, C.B., Owen, E. & Cook, A.S.C.P. (2019), 'Desk-based revision of seabird foraging ranges used for HRA screening'. Report of work carried out by the British Trust for Ornithology on behalf of NIRAS and The Crown Estate, ISBN 978-1-912642-12-0.