Ithaca Energy (UK) Limited

Jacky Decommissioning
Environmental Impact Assessment

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Prepared for Ithaca Energy (UK) Limited
by
Hartley Anderson Limited

CONTENTS

GLOSSARY AND ABBREVIATIONS

Term	Explanation
ASFB	Association of Salmon Fishery Boards
Beatrice AP	Beatrice Alpha Production Platform
Beatrice B	Beatrice Bravo Platform
BEIS	Department for Business, Energy and Industrial Strategy, formerly the Department of Energy and Climate Change (DECC)
Biota	The collective term for fauna and flora at a particular location
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Concrete mattress	A series of concrete blocks usually connected together by polypropylene ropes which resembles a rectangular mattress. These are used for the weighting and/or protection of seabed structures including pipelines
CoP	Cessation of Production: the stage at which, after all economic development opportunities have been pursued, an agreement is sought from BEIS that hydrocarbon production may cease at a particular field. The economic criterion for deciding CoP is typically the point at which the value of the hydrocarbons produced no longer covers the true costs of production.
CSV	Construction Support Vessel
DECC	Department of Energy and Climate Change, now the Department for Business, Energy and Industrial Strategy (BEIS)
DP	Dynamic Positioning: the use of thrusters and real time positional information to maintain the location of a vessel
DSV	Dive Support Vessel
DTI	Department of Trade and Industry (relevant regulatory functions now within BEIS and OGA)
EIA	Environmental Impact Assessment
ENVID	Environmental Issues Identification
ESP	Electric Submersible Pump
Frond mat	Scour prevention mats made from polyester and polypropylene. High tensile buoyant fronds on a mat base, which trap natural sediment forming a bank over the fronded area
Gabion bags	Flexible rock or concrete block filled bags, used for scour, cable and flowline protection
GHG	Greenhouse gas
Grout bags	Grout filled canvas bags with lifting lugs, typically around 25kg. Used to support spanning/transition sections of pipework, such as at the base of a riser and at spool tie-ins
GWP	Global Warming Potential: an emissions metric used to indicate the contribution of a certain greenhouse gas to radiative forcing, accounting for the atmospheric lifetime of a given gas relative to carbon dioxide (the principal greenhouse gas)
HAL	Hartley Anderson Limited
HLV	Heavy Lift Vessel

Term	Explanation
HPVC	Hard polyvinylchloride
HSE	Health Safety and Environment
Jacket	The structure comprising the “legs” of the installation
Jack-up rig	A mobile floating drilling rig typically with three long triangular truss legs which can be lowered to the seabed to provide stability once on location
JNCC	Joint Nature Conservation Committee
km	kilometre: 1,000m, equivalent to 0.54 nautical miles
Mariculture	The cultivation of marine species such as shellfish, finfish and seaweed within coastal waters
Mattress	Cast articulated concrete blocks linked by a polypropylene rope lattice, used to provide pipeline stabilisation and impact protection from dropped objects
MoD	Ministry of Defence
MLT	Midline tee
NCMPA	Nature Conservation Marine Protected Area
NUI	Normally Unattended Installation: an installation with minimal facilities which is not permanently crewed and is controlled from a remote location (e.g. other platform or shore)
OGA	Oil and Gas Authority
OPEP	Oil Pollution Emergency Plan
OWF	Offshore Wind Farm
ROV	Remotely Operated Vehicle: a small, unmanned submersible used for inspection and the carrying out of some activities such as valve manipulation
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation: established under the Habitats Directive
SFF	Scottish Fishermen’s Federation
SNH	Scottish Natural Heritage
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Protection Area: established under the Birds Directive
Spud can	Base-plate structure at the lower end of a jack-up rig leg; intended to support the load on the seabed sediments and reduce sinking-in
Topsides	The collective name for the many drilling, processing, accommodation and other modules which when connected together make up the upper section of the platform which rests on the installation jacket
UKCS	United Kingdom Continental Shelf
Water injection	The process of injecting water into dedicated water injection wells, typically to maintain the pressure in a hydrocarbon reservoir to sustain hydrocarbon flow
WBM	Water Based Mud
WDC	Whale and Dolphin Conservation
WI	Water Injection

Executive summary

Introduction and scope of facilities to be decommissioned

Ithaca Energy (UK) Ltd (Ithaca) is planning to decommission the Jacky Field facilities, located in Block 12/21c, approximately 19km to the east of the Moray Firth Caithness cliffs and 10km northeast of the Beatrice Field Alpha complex in Block 11/30. Water depths over the area are between 37-45m.

Under Part IV of the *Petroleum Act 1998* (as amended) and amendments to the Act through the *Energy Act 2008* (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit Decommissioning Programmes (DP) and Regulator guidance (DECC 2011) indicates that a DP must be supported by an Environmental Impact Assessment (EIA). The OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations sets out OSPAR Contracting Parties obligations on the decommissioning of offshore installations, prohibiting the leaving of these in place; there is a derogation option under OSPAR 98/3 whereby under certain circumstances, installations can be left *in situ*. There is no derogation option available for the Jacky Field facilities, with all installations (including subsea installations) having to be recovered from the seabed and either reused, recycled or disposed of in landfill.

Ithaca have prepared and submitted DPs for those Jacky facilities that have to be wholly recovered under OSPAR 98/3 (points 1-2 below), and the wells and other associated infrastructure, the decommissioning options for which have been identified through other assessment methods, such as comparative assessment in the case of pipelines:

1. The normally unattended Jacky Wellhead Platform (WHP) (topsides, monopile jacket and suction piles)
2. The gravity based midline tee structure (MLT), power cable tether and clump weight
3. Three Jacky wells (1 x production, 1 x water injection and 1 x suspended, never completed)
4. Pipelines and protective material– production and water flowlines, power cable, exposed mattresses, grout and gabion bags, frond mats and rock

The intention is to remove the Jacky WHP, gravity based MLT structure and tether and clump weight, in a reversal of the installation process; the Jacky WHP was designed such that it could be removed by reverse installation (i.e. in two sections), therefore alternative removal methods, such as removal in multiple sections, were not considered further. A heavy lift vessel and support vessels will be used to recover the Jacky WHP in two lifts, returning this to a UK yard for processing. The MLT, tether and clump weight will be recovered by construction support vessels.

A jack-up rig will be used for the well decommissioning activities; the final well decommissioning strategy is being developed and will be in accordance with the Oil and Gas UK guidance on well abandonment and Ithaca's HS&E policy.

The recommended decommissioning option from the comparative assessment carried out was to leave the trenched and buried pipeline/power cable *in situ*, remove all spool pieces, section of the power cable, and all exposed mattresses/grout bags. Dive, construction and other support vessels will be used for the subsea infrastructure decommissioning.

To minimise recycling and disposal to landfill, Ithaca have been actively seeking alternative use options for the Jacky WHP and associated infrastructure; *in situ* reuse or redevelopment have been explored but are not viable options leaving onshore reuse, recycling and disposal to landfill.

Environmental summary

The Jacky Field facilities lies on the north-west edge of Smith Bank, where the seabed is generally flat with in water depths of between 37-45m. Water depth increases to 60m to the north-west of the area. There is a substantial volume of information available on the seabed sediments and fauna around the Jacky platform and the production and water injection pipelines linking it to the Beatrice Alpha and Bravo platforms. This information derives from a sequence of surveys from 1958 to recent surveys of wind farm areas and by the oil industry; this information was reviewed as part of planning for the decommissioning of the Jacky Field facilities (Hartley Anderson 2014). The review concluded that the available older and recent surveys provide an adequate and robust characterisation of the seabed sediment, sediment chemistry (including of contaminants) and fauna for the areas at and in proximity to the Jacky WHP and pipelines.

The adjacent east Caithness coast is of conservation importance for breeding seabird populations, while the waters of the inner Moray Firth to the west are of considerable importance for bottlenose dolphins, seabirds, seals and otters. There are many other habitats, species and bird populations of conservation importance around the Moray Firth coastline.

A summary of the main environmental features of the area and their seasonal variability is given overleaf.

Tabulated seasonal and other environmental sensitivities

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
Location	The Jacky Field lies on the northwest edge of the Smith Bank in the Moray Firth and the infrastructure straddles UKCS Blocks 12/21c (Jacky WHP and pipelines) and 11/30 (MLT and pipelines). The Jacky WHP is approximately 19km southeast of the Caithness coast and 10.5km northeast of Beatrice A. None of the Jacky infrastructure makes landfall.												
Block licence constraints	**Block 12/21c (Jacky WHP and associated Jacky infrastructure)** There are periods of concern (January-March, August-September, November-December) for seismic surveys (Marine Scotland) Due to the presence of nearby important seabird breeding colonies and the importance of marine areas for feeding, the entire Block has year round concern for drilling (JNCC). There is a requirement on the Block to confirm whether there are any herring spawning sites present. There is a requirement to notify the MOD at least 12 months prior to siting any installation in the Block due to the area lying within MOD training ranges. **Block 11/30 (Beatrice A tie-in from Jacky and associated Jacky infrastructure)** There are periods of concern for January – April and November -December for seismic surveys (Marine Scotland). Due to the presence of nearby important seabird breeding colonies and the importance of marine areas for feeding, the entire Block has year round concern for drilling (JNCC). There is a requirement to notify the MOD at least 12 months prior to siting any installation in the Block as the area lies within MOD training ranges.												No seismic surveys are to be carried out as part of decommissioning activities. Well plug & abandonment activities are to be carried out in Block 12/21c only, this includes isolation of the reservoir. Note, the wells required artificial lift to assist flow. In addition, the pipelines have been cleaned and flushed. The Jacky site and pipeline route surveys found no indication of suitable substrates for herring spawning in the vicinity of the field.
Water column	Water depth is between 37m to 45m across the relevant area, with well mixed shelf water (34-35ppt salinity) for the majority of the year. Some stratification occurs in summer, although this is typically very minor over Smith Bank. In winter, lower water temperatures may reduce hydrocarbon evaporation and increase viscosity.												Well plug & abandonment activities will use a relatively small number and variety of chemicals; use and discharge of these will be subject to risk assessment prior to permitting.
Plankton	A spring bloom of phytoplankton is initially dominated by diatoms, followed by flagellates and dinoflagellates. Peak zooplankton abundance generally occurs shortly after the phytoplankton bloom. Primary productivity slows in summer, although zooplankton abundance may remain high. Autumnal breakdown of stratification initiates a second, smaller bloom of dinoflagellates.												Well plug & abandonment activities will use a relatively small number and variety of chemicals; discharge of these is not

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
	Key: Period of increased plankton abundance shown in darker blue												likely to significantly affect plankton.
Seabed and fauna	Seabed sediments at the site and along the pipeline route are predominantly medium to coarse sand with shell fragments, but extensive patches of coarse sand, gravel, pebbles and shells are also present. Sediments in the slightly deeper waters (>40m) consist of medium to fine sand with shell fragments. The seabed fauna is comparatively rich and numerically dominated by polychaete worms, amphipod crustaceans and bivalves. No Annex 1 habitats have been revealed by extensive surveys undertaken at Jacky and in the immediate vicinity. See Figure 4.1 and App1.												Sensitive features will be taken account of in the rig and HLV mooring analyses to avoid interactions where possible.
Fish	The Jacky infrastructure overlaps or abuts reported spawning grounds of eight commercially important fish and shellfish species (cod, herring, lemon sole, plaice, sandeel, sprat, whiting and *Nephrops*) and nursery grounds for these species and a further nine species (haddock, saithe, mackerel, monkfish, hake, ling, spurdog, thornback ray and spotted ray). See Figures 4.6 and 4.7.												Well plug & abandonment activities will use a relatively small number and variety of chemicals; discharge of these is not likely to significantly affect fish spawning/nursery grounds. Majority of fish species spawn over wide areas
	4	**5**	**4**	**4**	**4**	**4**	**3**	**4**	**3**	**1**	**2**	**3**	
	Key: 1 = 1 species spawning, 2 = 2 species spawning etc												
	The Moray Firth region contains important populations of Atlantic salmon; adult fish may be more abundant in coastal waters during spring and summer. There have also been sightings of basking shark in summer months, mainly in the southern Moray Firth.												
Birds	The region is important for breeding seabirds and contains important feeding areas. There are a number of coastal sites designated for their individual breeding species as well as bird assemblages. The new Seabird Oil Sensitivity Index describes the sensitivity of seabird concentrations to oil pollution. For the Jacky area, the median sensitivity, which represents the most likely assessment of sensitivity, is either high, very high, or extremely high, for the majority of the year – see Figure 4.8.												Reservoir sections of wells will be isolated (wells required artificial lift to assist flow) and pipelines have been flushed and cleaned. Spill prevention and management for diesel from rig will be in place. Vessels will have relevant spill plans.
	Coastal areas of the Moray Basin, the firths and the bays, form an integral unit that are of great importance for wintering and passage waterbirds. The area is of international importance for wintering seaduck.												
Marine mammals	The Moray Firth is important for bottlenose dolphin, harbour porpoise, & to lesser extent white-beaked dolphin & minke whale, the latter of which is a feature of the proposed Southern Trench MPA. The Moray Firth supports resident population of bottlenose dolphin, present all year, highest numbers seen in coastal waters May-September. Latest count (summer 2013) estimates 195 individuals. Risso's dolphin & killer whale also recorded.												Topsides to be unbolted; gas cutting equipment as contingency. Monopile jacket and suction piles to be removed through reverse engineering, no cutting anticipated. If cutting of suction piles required (contingency), a high-pressure water jet cutting tool. No explosive cutting will be undertaken.
	Key: Darker colours reflect months when marine mammals most frequently observed												
	Important breeding & haul out sites for harbour and grey seal. Grey seals forage over a wide area, travelling up to 145km from haul out sites. Extensive telemetry information shows they are widely distributed throughout the Moray Firth particularly outside the pupping season in October-November and the moulting season in February-April. Harbour seals tend to forage within 60km of their haul out sites, and foraging areas can change depending on fish abundance. Relatively recent studies have shown harbour seals to forage much further offshore than previously thought. Telemetry studies have shown low to moderate harbour seal density in the Moray Firth. See Figure 4.9.												
Conservation sites	The importance of the area for breeding seabirds, wintering and migratory waterbirds, marine mammals and other features is reflected in the number and variety of designated (and proposed) sites, protected under a variety of national, international and non-statutory provisions including SPAs, SACs and NCMPAs. See Figures 4.10 and 4.11 Work continues on the identification of important areas for birds; the East Caithness Cliffs were designated an NCMPA (2014) for the protection of the black guillemot population and important feeding areas for this species, and the proposed Moray Firth SPA and Pentland Firth marine pSPA were subject to public consultation in 2016 and 2017.												Spill prevention and management and contingency planning.
Other users	Fisheries in the wider area provide valuable landings of shellfish and demersal fish, and are primarily exploited by demersal trawls, dredges and pots. Fishing effort is generally greatest during summer months, and appears to be concentrated both closer to the adjacent coast and east of Jacky. There are a number fishing ports in the area. Fisheries along the Moray Firth coast are of significant local importance. See Table 4.6.												Well plug & abandonment activities will be carried out first, with the rig positioned in/close by to the Jacky 500m safety zone, which remains in

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
	Key: Darker colours reflect periods of increased fishing effort Shipping traffic density low. Overlaps Air Force Area D712D. The closest hydrocarbon energy facilities are the Beatrice Complex. Jacky abuts two renewable energy areas and the Beatrice Offshore Windfarm, which commenced construction in 2017. Several wrecks are known in area. Boat based wildlife watching popular & several beaches have awards.												place while the WHP is *in situ*. Once removed, the 500m zone will no longer apply, providing access for other users.

Potential sources of effect

A number of potential sources of effect from the proposed decommissioning activities were identified, with their impact assessed and where possible, mitigation measures to reduce the impact provided.

Physical presence

As well as the main vessels involved in the well abandonment programme (jack-up rig) and the infrastructure removal (Heavy Lift Vessel, (HLV) and Dive Support Vessel, (DSV)), the decommissioning programme will involve the use of a number of vessels for supply and support, including for the transport of waste and other materials to shore. The physical presence of vessels has the potential to disrupt other users of the sea, including shipping and fishing. However, the main source of effect will relate to vessels in transit, as most vessels undertaking work would be located within close proximity to the Jacky WHP normally within its 500m safety zone.

The physical presence of vessels will be temporary and localised; the HLV can accommodate the entire Jacky WHP during one deployment, and should not need to return to shore between removal of the topsides and the monopile jacket/suction pile sections. There is also the potential to reduce the scale of potential impact through the optimisation of work schedules and vessel synergies.

Seabed disturbance

Sources of physical disturbance to the seabed associated with the Jacky Field decommissioning activities are primarily:

- Jack-up rig's three spud-cans
- Anchors used to aid close positioning of the jack-up rig
- Anchoring of HLV (expected to be four point mooring system, anchors and chains)
- Any jetting required around suction piles/frond mats and MLT to gain access for removal
- Removal of suction piles, MLT tether and clump weight
- Moving/lifting of protective material
- Burial of exposed (cut) ends of pipelines/power cable, removal of spool pieces

Seabed disturbance will result in direct physical effects which may include mortality as a result of physical trauma, smothering by excavated sidecast and re-suspended sediment, and habitat modification due to changed physico-chemical characteristics. In view of the limited volume of water based mud (WBM) drilled cuttings discharged at Jacky, contaminant redistribution is not considered to be a significant issue during decommissioning activities. Anchoring and cable/chain catenary scarring will not result in changes to sediment characteristics, or significant compaction, with recovery of the seabed through natural sediment mobility expected to be rapid (<1 year), with subsequent recovery of faunal communities through a combination of larval settlement and immigration from adjacent seabed. Previous surveys have not indicated the presence of any Annex I habitats in the area.

Energy use and atmospheric emissions

Emissions will be generated from fuel combustion during well plug and abandonment operations, helicopter journeys used for crew changes, heavy lifting and tug use, and ancillary power generation (e.g. should mechanical cutting tools be required). Gas emissions will primarily comprise carbon

dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), methane (CH_4) and volatile organic compounds (VOCs). Although minor, these will contribute to atmospheric greenhouse gas (GHG) concentrations linked to global climate change and related effects including sea-level rise, ocean acidification; and other effects including on regional acid loading, and tropospheric ozone (resulting from reactions of NO_x, CO and VOCs).

Effects of noise

The primary source for underwater noise generation from the Jacky Field decommissioning activities is rig and vessel noise, for which there is a good knowledge base. The schedule of activities is such that each phase of decommissioning will follow, rather than overlap, thereby reducing the likelihood of having multiple vessels on location (other than support vessels) simultaneously.

It is not considered that the removal of the infrastructure will result in significant noise generation. The Jacky topsides will be unbolted from the monopile jacket/suction pile section. The suction cans will be "reverse installed" by pumping seawater in to release the suction piles (with a contingency to use high pressure water jet pile cutting equipment, either ROV or diver operated).

Effects associated with near-shore/onshore dismantling

Although the Jacky WHP is a relatively small installation (compared to platforms in the deeper North Sea), the dismantling of the facilities following their transport to shore has the potential to generate a range of impacts including visual intrusion, noise, dust, fumes and odour. The level of work to be undertaken onshore will in part depend on the chosen decommissioning option, and whether a reuse option has been identified. The dismantling facility is yet to be chosen, but will be an established yard to which the decommissioning programme will generate incremental activity, rather than the creation of a new site.

Fate of materials returned to shore

The eventual fate of materials will in part be controlled by the type of waste and how it is regulated, and also the potential for material reuse and recycling. All waste will be documented in a waste register, which will be used to record the types, quantities and fate of all waste.

Ithaca will ensure appropriate waste segregation and treatment is undertaken, in order to limit the quantity of waste going to eventual landfill disposal, and will consider a waste hierarchy whereby opportunities for the reuse or recycling of equipment and materials will be maximised. An inventory of items and materials on the Jacky WHP and any subsea infrastructure has been made to identify the potential quantities of wastes and the options for reuse and recycling.

Accidental events

Risk assessment of accidental events involves the identification of credible accident scenarios, evaluation of the probability of incidents and assessment of their ecological and socio-economic consequences. Evaluating spill risk requires consideration of the probability of an incident occurring and the consequences of the impact. Given the nature of the activities which could take place as a result of decommissioning, the following potential sources of spill risk have been identified:

- Worst case loss of fuel inventory from a vessel (HLV, support vessel)
- Worst case loss of diesel from the rig
- Loss of chemical containment, including legacy chemicals from the wells

Other users of the Jacky area and transportation routes will be alerted to the decommissioning activities via publication of Notices to Mariners detailing rig and vessel positions, activities and timing and by full navigation lighting on the rig and vessels. Current information indicates that shipping density in

the area is low, but a vessel traffic survey will be undertaken to inform rig siting and decommissioning planning.

All vessels and rigs to be used during well and wider facility decommissioning will have in place the relevant, current Shipboard Oil Pollution Emergency Plan (SOPEP) and/or Non-Production Installation Oil Pollution Emergency Plan (NPI OPEP), with the relevant interfacing Ithaca Plan, which would be implemented in the event of an accidental event. Further spill response resources would be available to Ithaca via contracted spill management contractors. In the unlikely event of a diesel spill, this would initially spread to form a sheen on the sea surface but would rapidly disperse.

Effects on conservation sites

The Moray Firth has many conservation sites, (SACs, SPAs and NCMPAs) designated for habitats and species; the closest of these to the Jacky area is the East Caithness Cliffs SPA and NCMPA boundary, approximately 17km distant. Though all Jacky facilities are outside of Natura 2000 site boundaries, mobile species which are qualifying features of these sites may forage in the Jacky area, the exception being black guillemot (the feature of the East Caithness Cliffs MPA), which are thought to forage only within ~2km of the shore (SNH 2016).

Detailed site information is provided in this EIA to enable the Secretary of State to undertake an Appropriate Assessment under the Habitats Regulations if required.

Cumulative effects

Incremental, cumulative and synergistic effects have been systematically reviewed. Minor incremental or cumulative risks (i.e. effects acting additively or in combination with those of other human activities, including the imminent completion of construction of the Beatrice Offshore Wind Farm) were identified in relation to potential impacts including noise, physical presence, emissions and accidental events; none of these were considered to represent a significant impact in a regional context.

Overall conclusions

Overall conclusions of the Environmental Impact Assessment of the decommissioning of the Jacky Field facilities are:

- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant spillage of reservoir hydrocarbons or chemicals are predicted, due to the low reservoir pressure, current status of the production well and topside production pipework
- Spillage of diesel from vessels (including the jack-up) are possible, but potential for this is small and the risks are mitigated as far as possible through operating procedures and spill response procedures that will be in place
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

1 INTRODUCTION AND BACKGROUND

1.1 Introduction

Ithaca Energy (UK) Limited (Ithaca) is planning for the decommissioning of the Jacky Field which has been producing since April 2009 and has now ceased production. To fulfil Ithaca's Health Safety & Environmental (HS&E) policy and in line with regulator guidance, the Decommissioning Programmes (DPs) for the Jacky Field facilities will be supported by an Environmental Impact Assessment (EIA) of the various activities associated with the decommissioning.

The terms of legislative provisions relating to decommissioning such facilities, and decommissioning guidance from the competent authority (the Department for Business Energy and Industrial Strategy, (BEIS), formerly the Department of Energy and Climate Change DECC) (DECC 2011, BEIS 2017c (Draft)) are such that, the Jacky WHP, MLT[1] and tether and clump weight, must be removed in their entirety.

While not a statutory requirement, a comparative assessment of options required to determine the best decommissioning method for the pipelines and power cable should be carried out – more details are provided in Section 3.

Ithaca has prepared and submitted their DPs for those Jacky facilities for which they have decommissioning liability, including infrastructure which has to be completely removed, namely:

- The normally unattended Jacky Wellhead Platform (WHP) (topsides[2], monopile jacket and suction piles)
- The gravity based midline tee structure, power cable tether and clump weight
- Three Jacky wells (1 x production, 1 x water injection and 1 x suspended, never completed)
- Pipelines and protective material – production and water injection flowlines, power cable, exposed mattresses, grout and gabion bags, frond mats and rock

1.2 Overview of the Jacky Field Facilities

The Jacky Field is located on the Smith Bank in the outer Moray Firth (UKCS Block 12/21c), approximately 19km southeast of the Caithness coast and 10.5km northeast of the Beatrice Complex (Block 11/30) (Figure 1.1). Jacky is tied-back to the Beatrice Alpha Production (AP) platform by flowlines and a power cable via a MLT, which also connects Beatrice AP to Beatrice Bravo (B), via two short spur pipelines (production and water injection) (Figure 1.2).

Crude oil was exported from Beatrice AP through a 67km submarine pipeline which makes landfall at Shandwick, and a buried 9km onshore section of pipeline carries the crude to the Nigg Oil Terminal. Power is supplied to the facilities from the onshore electricity grid by a 25km submarine cable from Dunbeath to Beatrice AP.

The Beatrice Complex platforms, associated subsea infrastructure and Nigg Terminal are not part of the Jacky Decommissioning Programme and not included in this EIA except where descriptions and assessments of tie-ins to Beatrice platforms are relevant – see also Figure 1.2 and Section 3).

[1] Although not separately identified in the OSPAR 98/3 Decision, subsea installations, which includes, production manifolds, wellheads, protective structures, risers and riser bases, fall within the definition of a steel (or concrete) installation, and as such must be completely removed for reuse, recycling or final disposal on land (DECC 2013).

[2] See the Glossary and Abbreviations section for an explanation of technical terms

To the south of the Jacky WHP and some 1.9km southeast of Beatrice AP, are two offshore wind turbines, installed as part of the Beatrice Offshore Windfarm Demonstrator Project. These turbines are not part of the Jacky decommissioning scope.

Figure 1.1 – Location of the Jacky Field facilities

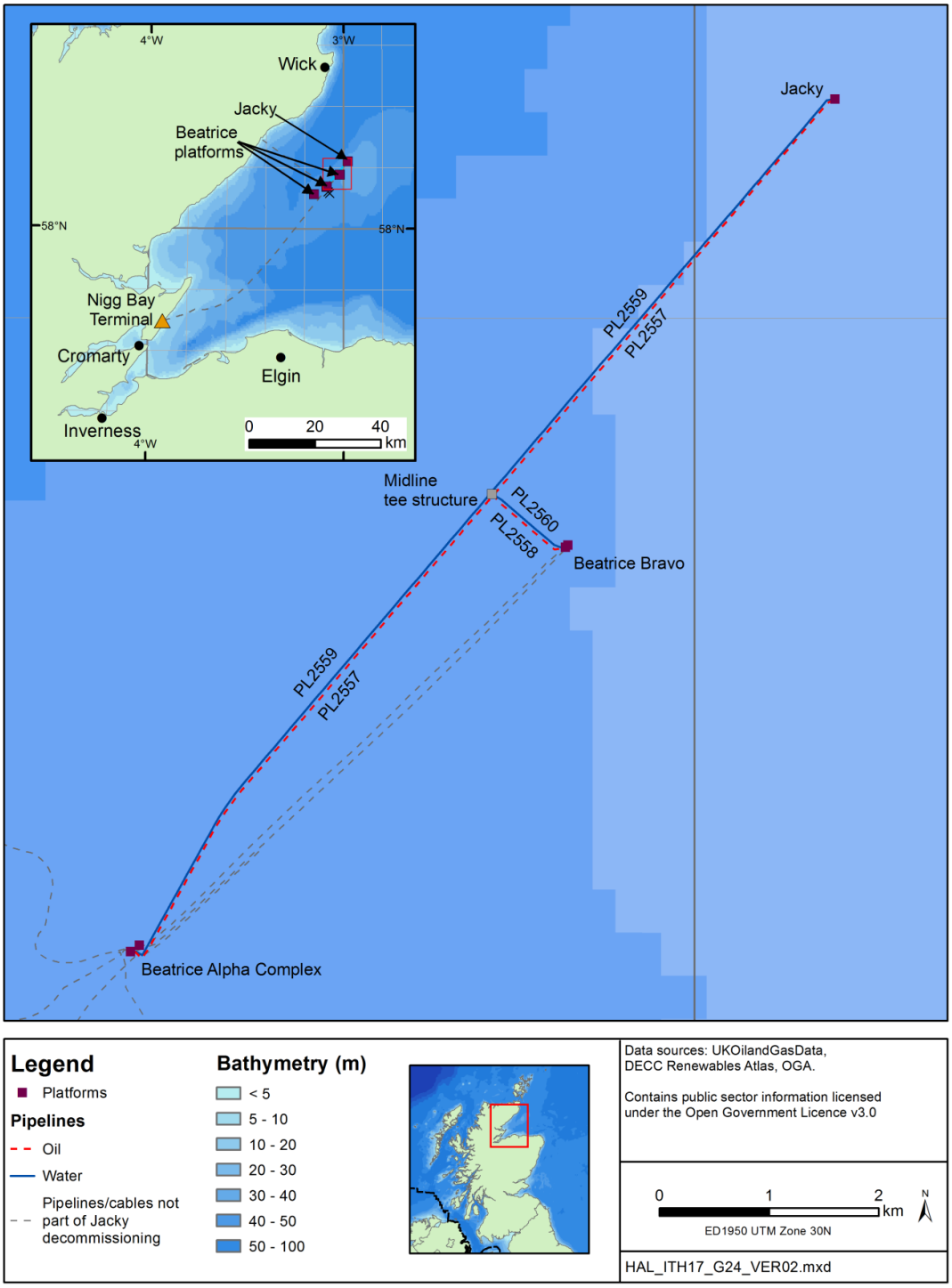
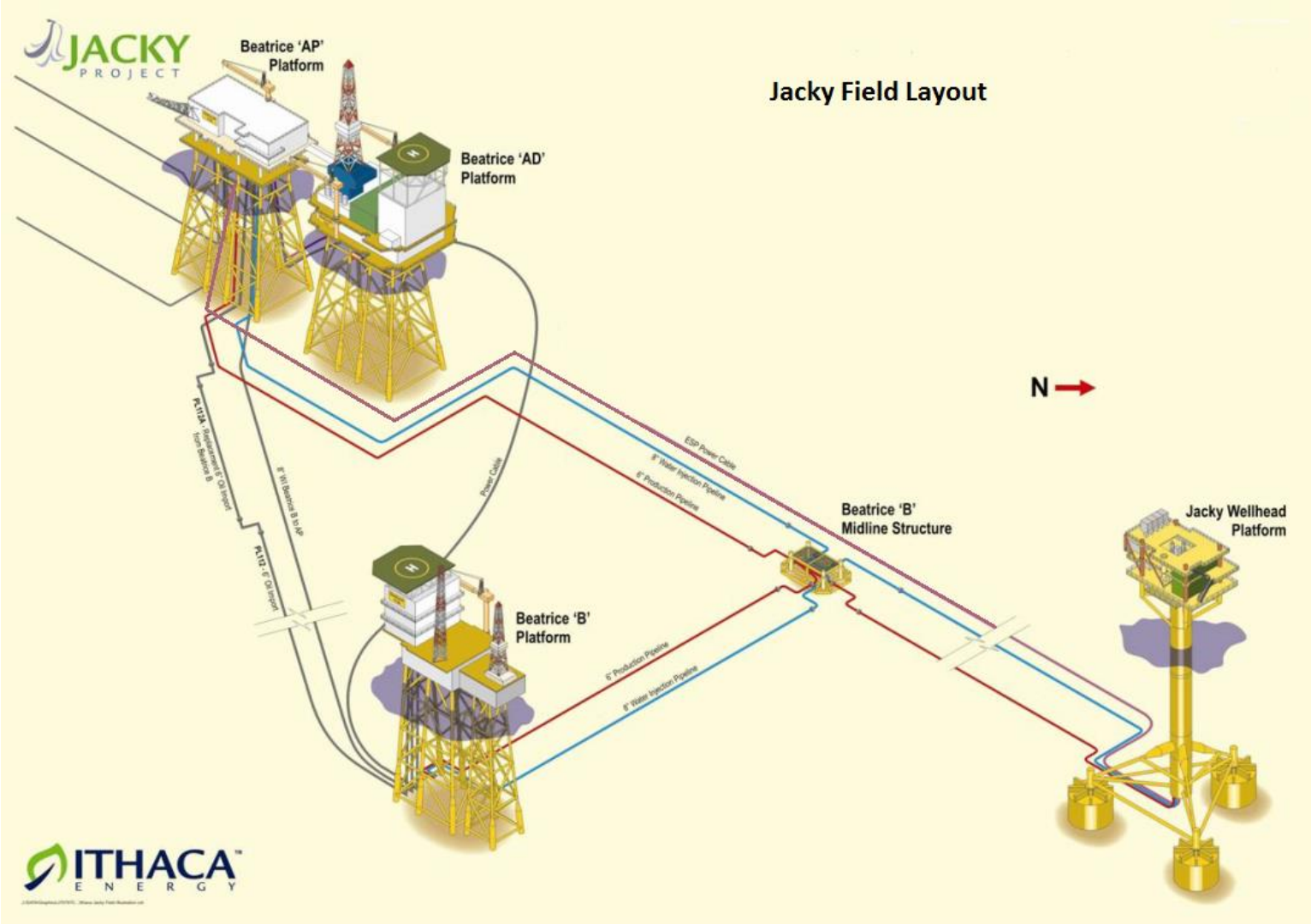


Figure 1.2 – Jacky and associated infrastructure



1.3 Offshore Decommissioning Regulatory Context

Under Part IV of the *Petroleum Act 1998* and amendments to the Act through the *Energy Act 2008* (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit a DP which must be approved by BEIS before activities may commence. Although there is at present no statutory requirement to undertake an EIA at the decommissioning stage, the Guidance Notes: *Decommissioning of Offshore Oil and Gas Installations and Pipelines* under *the Petroleum Act 1998* (2011)[3] require that a decommissioning programme must be supported by an EIA considering the effects on the environment and climate change, and which should include:

- All potential impacts on the marine environment, including exposure of biota to contaminants associated with the activities, other biological impacts arising from physical effects, conflicts with the conservation of species, with the protection of their habitats, or with mariculture, and interference with other legitimate uses of the sea.
- All potential impacts on other environmental compartments, including emissions to the atmosphere, leaching to groundwater, discharges to surface fresh water and effects on the soil.
- Consumption of natural resources and energy associated with re-use and recycling.
- Other consequential effects on the physical environment which maybe expected to result from the option.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

The EIA should identify any habitats or species listed in Annex I of the Habitats and Birds Directives and covered by the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), determine the likely impacts on them of the decommissioning activities propose any suitable mitigation and appropriate management system. For proposed activities within 40 km of the coast the possibility of the operations, or an accident or incident during the operations, impacting protected coastal habitats and species must also be considered.

An EIA would also be required to support applications for such decommissioning operations which may require a Licence under the *Marine and Coastal Access Act 2009* (MCAA) and *the Marine (Scotland) Act 2010*.

OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations sets out OSPAR Contracting Parties obligations on the decommissioning of offshore installations. The Decision prohibits the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore for reuse, recycling or final disposal on land, as must all jackets weighing less than 10,000 tonnes. Recognising that there may be difficulty in removing the footings of large steel jackets weighing more than 10,000 tonnes and concrete installations that were installed prior to 1999, there is a facility for derogation and the option of leaving the jacket footings or concrete structure in place may be considered. Such exceptions may only be granted if a comparative assessment and consultation shows that there are significant reasons why an alternative decommissioning option is preferable to complete removal. The Jacky WHP does not fall within categories under Annex I of the OSPAR Decision 98/3 for which derogations may be considered, and so all platform facilities must be removed on decommissioning.

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), among others, implement European Directives for the protection of habitats and species namely, Council

[3] Draft Decommissioning guidance has been issued by BEIS, in December 2017 (BEIS 2017c) and is currently out for consultation; the Environmental Consideration section of this guidance is to follow.

Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora and Council Directive 2009/47/EC (the codified version of 79/409/EEC) on the conservation of wild birds in relation to oil and gas activities carried out in whole or in part on the UKCS. The Competent Authority will, if considered that an activity completed under a project consent may have a significant effect on a Special Area of Conservation (SAC) or Special Protection Area (SPA), conduct a Habitat Regulations Assessment prior to granting the consent.

A range of permits, consents and licences are required in order to undertake any of the activities which would be required to decommission the Jacky field facilities. Approvals for these are contingent on complying with the requirements of applicable legislation. At present, applicable legislation includes (but not limited to):

- *The Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) Regulations 1998*
- *The Offshore Petroleum Production and Pipeline (Assessment of Environmental Effects) Regulations 1999 (as amended)*
- *The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017*
- *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended)*
- *The Offshore Chemical Regulations 2002 (as amended)*
- *The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)*
- *The Energy Act 2008, Part 4 Consent to Locate*
- *Marine and Coastal Access Act 2009*
- *The Conservation of Offshore Marine Habitats and Species Regulations 2017*
- *The Conservation (Natural Habitats &c.) Regulations 1994*
- *Marine (Scotland) Act 2010*
- *The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013*
- *The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015*

While the receiving port for the facilities is still to be determined, this is expected to be in the UK, therefore the *Transfrontier Shipment of Waste Regulations 2007* (as amended), should not be applicable. In the unlikely event that material is taken to a non-UK port, Ithaca will comply with the Regulations applicable for the transport of this waste.

The EIA will support these applications in due course.

Legislation and compliance requirements may change and as part of their management system, Ithaca has processes in place to monitor for new legislation relevant to their activities; Ithaca will ensure that all relevant regulations are complied with for the decommissioning of the Jacky Field facilities.

1.4 The EIA Process

1.4.1 The process

The EIA process considers the range of issues relevant to the decommissioning of the Jacky Field facilities. EIA is an integral part of Ithaca's management processes, which satisfies the company's environmental policy objectives with regards to the assessment of potential risks to the environment from its activities. The process considers the range of issues relevant to the decommissioning of the Jacky Field facilities, including those from post-decommissioning monitoring and assesses the potential effects of these on the environment and climate change, including cumulative effects. The assessment considers issues and potential effects from both offshore activities and the onshore processing of the

facilities and describes the proposed measures to avoid, reduce and if possible, remedy significant adverse effects.

The EIA also identifies any likely impacts on sites and species of designated conservation importance (including Natura 2000 sites), proposes any suitable mitigation and provides sufficient information to allow the competent authority (BEIS) to conduct further appropriate assessment[4] if necessary.

This document details the results of the EIA, highlighting environmental sensitivities, identifying potential hazards, assessing/predicting risks to the environment and identifying practical mitigation and monitoring measures to be carried forward into the engineering, execution and legacy of the decommissioning activities. It also forms part of the information base submitted to BEIS in support of the Jacky Field Decommissioning Programme.

1.5 Areas of Uncertainty

A number of assumptions have been made to inform the assessment process since the EIA covers future activities for which final definition is not yet available. Contracting has not commenced for the jack-up rig, the HLV and other vessels involved with the offshore decommissioning activities, nor has final selection been made of the receiving and handling onshore facilities, although the expectation is that it will be a UK port. Where definition is lacking, worst case estimates of emissions, seabed disturbance and other sources of interaction are used in the consideration of possible effects.

1.6 Consultation

To identify potential environmental issues associated with the Jacky Field decommissioning, Ithaca engaged with a number of stakeholders during the planning stage, to ensure the identification of questions, concerns and potentially useful information sources, so they can be appropriately considered in the EIA and other assessments. In particular Ithaca wanted to ensure:

- awareness of all relevant environmental information for the area
- identification of stakeholder issues and concerns to be considered in the EIA process

An EIA scoping document including a summary of the proposed decommissioning activities, a description of the environment of the area, and a summary of the key issues, was circulated to a range of consultees, who were invited to respond with issues and concerns and new information. The consultees and responses are summarised below.

[4] Appropriate Assessment (AA) is undertaken by the competent authority where a likely significant effect on European Sites (e.g. Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) has been identified for certain activities as part of the plan or project.

- Aberdeenshire Council
- Aberdeen University
- Association of Salmon Fishery Boards (ASFB)
- Beatrice Offshore Wind Farm (BOWL) - SSE
- Cetacean Rescue and Retrieval Unit (CRRU)
- Cromarty Firth Port Authority (CFPA)
- Defence Estates
- Department for Business, Energy and Industrial Strategy
- Global Marine Systems Ltd (GMS)
- Highland Council
- Historic Environment Scotland
- Joint Nature Conservation Committee (JNCC)
- Marine Conservation Society
- Marine Scotland (MS-LOT)
- Moray Council
- Moray Firth Partnership
- Moray Firth Trout Initiative
- Royal Society for the Protection of Birds (RSPB)
- Scottish Environment Protection Agency
- Scottish Fishermen's Federation
- Scottish Natural Heritage (SNH)
- Scottish Wildlife Trust (SWT)
- Crown Estate Scotland
- Whale and Dolphin Conservation (WDC)
- Wick Harbour
- WWF Scotland

Consultee	Summary of comments	Section
Aberdeenshire Council	The decommissioning works proposed under this stage of the operation largely consists of works beyond the supervision of the Planning Service in Aberdeenshire. As such, they confirm that subject to all works and decommissioning operations being carried out in line with relevant environmental and associated legislation, the Planning Service would have no adverse comments to make on the EIA Scoping Report.	N/A
Beatrice Offshore Windfarm Ltd	Jacky is close to the south west of the Beatrice Offshore Windfarm (OWF) site and construction activities for the OWF are due to commence imminently and continue for ~2 years. It is important that any potential impacts of the proposed decommissioning activities on the construction and operation of the OWF should be considered as part of the EIA. The potential for environmental impacts of decommissioning to occur in combination with potential impacts associated with the construction of the OWF should be considered in relation to timing, and potential additional impacts such as noise and vessel traffic considered. BOWL note the timing of decommissioning applications with a view to commence offshore activities in ca. 2022 and confirm this proposed timescale should ensure decommissioning activities will not overlap with the OWF construction activities. BOWL request that they be kept informed of progression of proposed decommissioning activities and are included in any further consultation.	6.2 and 6.10

Consultee	Summary of comments	Section
Marine Scotland (MS-LOT)	MS noted the document was well structured, providing a useful overview of the facilities and made good use of figures and tables to summarise the pertinent information. MS raised two issues to be addressed in the EIA: • The location of where and how the infrastructure is brought ashore and the marine environmental consequences that could arise from this if conducted within UK waters and • Contact with MS-LOT to be made closer to the time of offshore activities to determine the timing and nature of regulated offshore activities associated with the Moray Firth, in particular renewable developments and cable installations And provided additional data sources that should be considered: • National Marine Planning interactive tool (contains other data related to commercial fisheries, physical characteristics of the NS and conservation areas • Aires *et al*. (2014); contains high resolution spatial data regarding the distribution of 0 age group fish. • Kafas *et al*. (2012); report assesses Vessel Monitoring Systems (VMS) data for all UK-registered commercial fishing vessels (≥15m length)	1.7, 4.9, 4.16 and 6.6
RSPB	The RSPB acknowledged the scoping report referenced Natura 2000 sites and Habitats Regulations Appraisal; the scoping report described how sufficient information would be presented in the EIA to enable the Secretary of State to undertake an Appropriate Assessment under the Habitats Regulations, if likely significant effects are predicted. The RSPB felt the scoping summary omitted some potential impacts, particularly in relation to size and compositions of spills/chemical spills. They highlight the importance of the Moray Firth for species and the high levels of human activity in the region and support the intention to assess cumulative impacts, but felt further information on the scope of this cumulative assessment should have been provided in the scoping summary to provide clarity on the approach. The imminent construction of the Beatrice OWF should be included as well as any other development proposals associated with wind energy in the Firth and further afield. The scoping summary makes limited reference to mitigation for some sources of impact; the EIA should discuss these in relation to all sources of impact for decommissioning and accidental activities and the description of mitigation measures should include an assessment of their effectiveness.	3.5, 5, 6.2, 6.8, 6.9, 6.10 and Appendix 2
Crown Estate Scotland	There is a licence agreement with Ithaca for the Jacky WHP and intrafield pipeline and information submitted in support of this (2008) included a Decommissioning Summary for the Jacky infrastructure. If the decommissioning summary is not being followed, then a new consent will be required for a new decommissioning plan.	3.4.4
WDC	Unable to offer comments at this time.	N/A

1.7 Marine Planning

The Jacky facilities are within an area covered by Scotland's National Marine Plan (The Scottish Government 2015). Ithaca is aware of Scotland's National Marine Plan and polices which are relevant to their operations in Scottish waters, including those which are consistent with decommissioning taking place *in line with standard practice and as allowed by international obligations* (e.g. policy Oil&Gas2).

All works to be carried out (well plug and abandonment, subsea works and WHP removal) will involve the use of a rig and vessels; these will be undertaken with consideration to other existing users (e.g. consistent with policy GEN 4 Co-existence and also those interactions with other users noted in policy Oil&Gas1) and the environmental sensitivities of the area (policy GEN 9 Natural Heritage).

Other policies relevant to the proposed decommissioning activities design and execution include: Noise (GEN 13), no explosives are to be used and all cutting equipment will be either high water pressure cutting, diamond wire or hydraulic cutting tools; Air Quality (GEN 14), activities will be coordinated to ensure efficient use of vessels and Engagement (GEN 18); Ithaca have engaged in dialogue with the Scottish Fishermen's Federation (SFF), Repsol Sinopec Resources UK (Beatrice Facilities), and carried out a scoping exercise, the outcome of which has been incorporated into decommissioning project planning. Ithaca will continue to liaise with the SFF and others throughout the decommissioning process.

2 ENVIRONMENTAL MANAGEMENT IN ITHACA ENERGY (UK) LIMITED

Ithaca has an integrated Health, Safety and Environmental Management System and the environmental elements of the system have been independently verified as meeting the requirements of the OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry; the last verification was in May 2016. The company's environmental commitment is outlined in its Health, Safety and Environmental (HS&E) policy, which is endorsed by the Chief Executive Officer on behalf of the Board of Directors (see Figure 2.1). The policy acknowledges Ithaca's HS&E responsibilities in relation to its business activities and includes commitments to continual improvement, assessment and management of the risks and impacts associated with operations, including decommissioning activities, to meet legislative requirements and accepted best practice and a willingness to openly communicate these principles to company personnel and the general public.

Figure 2.1 – Ithaca Energy (UK) Ltd H S & E policy

ITHACA ENERGY (UK) LTD.

HEALTH, SAFETYAND ENVIRONMENTAL POLICY

ITHACA ENERGY (UK) LTD. is committed to proactively achieving excellence in Health, Safety and Environmental (HS&E) performance across all of our operations. We consider our HS&E performance and the health, safety and security of those who work for, with and alongside us as central to our business success.

ITHACA will comply with applicable legislation and guidance.

In order to meet our commitment ITHACA will:

- Provide competent resource to implement this policy and to develop and maintain our HS&E systems.
- Provide effective leadership, training and mentoring to sustain and develop workforce HS&E competency and skills and maintain a positive HS&E culture.
- Define clear responsibilities and accountabilities for HS&E issues within the company.
- Set realistic HS&E objectives and tagets and develop action plans to measure these as a contribution towards continual improvement of our HS&E performance.
- Ensure HS&E performance is prominent in the selection of our contractors
- Assess and manage operations through all stages to minimise risk of harm to people, the environment and facilities
- Communicate and consult with stakeholders and the public and have regard for their interests when planning activities.
- Ensure that appropriate plans and resources are in place to respond to incidents and emergencies.
- Investigate incidents, implement recommendations to prevent re-occurrence and share lessons learned.

To support our commitment to HS&E performance ITHACA will develop and maintain effective HS&E systems which will be independently verified against relevant ISO and other recognised standards. HS&E systems will be subject to periodic and management review to ensure ongoing compliance and improvement.

This policy applies to all company activities and ITHACA employees, and contractors and other associates engaged in work on our behalf, have a responsibility to comply with it and prevent harm to themselves and others and damage to the environment.

Les Thomas, CEO ITHACA ENERGY (UK) LTD
On behalf of the Board of Directors

12th March 2016

3 DESCRIPTION OF THE DECOMMISSIONING PROJECT

3.1 History and background of the Jacky Field

In 2005, Ithaca was awarded a production licence for the part Block 12/21c (Licence number: P1392) during the 23rd UK Seaward Licensing Round and became Block Operator (90%), with their then co-venturer North Sea Energy (10%). The Block had been previously licensed to other Operators and subsequently relinquished; during this period five exploration wells had been drilled in the Block, the first of these in 1969, with the Jacky reservoir discovered in 1982 by well 12/21-2.

In 2008, Ithaca leased the Beatrice offshore facilities (Beatrice Complex) from Talisman Energy UK Limited (now Repsol Sinopec Resources UK Limited), including the Nigg onshore terminal and 16" export line from Beatrice to Nigg, for a minimum of three years. In the latter quarter of 2008, Ithaca, in partnership with North Sea Energy (UK), began development of the Jacky Field, re-entering a previously suspended appraisal well and completing this as a production well, installing the Jacky WHP and the associated subsea infrastructure including the MLT to Beatrice B. A second phase of the development was the drilling and completion of a water injection well.

The development of Jacky assisted in maintaining the economic viability of the Beatrice Field over recent years, but due to declining rates and electrical submersible pump failures, Jacky ceased production in 2014, with a Cessation of Production (CoP) approved in August 2014. Ithaca's lease of the Beatrice Complex ended on 16th March 2015, with these facilities returned to the then Talisman Sinopec Energy UK Limited. Repsol Sinopec Resources UK Limited retains decommissioning liability for the Beatrice Complex, including the export pipeline and power cable from Dunbeath and the Nigg facilities.

3.2 Decommissioning Indicative Timetable

It is anticipated that the draft Decommissioning Programmes will be submitted to the Regulator and be available for public consultation Q1 2018, with approval (subject to any revision) expected Q2/Q3 2018. The schedule for decommissioning activities is still subject to change, but current estimates are shown in Table 3.1, with offshore activities expected to commence in 2022.

Table 3.1 – Indicative schedule for Jacky Field Decommissioning Activities

Activity	Timetable
Well Plug and Abandon	Q1-Q2 2022
Topside, monopile jacket and suction pile removal[1]	Q3 2022–Q1 2023
Subsea pipeline spool and equipment removal[1]	Q1–Q2 2023
Debris clearance and overtrawl	Q3 2023

Note: [1]There will be an initial programme of subsea work prior to the Jacky WHP removal to disconnect pipeline spool pieces and power cable connections attached to the WHP – see Section 3.4

The relevant permits and consents for decommissioning activities can only be sought following the approval of both the DP and EIA; these will therefore be applied for at a future date and prior to the commencement of any offshore activities.

3.3 Consideration of Potential for Alternative Use

Ithaca has considered the possibility of other *in situ* reuse or redevelopment of the field and facilities. However, given that no further exploitation of the field is considered viable, decommissioning will focus on complete removal of the Jacky WHP and MLT and the option derived from a comparative assessment for the pipelines and power cable.

3.4 Facilities to be Decommissioned

3.4.1 Scope

This EIA report considers the decommissioning of the Jacky Field facilities which Ithaca has responsibility for (see Table 3.2 below).

Table 3.2 – Jacky Field facilities and protective material

Wells	**Designation**		**Status**
12/21c-J01	Oil/gas production		shut in
12/21c-J02	Water injection		shut in
12/21c-J03	Never completed		shut in
Platform (and material)	**Topsides/ facilities weight (tonnes)**	**Jacket**	**Suction piles**
Jacky WHP (predominately steel with mixture of aluminium, copper, lead, zinc, plastics and other material)	663	596	354
Pipeline No. (and material)	**Length (km)**	**Installation method**	**Depth trenched (m)**
PL2557 Production Pipeline (Beatrice AP)[1] (Carbon steel, polyurethane coating)	10.5	Trenched and natural backfill	1
PL2558 Production Pipeline (Beatrice B)[1] (Carbon steel, polyurethane coating)	0.8	Trenched and natural backfill	1
PL2559 WI Pipeline (Beatrice AP) (Carbon steel, polypropylene coating)	10.5	Trenched and natural backfill	0.6
PL2560 WI Pipeline (Beatrice B) (Carbon steel, polypropylene coating)	0.8	Trenched and natural backfill	0.6
PLU2561 Power Cable (Polypropylene, bitumen, steel, armour wire, copper wire, fibre optic cable, hard polyvinyl chloride filler)	10.5	Trenched and natural backfill	0.6
Midline Tee Structure (MLT) (includes protective structure) (Carbon steel) 4 x Ballast weights (4 x 3.14 tonnes)	Size: 11.5m x 8m x 2.6m Wt:75 Wt: ~13	Gravity based with protective frame and four steel ballast weights	-
Protective material	**Total number/ (weight tonnes)**	**Location**	
Concrete mattresses	145[2,3] (725)	Jacky wellhead platform, MLT, Beatrice B and AP approaches	
Grout bags	113 (2)	Jacky wellhead platform, MLT, Beatrice B and AP approaches	
Gabion bags	2 (2)	MLT	

Frond mats	28 (4)	Jacky wellhead platform suction piles
Rock placement	(11,882)[2]	Jacky wellhead platform, MLT, Beatrice B and AP approaches
Other - power cable tether and clump weight	1 (75)	Beatrice AP approaches

Note: [1.]Lines marked Beatrice AP and Beatrice B denote lines going from either the Jacky WHP to Beatrice AP or the MLT to Beatrice B (the spur lines). [2]. There are 8 mattresses at the Jacky WHP location, 4 at the midline tee structure location and 35 mattresses at the Beatrice AP approaches that were covered with rock at installation. These 47 mattresses will not be recovered as part of the decommissioning work scope and will instead be decommissioned *in situ*. The potential impact of this has been assessed in Section 6.2. [3.]For context, the EIA for the development of the Jacky Field estimated and assessed the environmental impacts of 488 mattresses and 15,000 tonnes of rock.

A high level inventory of Jacky Field materials is shown in Table 3.3; the current intention being to reuse where possible, recycle where reuse is not an option and minimise, as far as practicable, the waste to landfill.

Wastes generated during the decommissioning of the Jacky WHP will be segregated and transported to shore by and to a licensed waste contractor; steel and other recyclable metals are estimated to account for the greatest proportion of the waste materials inventory.

At present, the Jacky WHP remains tied back to both the (Repsol Sinopec Resources UK Limited operated) Beatrice AP and Beatrice B installations via the MLT structure and power cable (Beatrice AP). None of the Beatrice facilities are included within the scope of this EIA.

Table 3.3 – High level inventory of Jacky Field Materials (tonnes)

Component	Concrete			Ferrous metal[1]			Non ferrous metal[2]			Plastic[3]		
Decommissioning route	Recycle	Leave *in situ*	Disposal	Recycle	Reuse	Leave *in situ*	Recycle	Reuse	Leave *in situ*	Recycle	Reuse	Leave *in situ*
Protection materials[4]	565	235	-	1.68	-	-	-	-	-	2.24	-	-
Topsides	-	-	-	593	11.39	-	42.75	-	-	11.39	-	-
Monopile jacket (including suction piles and well inventory)	-	-	-	950	-	-	-	-	-	-	-	-
Mid Line Tee	-	-	-	87.56	-	-	1.17	-	-	-	-	-
Pipelines (including spools)	-	-	-	50.04	-	1,380	1.33	-	-	2.47	-	65.51
Power cable	-	-	-	8.46	-	95.63	1.03	-	53.23	0.86	-	53.32

Notes: [1]steel, [2]includes aluminium, copper, stainless steel, lead, zinc and other metals including alloys [3]includes plastics used in pipeline coatings, electrical insulation and flooring (Polypropylene, Polyurethane, Polyethylene, polyvinylchloride (PVC)). [4]. The protection material includes the frond mats associated with the suction piles. In addition to the above materials, 2.26 tonnes of cement from grout bags will be sent to landfill, and 11,884 tonnes of rock cover will remain *in situ*.

3.4.2 Wells

Three wells are to decommissioned, one production, one water injection, (each with a Xmas tree wellhead structure) and one well that was never completed and has no wellhead or Xmas tree. The final well decommissioning strategy is in development and will be in accordance with the Oil and Gas UK guidance on well abandonment and Ithaca's HS&E policy. A jack-up rig will be used for the well decommissioning programme; the final rig selection is still to be made, but a typical jack-up is shown in Figure 3.1 and a generic overview of a typical system is provided here.

Figure 3.1 – Typical jack-up rig (e.g. shown is the Ensco 104) over a small platform

Source: Ensco website

A jack-up has three triangular truss legs, each of which terminates in a spud can (base plate). Initially the rig will be towed (floating mode) close to the Jacky WHP and will then use anchors to control its final position over the Jacky WHP within the statutory 500m safety zone. Once in position and jacked-down, the derrick will be skidded over to access the wells, ensuring all wells can be worked on without the need to move the rig. A seabed survey to determine the final rig position will be carried out prior to the rig arriving on location.

It is estimated the rig will be on location for ~33 days, including weather contingency and may require refuelling (bunkering) during the plug and abandonment programme. If required, bunkering will be conducted in favourable sea states and during daylight hours when practicable to do so and according to the rig operator's procedures. Bunkering procedures will be audited by Ithaca as part of the rig selection and contracting process. Hoses will be subject to formal inspection and have colour coded markings according to service and fitted with dry breakaway fittings. All bunkering valves will be locked in the closed position when not in use.

The rig will be supported by statutory standby and supply vessels, the latter of these transporting equipment, supplies, water, fuel and food to the field, and returning waste and surplus equipment to shore; the supply port is expected to be Peterhead, with estimated 8 supply trips throughout the well plug and abandonment programme. Helicopters, from their base in Aberdeen, will be used to transfer

personnel to and from the rig, with an estimated 8 helicopter rotations over the programme (see Section 3.5, Table 3.3 for a summary of vessels).

3.4.3 Topsides, Monopile Jacket and Suction Piles

The Jacky WHP consists of three elements: topsides, monopile jacket and suction piles (Figure 3.2), which have to be removed in their entirety (the derogation option under OSPAR 98/3 is not available for the Jacky Field infrastructure).

The topsides consist of four decks, with only an emergency helideck; access was normally by boat from Buckie and Beatrice AP. There are no processing facilities on the Jacky WHP and hydrocarbons were exported to Beatrice AP via the infield pipeline. The topsides are supported on a mono-tripod structure fixed to the seabed by three suction piles. The central column is approximately 4.5m in diameter, contains all risers and conductors, and is open to the sea. The suction piles are ~ 8m high (with a seabed penetration depth of approximately 7m) and ~10m wide and in a triangular arrangement, (Figure 3.3).

The total approximate weight of the Jacky WHP is 1,613 tonnes (topsides ~ 663 tonnes, monopile jacket ~ 596 and suction piles (total for three) ~354).

Marine growth will have added some weight (estimated at ~205 tonnes) to the monopile jacket; a visual inspection was made of the structure in 2013(Harkand 2013) and found that the marine growth present was not extensive nor were unusual species or species of conservation interest apparent, with growth typically consisting of anemones, barnacles, tubeworms and hydroids. The estimated weight of marine growth has been based on the calculated surface area covered, (e.g. truss supports surface area) and the thickness of material has been taken from the last inspection report, with an allowance for reduced growth at lower depths. It is anticipated the majority of this growth (*ca*. 75%) will be removed offshore, while the infrastructure is still *in situ* using a high powered water jet.

The topside section of the Jacky WHP will be disconnected and unbolted from the monopile jacket. In the event that the preferred option of unbolting cannot be achieved, gas cutting equipment will be available as a contingency.

The suction piles (essentially hollow tubes (caissons)) and monopile jacket will be removed in a single lift in a reverse of the installation process. Installation was achieved by lowering the caisson to the seabed with the self-weight penetration providing the required seal for pumping. Water was pumped out from within the caisson and the resulting pressure difference in- and outside of the caisson providing the force on the top plate to suck the caisson into the seabed. Recovery is a reverse of the installation process, water pumped into the caisson pushes it out of the sediment. Suction piles are used widely around the North Sea for a variety of applications including platform foundations, subsea manifold foundations and FPSO mooring piles and their recovery is well documented and is standard procedure.

The removal of the suction piles is not expected to result in either large depressions in, or mounds on, the seabed, with only limited seabed disturbance expected (a volume of seabed disturbance for each suction pile, has been calculated based on a worst case penetration depth of 7m, an outer diameter of 10m and internal diameter of 9.9m). The nature and scale of seabed disturbance around each removed suction pile will be inspected by ROV and/or debris clearance survey. In the unlikely event that reverse installation proves difficult, then the seabed round the pile(s) will be excavated, down to a depth of 3m (as recommended by BEIS) and the pile(s) then cut using an ultra high pressure (UHP) water jet. The upper section will remain attached to the monopile jacket and be recovered, with the remaining section left buried. It is anticipated that the sand/gravel from the now removed section of the suction pile will be sufficient to backfill any depression left and cover the remaining section of the pile without further remediation e.g. rock placement being required.

The dismantling and removal of the Jacky WHP is expected to be achieved in two lifts by a heavy lift vessel (HLV), (one for the topside section and one for the combined monopile jacket and suction pile section), in a reverse of the installation procedure. Once the topsides have been disconnected from the monopile jacket, it will be loaded onto the barge, and once released from the seabed, the suction piles, along with the monopile jacket attached, will also be lifted onto the barge. Final HLV selection is still to be made, but a suitable vessel to accommodate the WHP in its entirety will be selected, thus requiring only one deployment of the HLV at the Jacky location.

The HLV will be towed to site using tugs, and maintained on site by anchors; it is anticipated the HLV will have a four point mooring system, with a full mooring analysis to be completed during detailed planning. With regards to drainage, waste and sewage, the HLV and assorted tow vessels will operate to MARPOL requirements for Special Areas whilst on hire to Ithaca

Figure 3.2 – Jacky WHP topsides (left) and monopile and three suction piles (right)

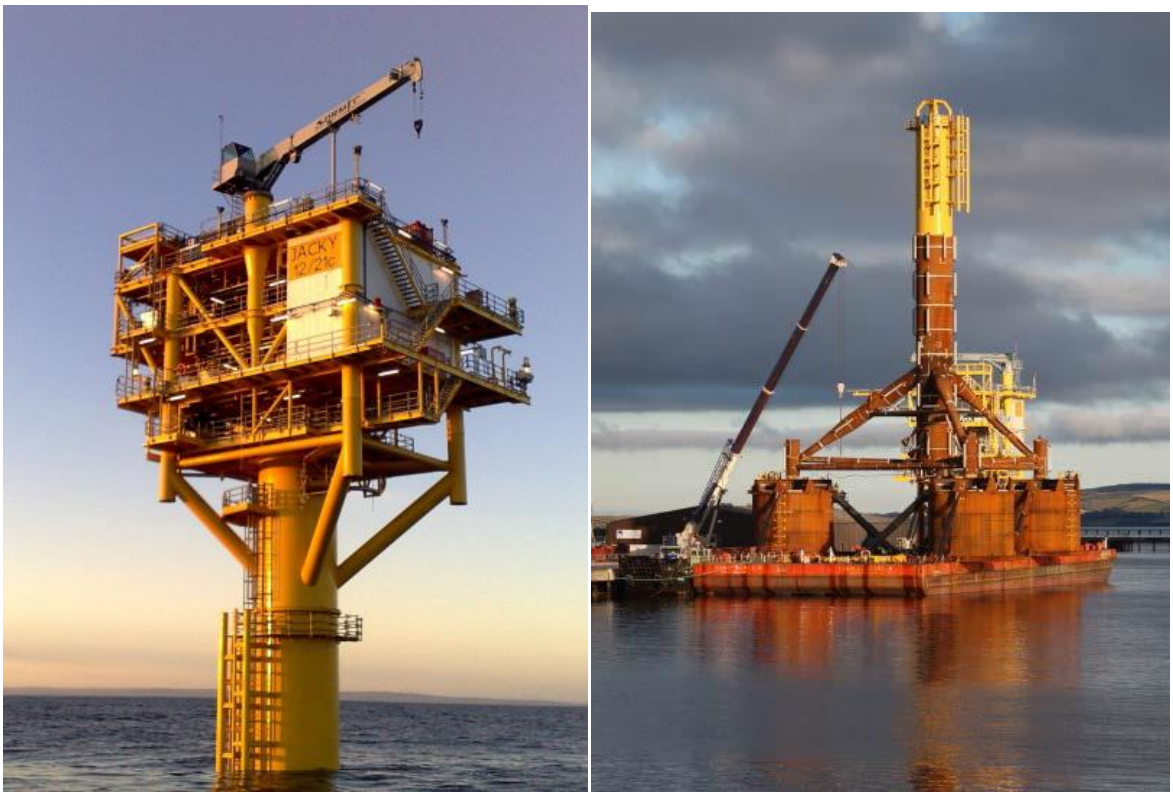
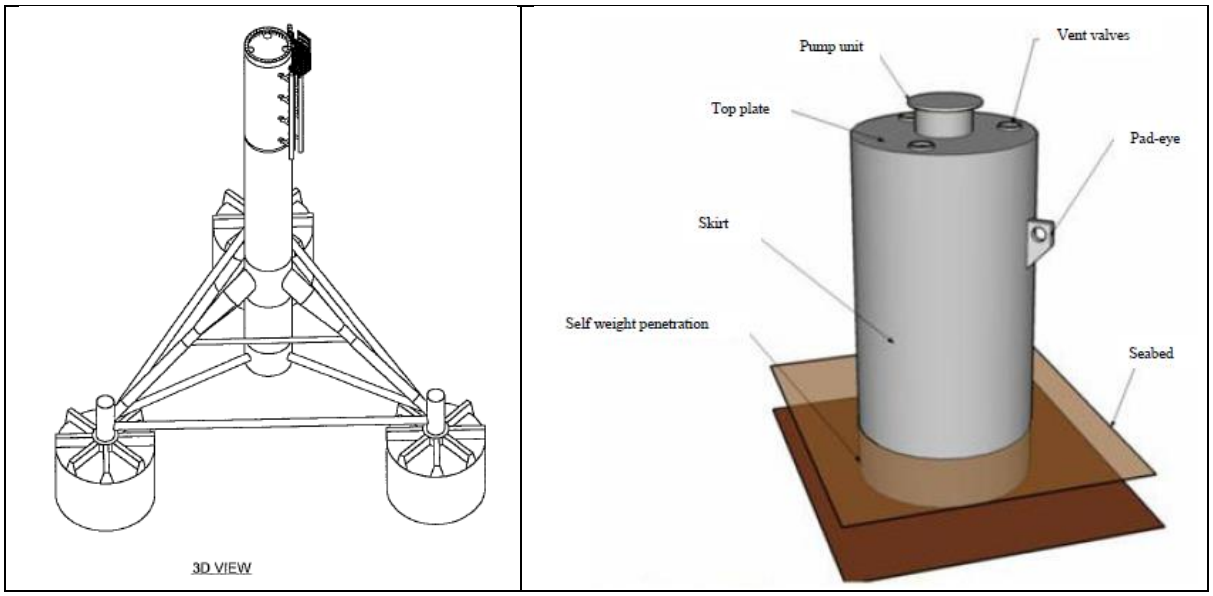


Figure 3.3 – Triangular arrangement of Jacky WHP suction piles and after seabed touchdown



Source – suction pile seabed touchdown: Offshore Engineering Website

The Jacky WHP was designed in such a way as to be removed by reverse installation using a HLV or jack-up vessel. As such, alternative removal options (e.g. using a floating vessel and removing in multiple sections) were discounted at an early stage and not considered further.

Prior to work commencing on the Jacky WHP, the production and water injection pipeline and power cable will be disconnected and where required, protective material will be displaced to expose the relevant sections. If the protective material is mattresses/grout bags, these will be removed and recovered to the Construction Support Vessel (CSV), where the protective material is rock, this will be displaced using a grab, the work carried out to recover the infrastructure and bury the now disconnected ends, with the rock then replaced to provided added protection. The flange bolts on the production and water injection lines will be removed or cut using a diamond or hydraulic cutting system (to be determined during detailed planning). The spools will be recovered to the vessel and the ends of the lines lowered into the seabed and re-covered with the existing rock. The power cable connections will be cut using a hydraulic cutting tool, with the ends lowered into the seabed and re-covered with existing rock.

3.4.4 Subsea infrastructure and protective material

All Jacky subsea infrastructure and protective materials were installed in 2008 and 2009 (Table 3.1 above). All lines are now disused (and notified to BEIS), the production lines have been cleaned and flushed of hydrocarbons (down to <10mg/ml Oil In Water (OIW)), and both the production and water injection lines currently contain inhibited seawater.

As the Jacky Field infrastructure lies on the 12 nautical mile (nm) boundary, Ithaca entered into a lease agreement with The Crown Estate (TCE) (now Crown Estate Scotland[5]) in 2008 for the Jacky WHP and the connecting pipelines. At the time of the lease agreement, a decommissioning summary (the

[5] The Crown Estate Scotland was established following the Scotland Act 2016 and now manages land and property owned by the Monarch in right of the Crown in Scotland; its predecessor organisation was The Crown Estate and in relation to the rest of the UK, the remit of The Crown Estate remains unchanged.

Summary) was also supplied to TCE. In this, the pipelines were described as trenched and buried (as is the case) and that decisions on the abandonment plans for these will be based on relevant legislation at that time and that a CA would be carried out. In order to estimate project decommissioning costs for the Summary, assumptions were made, including for the decommissioning of the pipelines. These were that no allowance was made for removal of rock placement, and all pipelines are assumed to be left *in situ*.

In line with regulator guidance[6], and the commitment made in the 2008 decommissioning summary provided to TCE, a comparative assessment (CA) was undertaken to inform decisions relating to the decommissioning of those pipelines and protective material described in Table 3.1. The pipeline decommissioning options considered for the Jacky pipelines, power cable and protective material, primarily related to whether these were to be left partially *in situ*, or fully retrieved, the methods used and their potential effects, and any proposed remediation.

The option to just "Leave *in situ*" with no additional work was not considered a feasible option as isolation of the Jacky pipelines and power cable from the Beatrice Complex is required (through removal of tie-in spool pieces) and was not included in the CA.

Drawing from OSPAR 98/3, BEIS Decommissioning Guidance (DECC 2011, BEIS 2017c (Draft)), OGUK Guidance on Comparative Assessment (OGUK 2015), and in line with their HS&E policy and Mission Statement, Ithaca developed a framework for conducting a CA using qualitative and quantitative data to evaluate the alternative decommissioning options based on five main criteria: Safety, Environmental, Technical, Societal and Economic and held a multi-disciplinary team workshop to assess the different options being considered. Sub-criteria were derived from the main criteria, which were then scored, with scores then weighted according to level of definition and understanding of methods, equipment and hazards. Final scores for each criterion were recorded in a matrix format, with relative ranking for each option derived from the weighted scores (see Hartley Anderson 2014). The preferred option identified from the CA was the removal of all spool pieces, MLT, section of power cable umbilical, clump weight and tether clamp and all exposed mattress/grout bags that can be removed safely (this aligns with the 2008 Summary provided to TCE).

The subsea decommissioning programme (removal of the MLT, tether and clump weight, mattresses/grout bags/gabion bags and the partial removal of the pipeline and power cable system) will be undertaken by dynamically positioned CSV and Dive Support Vessels (DSV), over a relatively short period of time (*ca*. 19 days – see Section 3.5). The work will be carried out within the 500m exclusion zones of the Beatrice Alpha and Bravo platforms and at the MLT location (disconnection of the pipelines and power cable at the Jacky WHP location will have been carried out under a separate scope of work, in preparation for the Jacky WHP dismantling and recovery). Of those mattresses that were buried by rock at installation, one of the eight at the Jacky location and two of the four at the MLT location are thought to be partially exposed, with all others (44) completely covered; the extent of partial exposure will be determined during the subsea programme of activities.

The final work scope for disconnection of the pipeline and power cables will be determined through detailed design, with the following an approximate of the likely activities involved.

At Beatrice B, the tie-in spool pieces will be removed from the production and water injection pipelines; the spool pieces are joined back to back and connected directly to the respective production and water injection risers on Beatrice B. The flanges on the spool pieces will be cut using a diamond or hydraulic cutter, with the spools recovered to the vessel and the ends lowered into the seabed and re-covered with

[6] Note that pipelines are not covered by OSPAR Decision 98/3, however the framework for their decommissioning is contained in *The Petroleum Act 1998*. See Section 10 of DECC (2011) (and BEIS 2017c (draft)) decommissioning guidance notes.

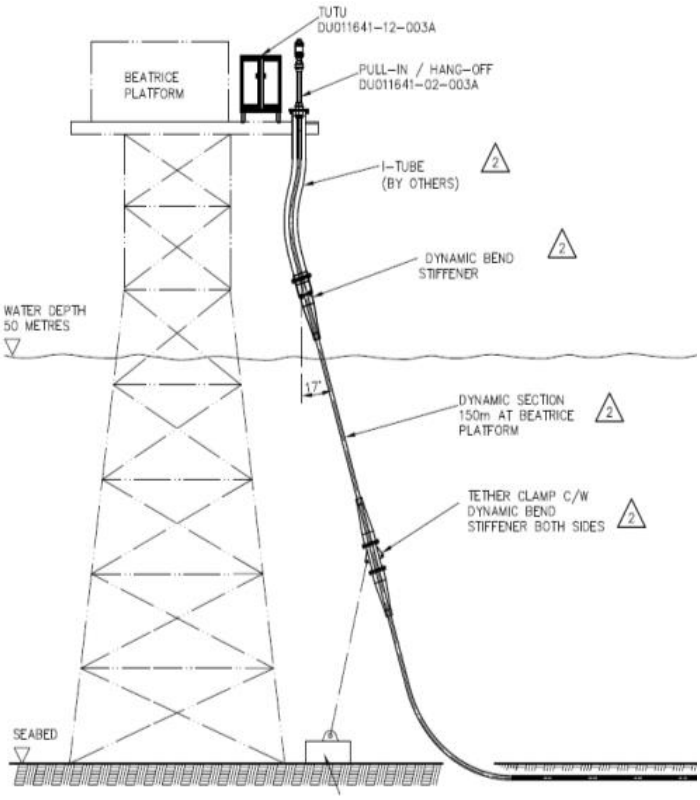
existing rock. The inhibited seawater left in the production and water injection lines will be left to dissipate from the lines. The pipeline has been cleaned and flushed and left in a "hydrocarbon free" state. The discharge of the inhibited seawater will be assessed for the required chemical permits at the appropriate time. In preparation for spool piece disconnection and removal, mattresses and grout bags will be lifted from the infrastructure and recovered to the CSV.

The same procedure to disconnect the production and water injection lines will be carried out at the Beatrice AP location, with the protective material covering the infrastructure retrieved to the CSV, exposing the tie-in spool pieces being removed.

Where rock has been used for protecting any sections to be removed, this will be displaced using a grab from the CSV, to expose the required sections. Once removed and the ends closed off, the intention is to bury the now disconnected ends in the sediment and where required, reuse the existing rock for further protection.

The safe disconnection of the power cable umbilical will be undertaken at Beatrice AP. The power cable will likely be cut (using hydraulic guillotine) below the bend stiffener, and a *ca*. 90m section of the umbilical (between the bend stiffener and the seabed rock placement location) removed to shore (Figure 3.4). The tether and clump weight will also be recovered in a single lift with no requirement for jetting.

Figure 3.4 – Jacky power cable at the Beatrice Alpha platform



The potential for disturbing cuttings piles at either Beatrice AP or B is not expected as the pipelines and power cable were surface laid at the platform locations.

All exposed protective material (mattress and grout bags) that can be, will be removed at the MLT to expose the spool pieces between the rigid pipelines and the MLT. These will then be removed to isolate the MLT for retrieval. There are 4 mattresses at the MLT location which were covered in rock at time of installation, these are to be decommissioned *in situ.*

The MLT, including a protective frame is a gravity based structure, with associated ballast weights; the MLT, frame and weights will be removed by a single lift and recovered to the CSV; there may be a requirement for jetting around the MLT to aid release from the seabed.

Preparatory work on the infrastructure included a programme of cleaning and flushing the relevant pipelines. However, there will potentially be small (limited by hydrostatic pressure) subsea discharges of inhibited seawater during the disconnection process, which may contain residual hydrocarbons. The potential discharge of this will be assessed as part of the term permits applied for.

All cut and exposed ends of the pipelines and power cable will be lowered into the seabed and backfilled with sediment and covered with rock where required; no additional rock placement is to be used, with all rock placement for cut ends being a recycle of the rock already on location as part of the original installation – see above.

3.5 Rig and vessel requirements

Along with the rig for the well plug and abandonment and HLV for the Jacky WHP lift, a variety of different vessels will be required during the decommissioning activities. While final vessel selection is still to be made, the types of vessels required are well known, as is their typical fuel consumption and these are summarised in Table 3.4; in the absence of named vessels, this information, along with estimated duration on location, forms the basis of estimating the vessel emissions to air from the Jacky decommissioning activities.

Table 3.4 – Approximate rig and vessel requirements for the Jacky Field decommissioning

Activity	Approximate no. days on site	Fuel consumption rate tonnes/day	Fuel type	Total fuel consumption (tonnes)
Well Plug and Abandon				
Anchor handler/tug (x 3)	1	25 (per vessel)	Diesel	75
Jack-up rig (positioning)	2	10	Diesel	20
Jack-up rig (on site)[2]	33	18	Diesel	594
Supply vessels[3]	22	8	Diesel	40
Standby vessel[4]	33	3	Diesel	99
Helicopter[5]	8 (hrs)	470 (kg/hr)	Helifuel	4
Topsides, monopile jacket and suction pile (Jacky WHP) removal				
Tugs x 3 (to move HLV to//from location)	1	25 (per vessel)	Diesel	75
Tugs x 2 and HLV to transport Jacky WHP to shore	1	50 (per vessel)	Diesel	100
HLV on location	3	18	Diesel	54
Standby vessel	3	3	Diesel	9
Subsea infrastructure removal				
CSV (removal of protective material, MLT, clump wt and tether, bury pipe/cable ends)	19	20	Diesel	380
DSV (disconnect and remove tie-in spools, cut/remove cable ends)	5	20	Diesel	100
Guard vessel	12	3	Diesel	36
Survey vessel (ROV) (post infrastructure removal survey)	3	8	Diesel	24
Fishing vessel (over trawl of site to confirm debris cleared)	5	5	Diesel	25
Total Diesel Consumption (all activities, except helicopter)				**1,613**

Note: [1]Assuming 1 day for jacking-up and 1 day for jacking-down. [2.]Rig estimated to be on site approximately 33 for the well plug and abandonment programme, rig fuel use is between 15-20 tonnes/day during drilling and -10 tonnes/day on standby, assuming an average of 18 tonnes/day while on location. [3.]The rig will require 1-2 supply trips per week (8 in total) for the duration of the well plug and abandonment programme and approx. 14hrs round trip for each sailing. [4.]A standby vessel will be on location for the duration of the well plug and abandonment programme. [5.]Average 2 helicopter round trips per week, total 8 rotations (average 1hr per flight).

The rig may require bunkering during the well activities (see Section 3.4.2 above); none of the other vessels are expected to require refuelling while on location and the rig, HLV and all other vessels will operate to MARPOL standards for Special Areas.

3.6 Fate of infrastructure and post decommissioning monitoring

The recovered Jacky WHP and subsea infrastructure will be returned to shore; the final port for receiving and processing the Jacky facilities is still to be determined, although Ithaca anticipates this will be a port in the UK and for assessment purposes, it has been assumed to be Nigg. Ithaca will ensure the port selected will have the appropriate environmental and operational licences and consents to receive and process the Jacky Field facilities and all waste will be documented in a waste inventory, which will be used to record the types, quantities and fate of all waste.

Once at the receiving port, the infrastructure will be processed; this will be cleaned, dismantled and segregated into components suitable for reuse or recycling before onward travel, e.g. to licensed recycling facilities. Ithaca have been actively seeking reuse opportunities for the infrastructure, including the topsides and the monopile jacket with suction piles; at present no reuse or redevelopment option is available. Ithaca will continue to explore reuse potential opportunities as and when these are identified and will recycle recovered materials to shore where this is possible. Current aspirations for reuse (installation inventory ~1%) and recycle (installation inventory ~96% and pipeline inventory ~99%) have been estimated, with the relatively small amount of materials for which reuse or recycling is not an option, e.g. residual marine growth, sent to appropriate disposal (Installations 3% and pipeline inventory 0.3%).

Upon completion of the offshore work a post decommissioning site survey will be carried out around a 500m radius of the Jacky WHP site and along a 200m corridor of each of the pipeline routes. Any Jacky related seabed debris identified will be recovered for onshore disposal or recycling in line with existing disposal methods, to ensure the seabed is clear of any items or obstructions that might pose a safety risk to other users of the area, e.g. fisheries.

Independent verification of seabed state will be obtained by overtrawl surveys. This will determine whether any additional remedial work is required to ensure sufficient burial of the remaining pipelines and power cable to enable unobstructed use of fishing gear and without potential for snagging.

Any seabed depression/mounds from jack-up spud cans or as a result of removing the Jacky WHP suction piles, will be surveyed to ensure these do not pose a snagging hazard to other users, in addition to being notified through the Kingfisher notice system.

Following decommissioning, the Jacky pipelines and power cables (with their associated rock placement and the small quantity (47) of buried mattresses) will remain *in situ*, and a post monitoring survey regime for this and the Jacky WHP site will be discussed and agreed with BEIS.

4 ENVIRONMENTAL SETTING

4.1 Location

The Jacky Field lies on the north-west edge of Smith Bank in the outer Moray Firth and the infrastructure straddles UKCS Blocks 12/21c (Jacky WHP and pipelines) and 11/30 (MLT and pipelines). The Jacky WHP is approximately 19km southeast of the Caithness coast and 10.5km northeast of the Beatrice AP (Block 11/30) (see Figure 1.1). The Jacky Field infrastructure has no direct connection to the coast.

4.2 Seabed Topography

The primary topographic seabed feature in the area is the Smith Bank, and this rises to a depth of 30-40m, notably elevated from the surrounding waters of up to 70m depth. The Jacky WHP is located off the northwest of the Smith Bank in approximately 37m of water. The seabed along the pipeline route from the Jacky WHP to Beatrice AP is generally flat, with depths ranging between 37-45m (Gardline 2007b).

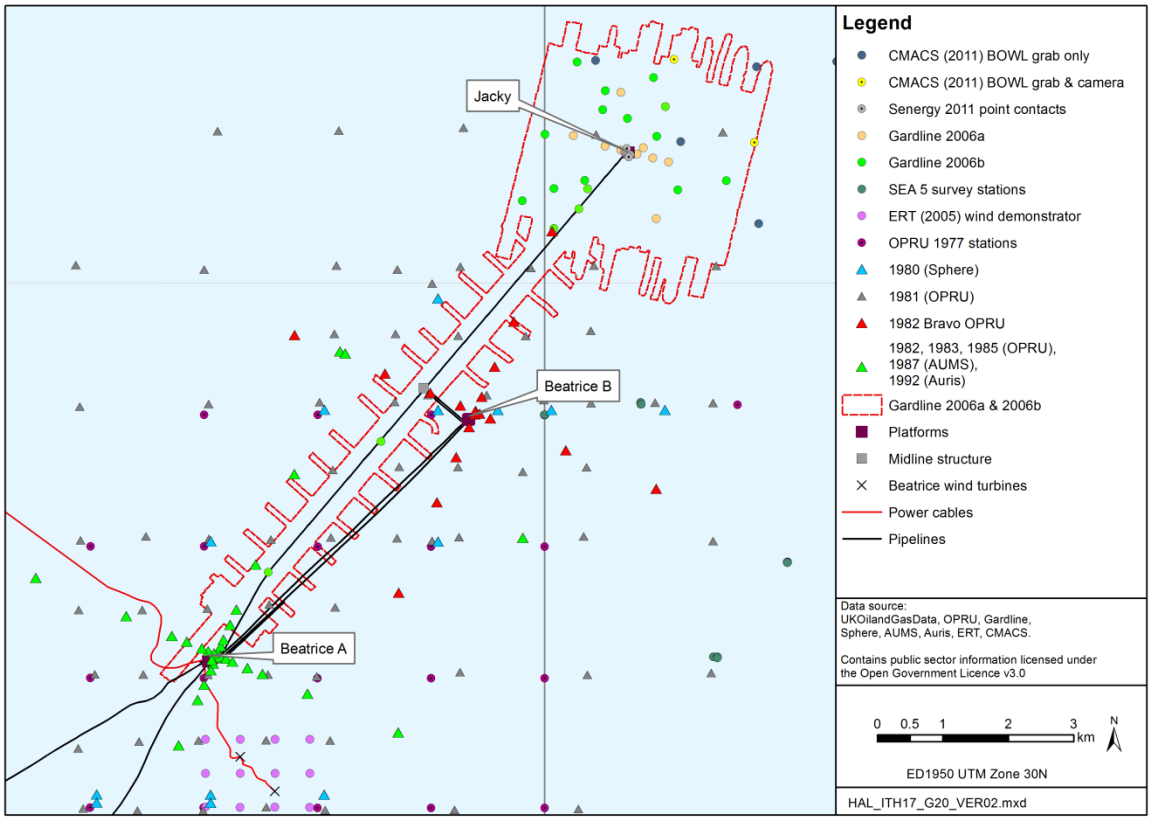
Sand waves occur in the inner Moray Firth and are present at the seabed surface in the Jacky area (Gardline 2007a, b). Linear sand patches in the Moray Firth are aligned parallel to the Buchan coast and indicate both east and west sediment transport directions (Andrews *et al*. 1990).

4.3 Seabed substrates

There is a substantial volume of information available on the seabed sediments and fauna around the Jacky WHP and the pipelines linking it to the Beatrice AP and Beatrice B platforms. This information derives from a sequence of surveys from 1958 to recent surveys of wind farm areas and by the oil industry (see Figure 4.1 for sampling points and Appendix 1 for seabed habitats and images) and was reviewed as part of the planning for the decommissioning of the Jacky Field facilities (Hartley Anderson 2014). The review concluded that the available older and recent surveys provide an adequate and robust characterisation of the seabed sediment, chemistry (including contaminants) and fauna for the areas at and in proximity to, the Jacky WHP and pipelines to the Beatrice facilities.

Offshore sediments in the area generally consist of sand and fine sand to a depth of approximately 50m, with coarser sand and gravel dominating the substrate closer to the coast (Reid & McManus 1987, Andrews *et al*. 1990) and relatively coarse sand-shelly gravel with occasional outcrops of rock in the Smith Bank (McIntyre 1958). Survey data for the area indicate sediments comprise moderately sorted medium to fine sand with shell fragments (Hartley & Bishop 1986, DTI 2004, Holmes *et al*. 2004, ERT 2005, Gardline 2007a, b), with some patches of gravel, pebbles and shells in proximity to the Jacky WHP Gardline (2007a, b) (Figure 4.2).

Figure 4.1 – Seabed sampling stations and multibeam coverage in the Jacky and greater Beatrice area

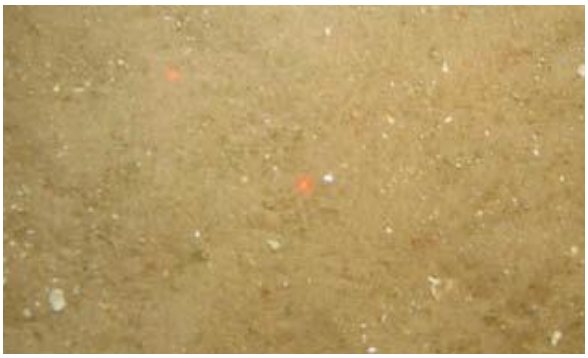


Sediments along the pipeline route showed minor troughs and ridges, with bands of coarser sediment oriented approximately northwest to southeast. At approximately 1.6km from Jacky the seabed sediments were notably coarser with abundant pebbles and some cobbles. Sediments in the slightly deeper water (>40m) towards Beatrice were found to consist of medium to fine sand with shell fragments.

The composition of seabed sediments around Jacky is a uniform top layer of loose sand (>0.2m) underlain by layers of dense to very dense fine/medium/coarse sand approximately 15m deep (Fugro 2008). Along the majority of the pipeline route the medium to coarse sand extends to >10m below the seabed (Gardline 2007b). The sand overlies Lower Cretaceous siltstone and shale clay (Fugro 2008, Gardline 2007b). The presence of ripples and waves in sediments at the seabed surface (Gardline 2007a, b) indicates some degree of active sediment transport in the Jacky area.

Figure 4.2 – Typical seabed images around Jacky and production pipeline route

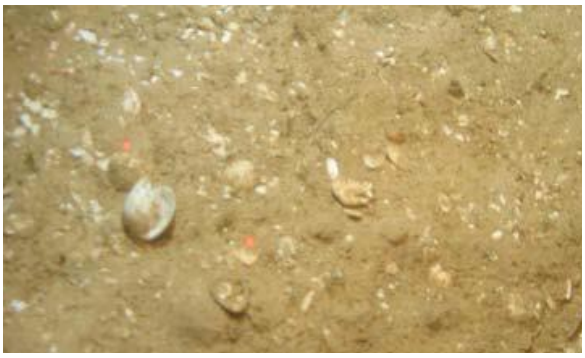
a) Jacky



PS02 Fix 179 (1.2km northeast of Jacky)

PS04 Fix 108 (761m northwest of Jacky)

b) Pipeline route



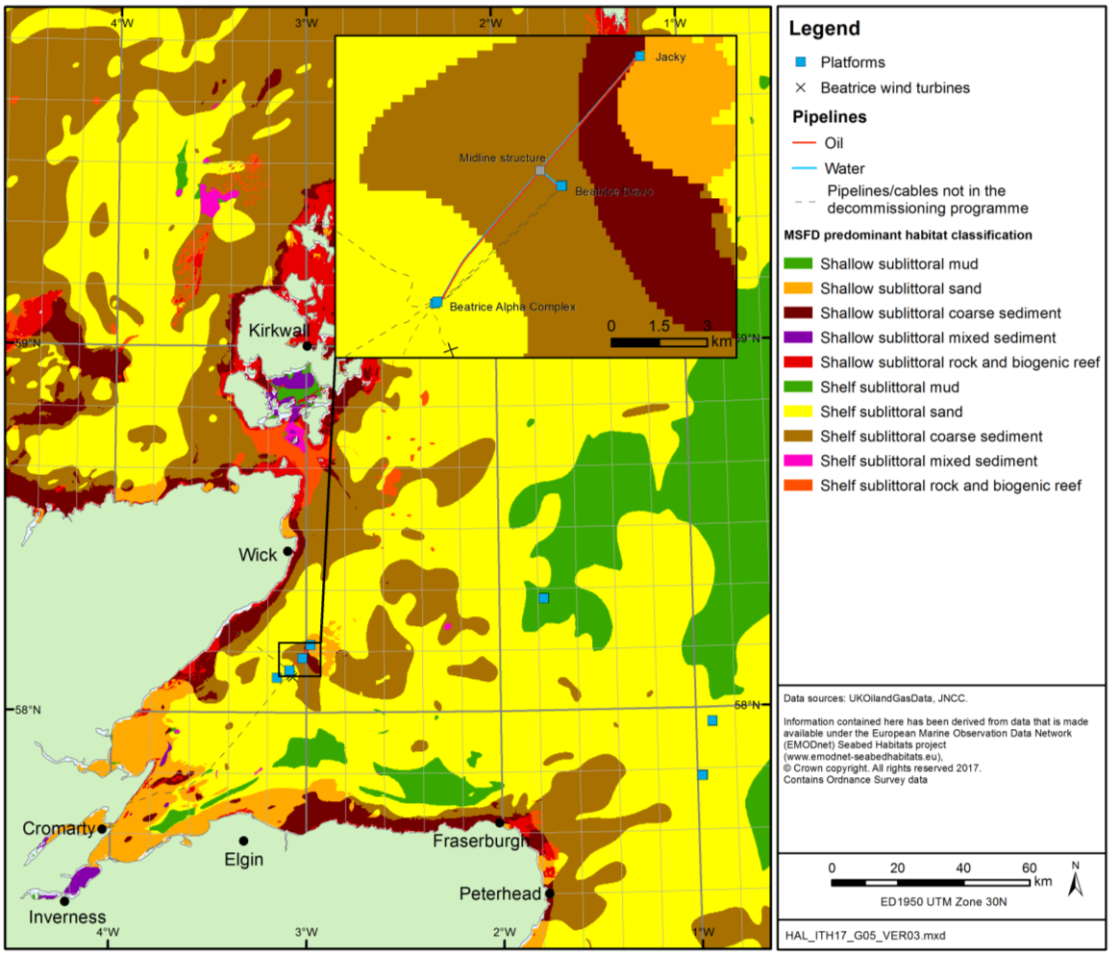
Station 5 Fix 67 (5.8km southwest of Jacky)

Station 3 Fix 60 (1.6km southwest of Jacky)

Source: Gardline (2007b)

The survey data aligns with that predicted by EUSeaMap2 of the Moray Firth; a map of predicted seabed broadscale habitats of the Moray Firth as produced by EMODnet Seabed Habitats in support of the Marine Strategy Framework Directive is shown in Figure 4.3 (EUSeaMap2 2016). This shows the wider area consisting predominately of shelf sublittoral sand and shelf sublittoral coarse sediment, but with areas of mud also present.

Figure 4.3 – Predicted seabed habitats (EUSeaMap)



A debris survey was carried out in 2011 in preparation for a rig coming on site to drill the second production well (this was drilled, but never completed, see Section 3.4.2). An area of 500m x 800m was surveyed to the south of the Jacky platform; coverage was required as close to the Jacky WHP as possible and sidescan sonar coverage was also obtained of four anchor corridor lines from the proposed rig stand-off location to the proposed anchor locations at that time (Senergy 2011). From this, no debris contacts were made either south of the Jacky WHP or along the anchor chain corridors. They also identified faint spud-can disturbance from previous jack-up activity; depressions were identified at two of the originally proposed jacking locations, the depth of the deepest being 0.3m and negligible. A faint spoil heap associated with the removal of another anchor was also identified.

Seabed contaminant concentrations (metals, total hydrocarbons, and PAHs) from around Jacky in 2007 were at around background levels and comparable to those reported for the 2010 and 2011 surveys at the nearby wind farm areas (OSPAR 2005, Gardline 2007a, CMACS 2010, EMU 2011).

Analysis of sediment samples taken from 9 stations around the Jacky WHP Gardline (2007a) showed total hydrocarbon concentrations (THC) were between 0.16-0.81µgg^{-1} with a mean concentration of 0.3 ±0.2µgg^{-1}. Contaminant concentrations along the pipeline and power cable routes are expected to be at background levels.

Only cuttings drilled with water based muds (WBM) were discharged to sea from the three drilling campaigns at Jacky (in 2007, 2009 and 2011). A substantial body of evidence is available from the North Sea and other monitoring studies (e.g. Daan and Mulder 1996, Currie & Isaacs 2005), laboratory

and field experiments (e.g. Trannum *et al*. 2011) which indicates little or no detectable effects of WBM discharges in shelf water depths.

The existing survey data is considered to be an adequate basis of information for an environmental impact assessment of potential seabed effects from Jacky Field decommissioning activities.

4.4 Climate and Meteorology

The Moray Firth experiences a mild maritime climate (UKHO 2012). Wind direction and strength in the Moray Firth are variable; there is marked seasonal variation with stronger winds from the south and southwest prevailing during the autumn and winter. The 30-year average wind speed mean at 110m ranges from 9.6-9.8m/s, varying between <8m/s in summer, to 10.2-10.4 and 11.3-11.6m/s in autumn and winter respectively (The Crown Estate 2015). Frequency of precipitation in the northwest Moray Firth is higher in winter (~30%) than in summer (~18%) (UKHO 2012), and sea fog is most frequent in the Moray Firth in summer during periods of southeast winds (UKHO 2012).

4.5 Oceanography and Hydrography

The waters over the inner and outer Moray Firth are described as 'coastal or a region of freshwater influence' and 'shelf water', with typical salinities of 30-34ppt and 34-35ppt respectively (Connor *et al*. 2006). This is due to the area being influenced by both oceanic water and coastal/mixed waters of the inner Moray Firth. Oceanic waters enter the North Sea primarily from the north by Atlantic inflow along the east of the Shetland Isles, and from the northwest through the Fair Isle current.

Water column characteristics of the shelf water in the Jacky area vary from stratified in summer to well-mixed in autumn and winter, before becoming weakly stratified in spring. The nearshore and shallow areas are influenced by freshwater inputs, resulting in some weak stratification throughout the year (Connor *et al*. 2006).

A very weak clockwise current exists around the shores of the Moray Firth due to a south-southwest flowing current passing the east of Shetland being deflected west at Rattray Head in the south of the Moray Firth (UKHO 2012).

Over the Smith Bank, tidal streams show maximum speeds of 0.5 and 0.3 knots during spring and neap tides, respectively. Tidal streams are slightly stronger closer to the coast and the strongest tidal streams (up to 1.3 knots) are found at the entrances to the inner firths (UKHO 2012). Due to protection afforded by the coast, wave heights are typically small, with mean annual significant wave height approximately 1.3-1.4m across the Jacky area, with heights lowest in summer (0.86-0.93m) and highest in winter (1.68-1.8m) (BERR 2008). However, stormy conditions will result in larger waves at times (DECC 2009).

4.6 Plankton

The plankton community may be broadly divided into a plant component (phytoplankton) and an animal component (zooplankton) and the plankton community present in the Jacky and wider Moray Firth areas, is similar to that found over a wide area of the central North Sea.

The phytoplankton community is dominated by the dinoflagellate genus *Ceratium* (*C. fusus*, *C. furca*, *C. lineatum*), with diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. also abundant (Johns & Reid 2001) and the zooplankton community is dominated, in terms of biomass and productivity, by the Calanoid copepods *Calanus finmarchicus* and *Calanus helgolandicus*; there is a strong geographical divide between these two species with the former more abundant in colder, more northern waters and the latter dominating warmer waters in more southerly regions, though their ranges show considerable

overlap (DECC 2016). Other calanoid genera such as *Paracalanus* spp. and *Pseudocalanus* spp. and *Acartia* are also abundant. There is also a high biomass of *Calanus* larval stages present in the region and abundant jellyfish species include *Aurelia aurita*, *Cyanea capillata* and *Cynaea lamarckii* (Pikesley *et al*. 2014).

An increase in Sea Surface Temperature (SST) may have resulted in a northwards spread in the population of *C. helgolandicus*, with a corresponding decline in *C. finmarchicus*; increasing dominance of *C. helgolandicus* has been seen since the mid 1980s and evidence suggests that the increase of warmer species at the expense of colder water species in the north-east Atlantic, has accelerated over the last 5 years (Edwards *et al*. 2014). The population of *C. finmarchicus* tends to peak in the cooler, spring months, and recent observations have indicated that the peak in abundance is arising earlier in the year, with the springtime *Calanu*s community between 2009-2012 dominated by *C. finmarchicus* for the first time in two decades (Edwards *et al*. 2013, Edwards *et al*. 2014). Warm water inflows have also been linked to the increases in euphausiid abundance around coastal regions (Reid *et al*. 2001).

In the North Sea, a phytoplankton bloom occurs in spring followed by a smaller peak in the autumn. Diatoms are the first to bloom, then as nutrients essential for diatoms become depleted, other groups bloom such as flagellates, followed later by dinoflagellates. The progress of the spring bloom is dependent predominantly upon episodic turbulence following short periods of stratification, which allows the mixing of nutrients into the photic zone. Diatoms comprise a greater proportion of the phytoplankton community from November to May, when mixing in the water column is greatest (McQuatters-Gollop *et al*. 2007). The spring bloom in the region is stronger, relative to the autumn bloom, than elsewhere in the North Sea (Longhurst 1998).

4.7 Benthos

The most detailed studies of benthic communities in the northern outer Moray Firth were carried out over the Smith Bank (McIntyre 1958) and the Beatrice oilfield (Hartley & Bishop 1986). McIntyre (1958) described the sediments of Smith Bank as relatively coarse sand-shelly gravel with occasional outcrops of rock, noting that polychaetes, molluscs and the small sea urchin *Echinocyamus pusillus* were numerically dominant, while the bivalve *Cochlodesma praetenue* dominated the biomass.

Hartley & Bishop (1986) presented the results of a series of benthic surveys around the Beatrice field area from 1977-1981, both before and after production operations had commenced. They noted high species richness, with several community types identified. In the fine sand sediment in slightly deeper waters in the south and west of the field, the assemblage was dominated by the bivalve *Thyasira flexuosa*, sea-pen *Virgularia mirabilis* and polychaete worm *Aricidea catherinae*, while at the coarser (>5% gravel) sediments of the Smith Bank in the northeast, benthic communities were dominated by the bivalve *Tellina (Moerella) pygmaea* and polychaetes such as *Scoloplos armiger*, *Lumbrineris gracilis* and *Polycirrus* spp. A later seabed survey of the Beatrice field in 1992 found undisturbed communities were dominated numerically by the polychaete worms *Spiophanes bombyx* and *S. armiger* (AURIS 1993).

Faunal analysis of samples taken at stations around Jacky during the predevelopment survey in 2006 (Gardline 2007a) showed some variation in the faunal community between stations (Table 4.1).

Table 4.1 – Species ranking for stations around Jacky

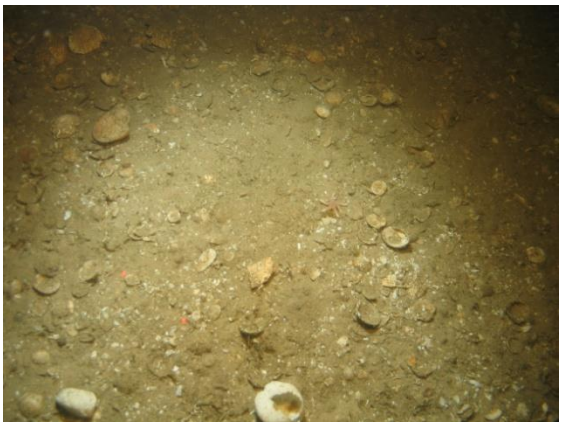
Rank	Taxon	Total Abundance (# from 18 0.1m² samples)
1	*Tellina (Moerella) pygmaea*	253
2	*Spiophanes bombyx*	246
3	*Galathea intermedia*	184
4	*Leptochiton asellus*	14
5	*Cochlodesma praetenue*	122
6	*Echinocyamus pusillus*	97
7	*Ophelia borealis*	66
8	*Scoloplos armiger*	56
9	Echinoidea spp. juv.	50
10	*Nephtys caeca*	51

Source: Gardline (2007a)

Most samples were of medium to coarse sands dominated by the polychaete *Spiophanes bombyx*, bivalves *T. pygmaea*, and *Cochlodesma praetenue* and the urchin *Echinocyamus pusillus*. At stations where the sediments contained a high proportion of gravel and pebbles, the fauna was numerically dominated by epifauna including the crustacean *Galathea intermedia* and the chiton *Leptochiton asellus*. Seabed photography (see Figure 4.4) was carried out at twelve stations around Jacky and six sites along the production pipeline route during a predevelopment survey (Gardline 2007b). Areas with coarse substrate were colonised by a diverse epibenthos such as dead man's fingers (*Alcyonium digitatum*), barnacles, horse mussels (*Modiolus modiolus*), squat lobsters (*Munida rugosa*), urchins (*Echinus esculentus*) and various brittle stars.

Figure 4.4 - Typical seabed images on the Jacky pipeline route near Beatrice Bravo and Alpha

Medium to coarse sand with shells/fragments. Brittlestar (Ophiura ophiura), unidentified hydroid.



Medium sand with shell debris, large shells and cobbles. Asteroid starfish.

Marine growth on parts of the Jacky WHP installation as described in the monopile jacket inspection report (Harkland 2013) appears to be typical for the depths and substrates. The plumose anemone, *Metridium senile*, appears to dominate, with barnacles, tubeworms and hydroids interspersed throughout (Figure 4.5); other anemone species are present occasionally and a solitary sea urchin, *Echinus esculentus*, was observed. At the shallower depth of 4.5m mussels are present with some barnacles; dense algae also appear to be present which is unusual at the depth of 36m. No unusual species or species of conservation interest appear to be present.

Figure 4.5 – Marine growth on the Jacky WHP monopile jacket

Plumose anemones and barnacles

Plumose anemones, barnacles, hydroids, anemones

Ecological changes around the Beatrice Alpha platforms were investigated by Addy *et al*. (1984) following the discharge of cuttings drilled with OBM. Results of surveys undertaken soon after OBM cuttings discharges indicated the presence of various zones of ecological effects, with the most marked effects localised (<115m) and characterised by a reduction in the number of dominant taxa and the abundance of the opportunistic polychaete *Capitella capitata*. Beyond 115m, progressively few *C. capitata* individuals were observed and faunal richness generally increased to undisturbed sediment levels.

A baseline survey from the Beatrice Wind Farm Demonstrator turbine sites, which lie approximately 7km from Jacky, revealed diversity was uniformly high across the survey area and overall, species diversity and richness showed a moderately strong relationship with sediment type, water depth and total organic content of sediment (ERT 2005). Analysis of the faunal grab data from all eighty-seven stations from the baseline survey, including nine stations located within 3.5km of Jacky, in similar water depths and sediment type to Jacky, revealed 7 sample groups. The largest grouping was associated with predominantly sand sediments with some gravel in moderately deep water and included characteristic species such as *S. bombyx*, *O. borealis*, *Poecilochaetus serpens*, *Owenia fusiformis*, *C. praetenue*, and *Crenella decussata*; this grouping compares reasonably well with the fauna found around Jacky (Gardline 2007a), with 4 of the characteristic species found in medium to coarse sand sediments. Little epifauna were observed from video footage and grab sampling around the wind farm site, apart from occasional fragments of hydroids, single specimens of the whelk *Buccinum undatum*, the scallop *Pecten maximus*, sea star *Asterias rubens* and a species of brittlestar (ERT 2005).

Important species found in the Moray Firth include the fan mussel (*Atrina fragilis*) and the horse mussel (*M. modiolus*); *Modiolus* beds may be afforded protection under the EC Habitats Directive as biogenic reefs. Surveys around the Jacky facilities, including the Jacky WHP and along the pipeline routes to Beatrice AP and Beatrice B, and the wider area, have not recorded any *A. fragilis* specimens (DTI 2004, ERT 2005, Gardline 2007 a, b, CMACS 2010, EMU 2011) and while seabed photography along the Jacky production pipeline route (Gardline 2007a, b) showed several solitary *Modiolus* at a number of stations with a gravel/pebble substratum, no evidence for the presence of *Modiolus* reefs was seen in any of the photos or video footage.

Findings from the available surveys suggest that no potential Annex I habitats occur within the existing survey coverage.

4.8 Cephalopods

Cephalopods are mainly short-lived, fast growing molluscs such as squid, octopus and cuttlefish. Cephalopods play a key role in marine foodwebs; they feed opportunistically on a wide variety of prey (polychaetes, molluscs, crustaceans and fish) and constitute a major prey source for a number of marine top predators including commercially important fish species, cetaceans, seals and seabirds. In the Moray Firth, cephalopods form an important part of the diet for several top predators; the grey seal (*Halichoerus grypus*) and harbour seal *(Phoca vitulina*) have a preference for octopus (*Eledone cirrhosa*), while squid are regularly found in the stomach contents of bottlenose dolphin (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*) as well as cod (*Gadus morhua*) (Boyle & Pierce 1994, Tollit & Thompson 1996, Daly *et al*. 2001, Santos *et al*. 1994, 1995).

The main commercial cephalopod species in Scottish waters is the veined squid (*Loligo forbesii*) (Boyle & Pierce 1994, ICES 2016). This species is thought to be present in all seasons; but the spatial pattern of abundance varies with season, with Scottish coastal waters yielding a clear peak in catches during October and November (Pierce *et al*. 1994, 1998). A fishery for *Loligo forbesii* has developed in the Moray Firth over the last 20 years, with fishermen taking advantage of the lack of quota restrictions on this species (DECC 2016). ICES landings data reveal that squid comprise almost all cephalopod landings and are a key component of landings within the Moray Firth (Scottish Government website).

Spawning grounds for *L. forbesii* are not fully understood; spatial patterns in fishery data suggest that spawning occurs in inshore waters, and juveniles then move offshore. It is possible that there are spawning grounds for *L. forbesii* within the Moray Firth, with spawning beginning in the winter months and small squid first appearing in July/August (Young *et al*. 2006, Hastie *et al*. 2009, Viana *et al*. 2009, Oesterwind *et al.* 2010).

4.9 Fish and Shellfish

The Moray Firth area supports a number of commercially important species, several of which use the area as spawning and/or nursery grounds. The spatial and temporal distributions of spawning and nursery ground of commercial species in the UK were described in Coull *et al.* (1998) and revised by Ellis *et al.* (2012). Aires *et al*. (2014) have produced a series of updated fisheries sensitivities maps, aiming to develop upon work presented in Coull *et al*. (1998). These maps display the probability of presence of aggregations of 0-group fish (those in the first year of their lives) in Scottish waters, and should be used in tandem with the earlier work.

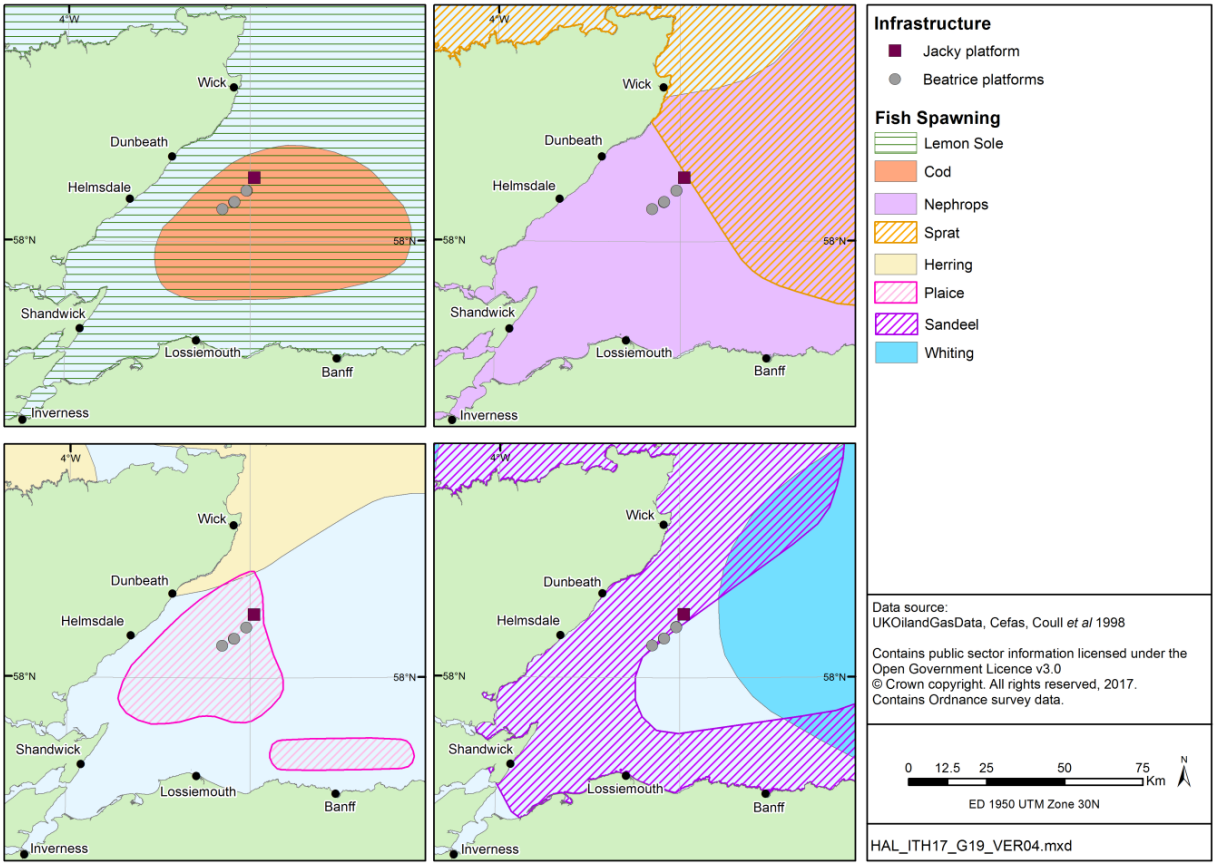
The Jacky WHP and associated pipelines lie within ICES Rectangles 45E6 and 45E7. These rectangles overlap or abut reported spawning grounds of eight fish and shellfish species of particular commercial importance, as well as nursery grounds of eighteen species (see Table 4.2 and Figures 4.6 and 4.7). At the scale of the Moray Firth, some uncertainty and data gaps remain, particularly relating to spawning grounds for elasmobranchs, although a number of likely nursery grounds for these species are identified by Ellis *et al*. (2012). Data from Aires *et al.* (2014) suggest that haddock, whiting and Norway pout and to a lesser extent, herring, plaice, cod, hake and monkfish, are likely to have 0-group aggregations present in waters near the Jacky area.

Table 4.2 – Spawning periods for fish and shellfish around Jacky/Beatrice area

Species	Spawning grounds	Peak spawning	Nursery
Herring (*Clupea harengus*)*	✓[1]	August – September	✓ (High intensity)[2]
Mackerel (*Scomber scombrus*)*	-	-	✓ (Low intensity)[2]
Sprat (*Sprattus sprattus*)	✓[1]	May – August	✓[1]
Blue whiting (*Micromesistius poutassou*)*	-	-	✓ (Low intensity)[2]
Cod (*Gadus morhua*)*	✓[1,2]	January – April[1,2]	✓ (High intensity)[2]
Haddock (*Melanogrammus aeglefinus*)	-	-	✓
Saithe (*Pollachius virens*)*	-	-	✓
Whiting (*Merlangius merlangus*)*	✓[1,2]	February – June[1,2]	✓ (High intensity)[1,2]
European hake (*Merluccius merluccius*)	-	-	✓ (Low intensity)[2]
Ling (*Molva molva*)*	-	-	✓ (Low intensity)[2]
Plaice (*Pleuronectes platessa*)	✓[1,2]	December – March[1,2]	✓ (Low intensity)[1,2]
Lemon Sole (*Microstomus kitt*)	✓	April – September	✓[1]
Monkfish (*Lophius piscatorius*)*	-		✓ (High intensity)[2]
Sandeel (*Ammodytes marinus*)*	✓(High intensity)[1,2]	November – February[1,2]	✓ (Low intensity)[1,2]
Spurdog (*Squalus acanthias*)*	-	-	✓ (Low intensity)[2]
Thornback ray (*Raja clavata*)	-	-	✓ (Low intensity)[2]
Spotted ray (*Raja montagui*)	-	-	✓ (Low intensity)[2]
Nephrops (*Nephrops norvegicus*)	✓[1]	January – December[1]	✓[1]

Source: [1]Coull *et al*. (1998), [2]Ellis *et al*. (2012) * Species considered Priority Marine Features in Scottish waters (JNCC website and see Tyler-Walters et al. 2016).

Figure 4.6 – Fish spawning areas



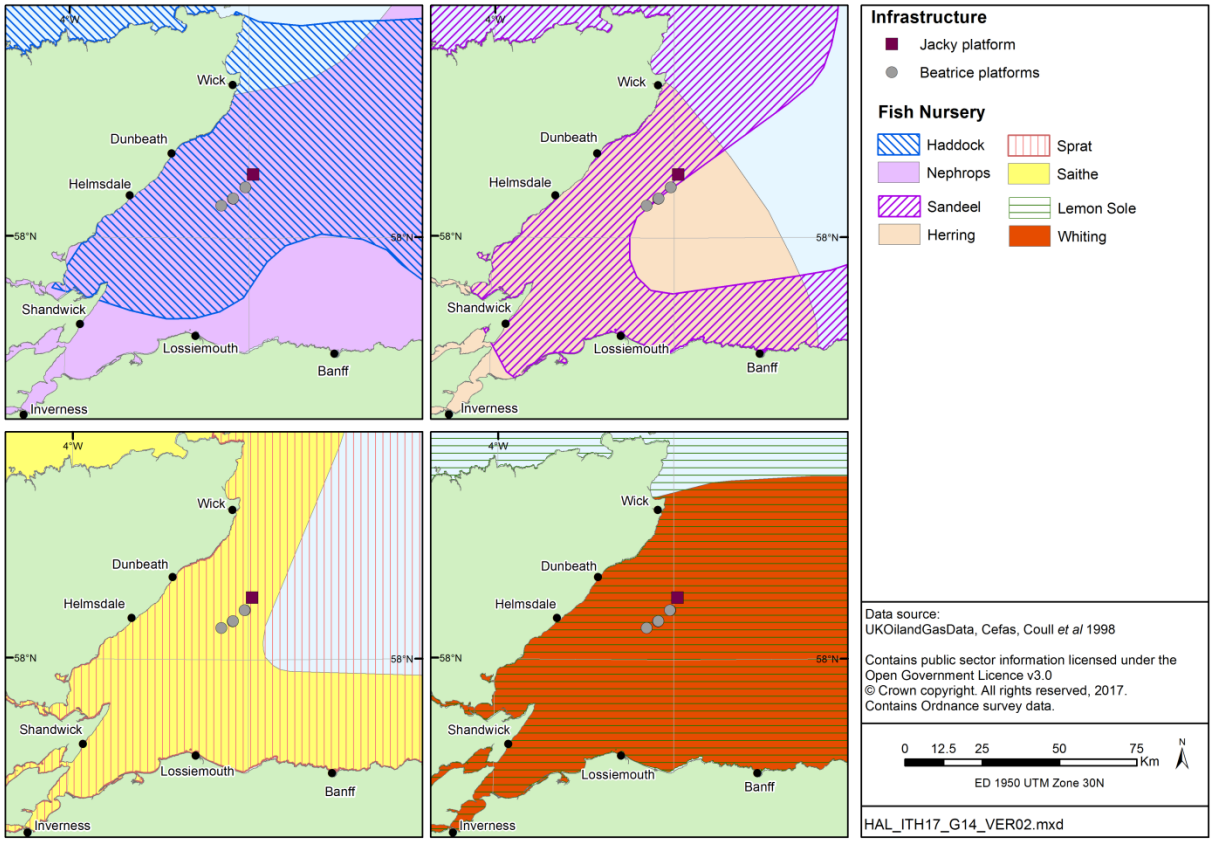
Herring are known to spawn on discrete banks of clean gravel in the Moray Firth (Gordon 2003), with juveniles from both the Moray Firth population and the west coast of Scotland, using the inner firth as nursery grounds (Marine Scotland website). After spending 1-2 years in the inner firth, they move to the outer firth and offshore, where they join adult populations. Sprat use deeper waters of the outer Moray Firth to spawn and adults overwinter in nearshore areas of the Firth.

The Moray Firth, and in particularly Smith Bank, is one of the most important spawning grounds in the central North Sea for plaice (Coull *et al*. 1998, Goldsmith *et al*. 2015). Smith Bank is also important for sandeel (Sparholt 2015) and cod, the latter migrating into the area from offshore to spawn (Hislop *et al*. 2015). The outer Moray Firth is of particular importance to adult spawning and juvenile lemon sole. Juvenile haddock remain and feed in the shallow waters of the Firth until they mature; adult haddock also feed in the Moray Firth and migrate in winter to spawn in the North Sea in spring.

Among sharks, skates and rays, the Moray Firth area is important for several commercial species including spurdog (*Squalus acanthias*), lesser spotted dogfish (*Scyliorhinus canicula*), starry ray (*Amblyraja radiata*) and cuckoo ray (*Leucoraja naevus*) as well as thornback ray (*Raja clavata*) and spotted ray (*Raja montagui*) (Ellis *et al*. 2004). In addition, sightings of basking shark (*Cetorhinus maximus*) occur regularly albeit infrequently during the summer (Solandt & Ricks 2009, Solandt & Chassin 2014).

Shellfish species including *Nephrops*, edible crabs, lobsters, scallops and queen scallops, edible winkles, edible mussels, whelks and razorfish occur on suitable seabed types throughout the Moray Firth (Chapman 2004). *Nephrops* utilise a narrow strip of muddy sediment in the inner Moray Firth that rapidly broadens east of Macduff.

Figure 4.7 – Fish nursery areas



Scallops are exploited in the Moray Firth; important fishing grounds exit on Smith Bank and off the northwest coast between Wick and Golspie. In muddy and sandy areas, particularly in the Dornoch, Cromarty and Inverness/Beauly Firths edible mussels form beds and also colonise rocky shores in the area; the main wild mussel fishery in the region is in the Dornoch Firth. Cockles, although widespread, are generally concentrated in the intertidal habitats of the inner firths and along the southern coast of the Moray Firth.

Diadromous and Freshwater Species

Several rivers supporting important populations of migratory Atlantic salmon (*Salmo salar*) (salmon) and lamprey (*Petromyzon marinus*), flow into the Moray Firth; more than one third of Scotland's main salmon rivers flow into the catchment area (Moray Firth Partnership website). Both are Annex II protected species under the EU Habitats Directive, as well as being on the OSPAR List of Threatened and/or Declining Species and Habitats[7], and several sites in the region have been designated Special Areas of Conservation (SACs) for the presence of one or more of these species. The Berriedale and Langwell Waters SAC is on the northwest coast has salmon as a primary qualifying feature; other main rivers in the area are on the southern shore, especially the River Spey, (a designated SAC with both salmon and sea lamprey as primary features) and its tributaries and also the rivers Deveron, Findhorn and Nairn; these rivers are also important for sea trout (*Salmo trutta*). The River Helmsdale and to a lesser extent the Rivers Fleet and Brora, are important for recreational fishing of salmon and sea trout.

Salmon migrate from Scottish rivers towards distant feeding grounds and have been found west of Greenland and around the Faroe Islands but the exact route is not known; on their return, tagging studies have shown evidence of movement into the Moray Firth along the mainland coast from both the northwest and south (Malcolm *et al*. 2010). A large migration of these anadromous fish through the

[7] OSPAR List of Threatened and/or Declining Species and Habitats (Reference Number: 2008-6).

Moray Firth has been inferred from the feeding habits of bottlenose dolphins which have been observed to move to inshore areas of the Firth and take large salmonids during summer (Wilson *et al*. 1997).

Sea lamprey are jawless fish which span in freshwater but complete their life cycle at sea. They require clean gravel for spawning, along with silt or sand habitat to accommodate the burrowing larval phase; surveys of the lower River Spey in 2002 (where they are a primary reason for the river's SAC designation – see above), identified many areas of suitable lamprey habitat, although sea lamprey larvae were rare (Laughton & Burns 2005).

The freshwater pearl mussel (*Margaritifera margaritifera*) is now a rare and threatened species which inhabits cool, clean, fast-flowing rivers and streams with healthy native salmonid populations; microscopic young (glochidia) are released into the river in late summer and these attach (or "encyst") to the gills of young salmon (or trout), where they remain throughout the winter, dropping off the following spring when they settle in the river bed to grow to adulthood. While the pearl mussel remains in freshwater for the duration of its life cycle, as it spends its larval stage attached to the gills of diadromous salmonid, it is reliant upon them for survival. They are found in several water courses draining into the Moray Firth and is a primary reason for the designation of several SACs in the region: the Rivers Oykel, Evelix, Spey and Moriston. In September 2012, a four year UK wide LIFE[8] nature project was set up (Pearls in Peril (PIP)) working to restore river habitats benefiting freshwater pearl mussel and salmonids. As part of this, in an attempt to increase the range of the endangered mollusc in the River Moriston, the Ness and Beauly Fisheries Trust (NBFT) attempted to (and have successfully) "encyst" juvenile salmon with young freshwater pearl mussels from areas of the river where mussels are currently absent (Ness and Beauly Fisheries Trust website: http://www.nessandbeauly.org.uk/pearls-in-peril/)

4.10 Birds

The coastline and waters of this region are of year round importance for birds, with breeding seabirds utilising the coastal cliff habitats and productive feeding areas close to colonies mainly through spring, summer and early autumn, and waterbirds, such as seaduck, divers and waders utilising sheltered bays and inshore waters throughout the winter. Birds on passage at this time of the year also exploit the rich habitats in the region. A summary of their distribution throughout the year is shown in Table 4.3.

Table 4.3 – Bird distribution in the Moray Firth throughout the year

Month	Summary distribution
January	Abundance of guillemot and razorbill in coastal areas. Concentrations of gannets in Smith Bank area. Herring gulls, fulmars and great black-backed gulls abundant at sea. Breeding fulmars can attend nest sites from early winter, but this species forages vast distances and nest attendance during this time can be sporadic. Large concentrations of common scoter (Dornoch/Moray Firth), goldeneye (Cromarty/Moray Firth) and long-tailed duck (Moray Firth).
February	Guillemots distributed at sea with main North Sea concentrations in the Moray Firth. Large numbers of eider ducks found along coast, large flocks of goldeneye still present in the Moray Firth and the Firth supports large concentrations of common and velvet scoter, goosander and red-breasted merganser.
March	Concentrations of gannets, razorbills, kittiwakes and guillemots recorded at sea, particularly in Smith Bank area. Guillemots and puffins return to the vicinity of their colonies. Abundance of herring gulls in inner Moray Firth area. Numbers of wading birds in estuarine areas decline, eiders move back towards breeding grounds. High Arctic nesting species e.g. bar-tailed godwit remain in UK sites (e.g. Cromarty/Dornoch Firths, Moray and Nairn coast, inner Moray Firth) later than more temperate species.
April	Breeding season for some seabirds begins at the end of the month, so attendance at colonies increases. Terns return in greatest numbers. Small numbers of lesser black-backed gull

[8] LIFE is the EU financial instrument supporting environmental, nature conservation and climate action projects throughout the EU: http://ec.europa.eu/environment/life/

	sighted throughout the Moray Firth and offshore. Large offshore concentrations of guillemots over Smith Bank. Cormorant sightings in coastal waters. Congregation of sea ducks in coastal waters. Estuaries used by birds on passage from southern wintering grounds to northern breeding grounds; in general, number of birds on passage is thought to be underestimated.
May	Start of breeding season for most seabirds, birds away from colonies likely to be immature. However, birds still forage at distances further from the colonies than during chick rearing period. Low numbers of great skua widely distributed at sea. Small numbers of lesser black-backed gull sighted throughout the Moray Firth and offshore. Waterbirds that have wintered in the area now returned to breeding sites. Eiders remain present, and males can form moulting flocks as early as May.
June	Peak of breeding season. Majority of seabirds in coastal areas. Major presence of guillemots, with most feeding no further than 30km from their breeding site. At the end of the month, young guillemot start to leave the colonies and disperse into the outer Moray Firth and North Sea. Breeding razorbill feed closer to shore than guillemot. Migrant waterbirds that winter on/pass through coasts of North Sea now returned to breeding grounds.
July	Nesting season for many seabird species ends in late June/early July and now moulting season for inshore and coastal birds. During this time some adult auks and ducks are flightless. Adult and juvenile birds start to move south to wintering grounds or move to areas where they form moulting flocks. Areas over some of the banks of the central North Sea and off the Moray Firth, support large concentrations of birds, with birds widely dispersed.
August	Offshore congregations of flightless moulting adult and juvenile auks. Peak in number of Arctic and great skua widely distributed in Moray Firth. Concentrations of herring gulls present over Smith Bank. Large concentrations of post-breeding puffins occur off northern Caithness coast. Density of guillemots is highest. Black guillemots moult and are concentrated in sheltered inshore waters. Start of main influx of wading birds and ducks into the North Sea; some may remain in area for winter, or stop to moult and/or feed before onward migration. Cromarty Firth holds large populations of bar-tailed godwit.
September	Large numbers of fulmars, sooty shearwaters, Arctic skua and great skua dispersed at sea. Largest concentrations of razorbills found off Moray Firth and peak abundance of Manx shearwater in coastal area of inner Moray Firth. High abundance of gannets over northeastern part of Smith Bank. Large migration of common scoter into Moray and Dornoch Firths and northern firths hold important numbers of wigeon. Large numbers of red-throated diver undergo wing moult, including in areas of southern Moray Firth.
October	Concentrations of gannets in Smith Bank area. Arctic skua widely dispersed over offshore area. Small numbers of lesser black-backed gull sighted throughout the Moray Firth and offshore. Southward shift in guillemot and razorbill population, although inshore Scottish waters still hold large numbers. Kittiwake distribution moves south and large numbers found in the Moray Firth. Continued influx of common scoter with large numbers found in Dornoch/Moray Firth (with lower numbers of velvet scoter associated with them).
November	Moray Firth remains important for razorbills, guillemots and herring gulls and an important feeding area. Area also important for long-tailed ducks arriving from breeding areas, with main feeding areas along the south-western shore – this species also roosts offshore. Goldeneye occur in important number in areas including Cromarty/Moray Firth.
December	Peak in herring gull abundance, especially off the Moray coast. Guillemots and razorbills still present in high numbers, particularly off the southern shore, and some may visit nest sites during this month. The area also sustains important flocks of long-tailed duck, common and velvet scoter, goosander and red-breasted merganser Cromarty Firth also supports important numbers of redshank.

Source: Tasker & Pienkowski (1987), Skov *et al.* (1995), Tasker (1996), Talisman (2006), Furness (2015)

4.10.1 Seabirds

Seabirds including black-legged kittiwake (kittiwake) (*Rissa tridactyla*), common guillemot (guillemot) (*Uria aalge*) and razorbill (*Alca torda*), breed at colonies along the Moray Firth coastline, commuting offshore to feed, particularly over the Smith Bank; species such as great cormorant (cormorant) (*Phalacrocorax carbo*), gulls, terns and European shag (shag) (*Phalacrocorax aristotelis*), tend to feed closer to shore; the area is very important for shag, with this being a qualifying species of the proposed Moray Firth SPA (see Section 4.13). Both the waters of the outer Moray Firth and the nearshore waters off the coast, are therefore of particular importance as feeding areas (Tasker 1996).

Following breeding, adults and juveniles disperse from colonies out to the wider North Sea, with some migrating out of the area completely to their wintering grounds. When they disperse, adult and juvenile auks move offshore where adults undergo a post-breeding moult, and, along with the flightless young, form rafts on the sea surface; unlike other auk species, black guillemots (*Cepphus grylle*) tend to remain close to breeding colonies even in winter (SNH 2016) (e.g. East Caithness Cliffs) and Atlantic puffin (puffin) (*Fratercula arctica*) undergo a main (body feather) moult, not after breeding, but instead *ca*. January-March, when still out at sea.

The importance of the Moray Firth area is reflected in the designation of a number of international and national conservation sites on land and at sea (see Section 4.13). The East Caithness Cliffs support vast numbers of breeding seabirds and the area is designated as a Special Protection Area (SPA), Special Area of Conservation (SAC) and Nature Conservation Marine Protected Area (MPA); the closest designation boundary is *ca*. 17km from the Jacky WHP. Qualifying features for these designations include sea-cliff habitat supporting breeding populations of European importance of peregrine (*Falco peregrines*), guillemot, herring gull (*Larus argentatus*), kittiwake, razorbill, shag and black guillemot, and these, along with others, contribute to the 300,000 individuals that regularly inhabit this area during the breeding season (JNCC website).

The JNCC reports by Kober *et al*. (2010, 2012) on the numbers and distribution of seabirds within the British Fisheries Limit aimed to assist in identifying potential marine SPAs, using a suite of analyses based on UK selection guidelines. From these, four important multi species regions were evident: the outer Firth of Forth, with the Wee Bankie and Marr Bank; the inner Firth of Forth; the north and west of the Shetland Islands and the Moray Firth. These areas were identified as being important for a variety of species of seabird assemblages; for the Moray Firth, these were guillemot (breeding and winter), shag (breeding and winter) and kittiwake (breeding). This analyses better informed the process of identifying which areas have a sufficiently robust ecological case to be suitable for classification.

The East Caithness Cliffs represents the most important area on the east coast of the UK for black guillemot, resulting in the most recent (2014) designation to the area, the MPA, which encompasses the nearshore waters off the coast between Wick and Helmsdale, used by >1,500 breeding black guillemot.

A main source of data on seabird population size is the census of British and Irish seabird colonies; the most recent of these took place from 1998-2002, with the results published by Mitchell *et al*. (2004). The JNCC co-ordinates a Seabird Monitoring Programme (SMP) and results of population trends and conservation status are regularly reported (JNCC 2016). Additionally, strategic programmes including the Future of the Atlantic Marine Environment (FAME) and more recently Seabird Tracking and Research (STAR), which sought to continue the work undertaken for FAME, have provided results on the movement of a number of seabird species since 2010, including in relation to a number of colonies in Scotland. Though involving relatively few birds and short tagging periods, the FAME study output did show use of the Moray Firth by northern fulmar (fulmar) (*Fulmarus glacialis*), kittiwake and razorbill from Orkney colonies for foraging during the breeding season.

A survey was conducted at the East Caithness Cliffs SPA in 2015, in order to provide up-to-date population estimates for the complete colony counts at the SPA; the last complete colony count was carried out in 1999. To enable comparison with the last complete count, the 2015 survey followed the same methodology, such as the colony counted in sections and a mixture of counts from land and sea, with a few exceptions: it was acknowledged the changes in methodology may have influenced the results, but not significantly (Swann 2016).

Compared to the 1999 results, the 2015 survey indicated there had been an increase in three species: razorbills (+69.5%); great black-backed gulls (+47.8%) and European shags (+3.6%) and a decrease in four species: northern fulmar (-3.6%), herring gulls (-4.2%), common guillemots (-6.2%) and black-legged kittiwakes (-39.5%). While these rates appeared to be following the trend for these species in a UK context, the rates of increase seen between surveys tended to be greater than those recorded for these species nationally while the decreases tended to be less than those recorded nationally (national figures both up to 2014) (Swann 2016).

Baseline bird surveys were conducted from the Beatrice Alpha platform throughout 2005 as part of the Beatrice Wind Farm Demonstrator project. Significant seasonal variations in seabird abundance were described. Auks showed clear peaks in abundance in April and June, while kittiwake abundance peaked in July, but stayed fairly high throughout spring-summer. Fulmar were abundant throughout the majority of the year, although less so from September-December. Northern gannet (gannet) (*Morus bassanus*) abundance was elevated from May-November, with peak numbers during October. Great black-backed gulls (*Larus marinus*) were most abundant during autumn and winter months (Talisman 2006).

Boat-based surveys were conducted for the Beatrice Offshore Wind Farm (BOWL) project in the Moray Firth between October 2009 and September 2011 (RPS 2012). These took place over two days each month covering an area of approximately 383km^2 which included a 4km buffer of the wind farm site boundary. A single aerial survey was undertaken in March 2011 where weather prevented the use of boat based methods.

For the 22 boat-based surveys, 21,419 individuals were recorded across 22 species. Those most frequently observed species are summarised in Table 4.4. Six pre-construction digital aerial surveys were undertaken between May and August 2015 covering the BOWL site and an area extending westwards to the East Caithness cliffs covering an area of 1,142km^2 (BOWL 2016). Densities of seabirds on the water and in flight were estimated for gannet, guillemot, kittiwake, puffin, razorbill, great black-backed gull and herring gull, which were found to be similar to those for the boat-based surveys undertaken in 2009 and 2011.

Table 4.4 – Most frequently observed birds from surveys relating to the Beatrice Demonstrator and BOWL Projects

Species	Beatrice AP		BOWL Area 2008-2011
	Observations	Individuals	Observations
Kittiwake	1138	2943	2519
Auk[1]	1113	5757	12249
Fulmar	887	1078	2459
Gannet	528	707	528
Great black-backed gull	246	424	502
Herring gull	137	193	415
Great skua	49	51	91
Shag	30	63	41
Meadow pipit	25	33	-
Sooty shearwater	17	34	118
Arctic tern	-	-	29
Arctic skua	-	-	19

Notes: All data are totals for the year. 1 All auk species segregated (includes guillemot, black guillemot, little auk, puffin and razorbill). Source: Talisman (2006), RPS (2012)

4.10.2 Waterbirds

Coastal areas of the Moray basin, the firths and bays form an integral unit that are of great importance for wintering and passage wildfowl, as well as for breeding waders and other waterbirds; several SPA and Ramsar sites are designated for such features in the region.

The Moray Firth is of international importance for seaduck, attracting (in some cases the largest or second largest British or Scottish) wintering populations of long-tailed duck (*Clangula hyemalis*), velvet (*Melanitta fusca*) and common scoter (*Melanitta nigra*), greater scaup (*Aythya marila*), common goldeneye (*Bucephala clangula*), common eider (Somateria mollissima) and others including red-breasted merganser (*Mergus serrator*), Slavonian grebe (*Podiceps auritus*) and divers such as great-northern diver (*Gavia immer*) and red-throated diver (*Gavia stellata*); these all being qualifying species for the Moray Firth proposed SPA (see Section 4.13), the closest boundary of which is *ca*. 21km to the Jacky WHP. Eider are resident throughout the year, but the long-tailed duck, great northern diver, common goldeneye, greater scaup and Slavonian grebe migrate long distances from their northern breeding grounds to reach the wintering grounds. Red-breasted mergansers are typically short distance migrants, using coastal areas in winter.

Wintering waders are widely distributed throughout the inner Moray Firth. Major concentrations can be found on the large intertidal areas at Loch Fleet, Dornoch Sands, and the various Bays in the area, such as Tain, Nigg, Udale and Munloch, with the most widespread wintering species including oystercatcher (*Haematopus ostralegus*), curlew (*Numenius arquata*), bar-tailed godwit (*Limosa lapponica*) redshank (*Tringa totanus*), knot (*Calidris canutus*) and dunlin (*Calidris alpina alpina*).

Numbers of non-breeding waterbirds throughout the UK are regularly estimated from land-based surveys as part of the Wetland Bird Survey (WeBS). Several sites in the Moray Firth area have such high numbers of birds (5yr average of >20,000 birds) to be consistently included in the UK list of principal sites for non-breeding waterbirds; these are the Inner Moray and Inverness Firth, the Dornoch Firth and the Cromarty Firth (Austin *et al.* 2014); these publications highlight the importance of the area for seaduck. In addition, aerial surveys of wintering seaducks, divers and grebes have previously been conducted annually (during the winter season, November to March) from 2000/2001 by JNCC

with a particular focus on the Moray Firth area to support work progressing the identification of SPAs; long-tailed duck, common and velvet scoter, common goldeneye and common eider were the most abundant species (Wilson *et al.* 2006, Söhle *et al.* 2006, Lewis *et al.* 2009, Lawson *et al*. 2015).

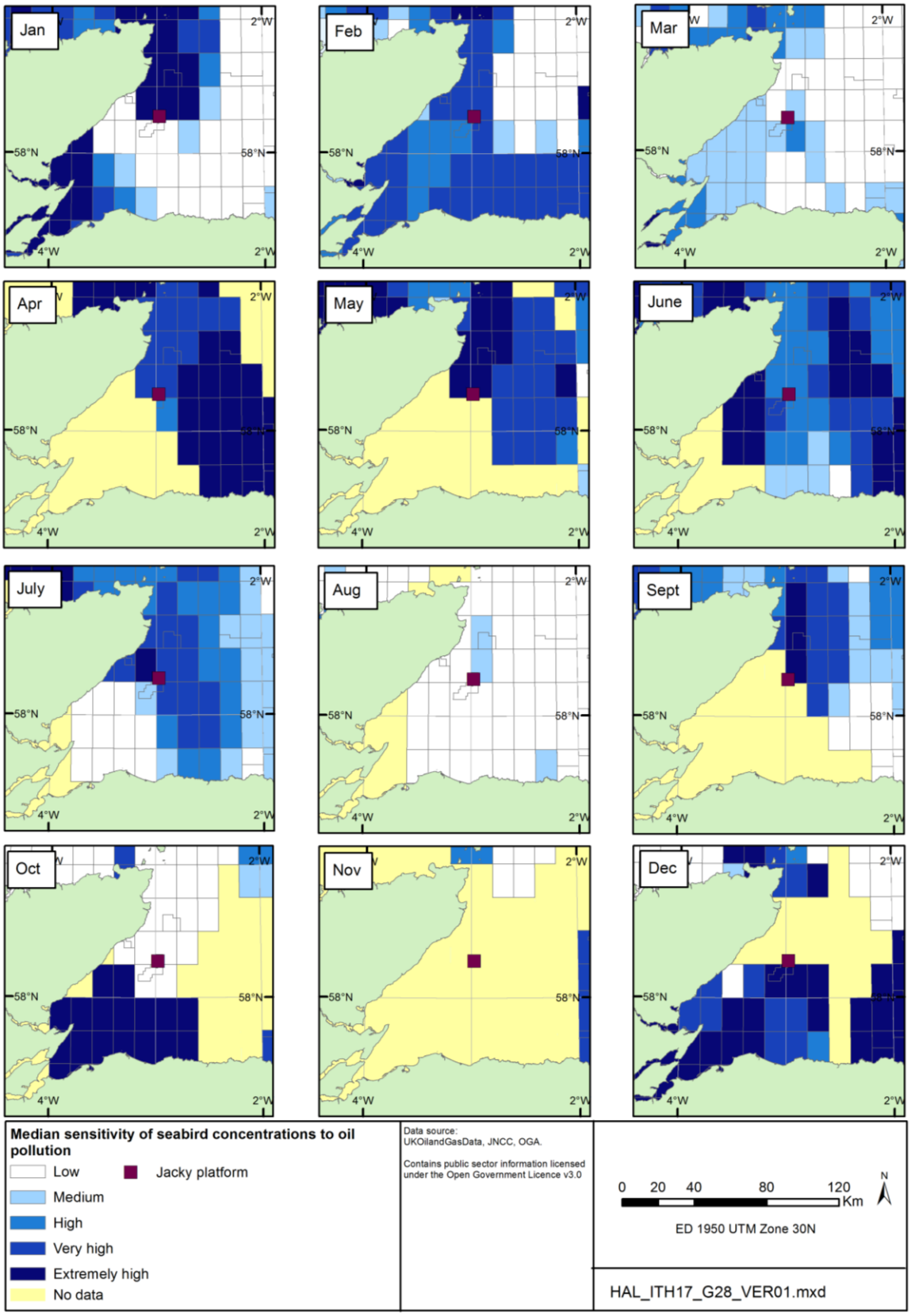
4.10.3 Vulnerability to Oil Pollution

The vulnerability of seabird species to oil pollution at sea is dependent on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) was developed by JNCC and was used to assess the vulnerability of bird species to surface pollution. This index considered four factors: amount of time spent on the water; total biogeographical population; reliance on the marine environment; and potential rate of population recovery (Williams *et al*. 1994, see JNCC 1999). In recent years the index and the methods underlying it were becoming dated, with some data in excess of 15 years old, and work commenced in 2015 to develop a new revised sensitivity index; this has now been published, the Seabird Oil Sensitivity Index (SOSI) (Webb *et al*. 2016).

The SOSI has been developed (Webb *et al*. 2016)[9] based on previous indices by Williams *et al*. (1994) and method refining according to Certain *et al*. (2015) using seabird survey data collected from 1995-2015 from a variety of survey techniques (boat-based, visual aerial and digital video aerial). This survey data was combined with an individual seabird species sensitivity index values, these values being based on a number of factors considered to contribute towards a species sensitivity to oil pollution such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate and potential annual productivity. The SOSI is presented as a series of monthly UKCS block gridded maps, with each block containing a score on a scale of low to extremely high; these scores indicate where the highest seabird sensitivities might lie, if there were to be a pollution incident. Seabird sensitivity in the Jacky area is high, very high or extremely high for at least eight months of the year (see Figure 4.8); but it should be noted that low data availability is indicated for a number of months, with data availability highlighted by Webb *et al*. (2016) as a wider issue for the index which requires extended data coverage to be improved.

[9] See JNCC: http://jncc.defra.gov.uk/page-7373. Also see OGA (2016). 29th Round Other Regulatory Issues – version at 23rd August 2016: https://www.gov.uk/guidance/oil-and-gas-licensing-rounds#th-seaward-licensing-round

Figure 4.8 – Monthly seabird oil sensitivity index scores



Source: Webb *et al.* (2016)

4.11 Marine Mammals

The Moray Firth is an important area for cetaceans, and is of particular year round importance for bottlenose dolphin (*Tursiops truncatus*) (the area supports a resident population of this species), and harbour porpoise (*Phocoena phocoena*), with regular sightings of white-beaked dolphin (*Lagenorhynchus albirostris*) and minke whale (*Balaenoptera acutorostrata*), during summer (Reid *et al*. 2003, Hammond *et al*. 2013, 2017). The Moray Firth area also supports important breeding colonies for harbour and grey seals. All of these species are considered Priority Marine Features in Scottish waters – see JNCC website, Tyler-Walters *et al*. (2016) and Section 4.13.

Reid *et al*. (2003) provides a summary of the distribution of cetaceans in north-west European waters, Hammond *et al*. (2004) summarises the spatial distribution and ecology of marine mammals in the central and northern North Sea, and Thompson *et al*. (2013) provides an overview of the marine mammals of the Moray Firth specifically. Widespread ship-based and aerial surveys of cetaceans in the North Sea and adjacent waters took place in the summers of 1994, 2005 and 2016 for the SCANS and programme (Small Cetacean Abundance in the North Sea); results of these are presented in Hammond *et al*. (2002, 2013, 2017).

Extensive information on the distribution and abundance of grey and harbour seals around Britain is regularly obtained from annual aerial surveys of breeding colonies and haul-out sites and from satellite-relayed data loggers studies; results are reported yearly by the Special Committee on Seals (SCOS) which is tasked with providing advice on matters related to the management of seal populations.

4.11.1 Cetaceans

Bottlenose dolphins occur across a large part of UK waters, in coastal inshore areas, on the continental shelf and further offshore but for this species there is evidence for sub-population structuring. Offshore dolphins are likely part of a wide-ranging large oceanic population but inshore dolphins frequently reported off northeast and southwest Scotland, in the Irish Sea, and in the western English Channel, form four seemingly semi-resident and much smaller populations, for which separate Management Units have been recently agreed (IAMMWG 2015). The relevant one to the Moray Firth is the Coastal East Scotland Management Unit covering inshore waters from Orkney to the Firth of Forth.

In the Moray Firth, bottlenose dolphins are regularly observed throughout the year, with a clear preference for areas within 15 km of the coast and with highest densities in the inner Moray Firth and along the southern coast (Thompson *et al*. 2013). This species is listed in Annex II of the Habitats Directive, and the importance of this population, and the Moray Firth, is reflected in the designation of part of this area as a SAC. The most recent number of bottlenose dolphin using the SAC (in the summer of 2013) is estimated at around 195 individuals (95%CI: 81-110) (Cheney *et al*. 2014). Annual estimates over the period 1990-2013 show considerable inter-annual variability (range 43-134), but no significant linear trend over time has been detected (Cheney *et al*. 2014 – data from this and further survey and monitoring data from 2014 to 2016 will be incorporated into the next full site condition monitoring report due in 2018).

In the 1980s, the core of the population's range was observed in the inner Moray Firth, typically within three main areas: the Kessock Channel, Chanonry Narrows, and around the mouth of the Cromarty Firth (Wilson *et al*. 1997, 2004; Hastie *et al*. 2003). While dolphins are seen in these areas throughout the year, an apparent influx of animals is observed from May-September (Thompson *et al*. 2011). Surveys along the southern coast of the Moray Firth from 2001-2005 encountered bottlenose dolphins along the majority of the coastline, primarily in waters <25m depth (Robinson *et al*. 2007). Since the early 1990s, data have shown the population's range to include waters off Aberdeenshire, Tayside and Fife, including the Firth of Forth with high individual variability in patterns of movement between Moray Firth SAC and Tayside and Fife areas (Wilson *et al*. 2004, Thompson *et al*. 2011, Quick *et al*. 2014). A series of hydrophones have been deployed off the Scottish east coast by Marine Scotland which detect

cetacean vocalisations and will provide information on seasonal presence and movements. Bottlenose dolphins are considered generalist predators, with a broad diet that includes many demersal and pelagic prey species; in Scotland, analyses of stomach contents have shown gadoids to be the main component, along with salmon, other fish species and cephalopods (Santos *et al*. 2001).

The harbour porpoise is the most common cetacean in UK waters; it is wide-ranging and abundant throughout the UK shelf seas, both coastally and offshore. It is also the smallest cetacean in UK waters, and typically occurs in small groups of 1-3 animals; larger aggregations have been reported, probably where many small groups are concentrated in the same area, rather than coordinated schools (Reid *et al*. 2003). Individuals across the UKCS are part of the north east Atlantic population, which is mainly considered to be a single "continuous" population, even though some degree of genetic differentiation has been observed (Anderson *et al*. 1997, 2001, Tolley *et al*. 2001, Fontaine *et al*. 2007). However, for management and conservation purposes, three distinct UK Management Units have been proposed; the one which encompasses the Moray Firth area is the North Sea MU.

Harbour porpoise are widely distributed throughout the Moray Firth, with frequent sightings in nearshore and offshore waters. Although seen throughout the year, sightings are most frequent and widespread in this region between April and September. Boat-based visual and acoustic surveys of the Moray Firth SAC and adjacent waters from January-October 2001 encountered small schools of harbour porpoise throughout most of survey area (Hastie *et al.* 2003). However, porpoises were rarely encountered in inshore waters of the inner Moray Firth, where bottlenose dolphin were most frequently encountered. Passive acoustic monitoring during late summer/autumn at the Beatrice Field showed harbour porpoise to be frequently present, with short visits recorded several times per day (Talisman 2006). Widespread distribution and regular presence across the Moray Firth was confirmed in more recent studies (Thompson *et al*. 2013). The Smith Bank and Outer Moray Firth have been identified as persistent summer high density areas following distribution modelling of survey data across the UKCS (Heinänen & Skov 2015).

Analyses of the stomach contents of harbour porpoise stranded in Scotland from 1992-2003 (primarily the east coast) revealed sandeels and whiting to be the main prey items (Santos *et al*. 2004). Other small gadoids and cephalopods were also important, along with herring in some years.

White-beaked dolphins are frequently sighted in the Moray Firth, primarily in offshore waters of the outer firth. Along with harbour porpoise, they are the most commonly occurring cetaceans in the central and northern North Sea. Although sightings are made throughout the year, the species is most frequently observed between June and October. This species has been recorded taking whiting and other gadoids, sandeels, herring and octopus. Studies of the stomach contents of animals stranded mainly on the Scottish east coast identified haddock and whiting as predominant fish species consumed (Canning *et al*. 2008).

Minke whales are found throughout much of the Moray Firth during summer months, with sightings recorded across the outer Moray Firth, the southern coast and occasionally the inner Moray Firth. They have been recorded in this area during all three SCANS surveys (Hammond *et al*. 2002, 2013, 2017), and the inshore waters of the southern Moray Firth (primarily between Spey Bay and Fraserburgh (Robinson *et al*. 2009)), are thought to provide a rich feeding ground, especially between June and October (Robinson & Tetley 2007, Paxton *et al.* 2014). Minke whales in the Moray Firth area appear to have a strong preference for water depths between 20 and 50m, steep shelf slopes and sandy-gravel sediment type, and as a consequence, are a feature of the proposed Southern Trench MPA. They feed on a variety of fish. Analysis of stomach contents of ten minke whales stranded in Scotland from 1992-2002 showed sandeels to be the dominant prey item, with sprat, herring, mackerel and Norway pout consumed to a lesser extent (Pierce *et al*. 2004); animals caught in the North Sea by Norwegian fisheries showed a similar diet composition, along with the addition of whiting (Olsen & Holst 2001).

The Moray Firth lies within survey stratum 'S' covered by the SCANNS-III survey in summer 2016. This 40,383km^2 north-south elongate polygon includes waters of the inner and outer Moray Firth, Pentland Firth and waters around Orkney north to shelf waters west of Shetland. For this area, surveyed by plane, design-based density estimates included 0.152 harbour porpoise per km^2, 0.021 white-beaked dolphin, 0.010 minke whale and 0.004 bottlenose dolphin per km^2 (Hammond *et al.* 2017).

While mainly seen along the shelf break and over deeper waters such as the Faroe-Shetland Channel, long-finned pilot whale (*Globicephala melas*) are occasionally sighted in the Moray Firth; most sightings have occurred in June-August. Atlantic white-sided dolphin (*Lagenorhynchus acutus*) is common along the continental slope and deeper waters to the north and west of Scotland; they are occasionally seen in the northern North Sea, particularly from July-August, and may be occasionally present in the outer Moray Firth. Risso's dolphin (*Grampus griseus*) have also been recorded in the outer Moray Firth area with sightings most common between October and May. Robinson *et al.* (2017) reviewed killer whale (*Orcinus orca*) sightings in the Moray Firth between 2001 and 2015; the majority of sightings were in the Outer Moray Firth, particularly along the northern coastline. Killer whales were seen throughout the year with peak observations between May and July.

4.11.2 Grey and Harbour Seal

The Moray Firth area supports important breeding colonies for grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals

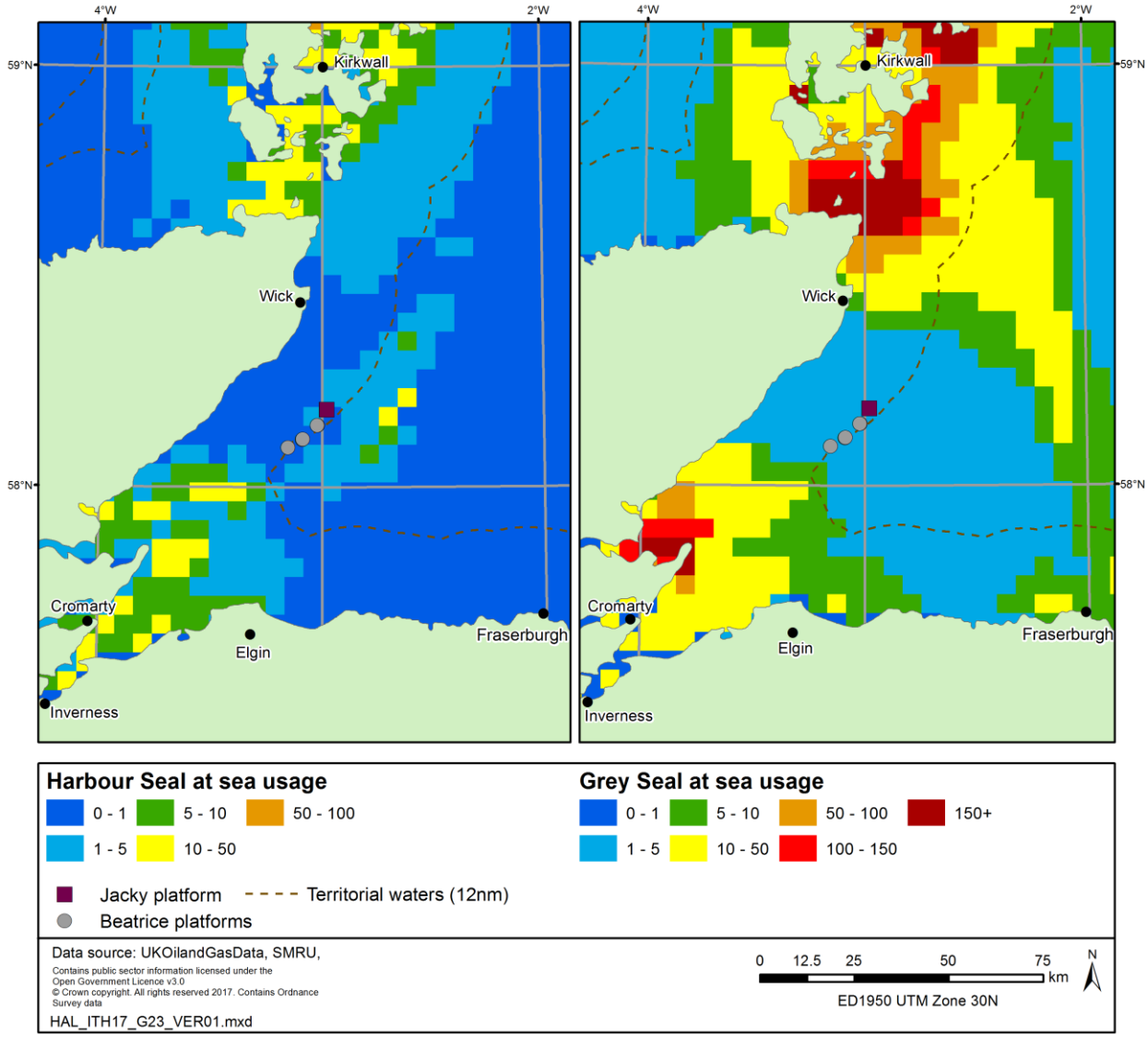
Harbour seals haul out on tidally exposed areas of rock, sandbank or mud throughout the Moray Firth area, with the greatest concentration found in the inner Moray Firth particularly during June, July and August (breeding season and moult) (Thompson *et al*. 1996). Important haul-out sites are found at Ardersier (at the mouth of Inverness Firth), the Beauly, Cromarty and Dornoch Firths. This species is listed in Annex II of the Habitats Directive and the importance of its presence in the region is reflected in the designation of Dornoch Firth and Morrich More as a SAC.

In the area surveyed annually (Helmsdale to Findhorn) 705 harbour seals were counted in 2015, compared with 693 counted in 2014. These are the two lowest counts, but in contrast with the extreme and prolonged declines experienced elsewhere on the East Coast of Scotland (in particular Shetland, Orkney and Forth of Firth) these represent a decline of just over 20% than the mean count between 2002 and 2013 (909 seals). Considerable variability between years across different sites within the Moray Firth has been recorded; for example, in 2015 Cromarty Firth had the lowest count (n=22), but Culbin and Findhorn had the highest (330) (Duck & Morris 2016). Following a period of decline, harbour seal counts in the Moray Firth have stabilised, while general declines have continued across several areas, in particular Shetland, Orkney and the Firth of Tay; research into the causes of the decline is ongoing (SCOS 2015).

Faecal analyses have revealed sandeels, followed by flatfish, to be the main harbour seal prey items, with important contributions from gadoids (e.g. cod, haddock, whiting, ling), salmonids and cephalopods (Thompson 2003). Clupeids such as herring may also contribute a large proportion of their prey, although this varies considerably between years (Tollit & Thompson, 1996). Harbour seals tend to forage within 60km of their haul out sites, and foraging areas can change depending on fish abundance (Thompson *et al*. 1996). In the Moray Firth, important foraging areas, include east of Tarbat Ness, north of Burghead, as well as the deep water of the inner Moray Firth. Larger seals appear to travel further out into the Moray Firth to forage than smaller seals. They also feed in rivers flowing into the Moray Firth. More recently, studies of harbour seal foraging distribution using satellite telemetry have revealed this species to forage much further offshore that previously thought and to display a large degree of individual variation in foraging patterns and behaviour (Hammond *et al*. 2004, Sharples *et al*. 2008, Sharples *et al*. 2012). In addition to seals from local haul-out sites, tagging studies have shown the Moray Firth to be part of the foraging range of seals from Orkney (Sharples *et al*. 2012).

Maps displaying estimates of at sea usage by harbour seals (Jones *et al*. 2013, also see Jones *et al*. 2015), show low to moderate seal density in the Moray Firth (Figure 4.9)

Figure 4.9 – Habitat usage by harbour and grey seals in the Moray Firth



Approximately 88% of the UK population of grey seals breed in Scotland, largely in the Hebrides and Orkney, with major colonies also present on Shetland and along the east coast of Scotland. In the Moray Firth, they breed on rocky beaches and in caves north of Helmsdale and also use haul out sites in the Dornoch Firth and on the south coast, particularly Culbin and Findhorn.

Grey seals forage over a wider area than harbour seals, travelling up to 145km from haul out sites (Thompson *et al*. 1996). Numbers of seals at haul out sites are generally greatest from June-September. Grey seals are an Annex II listed species but there are no SACs designated specifically for grey seals within the Moray Firth area. Extensive telemetry information from British grey seals at sea shows that they are widely distributed throughout the Moray Firth (Russell & McConnell 2014), particularly outside the pupping season in October-November and the moulting season in February-April (Matthiopoulos *et al*. 2004). Maps displaying estimates of at sea usage by grey seals have been produced by Jones *et al*. (2013) (also see Jones *et al*. 2015 and Jones & Russell 2016), which show moderate to high seal density in the Moray Firth (Figure 4.9). Grey seals foraging in the Moray Firth

are likely to include many individuals breeding across North Scotland particularly from those major colonies on Orkney as well as from the Hebrides (Russell *et al*. 2013). Faecal analyses indicate sandeels to be the main prey, along with an important contribution from flatfish (plaice) and gadoids (e.g. cod, haddock, whiting, ling), clupeids and cephalopods are also consumed (Hammond & Grellier 2006).

There has been a continual increase in pup production since regular surveys began in the 1960s; consequently, population estimates are also increasing with a total estimate for the UK population in 2014 of 116,800 individuals (95% Confidence Interval 96,600-143,000) (SCOS 2015). The 2015 August count at haul-out sites across the Moray Firth was the highest ever recorded (n=1917) but variability is very high, with only 532 seals recorded in 2014 and ranging between 392 and 1917 seals between 1997 and 2015 (Duck & Morris 2016).

4.12 Otters

The otter (*Lutra lutra*) is a semi-aquatic mammal occurring throughout a range of ecological conditions, including inland freshwater and coastal habitats. The northern and eastern Highlands surrounding the Moray Firth are important areas for this species, with a number of SACs designated for their presence. Of these, the River Spey SAC and Dornoch Firth and Morrich More SAC include coastal and/or estuarine habitats. The otter is also considered a Priority Marine Feature– see JNCC website, Tyler-Walters *et al*. (2016) and Section 4.13.

The River Spey SAC maintains a persistently large population of otters; evidence of breeding has been observed (Strachan 2007) and areas of the nearby Insch Marshes provide ideal sites for feeding, resting and shelter. The Dornoch Firth and Morrich More SAC provides excellent habitat for otters, as do the Rivers Evelix and Oykel, which both feed into the site. This is the only specifically estuarine site designated as a SAC for otter on the east coast of Scotland and supports a good population of this species; evidence of breeding has also been observed here (Strachan 2007).

4.13 Conservation Sites

The importance of the area is reflected in the designation of a number of international and national conservation sites on land and at sea, including Special Protection Areas (SPAs) established under Birds Directive[10], Special Areas of Conservation (SACs) under the Habitats Directive[11] (SPAs and SACs collectively form part of the European ecological network of *Natura 2000* sites) and Ramsar sites designated under the Ramsar Convention[12]. At a national level, Nature Conservation Marine Protected Areas (NCMPAs) are designated under the *Marine (Scotland) Act 2010* in Scottish territorial waters and by the *Marine and Coastal Access Act 2009* for offshore waters; administered by SNH and JNCC respectively. Globally, the value of the Moray Firth in bird conservation has been recognised with five sites listed as Important Bird Areas by BirdLife International; protection for these areas has been provided for through SPA and Ramsar site designations.

The names and locations of SACs, SPAs and NCMPAs currently designated or proposed are shown in Figure 4.10 (marine and coastal) and Figure 4.11 (riverine and inland[13]). Further details on the specific features for each site are given for those within the Moray Firth in Table 4.5.

The suite of SPAs on land in Scotland is well established, but further work is needed to complete a network at sea; in 2009 the East Caithness Cliffs SPA was extended seaward by 2km due to the presence

[10] Council Directive 2009/147/EC on the conservation of wild birds
[11] Council Directive 92/43/EEC on the conservation of natural habitats of wild flora and fauna
[12] The Convention on Wetlands of International Importance, especially as Waterfowl Habitat
[13] Only inland sites with features linked to the marine environment are shown

of fulmar as a qualifying feature (three other qualifying species required marine extensions to the SPA, guillemot, razorbill and puffin, but only by 1km; fulmar required the greatest extension distance based on JNCC generic guidance, e.g. McSorley *et al*. 2003, therefore the classified terrestrial SPA was extended by 2km).

Work continues on the identification of important areas for birds, (e.g. Kober *et al.* 2012) and some of these have been taken forward for potential designation (Moray Firth pSPA, and Pentland Firth marine pSPA) and were subject to public consultation in 2016 and 2017, with a decision on designation to be made by Ministers thereafter.

The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 were introduced to facilitate the designation of SACs and SPAs in offshore waters beyond 12nm. Twenty offshore SACs have now been submitted to the European Commission but none is within the Moray Firth, the closest being the Scanner pockmark SAC approximately 231km to the east; no offshore SPAs have yet been identified although work to identify these continues (e.g. Kober *et al*. 2010, 2012).

The NCMPAs give protection to features not currently covered by SPAs and SACs and contribute further to measures aimed at achieving Good Environmental Status across Europe's seas by 2020 under the EU Marine Strategy Framework Directive. The first tranche of NCMPAs was designated in July 2014, and this included the designation of the East Caithness Cliffs NCMPA, designated for the conservation of black guillemot. The boundary of the site overlaps the 2km seaward extension of the terrestrial SPA site (approximately 17km from Jacky), as this provides important feeding areas for this species; field studies and modelling indicate that ~95% of all black guillemot forage within 2km of the coastline where they nest (SNH 2016). A second NCMPA in the general area, was designated in this round, at Noss Head, designated for the protection of the largest known horse mussel bed in Scotland; this is approximately 21km to the north of Jacky.

At the same time the first tranche of NCMPA sites were being designated in 2014, formal advice was submitted recommending four additional NCMPA proposals for designation, one of which, the Southern Trench, is located in the Moray Firth and approximately 32km south of Jacky.

As part of the MPA process, a set of Priority Marine Features (PMFs) were identified based on an assessment of species and habitats on existing conservation schedules against whether a significant proportion of their population occur in Scotland's seas, whether they are under threat or in decline and the functional role they play. Specialists were consulted on these PMFs, and following public consultation (as part of the wider "Planning Scotland's Seas" consultation), a final list of 81 habitats and species was adopted in July 2014 (also see Tyler-Walters *et al.* 2016). It is intended that the list will help focus future marine planning, research and conservation, and a subset of this list is being used to underpin the identification of further nature conservation MPAs.

If a proposed activity has the potential to impact a Natura 2000 site, the competent authority is required to carry out an Appropriate Assessment. Detailed site information is provided in Appendix 2 to enable the Secretary of State to undertake an Appropriate Assessment under the Habitats Regulations if so required.

Figure 4.10 – Inshore and offshore SACs, SPAs and MPAs

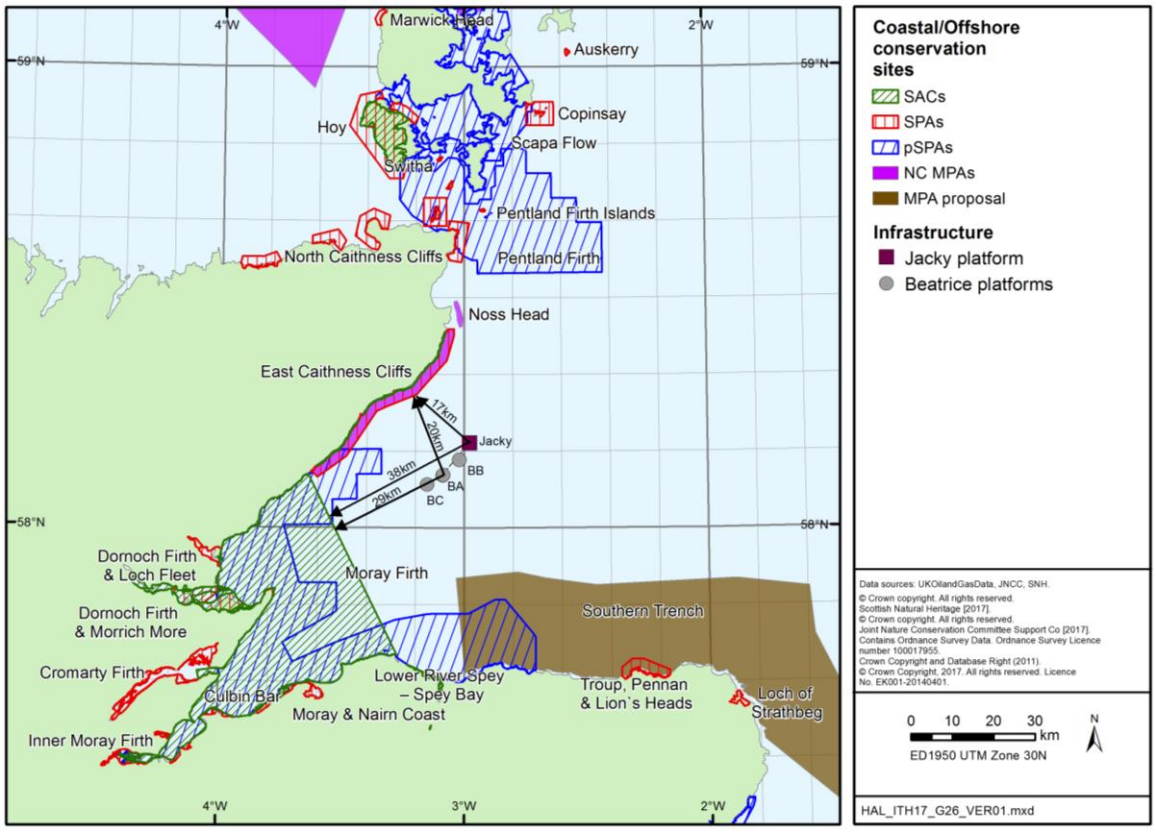


Figure 4.11 – Relevant onshore SACs and SPAs

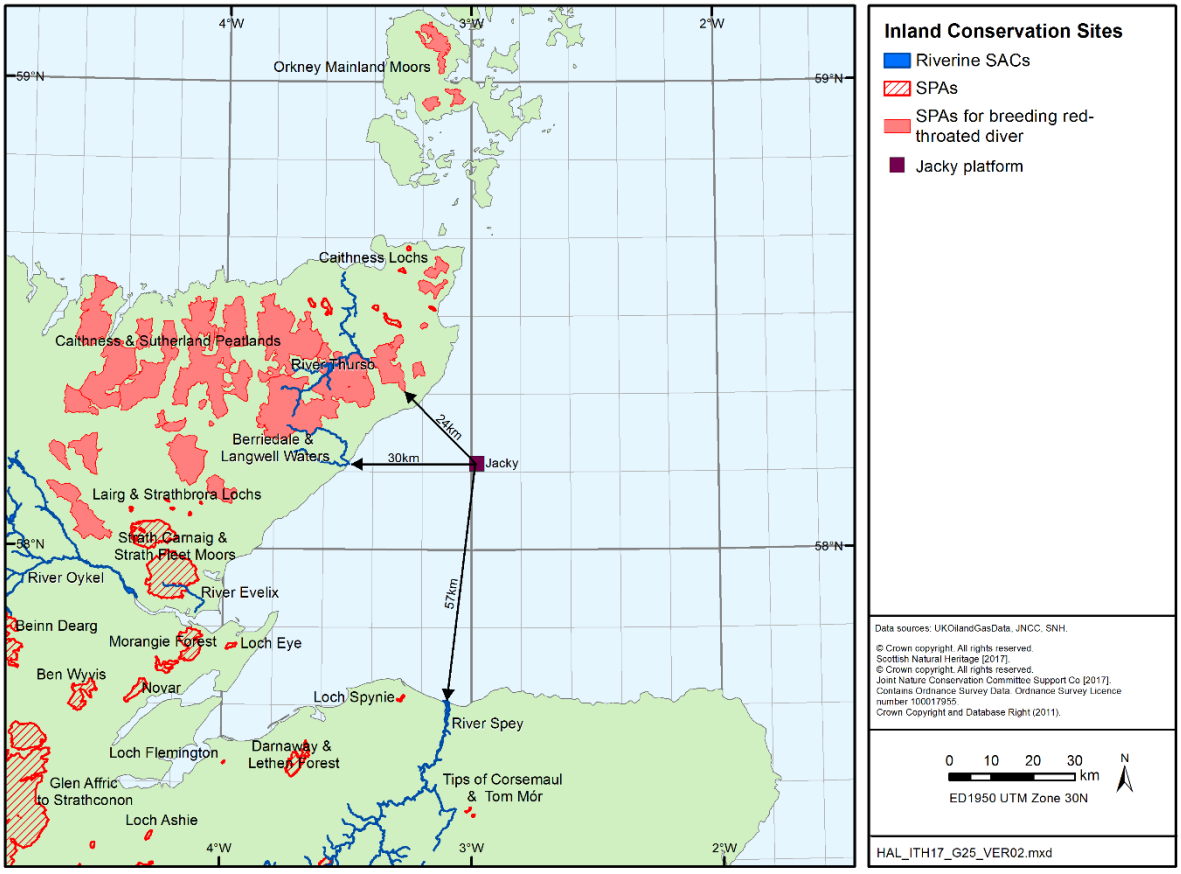


Table 4.5 – Relevant conservation sites and their features

Name	Status	Summary of features – see also Appendix 2
Auskerry	SPA	Arctic tern, Storm petrel (breeding)
Berridale and Langwell Waters	SAC	Atlantic salmon (primary)
Caithness and Sutherland Peatlands	SPA/Ramsar	Black-throated diver, golden eagle, golden plover, hen harrier, merlin, red-throated diver, short-eared owl, wood sandpiper, dunlin (breeding)
Calf of Eday	SPA	Seabird assemblage of international importance including: common guillemot, black-legged kittiwake, great black-backed gull, great cormorant and northern fulmar (breeding)
Copinsay	SPA	Seabird assemblage of international importance including: common guillemot, black-legged kittiwake, great black-backed gull and northern fulmar (breeding)
Cromarty Firth	SPA/Ramsar	Common tern, osprey (breeding); bar-tailed godwit, whooper swan, greylag goose (over winter). Waterfowl assemblage of international importance including: redshank, curlew, dunlin, knot, oystercatcher, red-breasted merganser, scaup, pintail, wigeon, greylag goose, bar-tailed godwit, whooper swan (breeding)
Culbin Bar	SAC	Perennial vegetation of stony banks (primary), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), embryonic shifting (qualifying)
Dornoch Firth and Loch Fleet	SPA/Ramsar	Osprey (breeding); bar-tailed godwit, greylag goose, widgeon (over winter). Waterfowl assemblage of international importance including: curlew, dunlin, oystercatcher, teal, wigeon, greylag goose, bar-tailed godwit (over winter)
Dornoch Firth and Morrich More	SAC	Estuaries, mudflats and sandflats not covered by seawaters at low tide, *Salicorna* and other annuals colonising mud and sand, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), embryonic shifting dunes, shifting dunes along the shoreline with *Ammophilia arenaria* ('white dunes'), fixed dunes with herbaceous vegetation ('grey dunes')*, decalcified fixed dunes with *Empetrum nigrum**, Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)*, humid dune slacks, coastal dunes with *Juniperus* spp.* (primary); reefs, sandbanks which are slightly covered by sea water all the time (qualifying); otter, harbour seal (primary)
East Caithness Cliffs	SAC	Vegetated sea cliffs of the Atlantic and Baltic coasts (primary)
East Caithness Cliffs	SPA	Peregrine, common guillemot, herring gull, black-legged kittiwake, razorbill, European shag (breeding). Seabird assemblage of international importance including: Atlantic puffin, great black-backed gull, great cormorant, northern fulmar, razorbill, common guillemot, black-legged kittiwake, herring gull, European shag (breeding)
East Caithness Cliffs	MPA	Black guillemot
East Sanday Coast	SPA	Purple sandpiper, turnstone (over winter)
Hoy	SAC	Vegetated sea cliffs of the Atlantic and Baltic coasts, natural dystrophic lakes and ponds, northern Atlantic wet heaths with *Erica tetralix*, alpine and boreal heaths, blanket bogs* (primary); European dry heaths, petrifying springs with tufa formation (*Cratoneurion*)*, alkaline fens, calcareous rocky slopes with chasmophytic vegetation (qualifying).
Hoy	SPA	Peregrine, red-throated diver, great skua (breeding). Seabird assemblage of international importance including: Atlantic puffin, common guillemot, back-legged kittiwake, great black-backed gull, Arctic skua, northern fulmar and great skua (breeding)
Inner Moray Firth	SPA/Ramsar	Common tern, osprey (breeding), bar-tailed godwit, greylag goose, red-breasted merganser, redshank (over winter)
Lairg & Strathbrora Lochs	SPA	Black-throated diver (breeding

Name	Status	Summary of features – see also Appendix 2
Loch Ashie	SPA	Slavonian grebe (breeding)
Loch Flemington	SPA	Slavonian grebe (breeding)
Loch of Strathbeg	SPA/Ramsar	Sandwich tern (breeding); whooper swan, teal, greylag goose, pink-footed goose, goldeneye (over winter)
Loch Ruthven	SPA	Slavonian grebe (breeding)
Lower River Spey-Spey Bay	SAC	Perennial vegetation of stony banks, alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salison albae*)* (primary)
Marwick Head	SPA	Common guillemot (breeding). Seabird assemblage of international importance including: black-legged kittiwake and common guillemot (breeding)
Moray & Nairn Coast	SPA/Ramsar	Osprey (breeding); greylag goose, pink-footed goose, redshank (over winter). Waterfowl assemblage of international importance including: pink-footed goose, redshank, greylag goose (over winter)
Moray Firth	SAC	Sandbanks which are slightly covered by sea water all the time (qualifying); bottlenose dolphin (primary)
Moray Firth	pSPA	Great northern diver, red-throated diver, Slavonian grebe (over winter). Shag (breeding); scaup, eider, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser (over winter).
North Caithness Cliffs	SPA	Peregrine, common guillemot (breeding). Seabird assemblage of international importance including: Atlantic puffin, razorbill, black-legged kittiwake, northern fulmar, common guillemot.
North Inverness Lochs	SPA	Slavonian grebe (breeding)
North Orkney	pSPA	Red-throated diver (breeding); great northern diver, Slavonian grebe, common eider, long-tailed duck, velvet scoter, red-breasted merganser, European shag (over winter)
North-west Orkney	MPA	Sandeels
Noss Head	MPA	Horse mussel beds (largest known horse mussel bed in Scottish waters)
Papa Westray	MPA	Black guillemot
Papa Westray (North Hill and Holm)	SPA	Arctic tern (breeding)
Pentland Firth	pSPA	Arctic tern (breeding). Seabird assemblage of international importance (breeding)
Scapa Flow	pSPA	Red-throated diver (breeding); great northern diver, black-throated diver, Slavonian grebe, European shag, common eider, long-tailed duck, goldeneye, red-breasted merganser (over winter).
Pentland Firth Islands	SPA	Arctic tern (breeding)
River Evelix	SAC	Freshwater pearl mussel (primary)
River Oykel	SAC	Freshwater pearl mussel (primary); Atlantic salmon (qualifying)
River Spey	SAC	Freshwater pearl mussel, sea lamprey, Atlantic salmon (primary); otter (qualifying)
River Thurso	SAC	Atlantic salmon (primary)
Rousay	SPA	Arctic tern (breeding). Seabird assemblage of international importance including: common guillemot, black-legged kittiwake, Arctic skua, northern fulmar and Arctic tern (breeding)
Sanday	SAC	Reefs (primary); sandbanks which are slightly covered by seawater all the time, mudflats and sandflats not covered by seawater at low tide (qualifying); harbour seal (primary)
Southern Trench	pMPA	Burrowed muds, fronts, minke whale; shelf deeps
Switha	SPA	Barnacle goose (over winter)
Troup, Pennan and Lion's Head	SPA	Common guillemot (breeding). Seabird assemblage of international importance including: razorbill, black-legged kittiwake, herring gull, northern fulmar, common guillemot (breeding)

Name	Status	Summary of features – see also Appendix 2
West Westray	SPA	Arctic tern, common guillemot (breeding). Seabird assemblage of international importance including: razorbill, black-legged kittiwake, Arctic skua, northern fulmar, common guillemot and Arctic tern (breeding)
Wyre and Rousay Sounds	MPA	Kelp and seaweed communities on sublittoral sediment; maerl beds

*Note: *priority feature. Source: JNCC website (http://jncc.defra.gov.uk/default.aspx?page=4) accessed November 2017, SNH website (http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas-%28mpa%29/) accessed November 2017*

No Annex I habitats, under the EC Habitats Directive, were observed in any of the survey work undertaken at the Jacky and Beatrice areas.

Sites of Special Scientific Interest (SSSIs) are designated for both biodiversity and geodiversity, and in the case of the former, several SSSIs have also acquired European protection by being included within SPAs and SACs. There are several SSSIs in and around the Moray Firth area, including the Culbin Sands, Culbin Forest and Findhorn Bay SSSI and these sites are largely designated for their botanical and marine biological interests. The designation of geological and geomorphological features is underpinned by the identification along the Moray Coastline of Geological Conservation Review (GCR) sites. The Sarclet (Non Marine Devonian) GCR is the closest site to Jacky, approximately 22km to the west.

There are a number of other national and local conservation sites around the Moray Firth area including Royal Society for the Protection of Birds (RSPB) and Scottish Wildlife trust (SWT) reserves; the RSPB are concerned with the protection and conservation of wild birds and have several coastal reserves in the area (e.g. Culbin Sands, Nigg Bay, Troup Head), while the SWT manage two coastal reserves (Loch Fleet and Spey Bay) here. Other reserves and areas of interest include Local Nature Reserves (LNRs) (Findhorn Bay), National Nature Reserves (NNRs) (Loch Fleet) and National Scenic Areas (NSAs) (Dornoch Firth).

4.13.1 Species Conservation

In addition to the designation of specific conservation sites within the area, a number of individual marine species are afforded protection throughout their range. At a European level, strict protection is afforded to species on Annex IV (Animal and Plant Species of Community Interest in Need of Strict Protection) of the Habitats Directive, including all cetacean species, otters, marine turtles and a number of fish and invertebrate species. Under this Annex, the 'deliberate capture, killing or disturbance[14] is an offence, as is their keeping, sale or exchange'. Nationally, several marine species are protected under Schedule 5 of the Wildlife and Countryside Act, 1981. These include all cetacean species, otters, all turtle species, a range of fish including sturgeon, allis shad (*Alosa alosa*), twaite shad (*Alosa fallax*) and basking shark (*Cetorhinus maximus*), and a number of marine invertebrates.

The cold water coral *Lophelia pertusa* is a species of conservation concern, is listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and is also a species considered a Priority Marine Feature (see JNCC website and Tyler-Walters *et al*. 2106). *Lophelia* has been found growing on some North Sea oil and gas platforms, but none has been recorded at the Jacky WHP; a survey of the monopile jacket in 2013 showed the majority of marine growth to comprise the plumose anemone *Metridium senile* with interspersed barnacle, tube worms and hydroids; no species of conservation interest appear to be present.

[14] See JNCC (2008) for information regarding the definition of disturbance.

4.14 Archaeology and Wrecks

The Moray Firth has a number of coastal sites of archaeological interest, found mainly in the sheltered areas of the Beauly and Cromarty Firths, Munlochy Bay and the mouth of the River Ness; in 1998, the Centre for Field Archaeology, University of Edinburgh, surveyed the Inner Moray Firth coast, encompassing a 160km coastal strip from Inverness to Tarbet Ness (Hale & Cressey 2003) and uncovered evidence of such features as Mesolithic shell middens, late Bronze and Iron Age marine crannogs, Bronze Age cist cemetery sites and fishtraps dating from the 17th-19th century.

Flemming (2004) indicated that prehistoric submarine archaeological remains could occur, with low probability, anywhere between the northern mainland coast out to about 1°E. It is thought that prehistoric sites from the last 5,000-10,000 years can survive marine transgression (see Flemming 2004 and Flemming *et al*. 2012). However, the strong prevailing current conditions, the exposure to North Atlantic storms, the thin sediment cover in many places and the large areas of exposed bedrock make the exposed areas of the UK continental shelf poor prospects for the survival of prehistoric deposits *in situ*, other than in submerged caves and gullies.

The CANMORE database, compiled and managed by Historic Environment Scotland (an amalgamation of the previous custodians of the database, the Royal Commission on the Ancient and Historical Monuments of Scotland and Historic Scotland) contains details of archaeological sites, monuments and maritime sites in Scotland. The database indicates a large number of monuments around the coast of the Moray Firth, and occasional marine wreck sites.

No archaeological sites or artefacts have been identified in the Jacky WHP area, or along the pipeline routes from any previous surveys conducted in these areas and no Historic Marine Protected Areas[15] are located in the Moray Firth. Three protected wrecks are located within the area, (Table 4.8) designated under *The Protection of Military Remains Act 1986*[16].

Table 4.8 – Protected wrecks in the Moray Firth area

Wreck	Location	Distance to Jacky WHP (km)
HMS Natal (WWI)	Cromarty Firth, an area 100m radius around 57°41'244"N 4°05'310"W	86
HMS Exmouth (WWII)	Northeast outer Moray Firth, an area 750m radius around 58°18'467"N 2°28'938"W	32
HMS Lynx	Moray Firth, approximately 57°57'35.8"N 3°14'39.5"W	29

Information obtained on wrecks within a 10nm radius of the Jacky Field, was obtained from UK Hydrographic Office to support the original environmental assessment of the installation and operation of the Jacky facilities. This provided coverage of the seabed throughout the pipeline route to the Beatrice Alpha complex, within which six live and two dead wrecks[17] were identified (the closest being 11.5km to the northwest).

The strategic importance of the North Sea area to the navy during WWI and WWII; the concentration of much of the North Sea fishing fleet in coastal ports; the importance of maritime trade routes in the

[15] Note that HMPAs replaced those designations under the *Protection of Wrecks Act 1993*, which was repealed in Scotland in November 2013.
[16] *The Protection of Military Remains Act 1986 (Designation of Vessels and Controlled Sites) Order 2017*
[17] Live wrecks are charted and considered to exist; dead wrecks are not considered to exist (e.g. may be fragmented and dispersed) and not shown on charts.

region and the treacherous nature of nearshore waters, have led to a large number of ship and aircraft wrecks. While many of the locations of these wrecks have been identified and listed by the UK Hydrographic Office, the locations of many more remain uncharted. Decommissioning activities will be largely undertaken within areas which have already been developed; information already obtained on the identification and positioning of known wrecks, is considered sufficient to assess potential impacts from these activities.

4.15 Land and Seascapes

A number of assessments of the landscape and seascapes of the Caithness and Sutherland coast and adjacent land including the inner Moray Firth, Moray and Nairn have been carried out (see for example Scott *et al*. 2005). These provide an overview of landscape features and character, including a consideration of key issues relating to these landscapes and their sensitivity to particular activities, some of which are predicted to expand in these areas (e.g. onshore wind farms). Most recently the landscapes of the area have been characterised through The Landscapes of Scotland project[18], which provides a high level overview of Scotland's landscapes which complement the more specialist analysis in landscape character assessments.

There are relatively few landscape designations within the Moray Firth; the Dornoch Firth National Scenic Area (NSA) being the closest to Jacky. Additionally, there are a number of non-statutory local landscape designations, including on the south coast of the Black Isle and inner Moray Firth, and along the east Caithness coastline. Such sites are designated at a local level, are shown on local development plans, and have associated policies to safeguard their valued features[19].

4.16 Socio Economics and Users of the Offshore Environment

4.16.1 Offshore Energy

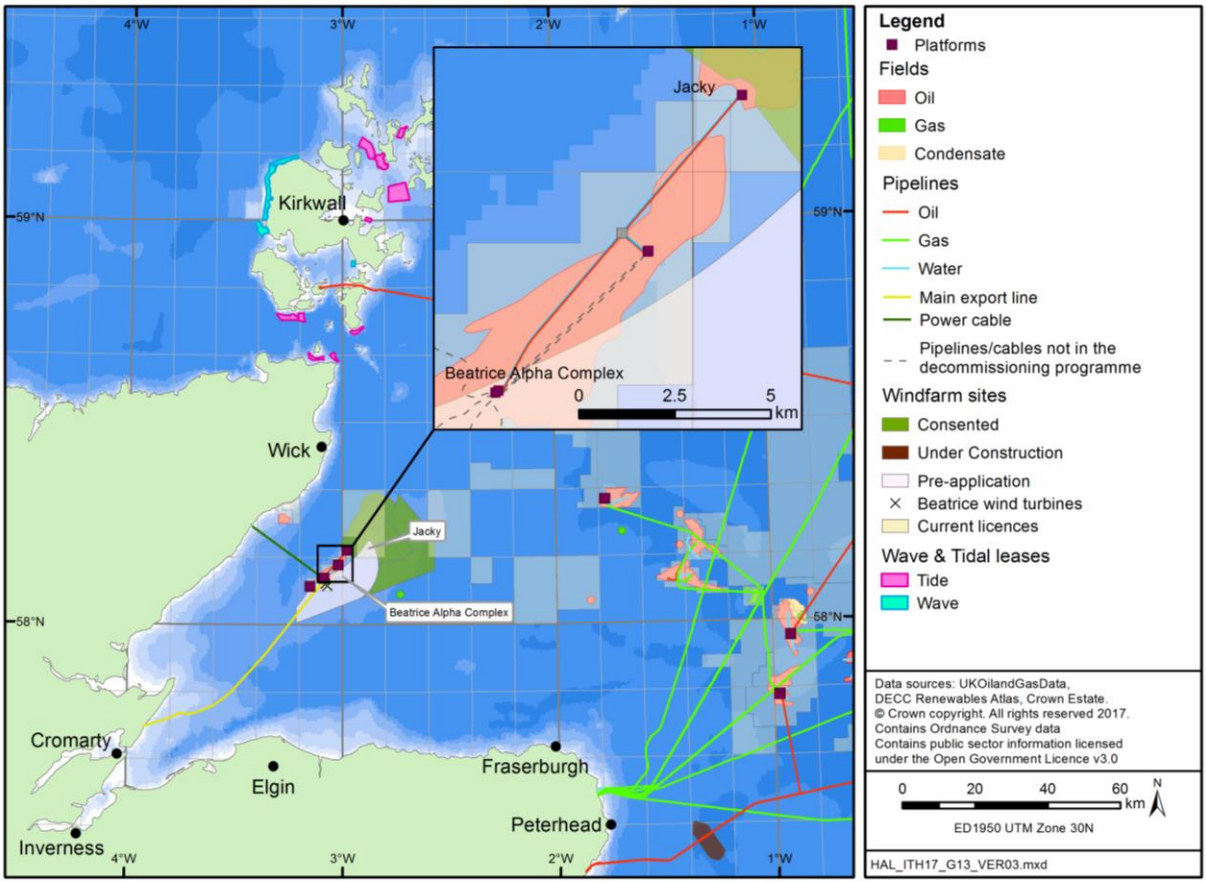
The only other offshore oil and gas infrastructure in the Moray Firth, and the closest to Jacky, is the Beatrice Complex (Block 11/30). Jacky currently remains tied back to Beatrice Bravo via a spur line from the MLT and to Beatrice Alpha via the production and water injection pipelines (see Figure 1.2, Section 1); all Jacky pipelines, including the spur line to Beatrice Bravo have been cleaned and flushed and classed as disused (Figure 4.12). Other North Sea hydrocarbon fields are distant from the Jacky facilities.

The Jacky WHP and associated facilities are located near (~3km) the Moray Firth Round 3 wind farm zone with the tie-in at Beatrice Alpha just overlapping the zone, while the Beatrice Scottish territorial waters wind farm leasing zone, borders the Jacky WHP 500m zone. The Beatrice Offshore Wind Farm was granted consent in March 2014 and offshore construction activities commenced in April 2017; the windfarm is being constructed in phases, and is expected to be fully operational in 2019. The Round 3 area contains two sections: the Eastern Development Area, which comprises the consented Telford, Stevenson and MacColl offshore wind farms and the Western Development Area which to date has been subject to scoping for a development of up to 90 turbines with a capacity of 750MW.

Cable export agreement areas are in place for the Beatrice and Moray Firth wind farm zones which both have their landfall on the southern Moray Firth coast at Portgordon and near Banff respectively.

[18] http://www.snh.gov.uk/about-scotlands-nature/scotlands-landscapes/landscapes-varieties/
[19] Scottish Planning Policy, published June 2014.

Figure 4.12 – Offshore Energy Infrastructure and Activity around Jacky



4.16.2 Fisheries

Commercial Fisheries in the Region

ICES rectangles are subareas of larger ICES sub-divisions and are used for fisheries data recording and management. The northwest outer Moray Firth area lies in ICES sub-division IVa and the Jacky facilities, including the tie-back infrastructure to Beatrice Alpha, is within ICES rectangles 45E7 and 45E6 (Figure 4.14). Table 4.6 lists the weight and first sale value of fish and shellfish landings into UK ports from these rectangles over the period 2014-2016.

Table 4.6 – Weight and value of landings from 45E6 and 45E7, 2014-2016

Species type	2014		2015		2016	
	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)
ICES rectangle 45E6						
Demersal	65	80,646	22	35,304	29	34,312
Pelagic	5	5,173	10	10,063	1	428
Shellfish	901	2,289,443	600	2,037,583	639	1,261,218
TOTAL	**971**	**2,375,21**	**632**	**2,082,950**	**669**	**1,295,957**
ICES rectangle 45E7						
Demersal	535	595,697	1,015	1,329,620	236	312,199
Pelagic	2	3,237	196	67,932	254	113,219
Shellfish	984	2,639,955	560	1,267,046	679	1,867,566

Species type	2014		2015		2016	
	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)
Total	**984**	**2,639,955**	**560**	**1,267,046**	**1,169**	**2,292,984**
Total 45E6 + 45E7	**1,955**	**5,015,216**	**1,192**	**3,349,996**	**1,837**	**3,588,941**
Percentage of UK total	**0.3%**	**0.8%**	**0.2%**	**0.6%**	**0.37%**	**0.5%**

Note: All landings into UK ports. Figures rounded to nearest tonne/£. Source: Scottish Government website, accessed November 2017

Over the period 2014-2016, fisheries in these ICES rectangles were exploited using a variety of fishing gears, with dredges, seine nets and trawls being the most common. Small inshore vessels tend to operate static gears such as pots and traps for crabs and lobster, which makes up a large part of the inshore fishery; fisheries along the Moray Coast are of significant local importance.

With the exception of figures for ICES rectangle 45E7 in 2015 where demersal was dominant, reported landings were dominated by shellfish in terms of weight and value, generally ranging between 61-98% of the total catch. Over the same period, and both rectangles, pelagic fish were landed in small numbers, with relatively low value, with the exception of landings in 2016 in rectangle 45E7, where they accounted for 22% and 5% of the weight and value of the total catch respectively. The catch mainly comprised crabs, *Nephrops*, scallops, squid, haddock and monks/anglers, with herring (particularly in 45E7) and mackerel the dominant pelagic species landed. The large catch of high value demersal and shellfish species contribute to the relatively high percentage of the UK total value landed from these rectangles.

Logbooks submitted by fishermen allow an examination of the gears operated and seasonal patterns in fishing effort (Table 4.7). Effort was higher in summer months, with better weather for small, inshore vessels to operate, reducing considerably during the winter months.

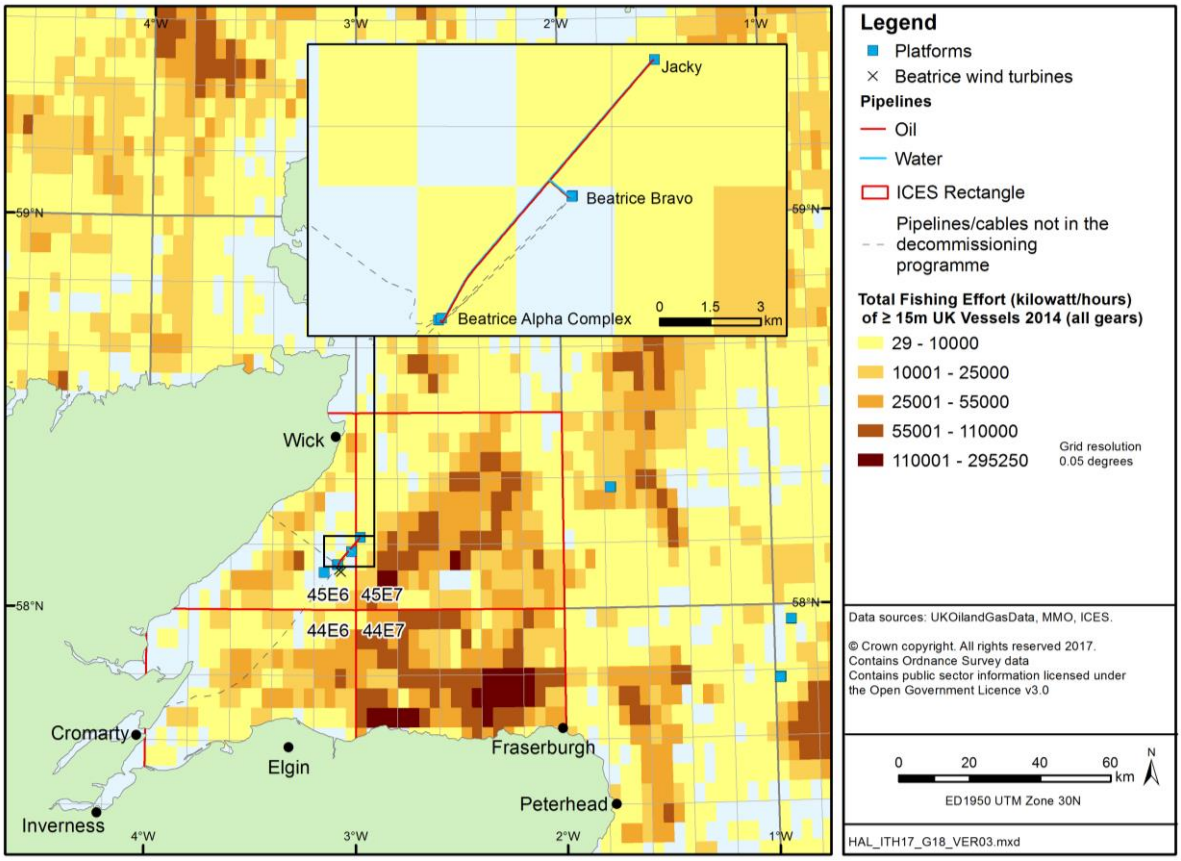
Table 4.7– Number of days fished per month (all gears) in 45E6 and 45E7, 2014-2016

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ICES rectangle 45E6													
2014	12	14	-	22	29	51	43	61	88	32	-	41	**421**
2015	11	-	-	50	56	65	62	50	43	-	44	-	**498**
2016	-	-	60	49	47	43	63	91	31	21	27	-	**432**
ICES rectangle 45E7													
2014	24	11	28	30	116	152	149	88	90	46	32	-	**773**
2015	22	54	16	21	39	170	128	125	79	44	18	19	**734**
2016	26	24	66	83	56	44	116	117	85	14	11	9	**652**

Note: Monthly fishing effort by UK vessels >10m; 'days fished' includes time travelling within rectangles; - = disclosive data, green = 0-60 days fished, yellow = 61-120, orange = 121-180, red = ≥181 Source: Scottish Government website, accessed November 2017

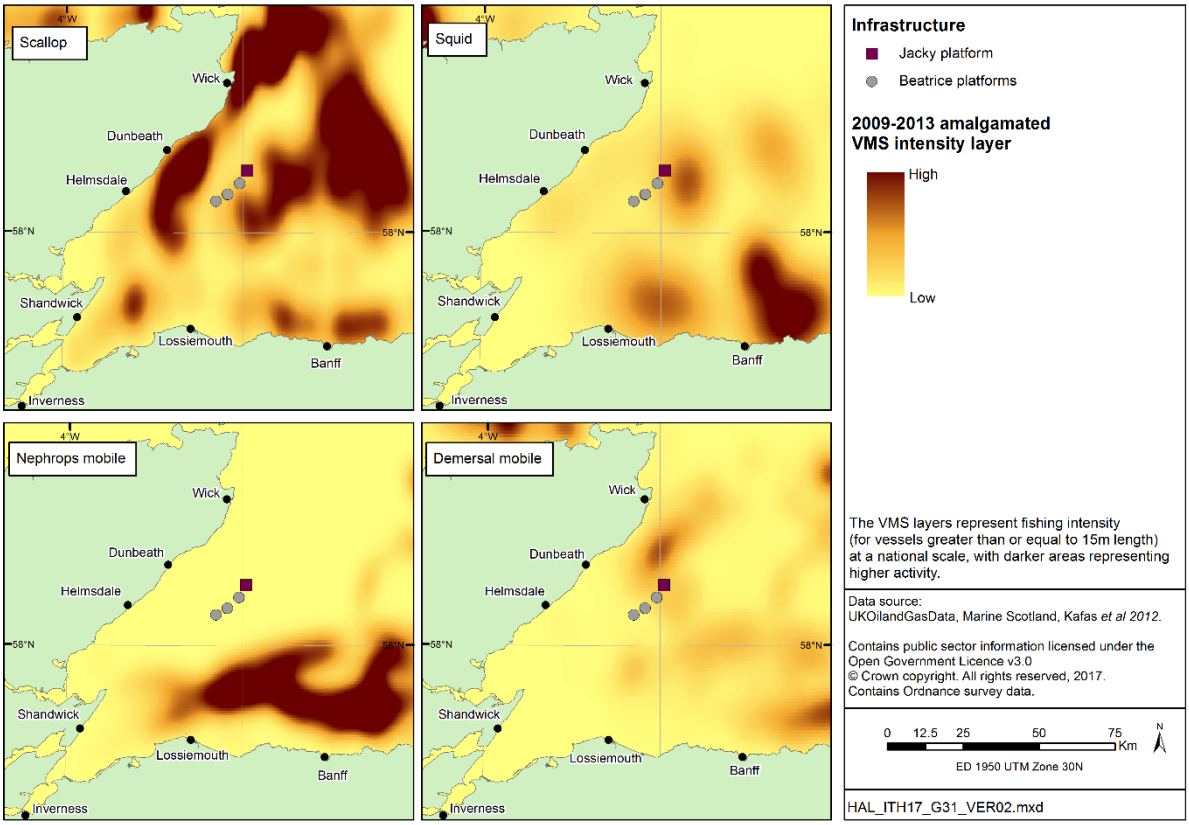
Vessel Monitoring System (VMS) data from 2015, shows fishing activity in the Moray Firth to be greatest along the southern coast (Figure 4.13). The majority of fishing effort in 45E6 and 45E7 is carried out along this coast, and on the Smith Bank, to the east of the Beatrice/Jacky complex. The Jacky area itself experiences low to moderate total levels of fishing effort.

Figure 4.13 – Total fishing effort by UK vessels >15m (all gears), 2015



Amalgamated data from 2009 to 2013 has been used to demonstrate fishing intensity for particular target species (e.g. scallop) and gears (e.g. demersal mobile) (Kafas *et al.* 2012). Figure 4.14 shows the four species most relevant to the Jacky and wider Moray Firth area (of the 10 species mapped in this way). The remaining layers showed low intensity and little spatial variation in these areas.

Figure 4.14 – VMS amalgamated UK vessel (>15m) data for the period 2009-2013



Inshore, Salmon Fishers and Mariculture

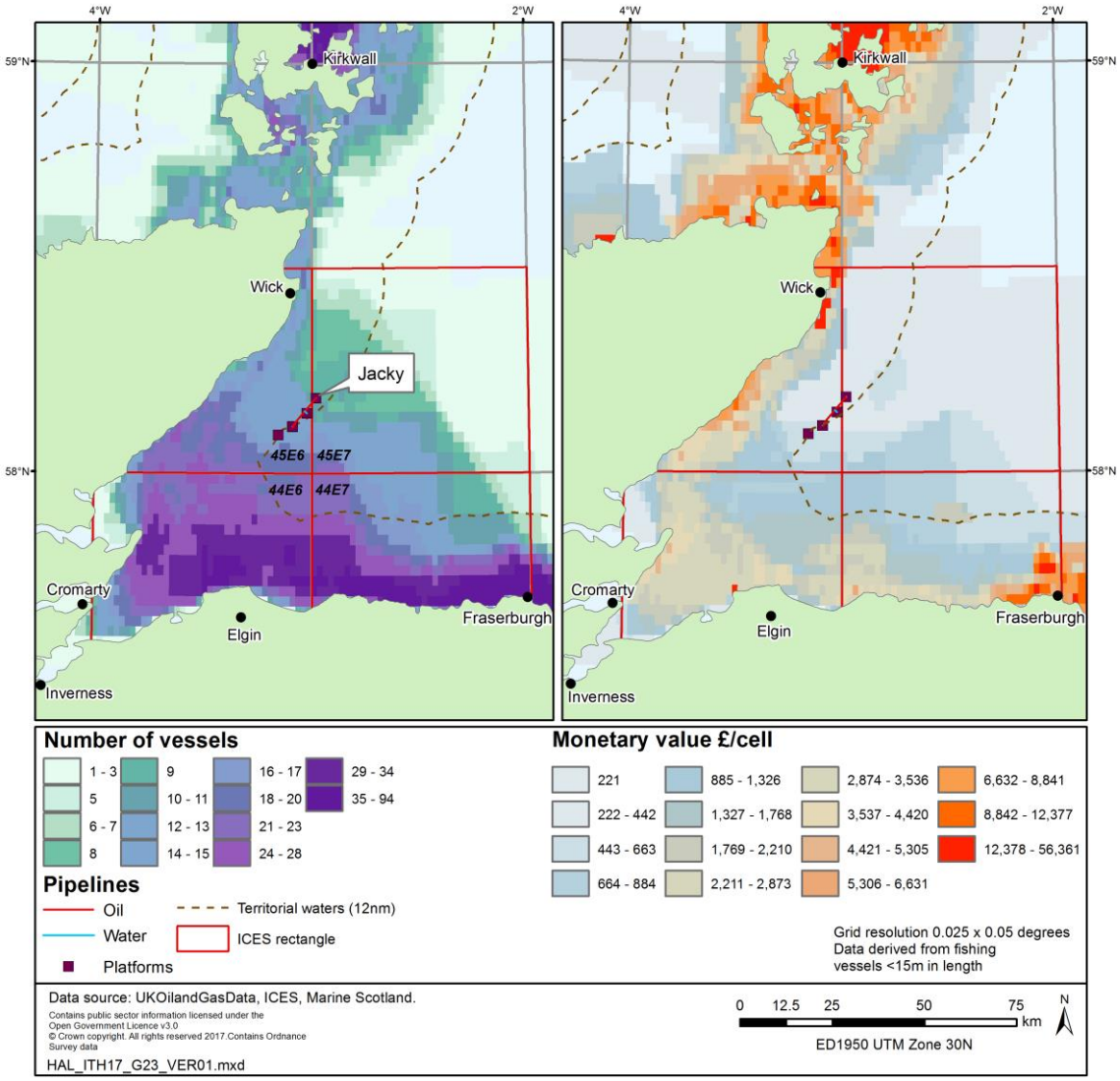
An important inshore (0-6nm from the coast) mixed fishery exists in the Moray Firth operating a variety of gears, with landings almost exclusively comprising crab, scallops, lobsters, squid, whelks and periwinkles. The main landing ports for these inshore catches are Buckie, Burghead, Wick, Lybster and Fraserburgh, but landings are also recorded for other smaller ports. The number of active vessels is greatest along the southern coast of the Moray Firth (Figure 4.15). The data displayed in Figure 4.15 was collected as part of the ScotMap project (Kafas *et al*. 2014, 2017) through interviews with fishermen for activities covering the period 2007-2011. There are significant numbers of vessels trawling for *Nephrops*, squid, haddock and plaice or laying creel pots for crabs and lobsters along the north and south coasts of the Moray Firth (Kafas *et al*. 2017).

The Moray Firth area also supports an important salmon and trout fishery; in 2013, the region contributed 15% of the total wild salmon and 8% of the total wild sea trout caught and retained in Scotland (data from Marine Scotland 2014). While fixed engine boats and rod and line anglers are responsible for the majority of catches, net and cob techniques are also used, but to a much lesser extent. Various initiatives have been set up in recent years to collect data to monitor and support inshore fisheries in the region. The Scottish Inshore Fisheries Integrated Data System (SIFIDS) project[20] (led by the Marine Alliance for Science and Technology for Scotland (MASTS)) aims to collate and analyse inshore fisheries data in order to support fisheries management and marine planning. Projects to further monitoring of inshore fisheries using AIS are also being developed by MASTS[21], while the Fisheries Local Action Group (FLAG) for Highland and Moray[22] aims to initiate a community-led approach to the sustainable development of local fisheries.

[20] http://www.masts.ac.uk/research/emff-sifids-project
[21] http://www.masts.ac.uk/research/sustainable-scottish-inshore-fisheries
[22] http://www.highlandmorayflag.co.uk/

There are currently two active shellfish sites in the Moray Firth, one each in the Dornoch Firth (common mussel) and Cromarty Bay West (Pacific oyster) (Scotland's Aquaculture website[23]). There are no active licensed finfish farms located within the Moray Firth (Scotland's Aquaculture website, Moray Firth Partnership website); the last operational farm closing in 2002.

Figure 4.15 – Inshore fisheries by vessel number and value, 2007-2011



[23] Production from the site has been reported to Marine Scotland within the last three years and data supplied to Scotland's Aquaculture, by Marine Scotland, on 3rd February 2017.

4.16.3 Navigation

There are several important ports for fish landings, the transport of oil industry supplies and products, as well as general cargo and tourism. Fraserburgh and Buckie are important fishing ports and were the base for a total of 284 vessels in 2015 (Marine Scotland 2016). The port of Inverness, located in the Beauly Firth, is of strategic importance to the north of Scotland, supporting cargo and cruise ships and renewable energy industry related activities.

Shipping density data (OGA website[24]), provided as part of the 29th Licensing Round, show Blocks 12/21 and 11/30 as having very low levels of shipping traffic. There are no IMO routeing measures close to Jacky or in the wider Moray Firth. Lower levels in the area are associated with "non-route based" traffic such as fishing vessels, naval vessels, tugs, dredges, yachts, supply vessels to mobile drilling installations and non-routine traffic. Relevant vessel traffic surveys will be undertaken to inform and support permit and consent applications, prior to any offshore decommissioning work being undertaken.

4.16.4 Defence

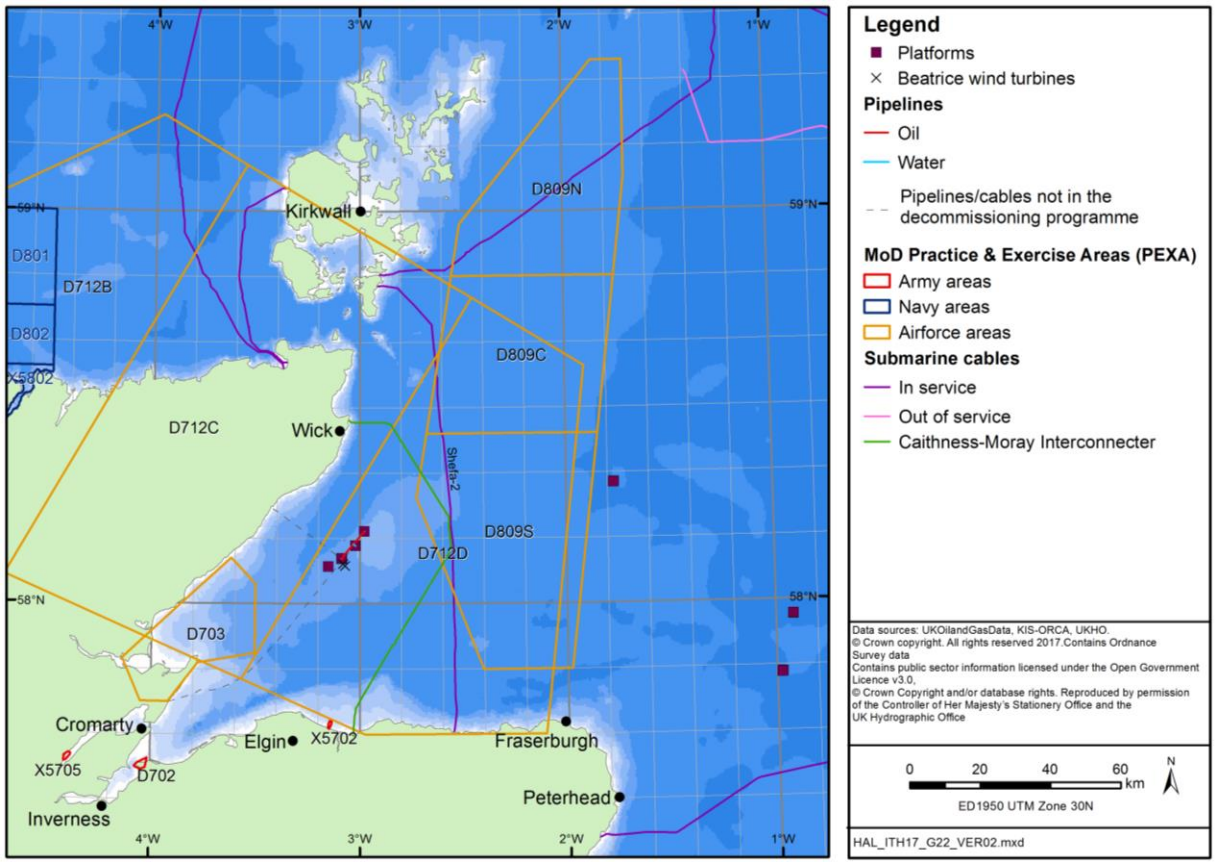
Several areas of the inner and outer Moray Firth are used by the Royal Air Force for training. The Jacky area, along with the majority of the Moray Firth, lies within the large Air Force Department Area D712D (Figure 4.16). Additionally, there is an area of restricted air space on the north coast of the Firth, approximately 18km northwest of the complex.

4.16.5 Cables

There are no telecommunication or subsea cables in the Jacky facilities area and areas within which the Jacky infrastructure ties into either the Beatrice Alpha or Beatrice Bravo platforms. The Shefa-2 telecommunications cable and the proposed Caithness-Moray HVDC transmission project cable (estimated completion in 2018) do traverse the wider Moray Firth area and are approximately 24km and 23km to the east of Jacky respectively (Figure 4.16).

[24] OGA website, Information on levels of shipping activity (29th Seaward Licensing Round) – accessed November 2017
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540506/29R_Shipping_Density_Table.pdf

Figure 4.16 – Military areas and subsea cables



4.16.6 Tourism and Recreation

The Moray Firth coastline and adjacent land and waters provide for a variety of recreational activities which make tourism and leisure an important contribution to the local economy (see LUC 2016), with approximately 700,000 visitors bringing around £106 million to the Moray area in 2015. There are a large number of easily accessible beaches in the wider area, several of which are designated by the Scottish Environment Protection Agency (SEPA) as bathing water sites under the Bathing Water Directive (Directive 2006/07/EC) (SEPA 2016), but these are predominately along the southern coast of the Moray Firth between Nairn and Fraserburgh, with only one on the east coast at Dornoch (SEPA 2016). Sailing is popular in the area with Moray Firth harbours being home to several hundred recreational vessels.

In addition to this, land-based wildlife watching and boat-based dolphin watching attracts many tourists to the Moray Firth; dolphin watching occurs at several locations within the Moray Firth, from Cromarty to Nairn and in 2014, the Scottish Dolphin Centre at Spey Bay received over 90,000 visits.

Other popular activities include sea kayaking/canoeing, scuba diving, surfing, walking and hiking; (Moray Firth Partnership 2011, Luc 2016); there is no official coastal footpath around the Moray Firth, but the Moray Coast Trail, a long distance path that covers almost the entire 50 miles of Moray's coat, stretches between Findhorn and Cullen.

5 IDENTIFICATION AND SCREENING OF POTENTIAL ENVIRONMENTAL ISSUES

5.1 Introduction

Activities associated with the decommissioning of the Jacky Field have the potential to affect the environment in a number of ways, including physical and other disturbance, emissions and discharges, waste generation and accidental events. This section describes the process used to identify and screen the relative significance of the potential environmental issues associated with the decommissioning activities.

5.2 Issue identification and screening of potential effect

Ithaca undertook an Environmental Impact Identification (ENVID) workshop and this contributed to the identification of activity/environment interactions, as well as raising awareness within the Ithaca decommissioning team of the baseline environment and potential sources of environmental effects from decommissioning activities.

At the workshop, the activities associated with the decommissioning of the Jacky Facilities were considered together with their potential interactions with the environment and legislative and policy requirements; these were identified using a range of data sources including:

- Regional and site specific environmental data
- Typical vessel specifications (e.g. for jack-up, infrastructure removal and support)
- Experience of analogous projects in the North Sea and elsewhere
- Reviews and assessments of the environmental effects of offshore oil and gas operations
- Peer reviewed scientific papers describing the effects of specific interactions
- Other publicly available "grey" literature
- Offshore Energy Strategic Environmental Assessment Environmental Reports and underpinning studies (DECC 2016)
- OSPAR Quality Status Report 2010 (OSPAR 2010) and DEFRA's Charting Progress 2 (DEFRA 2010)
- Conservation site designation, potential designations and related information
- Initial consultation
- Applicable legislation, regulatory and industry guidance (e.g. DECC 2011, OGUK 2015) and policies

Ithaca also engaged with a number of stakeholders and statutory bodies (see Section 1.6) and sought their feedback on an initial scoping summary for consideration in the EIA.

Continuing on from the ENVID, and based on the current level of definition of the potential decommissioning options, and stakeholder feedback from the scoping consultation, the EIA took both qualitative and quantitative approaches to the identification of the likely magnitude of effects, as appropriate, and used defined severity criteria to assist in describing the magnitude of environmental effect from the decommissioning activities; these also allowed for the consideration of the likelihood, scale and frequency of potential effects (See Table 5.1); results from this are shown in Table 5.2.

Table 5.1 – Assessment criteria for potential environmental effects from Jacky decommissioning

Effect	Consequences
None Foreseen	No detectable effects
Positive	Activity may contribute to recovery of habitats Positive benefits to local, regional or national economy
Negligible	Change is within scope of existing variability but potentially detectable.
Moderate	Change in ecosystem leading to short term damage with likelihood for recovery within 2 years to an offshore area less than 100 hectares or less than 2 hectares of a benthic fish spawning ground Possible but unlikely effect on human health Possible transboundary effects Possible contribution to cumulative effects Issue of limited public concern May cause nuisance Possible short term minor loss to private users or public finance
Major	Change in ecosystem leading to medium term (2+ year) damage with recovery likely within 2 - 10 years to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Transboundary effects expected Moderate contribution to cumulative effects Issue of public concern Possible effect on human health Possible medium term loss to private users or public finance
Severe	Change in ecosystem leading to long term (10+ year) damage with poor potential for recovery to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Major transboundary effects expected Major contribution to cumulative effects Issue of acute public concern Likely effect on human health Long term, substantial loss to private users or public finance

Frequency with which Activity or Event Might Occur	Likelihood
Unlikely to occur during the lifetime of operation	**Unlikely**
Once in the life of the rig or facility	**Low**
Once a year	**Medium**
Once a month or regular short term events	**High**
Continuous or regular planned activity	**Very High**

	Likelihood				
Consequences	Very High	High	Medium	Low	Unlikely
Severe					
Major					
Moderate					
Negligible					
Positive					
None foreseen					

	Issues requiring detailed consideration in the ES
	Positive or minor or negligible issues
	No effects expected

Notes:
1. The criteria to the left include consideration of issues of known public concern
2. In addition to screening on the basis of these criteria, issues/interactions raised during stakeholder consultation are normally treated as requiring detailed consideration. These issues/interactions are indicated in Table 5.2 by C (raised in stakeholder consultation)

Table 5.2 – Sources of potential environmental effect

Potential for significance
Minor issue

Activity/Source of Potential Impact	Environment Receptors																	Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Communities	Landscape/seascape	Conservation sites/species	Cultural heritage	Transboundary issues	
Vessels (applicable to survey, WHP removal, pipeline and cable interventions, subsea facilities, rig support and post decommissioning monitoring)																		
Power generation (including dynamic positioning)																		Minor, temporary contribution to existing atmospheric emissions. See Section 6.4.
Physical presence							C	C		C								Vessels will be present for a limited period of time, with much activity taking place in existing exclusion zones, limiting potential interactions with other users. There is the potential for interaction with mobile species. See Section 6.2.
Machinery space, deck, sewage and other discharges																		Discharges relating to vessel activity will be minor and of limited duration.
Underwater noise																		Vessels will contribute to overall Jacky decommissioning underwater noise. See Section 6.5.
Airborne noise																		Incremental lighting and airborne noise will be temporary and will not significantly add to existing levels, which will be eliminated following decommissioning. Activity is concentrated at the Jacky location at least 19km from shore.
Lighting																		
Potential for introduction of alien species																		Ballasting will be undertaken in keeping with Ballast Management Plans under the Ballast Water Management Convention.
Anchoring (including HLV)																		Majority of vessels likely to use DP which limits anchoring impacts. HLV will be anchored, therefore limited seabed disturbance from anchor lay and catenary action of anchor chain. Potential for anchors and portion of anchor chain to be laid outside existing 500m zone. See Section 6.3.
Wells																		
Drilling rig tow in/out																		The tow in/out of the drilling rig will create temporary, short-term and small scale increment to atmospheric emissions and physical presence, including within the landscape/seascape of the Moray Firth.

Potential for significance

Minor issue

Activity/Source of Potential Impact	Environment Receptors																	Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Communities	Landscape/seascape	Conservation sites/species	Cultural heritage	Transboundary issues	
Rig positioning (spud cans and anchoring)																		Seabed disturbance from anchor lay and catenary action of anchor chain, and from spud can depressions. See Section 6.3.
Physical presence of rig (existing 500 zone)																		Rig presence will be short-term (~33 days), and within the established Jacky safety zone.
Discharge of cement and chemicals																		All chemicals from plug & abandonment work will be subject to assessment as part of well decommissioning consenting mechanisms (e.g. under the *Offshore Chemical Regulations 2002*), *as amended*.
Power generation on drilling rig																		Minor, temporary contribution to existing atmospheric emissions. See Section 6.4.
Fugitive emissions from fuel and chemical storage																		Minor, temporary contribution to existing atmospheric emissions.
Drainage, sewage and other discharges																		Discharges relating to well plug and abandonment activity will be minor and of limited duration.
Other solid and liquid wastes to shore																		Waste returns e.g. ESPs, well heads, recovered casings. See Section 6.7.
Underwater noise							C											Drilling will contribute to overall Jacky decommissioning underwater noise. See Section 6.5.
Surface noise and light								C										Incremental lighting and airborne noise will be temporary and will not significantly add to existing levels, which will be eliminated following decommissioning. Activity is concentrated at the Jacky location at least 19km from shore. Helicopters will follow established routes.
Mechanical cutting of casings																		Underwater cutting will contribute short term increase to overall underwater noise. See Section 6.5.
NORM/LSA contaminated equipment																		Presence of NORM is not expected. All material recovered for recycling and re-use will be checked for NORM and treated appropriately. See Section 6.7.

Potential for significance
Minor issue

Activity/Source of Potential Impact	Environment Receptors																	Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Communities	Landscape/seascape	Conservation sites/species	Cultural heritage	Transboundary issues	
Topsides																		
Unbolting and rigging of topsides to be lifted																		No significant interaction identified. The operations will make a minor contribution to overall Jacky decommissioning emissions.
Contingency (oxy cutting) of topsides to be lifted																		
Monopile jacket and suction pile																		
Excavation of suction piles and frond mats																		Seabed disturbance and temporary sediment dispersal in the water column. See Section 6.3.
Removal of monopile jacket, and suction piles																		Seabed disturbance and temporary sediment dispersal in the water column, largely limited to the footprint of the suction piles. See Section 6.3.
Removal of fouling growth (offshore and onshore)																		Temporary increase in turbidity, nutrient enhancement and an increase in biological oxygen demand, though expected to be rapidly dispersed and broken down. Limited (~1%) marine growth returned to shore. See Section 6.7.
Contingency cutting (suction piles - high pressure water tool)																		Seabed disturbance, and temporary sediment dispersal, associated noise from tool use. See Section 6.3 and 6.5.
Onshore[2]																		
Offloading of structure		C																Structures will be transported to established yards where dismantling will represent an increment to existing activity rather than a new type of activity. See Section 6.6.
Dismantling structure at yard																		Potential for minor incremental effects from noise, dust, odour and visual intrusion, though note above that this would be incremental to ongoing activity. See Sections 6.6 and 6.7.
Storage of structure at yard																		
Refurbishment and reuse of items																		Minor positive effect from material reuse, offsetting use of primary raw material. See Sections 6.4 and 6.7.
Recycling of items																		
Energy recovery from materials																		

Potential for significance
Minor issue

Activity/Source of Potential Impact	Environment Receptors																Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Communities	Landscape/seascape	Conservation sites/species	Cultural heritage	Transboundary issues	
Onshore waste treatment and disposal																		All represent a minor increment to waste handling and disposal at existing licenced facilities, and to the transport of such material to these sites. Possible, but unlikely, that the material will be sent to a yard outside of the UK for treatment/disposal.
Road transport of materials/waste																		
Treatment of NORM/LSA scale																		
Removal of marine growth																		
Pipeline and cables																		
Disconnection/partial removal of pipelines & cables																		Cleaning and flushing limits the hydrocarbon content of pipelines. Any discharge will be made in accordance with relevant term permits. Pipeline/WI line and cable cutting method and unbolting of spools limits incremental underwater noise. See Section 6.3.
Removal of MLT																		Cleaning and flushing limits the hydrocarbon content of MLT. Seabed disturbance and resuspension of sediment into the water column from the removal of MLT.
Left *in situ* degradation of pipelines, cable, mattresses																		Potential future third party risks resulting from the snagging of fishing gear or vessel anchors. See Section 6.2.
Discharge of pipeline/WI line chemicals and residual hydrocarbons																		Discharges relating to the pipelines during decommissioning will be minor and of limited duration
Burial/rock placement at pipelines/cables cut ends																		Seabed disturbance from movement of rock cover. Anticipated that existing rock can be reused, limiting introduction of new hard substrates. See Section 6.3.
Protective material removal																		Seabed disturbance and resuspension of sediment into the water column from the removal of protection materials to gain access to pipelines/cable. See Section 6.3.
Accidental events																		
Dropped objects																		Any dropped objectives would be recovered.

Potential for significance
Minor issue

Activity/Source of Potential Impact	Environment Receptors																	Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Communities	Landscape/seascape	Conservation sites/species	Cultural heritage	Transboundary issues	
Accidental spill of fuels/lubes/crude to sea						C	C	C										Appropriate handling and bunkering procedures, if required, would be in place to minimise the risk of accidental releases of fuels. Preparatory flushing and cleaning limits the inventory of facility hydrocarbons.
Vessel collision																		Vessel traffic during decommissioning will represent a minor increment to traffic in the area, with activities concentrated within the existing exclusion zone. Vessels will display navigational lighting, guard vessels will be used for certain activities, and all activities will be communicated through notices to mariners.
Discharge of hydraulic fluid from subsea tools																		Hydraulic fluid usage will be monitored.
Chemical spill including drilling chemicals																		Appropriate chemical handling and storage procedures will be in place. Selected chemicals will be subject to assessment and permitting.
Litter																		All wastes generated offshore will be managed in accordance with a garbage management plan.

Notes: [1]Includes offshore renewables, oil and gas, military activities, subsea cables, recreational yachting etc. [2] Some equipment/waste from the topsides will be secured during preparation of the topsides and lifted as one package and removed onshore e.g. WEEE

From the screening process, a number of environmental interactions were identified with the potential to result in significant effects; these are summarised in Table 5.3 and considered in greater detail in Section 6, where mitigation and potential cumulative effects are identified.

Table 5 3 – Environmental interactions considered further in Section 6

Issue	Potential Source of Effect	Section
Physical presence during decommissioning activities and legacy of pipelines infrastructure and mattresses left *in situ*	• Rig, HLV, supply and other vessels presence/movements, including when in transit and within-field movements • Disturbance of seabirds (noise and light), marine mammals and diadromous fish • Legacy of subsea infrastructure and protective material left *in situ*	6.2
Seabed disturbance during decommissioning	• Disturbance of seabed from rig installation, HLV and support vessels presence (e.g. anchors and spud cans) • Excavation (jetting) around Jacky suction piles, MLT and pipelines/power cable, to gain access • Removal of mattresses and other pipeline and cable protection • Seabed condition (e.g. presence of clay mounds/depressions) following pipeline/power cable/suction pile removal and excavation	6.3
Energy use and atmospheric emissions	• Combustion emissions from rig power generation, vessel operation • Energy use for recycling/disposal	6.4
Underwater noise	• Underwater noise from jack-up associated with well plug and abandon activities • Production and WI lines and power cable ends cut by diamond or hydraulic cutter (short duration)	6.5
Onshore dismantling of structures, cleaning of marine growth from monopile jacket, fate of materials returned to shore (recycling, reuse, disposal)	• The landfill resource for waste generated by facilities removal • Landscape/noise and disruption to communities and other users • Air quality effects (dust fumes, decaying marine growth)	6.6 & 6.7
Accidental events	• Diesel and other (e.g. chemical) spills • Collision risk • Dropped objects	6.8
Conservation sites	• Noise and disturbance effects	6.9
Cumulative effects	• Possibility of interactions between decommissioning activities and those ongoing or proposed activities/developments in the Moray Firth	6.10

6 EVALUATION OF POTENTIALLY SIGNIFICANT ISSUES

6.1 Introduction

For each source of effect (e.g. physical presence and disturbance), a description of the potential impacts is expanded upon below and where mitigation of any significant adverse effects may be possible, this has also been included.

In addition to the acceptance of Decommissioning Programmes, activities to be undertaken for the Jacky Field decommissioning are regulated and will be subject to individual consenting mechanisms which the EIA will support (e.g. under the *Offshore Chemical Regulations 2002*, *Marine (Scotland) Act 2010*, *Energy Act 2008*). Ithaca will also maintain awareness of any additional provisions which come into force during decommissioning planning and implementation.

Ithaca is aware of Scotland's National Marine Plan and the role the oil and gas industry plays within it. The responsibilities of the industry to interact positively with other users for mutual benefit, and to live within environmental limits to minimise the impact of activities, are noted and are key considerations in project planning. Other users (the fishing industry, the MoD) will be kept notified of project schedules and progress as appropriate, in order that any impact on their activities may be minimised and mitigated as far as possible.

6.2 Physical presence during decommissioning activities and legacy of pipeline infrastructure and protective material left *in situ*

Potential Impacts

As well as the main vessels involved in the decommissioning activities (jack-up for wells, HLV for the Jacky WHP dismantle and lift and CSV/DSV for the subsea infrastructure programme), a number of other vessels will be used for supply and support, including for the transport of waste and other materials to shore (see Section 3.5 Table 3.4 and 6.4 below). The physical presence of vessels has the potential to disrupt other users of the sea, including shipping and fishing. However, the main source of effect will relate to vessels in transit, as most vessels undertaking work would be located within close proximity to the Jacky WHP normally within its 500m safety zone. There is the requirement to carry out work on the Jacky pipelines and power cable within the Beatrice AP 500m zone, and a proximity agreement will be discussed with Repsol Sinopec Resources UK Limited.

In addition to potential socio-economic effects, ecological effects could arise for birds (e.g. from surface noise and light), marine mammals and migratory salmon (e.g. shipping noise), particularly during the peak smolt run (spring-summer), rather than when adult salmon are returning to rivers.

The importance of the Smith Bank for bird foraging and moulting is recognised (see Section 4.10); the main species using this area are black-legged kittiwake, guillemot, razorbill and northern gannet with some seasonal variation in usage (see Table 4.3 in Section 4.10). Water depths are too great for diving seaduck such as common scoter (recognised as sensitive to vessel and other disturbance) and long-tailed duck which prefer the shallower coastal areas of the Moray Firth. However, it is proposed to include explicit coverage of the importance of the area for seabirds and methods to minimise vessel based disturbance (e.g. through avoidance of large rafts of birds) in environmental awareness training to operational staff, prior to the commencement of offshore decommissioning activities.

The potential effects of light on birds has been raised in connection with offshore oil and gas over a number of years (e.g. Weise *et al*. 2001); as part of navigation and worker safety, and in accordance with international requirements, rigs and associated vessels are lit at night and the lights will be visible at distance (some 10-12 nm in good visibility). Although offshore decommissioning activities may occur during periods of bird migration, significant effects from the HLV, rig and associated vessel lights are considered to be unlikely in view of a variety of factors. The lights on the HLV, rig and vessels are primarily non-flashing so the behavioural effects noted by Bruderer *et al*. (1999) in response to a strong searchlight being switched on and off are unlikely. Since the Jacky location is coastal (as opposed to far offshore), adverse effects from HLV/rig/vessel lights are seen as less likely, as the lights of settlements, towns and roads are visible and the greater Jacky area is traversed by fishing and other vessels. In addition, there have been no reported effects on birds from platform lights during the operational life of Jacky, or from the Beatrice Field installations nearby.

The potential longer term source of effect to other users (e.g. fisheries) is the physical presence of pipelines, power cable sections and protective material to be left *in situ*. Snagging risk for leaving the pipeline *in situ* was higher than removal. However, where there is existing rock covering the pipelines/cables, the current profile is over-trawlable; existing depth of burial into soft sediment appears sufficient as there is no evidence of scour, and the buried pipelines/cable are expected to remain buried. Approximately 47 mattresses which are presently under rock cover will be decommissioned *in situ*, (8 at the Jacky WHP location, 35 at the Beatrice AP approaches and 4 at the MLT). If any areas of buried mattresses are partially exposed, remedial work will be undertaken to rebury these, either by natural backfill, or the replacing of existing rock cover over these sections.

Given that the rock profile covering the mattresses is overtrawlable, the fisheries snagging potential is considered low. The potential for this rock and buried mattresses to be disturbed during Repsol Sinopec Resources UK Limited decommissioning activities has been identified; Ithaca have and will continue to be, in discussion with Respol Sinopec Resources UK, during the decommissioning process for both sets of assets, to ensure as far as practically possible, disturbance of these does not take place.

An over-trawlable verification will be carried out post decommissioning.

There will be a discharge to sea of pipeline contents; the production line has been cleaned and flushed and left in a "hydrocarbon free" state and both it and the water injection line now contain inhibited seawater. The discharge of chemicals, and residual hydrocarbon in the case of the production line, is considered minor given the type (typical corrosion inhibitors and biocides) and quantities of chemical involved. The discharge of the pipelines will be risk assessed in the appropriate chemical permitting regime prior to these decommissioning activities.

Mitigation

Available information indicates that vessel traffic in the area is low, and a vessel traffic survey will be undertaken to inform decommissioning, particularly those activities to be undertaken outside of existing safety zones.

The movements of and the "as laid" positions of the jack-up anchors and the HLV, will be notified to fishermen and others through the normal routes, including publication in Notice to Mariners and in Kingfisher bulletins detailing jack-up rig and HLV positions, activities and timing. In addition, other measures to minimise the risk of collision between shipping and the jack-up rig and HLV include full navigation lighting on these and associated vessels.

A number of vessels will be in-field for relatively short periods of time (see Table 3.4 in Section 3.5, with the rig and standby vessel being of the longest single duration of *ca*. 33 days) during the decommissioning activities. Given that not all of the vessels including the jack-up rig and HLV will be

present at the same time, it is unlikely that the presence of these vessels will cause significant interference to fishing or other vessels.

The physical presence of vessels will be temporary and localised; the HLV can accommodate the entire Jacky WHP during one deployment, thereby reducing the need to return to shore between removal of the topsides and the monopile jacket/suction pile sections. There is also the potential to reduce the scale of potential impact through the optimisation of work schedules and vessel synergies.

The positions of the pipeline and cable that are to remain will be charted and where there is existing rock covering of the pipelines/cables, and the mattresses remaining *in situ*, the current profile is over-trawlable and an agreed monitoring programme with the regulator will be established to identify future exposure of these, debris if the pipelines/cable become exposed, and degrades.

Conclusion

Interactions with other users of the area from the Jacky Field decommissioning activities, specifically fishing and navigation are considered to be short lived (*ca.* 33 days on site for the rig and standby vessel). The 500m zone around the Jacky WHP and MLT will be removed when the installations are removed, allowing access for other users, details of infrastructure remaining *in situ* will be publicised through Notices to Mariners and marked on navigation and fisheries charts and an agreed monitoring programme for these will be established with BEIS.

The physical presence of vessels (including the jack-up and HLV) on location are going to short term and activities confirmed to a relatively small area; impacts associated with vessel presence such as noise and light are not considered to be significant on potential receptors due to the short term duration and localised aspect of the activities. Where scheduling allows, activities will be timed to avoid the most sensitive periods and environmental awareness of the Jacky and the wider Moray Firth area will be provided prior to offshore activities commencing.

6.3 Effects of Seabed Disturbance during decommissioning

Potential Impacts

Sources of physical disturbance to the seabed associated with the Jacky Field decommissioning activities are primarily:

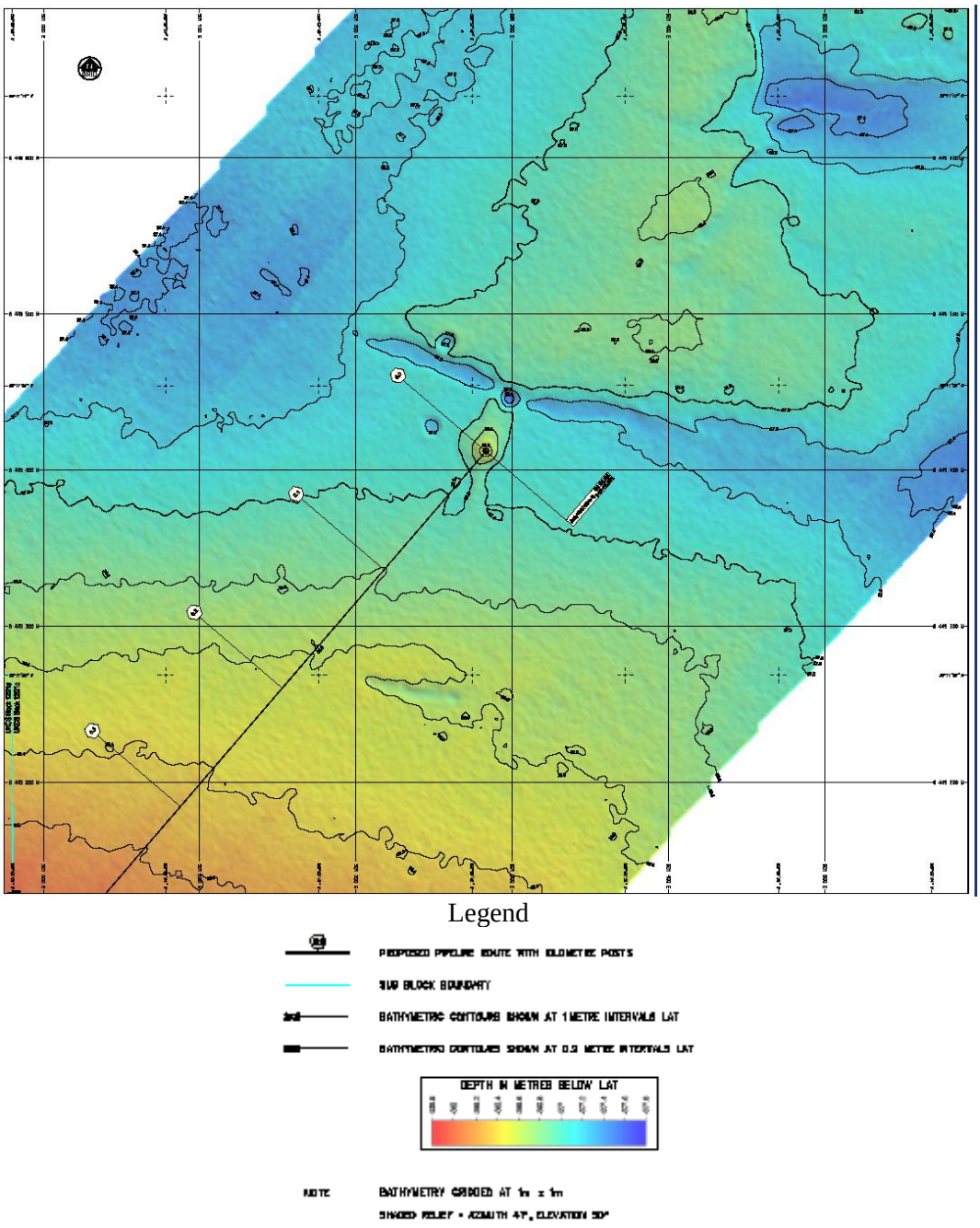
- Jack-up rig's three spud-cans
- Anchors used to aid close positioning of the jack-up rig
- Anchoring of HLV (expected to be four point mooring system, anchors and chains)
- Any jetting required around suction piles/frond mats and MLT to gain access for removal
- Removal of suction piles, MLT, tether and clump weight
- Moving/lifting of protective material
- Burial of exposed (cut) ends of pipelines/power cable, removal of spool pieces

Anchoring and jetting

Typically, each of a jack-up rig's three legs terminates in a spud-can with a typical diameter of 15-20m, spaced approximately 50m apart. These form seabed depressions as a result of sinking into the seabed during the process of jacking the rig legs to the seabed. Such jack-up rigs have spud can jetting systems with both bottom and top jets to facilitate spud can release from seabed sediments. The remains of spud-can depressions from the Jacky appraisal well were evident to the north of the suspended wellhead from swathe bathymetry (Figure 6.1). Estimated depth of these was 0.3-0.4 m, which is consistent with observations from elsewhere (e.g. Daan and Mulder 1993) and the 2011 debris survey at the Jacky WHP recorded faint spud can depressions and a faint spoil heap from spud can removal, again with the deepest

of these depressions measuring only 0.3m. This suggests that the seabed depressions formed are short-lived and that the spatial extent of effects is negligible.

Figure 6 1 – Seabed topographic map around the Jacky appraisal well showing 3 spud can footprints near the well

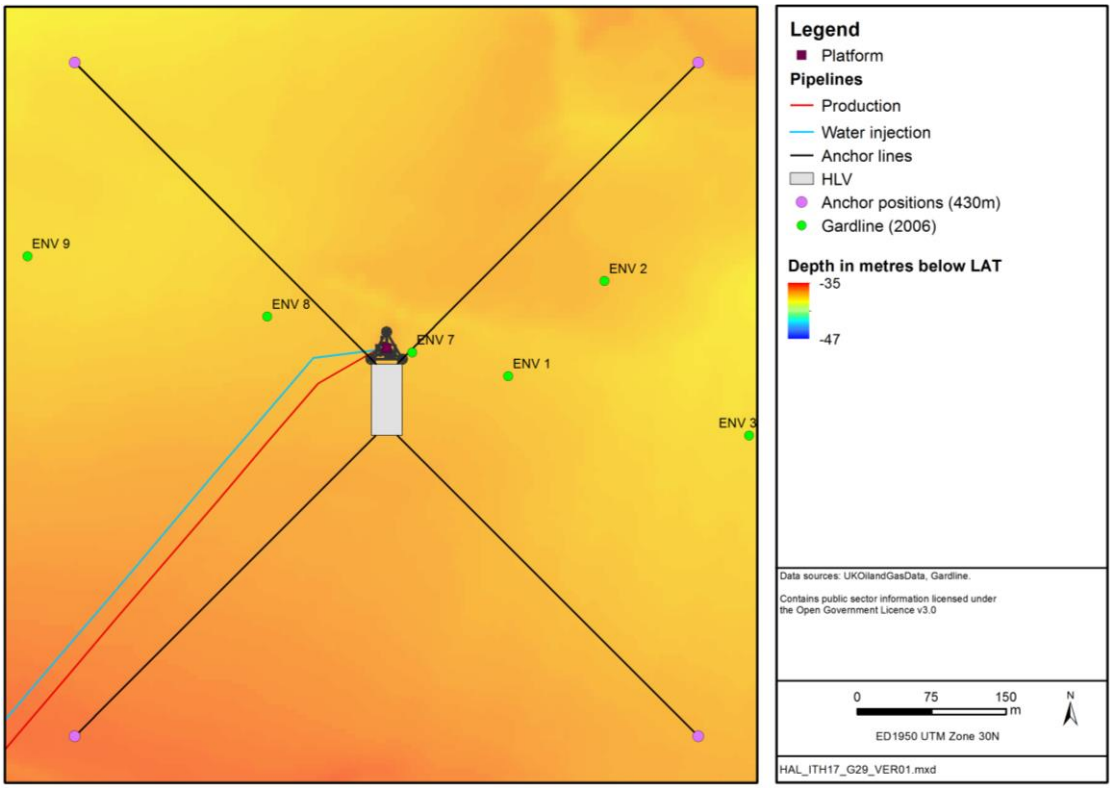


Anchors will be used for two stages of the decommissioning process: for positioning of the jack-up rig over the WHP and for positioning the HLV. Although final selection of HLV is still to be made, it is anticipated it will have a four point mooring system. Typically, the mooring system comprises an anchor and chain/cable element.

Each anchor produces a linear scar during setting and recovery with surface scrape also produced as a result of catenary contact of the anchor chain and/or cable. For assessment purposes, it has been

assumed that the anchoring of both the jack-up and the HLV involve 15-20 tonne anchors, placed radially by specialised anchor-handler vessels – the estimated anchor spread for the HLV is shown in Figure 6.2. Mooring analysis for both the jack-up and the HLV will be carried out prior to both arriving on site.

Figure 6 2 – Indicative anchor pattern for the HLV



The projected anchor spreads are 430-700m, or 12-20 times the water depth. Each anchor will produce a linear scar of the order of 10m length during setting and recovery, with surface scrape (maximum ≈200m) also produced as a result of catenary contact of the anchor chain and/or cable. The jack-up rig will be moved into final position over the WHP by anchor, which will elongate the catenary contact scar by approximately 50m. The length of catenary contact is dependent on water depth, anchor spread and cable tension, and is therefore difficult to predict accurately. In the worst case, total seabed area affected by anchoring is estimated as 1600m^2, or <0.5% of the total area within the anchor spread.

Anchoring and catenary scarring will not result in changes to sediment characteristics, or significant compaction. Recovery of the seabed habitat through natural sediment mobility is expected to be rapid (< 1 year), with subsequent recovery of faunal communities through a combination of larval settlement and immigration of animals from the adjacent seabed.

Other vessels involved in decommissioning activities will be kept on station using DP.

There may be a small amount of jetting required to expose infrastructure/aid in seabed release (e.g. suction piles/MLT). The extent of seabed disturbance as a result of this is difficult to predict as the extent of jetting is unknown. However, if jetting is required, given the sandy nature of seabed sediments the spread of displaced materials will be limited to the immediate vicinity of the activity and significant effects would not be predicted.

Removal of infrastructure, protective material and burial of pipeline ends

Displacing/removing the protective mattresses/grout bags, removing spool pieces and burying the cut exposed ends, excavating the suction piles and removing the MLT, will result in some disturbance to seabed sediments and communities. This disturbance would be localised to areas where protective material is removed and sediment displaced to lower the exposed ends into the seabed (and re-covered by reused rock) and to areas where infrastructure is removed. The removal of the suction piles is not expected to result in depressions being left in the seabed as the scale of force required to pull out a plug of sediment encompassed by a suction pile is not achievable with the removal equipment and the removal is a reversal of the installation. Based on a burial depth of 7m, outer radius of 5m and inner radius of 4.9m, an estimated volume of seabed disturbance of 65m^3 (total for the three suction piles) has been calculated for the removal of these piles.

In the unlikely event that the suction piles cannot be freed from the seabed, the contingency removal method would be to excavate the seabed around the piles and to cut these with a high pressure water jet to a satisfactory depth below seabed level (*ca*. 3m) and to recover the top section to the CSV with the deeper buried part remaining *in situ*. If required, rock placement would be used to cover the suction piles to ensure these were fully covered and this would be a re-use of existing rock, with no additional rock being used; the requirement for this contingency method will only be known once offshore work has commenced. If this is required, this would be assessed and approval sought for this change of work scope in a variation to the term permit applicable, in advance of the contingency works being carried out.

The MLT is a gravity based structure (11.5m (length) x 8m (width)) and will be lifted off the seabed; for assessment purposes an additional 1m on all sides of the structure has been added to allow for disturbance from work required to facilitate its release from the seabed and retrieval. Removal of the tether and clump weight will be a lift off the seabed with minimal disturbance expected (i.e. no additional excavation required).

An ROV survey conducted in 2012 (Andrews Survey 2013) showed the presence of mobile and sessile epifauna, including the plumose anemone *Metridium senile* and the urchin *Echinus esculentus* on the mattresses/grout bags covering the spool pieces; with most observed along the PL2558 and PL2560 pipelines at their approach to Beatrice Bravo. The survey also indicated that the spool pieces and protective mattresses have not been smothered by sediment in the period since they were laid.

After removing some of the protective material and spool pieces, the exposed ends of the pipelines and power cable are then lowered into the seabed with sediment having first been excavated using mass flow excavation and then back filled with the natural sediment and where required, recovered with existing rock. Mass flow excavation is where a flow of water is directed at the seabed to displace the sediment, using proven technology and methods. This disturbance would be localised to areas where the sediment is displaced to lower the exposed ends into the seabed. Seabed remediation after this operation is expected to be minimal. Typical spool piece size at Jacky is *ca*. 9m x 3.5m and for assessment purposes, it has been assumed that two spool pieces at each tie-in location (total of 16 spool pieces) will be removed, along with a disturbance corridor width of 2m at each for sediment clearance (see Table 6.1 below).

Given the present understanding of the shallow sediments in the area, there is the possibility that some of the excavated sediment may be clay which has the potential to form persistent mounds which unless remediated could hinder towed fishing gears. If present, these will be evident from the post decommissioning survey and assessed for remediation.

Disturbance of historic cuttings deposits at the Beatrice platforms is not expected, since the pipelines and power cable were surface laid at the platform approaches and, due to the relative distance of potential cuttings piles (beneath and immediately adjacent to Beatrice Alpha and Beatrice Bravo) from

the spool pieces. An ROV survey of the Beatrice Alpha drilling template in 2012 did not show an appreciable depth of cuttings and a much smaller accumulation than was recorded by BRITOIL in 1989 which indicated a mound 9m in height. Between these surveys, it is likely that the pile was subject to redistribution and degradation by natural hydrographic and biological processes. An ROV survey conducted at Beatrice Bravo in 2008 showed no substantial variation in sediment topography, suggesting a cuttings pile was not evident.

Extent of estimated seabed disturbance from decommissioning activities

Drawn from the information available and based on a number of assumptions, an area of seabed affected by the decommissioning of the Jacky Field facilities has been estimated (Table 6.1).

Table 6 1 – Estimated temporary seabed disturbance from Jacky decommissioning activities

Activity	Estimated disturbance of sediment (m^2)
Anchors (jack-up and HLV)	1600
Recovery of MLT[1]	135
Recovery of mattresses[2]	5800
Recovery of spool pieces[3]	968
TOTAL (m^2) of seabed temporarily disturbed from decommissioning activities	8,503 (*ca*. 0.009km^2)

Notes: [1]Impact has been calculated based on size of MLT plus an additional 1m area of impact on each side for diver intervention. [2].Area has been calculated based on size of mattresses, with an additional area of impact of 1m on each side, to account for diver intervention. [3]Calculated based on a spool piece size of 9 x 3.5m with an additional 2m disturbance area around each for diver intervention and 16 pieces being removed.

In addition to the disturbance in Table 6.1, the estimated total disturbance from removal of the three suction piles is 65m^3, again this is expected to be of a temporary nature, with rapid faunal recolonisation of disturbed sediments.

Seabed disturbance will result in direct physical effects which may include mortality as a result of physical trauma, smothering by excavated sidecast and re-suspended sediment, and habitat modification due to changed physico-chemical characteristics. Disturbance during removal operations would be limited to those benthic communities colonising the hard surfaces of the mattresses to be lifted, those immediately adjacent to the pipelines and power cable and those around the suction piles location.

Mitigation

Mitigation may be possible including the minimisation of rig and vessel movements. The jack-up rig will be positioned over the Jacky WHP with the derrick skidding to each well individually; resulting in only one deployment of the rig spud cans. The entire Jacky WHP can be accommodated on the HLV, therefore this should also require only one deployment in field, before returning the now sectioned Jacky WHP to shore.

Although not expected, should any large mounds be evident from the removal of the suction piles, which could potentially cause a snagging hazard to towed fishing gear, these will be notified through the Kingfisher notices system and remedial action taken e.g. through heavy trawling across the mounds to flatten them. Similarly, if seabed depressions are caused, these will also be notified via the Kingfisher system although fisheries impacts are not anticipated.

The nature and scale of seabed disturbance will also be assessed by ROV inspection and/or debris clearance survey, post-decommissioning.

Conclusion

Upon completion of the Jacky decommissioning work scope, access to the area for other users of the marine environment, particularly for commercial fisheries will not be restricted and any material remaining on the seabed will be marked on charts.

Previous surveys have not indicated the presence of any Annex I habitats in the area. No dense populations of especially long lived or reef forming species were previously observed in the wider area, and species composition and life history characteristics of the infaunal and epifaunal community (from previous surveys carried out both as part of the initial installation of Jacky and subsequent operation, e.g. Gardline 2006, 2007a,b, Senergy 2011, and the wider North Sea communities, e.g. Basford *et al*. (1990) and Reiss *et al*. 2010) indicate it is likely to be relatively resilient to the effects of sediment mobilisation (as a result of the decommissioning activities) and to recover rapidly.

Taking account of these factors, it is concluded that the potential for significant effects on the regional distribution of features and habitats, or population viability of benthic species from the decommissioning activities is low.

6.4 Effects of energy use and atmospheric emissions

Potential Impact

Atmospheric emissions were identified in Section 5 as being a potential source of effect from activities associated with the Jacky Decommissioning Programmes. Sources of emissions include:

- Drilling rig power generation and helicopter traffic
- Combustion emissions from vessels (e.g. involved in subsea disconnection of pipelines and cables, removal of the midline tee structure, Jacky WHP and monopile jacket/suction cans and transport onshore, and the recovery and placement of protection materials)
- The recycling of materials returned to shore including steel (note that reuse of parts of the Jacky infrastructure (including the topsides, monopile jacket/suction cans and midline tee) may be possible which would defer such emissions to a later date), and the loss of materials left *in situ* for future use

Gaseous emissions associated with activities to be undertaken during the decommissioning of the Jacky field will contribute to atmospheric greenhouse gas (GHG) concentrations, regional acid loading and tropospheric ozone. In addition to air quality effects, anthropogenically enhanced levels of greenhouse gases (principally CO_2) have been linked to global climate change (IPCC 2013). Predicted effects include *inter alia* an increase in global temperate (Kirtman *et al*. 2013, Collins *et al*. 2013), rising sea-levels (Lowe *et al*. 2009, Church *et al*. 2013, Horsburgh & Lowe 2013), changes in ocean circulation (Collins *et al*. 2013) and potentially more frequent extreme weather events (see Woolf & Wolf 2013 for a UK specific discussion), and other effects including ocean acidification generated by enhanced atmospheric acid gas loading, deposition and exchange (see Bates *et al*. 2012). These effects have most recently been summarised in the Intergovernmental Panel on Climate Change (IPCC) 5th assessment report (IPCC 2013).

Emissions resulting from activities associated with the decommissioning programmes will primarily comprise carbon dioxide (CO_2), together with carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), methane (CH_4) and non-methane volatile organic compounds (NMVOCs). Those gases of relevance when discussing their contribution to anthropogenically augmented climate change are CO_2, N_2O, CH_4 and F-gases (which generate direct radiative effects and make up the basket of greenhouse gases considered by the Kyoto protocol), NOx, CO and NMVOCs (which provide indirect radiative forcing by enhancing tropospheric ozone concentrations) and SO_2 (contributes to aerosol formation, and can have a warming or cooling effect).

The principal GHG of concern is CO_2 as it constitutes both the largest component of global combustion emissions (for instance, in 2016 CO_2 from UK sources is provisionally estimated to have comprised 80% of all UK GHG emissions at 374.1 million tonnes), and has a long atmospheric residence time such that emissions made today continue to contribute to radiative forcing for some time. Emissions of relevant gas species and their associated Global Warming Potential (GWP) have been estimated for activities associated with the decommissioning programmes (covered in Section 3) – see Tables 6.3 to 6.4 and 6.5. This has involved the use of standard Environmental and Emissions Monitoring System (EEMS) conversion factors (DECC 2008) to estimate the relative quantity of each gas species following combustion associated with the removal operations, and additional factors relating to recycling (Table 6.2 and outlined in Section 6.4.2).

The most recent GWP metrics (Table 6.1) are used to estimate a value in tonnes of CO_2 equivalent (CO_2 eq.) based on the radiative forcing effect of each GHG species relative to CO_2 and the atmospheric residence time of each gas. The GWP factor therefore changes depending on the "time horizon" considered (see IPCC 2001, 2007, Myhre *et al.* 2013, and Shine 2009 for a synthesis and critical review). GWP factors for CO have previously been calculated as 1.9 at 100 years, and that for NOx is considered highly uncertain (Forster *et al.* 2007), and these are therefore not generally calculated.

Table 6.2 – Emissions Factors

Gas	CO2	N_2O	CH_4	CO	NOx	SO_2	NMVOCs
Diesel (turbine)	3.22	0.00022	0.0000328	0.00092	0.0135	0.0020	0.000295
Diesel (engine)	3.22	0.00022	0.00018	0.0157	0.0594	0.0020	0.002
Aviation fuel (helicopter)	3.15	0.00012	0.00035	0.00953	0.012	0.0009	0.00306
GWP at 100 years	1	265	28	-	-	-	-

Notes: [1]sulphur content of marine diesel fuel assumed to be 0.1% based on requirements for Emissions Control Areas: IMO website (accessed November 2017). Source: IPCC (1996), DECC (2008), Myhre *et al*. (2013), AEA-Ricardo (2015)

6.4.1 Removal of Jacky Field facilities

The well abandonment programme is the primary source of emissions (2,484 tonnes CO_2 eq.), and together with removal of the facilities from their present location to a disposal site (assumed to be at a yard in the Cromarty Firth) results in an estimated 5,121 tonnes CO_2 eq. It should be noted that the emissions calculations are based on a range of assumptions relating to vessel type and timings and that actual vessel use at the time of decommissioning will be informed the final decommissioning options and detailed engineering design (see Section 3). For example, should a re-use application of all or part of the Jacky WHP and substructure be identified then the transport route may alter. The estimated emissions will be small when compared to other sources of emissions on the UKCS oil and gas sector, and the wider UK (see below).

Table 6.3 – Estimated emissions from well plug and abandonment (all 3 wells)

Gas	Rig tow in/out	Rig on location	Standby vessels	Supply vessels	Helicopter traffic	Total emissions	Emissions (CO_2 eq.)
CO_2	64.4	1912.7	318.8	128.8	11.9	2,436.5	2,436.5
N_2O	0.0	0.1	0.0	0.0	0.0	0.2	44.0
CH_4	0.0	0.1	0.0	0.0	0.0	0.1	3.8
SO_2	0.0	0.0	0.2	0.1	0.0	0.3	-
CO	0.3	9.3	1.6	0.6	0.0	11.9	-
NOx	1.2	35.3	5.9	2.4	0.1	44.8	-
VOC	0.0	1.2	0.2	0.1	0.0	1.5	-
						Total CO_2 eq. at 100 years	**2,484.4**

Table 6.4 – Estimated emissions subsea pipeline decommissioning

Gas	Protection material removal;	Disconnect & remove tie-in spools & remove cable ends	Recovery of MLT	Bury pipeline and cable ends	Guard vessel	Post-activity survey	Overtrawling	Total emission	Emissions (CO2 eq.)
CO_2	450.8	322	322	450.8	115.9	77.3	80.5	1819.3	1,819.3
N_2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	32.9
CH_4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.9
SO_2	0.3	0.2	0.2	0.3	0.1	0.1	0.1	1.1	-
CO	2.2	1.6	1.6	2.2	0.6	0.4	0.4	8.9	-
NOx	8.3	5.9	5.9	8.3	2.1	1.4	1.5	33.6	-
VOC	0.3	0.2	0.2	0.3	0.1	0.1	0.1	1.1	-
							Total CO_2 eq. at 100 years		**1,855.1**

Table 6.5 – Estimated emissions from Jacky WHP removal

Gas	HLV mob/demob	HLV on location	HLV transport of Jacky WHP	Standby vessel	Total emissions	Emissions (CO_2 eq.)
CO_2	241.5	173.9	322	29	766.4	766.4
N_2O	0.0	0.	0.0	0.0	0.1	13.9
CH_4	0.0	0.	0.0	0.0	0.0	1.2
SO_2	0.2	0.1	0.2	0.0	0.5	-

Gas	HLV mob/demob	HLV on location	HLV transport of Jacky WHP	Standby vessel	Total emissions	Emissions (CO_2 eq.)
CO	1.2	0.9	1.6	0.1	3.7	-
NOx	4.5	3.2	5.9	0.5	14.1	-
VOC	0.2	0.1	0.2	0.0	0.5	-
					Total CO_2 eq. at 100 years	**781.4**

6.4.2 Emissions from reuse, recycling and disposal

To provide a more complete indication of the emissions associated with the decommissioning of the Jacky field facilities, emissions relating to the disposal of its primary components have been estimated. Re-use of some of the Jacky facilities (particularly the MLT, Jacky WHP, monopile jacket and suction cans, but also includes some concrete protection materials) is being actively pursued as indicated in Section 3, and where this is undertaken end-of-life emissions are deferred to a later date with the exception of those materials being left *in situ* or for those which are to be removed and which have no further use (e.g. spool pieces, cable ends, frond mats). The following assumes that of those parts of the Jacky infrastructure that are removed, all are returned to shore for recycling or disposal as appropriate, as this represents the highest energy use outcome of the decommissioning options being considered.

Most materials to be recovered from the Jacky field are highly recyclable (e.g. steel, making up ~99% of the Jacky WHP, monopile jacket/suction cans) and therefore have a strong end-of-life benefit (i.e. through the displacement of virgin material in the wider steel supply chain (Hammond & Jones 2011, Weinzettel *et al.* 2009, Yellishetty *et al.* 2012), which also has wider implications than just emissions. Conversely the leaving of some components *in situ* results in a loss of future use of that material (assuming that the market for recycled materials is not saturated, World Resources Institute 2011). However, the leaving of the material *in situ* does negate additional vessel time in the field to recover and transport additional materials to shore. A high level breakdown of the dominant material components of the Jacky facilities are indicated in Table 3.3 in Section 3.4.1 along with the proportion of these items assumed to be re-used and/or returned to shore for recycling and left *in situ*.

The energy use and emissions associated with the end-of-life of materials such as steel are not always clear, as they may already have a recycled content and moreover pass on the benefit of recycling to the next end user of the materials, such that energy benefits can be double-counted (Hammond & Jones 2011, Weidmann *et al*. 2011, World Resources Institute 2011). The original recycled content of the steel used at Jacky is not known, and it is therefore assumed that any benefit of steel recycling is split between the end-of-life for the Jacky materials, and any new products resulting from the use of the recycled material. The calculations of emissions associated with the decommissioning of the Jacky field are based on factors in IoP (2000) (also see Ekins *et al*. 2005) and Hammond & Jones (2011), and are shown in Table 6.6. Emissions from the transport of all components to shore have already been estimated in Section 6.4.1.

Table 6.6 – Estimated emissions[1] associated with recycling and manufacture of replacement materials left *in situ* (tonnes CO_2 eq.)

Concrete	Ferrous metal	Non ferrous metal	Plastic	TOTAL
Recycled				
88	2,469	77	25	2,658
Left *in situ*				
37	4,264	203	415	4,919

Notes: [1.] Figures rounded to nearest whole. The recycling emissions are also part of the life cycle of future products such that the above emissions can be split between the end-of-life of the Jacky materials and those of new products/materials, noting that the recycling also generates a benefit by displacing the use of virgin material in new products (for example, typical recycled content of steel in the EU is 59%). The benefit can be expressed as the difference between emissions relating to the use of recycled material from Jacky and virgin material, primarily related to steel, which is approximately 2,785. Emissions factors follow IoP (2000), Ekins *et al*. (2005) and Hammond & Jones (2011).

Conclusion

In 2016, UK emissions of the basket of six greenhouse gases covered by the Kyoto Protocol are provisionally estimated to be 466 million tonnes CO_2 eq. (374.1 tonnes CO_2). This was 7.4% lower than the 2015 figure of 495.7 million tonnes, and primarily related to a change in the mix if fuels used in electricity generation, with reduced use of coal and greater use of gas (BEIS 2017a). To place the decommissioning of the Jacky Field in the context of UK CO_2 emissions, operational sources would represent an increment of 0.001% on those emitted from all UK sources in 2016 (or 0.04% of those in 2014 for oil & gas operations on the UKCS). Taking into account the estimated emissions relating to the fate of structure materials, decommissioning represents 0.0024% of total UK CO_2 emissions in 2016, however, when considering the benefit of material recycling, this is reduced to 0.001%.

6.5 Effects of noise from decommissioning activities

Potential Impact

Anthropogenic noise in the marine environment is widely recognised as a potentially significant concern, especially in relation to marine mammals (e.g. Richardson *et al*. 1995). Potential effects of anthropogenic underwater sound on receptor organisms range widely, from masking of biological communication and small behavioural reactions, to chronic disturbance, auditory injury and mortality; in addition to direct effects, indirect effects may also occur (e.g. via effects on prey species).

The primary source for underwater sound generation from the Jacky Field decommissioning activities is a combination of rig and vessel noise, for which there is a good knowledge base, and equipment use (there is no plans for activities generating impulse sounds, such as explosives), see bullet points and Table 6.7 below:

- Jack-up drilling rig (plug and abandon operations)
- Vessels, including use of thrusters for positioning by HLV, DSV/CSV (and support vessels
- Pump (for removal of suction piles)
- High pressure water cutting tool (contingency use for removal of suction piles)
- Diamond wire or hydraulic cutting tool (contingency use for cutting pipeline and water injection connections)

Table 6.7 – Summary of indicative noise sources associated with Jacky decommissioning activities

Noise source (relevant activities)	Approximate indicative broadband source level (dB re 1µPa@1m)	Indicative dominant frequency	Source
Vessels of 50-100m length (e.g. CSV, DSV)	165-180[1,2]	<1,000Hz	OSPAR (2009)
Vessels of 100-300m length (HLV)	175-195[1,2]	<200Hz	OSPAR (2009), McKenna *et al*. (2012), Veirs *et al*. (2016)
Diamond wire cutting tool	na; at 100m from source: ≤130dB re 1 µPa^2 per 1/3 octave band for all recorded frequencies from 5,000-40,000Hz[3]	>10,000Hz	Pangerc *et al*. (2016)
Water jet lance tool (broadly indicative of abrasive water jet cutting)	160.1-170.5	>200Hz	Molvaer & Gjestland (1981)

Notes: [1.] Within the ranges provided, broadband source levels are generally higher for larger vessels of these categories. [2.] Slight increases in broadband source levels anticipated during use of DP thrusters. [3]. Generally indistinguishable above background noise at low frequencies; ca. 4 and up to 15dB re 1µ Pa2 per 1/3 octave band above background between 10,000-40,000Hz.

Underwater sound radiates from a vessel as the combined effect of multiple sources and paths; the main sources are propeller/thrusters cavitation and machinery noise; additional sound is generated as the hull moves through the water (hydrodynamic noise) or by sea-connected systems (e.g. pumps) (Spence *et al*. 2007, Abrahamsen 2012).

Propeller cavitation is the process of bubble formation and implosion resulting from pressure fluctuations (above and below the saturated vapour pressure of water) generated by the rotating propeller blades when a given speed (cavitation inception speed) is reached or exceeded; noise is generated by the collapse of bubbles. Cavitational noise commonly arises at speeds between 8 and 12 knots and grows in amplitude with increasing speed; its frequency spectrum is broad with dominant frequencies above a few hundred Hz. However, cavitational noise mechanisms are varied and complex; in addition to vessels in transit, cavitational noise is important when vessels are operating under high load conditions (high thrust) and when dynamic positioning systems are in use (Spence *et al*. 2007, Abrahamsen 2012). For example, the use of thrusters for DP has been reported to result in increased sound generation (>10dB) when compared to the same vessel in transit (Rutenko & Ushchipovskii 2015).

Shipboard machinery creates both vibrations and airborne noise which in turn can generate underwater sound radiation; most pronounced is the sound generated from propulsion machinery such as diesel engines or turbines and diesel generators. Machinery induced noise is generally tonal in nature and can span across a wide range of frequencies, from very low (below 10Hz) to several thousand Hz. Higher frequency tones are typically seen only at slow speeds i.e. in the absence of propeller cavitation but low frequency tones (<500Hz) tend to be predominant at all speeds (Spence *et al*.2007, Abrahamsen 2012).

While the sources and paths of sound from vessels are well understood, predicting sound exposure on the basis of vessel information is complex; it depends not just on engineering and design of the vessel, but on how it operates and on its age (or time since regular maintenance) as well as on the characteristics of the environment in which it operates (OSPAR 2009). In generic terms, small leisure crafts and boats (<50m) tend to have a lower source level (160-175 dB re 1µPa@1m) and have greater sound energy in relatively higher frequency (above 1kHz) than large ships; support and supply vessels (50-100m) are expected to have source levels in the middle range 165-180dB re 1µPa@1m range and large vessels (>100m) produce louder and predominantly lower frequency emissions (OSPAR 2009)

Historically, measurements have mainly concentrated on shipping vessels or on vessels with special requirements to minimise sound as in the case of some Navy and fisheries research vessels. With respect to support vessels for offshore industry, many data gaps remain; in 2014, a workshop on quieting technologies organised by the US Department of the Interior, Bureau of Ocean Energy Management concluded that available information did not allow to determine what contribution support vessels make to ambient noise and called for the development of a database of sound source levels for different types of vessels at different speeds and operation scenarios (CSA Ocean Sciences 2014).

Overall, noise from vessels is predominantly low frequency and the global shipping fleet is recognised as the main contributor to ambient noise in the open ocean. The indicator being developed for 'ambient noise' as part of the implementation of the Marine Strategy Framework Directive focuses on two low frequency third-octave bands, centred at 63 and 125 Hz; these bands are where the contribution of noise from shipping (relative to other sources, including natural) is likely to be greatest (Dekeling *et al*. 2014).

Underwater sound from commercial ships was described by McKenna *et al*. (2012). Broadband source levels were estimated for 29 ships, across 7 categories; these ranged between 177 and 188 dB re1 µPa2 (20-1000Hz). Spectral characteristics differed between categories, with bulk carrier noise predominantly near 100 Hz and container ship and tanker noise predominantly below 40 Hz. A difference of 5-10dB between stern and bow aspect noise levels was also measured. Veirs *et al*. (2016) estimated sound characteristics for a wider variety of ships (from pleasure craft to container ships) in transit across the Haro Strait (west coast of North America) and compared them to previous results. In their study, average broadband source levels by vessel category ranged from 159 to 178 dB re 1µPa@1m (20-40,000Hz), with a maximum value for an individual ship of 195 dB re 1µPa@1m (20-40,000Hz). Median received levels of ship noise within the study area were measured to be elevated above ambient not only at the lower frequencies (20-30dB from 100-1,000Hz) but also at high frequencies (5-13dB 10,000-40,000Hz); as a consequence of this study, authors recommend the upper frequency limit of recording systems to be raised to at least 50kHz when monitoring ship noise.

Likely vessels to be used during decommissioning are described in Section 3.5 (Table 3.4). The largest vessel expected to be in operation is the HLV (vessel to be finalised) which would be on site for approximately 3 days. The bulk of the activity would be carried out by medium sized vessels with an overall presence on site of 19 days (note the rig and the standby vessel for the rig will be on location for ~33 days). In the absence of exact vessel operational information and direct measurements, it is assumed that as a precautionary approach the average broadband source levels of container ships (e.g. the noisiest ship category recorded) would be adopted.

Acoustic modelling in support of oil & gas operations have shown that across a variety of vessels, activities and localities, exposure to sound pressure level (SPL) above >180 dB re 1 µPa rms is highly unlikely; SPL >160 dB re 1 µPa rms are encountered only within the immediate vicinity of the activity (<50m) while SPL >120 dB re 1 µPa rms are encountered up to a few kilometres (Neptune LNG 2016, Fairweather 2016, Owl Ridge Natural Resource Consultants 2016).

Removal of the infrastructure is not considered to result in significant sound generation; the topsides are to be unbolted from the monopile jacket/suction pile section (contingency to use gas cutting equipment) and the removal of the suction piles is a reverse of installation, using a pump (contingency to use high pressure water jet pile cutting equipment, either ROV or diver operated). If the pump is unable to release the suction piles, noise will also be generated if the high pressure water jet is used to cut the piles and also by the diamond wire or hydraulic cutting tools used to cut the pipeline water injection line and cable ends.

Measurements of an ROV-operated diamond wire cutting tool on a platform conductor at 80m water depth found noise levels to be not easily discernible above background levels between 100-800m from the source, with associated increases of around 4dB and up to 15dB re 1 µPa2 per 1/3 octave band for

some frequencies, mostly above 10kHz (Pangerc *et al*. 2016). Direct measurements of noise levels generated by non-impulsive underwater tools are limited, but where available they have been reported to generate sound of an amplitude that does not exceed those from average vessels. For example, Anthony *et al*. (2009), as part of a review of diver noise exposure, presents estimates of source levels of 148 – 180 dB re 1µPa@1m for several hand held tools (excluding impulsive stud/bolt guns). These include estimates of 160.1 and 170.5 dB re 1µPa@1m for water jet lances (most energy > 200 Hz; Molvaer & Gjestland 1981), which are likely to be broadly representative of noise emissions from abrasive water jet cutting tools (Molvaer & Gjestland 1981).

Marine Mammals

The Moray Firth is an important area for several cetaceans, including a resident bottlenose dolphin population, harbour porpoises widespread year-round and minke whale present in summer. The Firth also supports important breeding colonies for grey and harbour seals.

Marine mammals show high sensitivity to underwater sound. In terms of impact, anthropogenic sound sources have been categorised based on acoustic and operational features (Southall *et al*. 2007); the main distinction is between pulsed and non-pulsed sounds due to differences in the auditory fatigue and acoustic trauma they induce, with the brief, rapid-rise of impulsive sounds being potentially more damaging. Generally, the severity of effects tends to increase with increasing exposure to noise with both sound intensity and duration of exposure being important. A distinction can be drawn between effects associated with physical (including auditory) injury and effects associated with behavioural disturbance. With respect to injury, risk from an activity can be assessed using threshold criteria based on sound levels (e.g. Southall *et al*. 2007, Lucke *et al*. 2009, NMFS 2016). With respect to disturbance however, it has proved much more difficult to establish broadly applicable threshold criteria based on exposure alone (NPWS 2014).

In addition, auditory capabilities are frequency dependent and vary between species (Southall *et al*. 2007). In the vicinity of the Jacky area, several species of marine mammals may be present (see Section 4.11); Table 6.8 provides details of the relevant species listed by functional hearing group and the relevant auditory bandwidth as defined by Southall *et al*. (2007), Lucke *et al*. (2009) and more recently in NMFS (2016). As described above, sound from vessels has a wide frequency spectrum, but the dominant frequency tends to be low (<100Hz); this means that while all marine mammal species are expected in principal to be able to detect these sounds, low-frequency cetaceans and pinnipeds are more likely to do so.

Table 6.8 – Marine mammal species relevant to the area covered and their auditory capabilities

Species expected to be present in the wider area	Functional hearing group	Hearing range	
		Southall *et al*. 2007	NMFS 2016
Minke whale *Balaenoptera acutorostrata*	Low-frequency cetaceans	7Hz to 22kHz	7Hz to 35kHz
Bottlenose dolphin *Tursiops truncatus* White-beaked dolphin *Lagenorhynchus albirostris* Atlantic white sided dolphin *Lagenorhynchus acutus* Risso's dolphin *Grampus griseus* Long-finned pilot whales *Globicephala melas* Killer whale *Orcinus orca*	Mid-frequency cetaceans	150Hz to 160kHz	150Hz to 160kHz
Harbour porpoise *Phocoena phocoena*	High-frequency cetaceans	200Hz to 180kHz	275Hz to 160kHz
Harbour seal *Phoca vitulina* Grey seal *Halychoerus grypus*	Pinnipeds in water	75Hz to 75kHz	50Hz to 86kHz

Notes: [1.] Injury is defined as the level at which a single exposure is likely to cause onset of permanent hearing loss.
Sources: Southall et al (2007), NMFS (2016) and Lucke et al. (2009)

Sound from vessels has a wide frequency spectrum but the dominant and most widely propagated frequency tends to be low (<200Hz). Therefore, while all marine mammal species which may occur in the Moray Firth area are expected in principal to be able to detect these sounds, it is low-frequency cetaceans and pinnipeds whose hearing ranges show the greatest overlap with noise generated by the Jacky decommissioning activities. With respect to injury thresholds and disturbance considerations, continuous underwater sound generated from vessels and cutting tools is understood to be relatively minor in comparison to impulsive sounds derived from high amplitude sources such as airguns during seismic surveys, impact piling or explosives (DECC 2016).

While it cannot be excluded that sound from the rig and vessels will in the short-term influence the behaviour of individual marine mammals within the vicinity of the decommissioning operations, the risk that any effect could become significant at the population level, or cause short or long term displacement from key habitat, is deemed to be extremely low due to a combination of sound characteristics, duration of activity, current understanding of marine mammals movement and behaviour in the Jacky and wider Moray Firth area and distance to the closest marine protected areas (29-38km).

Nonetheless, in recognition that any increase in vessel activity will add to the overall ambient noise and this should ultimately be avoided, a phased approach to decommissioning will ensure that vessel time in the field is minimised.

Fish

Many species of fish are highly sensitive to sound and vibration and broadly applicable sound exposure criteria have been published (Popper *et al* 2014). While it is recognised that vessel and other continuous noise may influence several aspects of fish behaviour, including inducing avoidance and altering swimming speed, direction and schooling behaviour, (e.g. De Robertis & Handegard 2013), there is no evidence of mortality or potential mortal injury to fish from ship noise (Popper *et al* 2014). Given the source level characteristics and the context of similar contributions to the ambient anthropogenic noise spectrum of the area over several decades (i.e. the oil and gas associated vessels and rigs that have been stacked or refurbished in and around the Cromarty, Nigg and wider Moray Firth areas), no injury or significant behavioural disturbance to fish populations is anticipated.

Mitigation

The rig will be the longest on location, at *ca*. 33 days, with vessels (including the HLV) being on site for between *ca*. 1 and 19 days; therefore, the majority of operations will be both short-term and localised. Unbolting of infrastructure is the preferred method of disconnection rather than cutting, although the cutting tools identified as alternatives are not considered significant in terms of noise generation.

The schedule of activities is such that each phase of decommissioning will follow, rather than overlap, thereby reducing the likelihood of having multiple vessels on location (other than support vessels) carrying out multiple decommissioning activities simultaneously.

Conclusion

Given the characteristics of the underwater noise generated by the proposed decommissioning activities and the relatively short duration of these operations, they are highly unlikely to represent a risk of disturbance; for example, based on low expected noise generation, current EPS guidance (JNCC 2010), support the use of cutting technology (as opposed to explosives) during decommissioning operations.

Under the EU Habitats Directive 92/43/EEC member states are required to establish a system of strict protection for the animal species listed in Annex IV which includes all cetaceans. *The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) implements the Habitats Directive for all oil and gas activities within the UKCS (including decommissioning activities). However, significant noise sources which could pose a significant effect have not been identified for the decommissioning of the Jacky Field facilities.

6.6 Effects associated with near-shore/onshore dismantling of structures

Potential Impact

The scale of the Jacky facilities being decommissioned are such that no nearshore dismantling should be required, with the infrastructure lifted directly onto the quayside from the transporting vessels. In addition, existing quay capacity of possible ports is sufficient for receiving the infrastructure, resulting in no new quay facilities requiring to be built to accommodate the Jacky infrastructure.

The dismantling of the infrastructure following their transport to shore has the potential to generate a range of impacts including visual intrusion, noise, dust, fumes and odour. The level of work to be undertaken onshore will in part depend on whether a reuse option can be identified. Where infrastructure is recycled, potential impacts associated with this include: degradation of air quality (i.e. transport to a recycling facility and emissions associated with the recycling process) and nuisance (noise, vibration, odour) to the local community (e.g. from traffic, dismantling of equipment, removal of residual marine growth). The Jacky WHP is a relatively small installation and would require less work dismantling components, compared to manned platforms in the deeper North Sea.

The dismantling facility is yet to be chosen, but will be an established yard to which the decommissioning programmes will generate incremental activity, rather than the creation of a new site which could generate additional sources of effect. Should, in the unlikely event, the destination of any material be a non-UK yard, Ithaca will ensure that waste is exported in a manner consistent with relevant waste shipment Regulations (e.g. *The Transfrontier Shipment of Waste Regulations 2007 (as amended*)).

Decommissioning of oil and gas infrastructure from the UKCS is set to rise over the next five to ten years if extensions to the life of these fields is no longer possible; decommissioning plans for several large installations/complexes from the North Sea have recently been submitted to the Regulator. A growing demand for receiving, dismantling and recycling facilities could have implications on the capability/ability of existing facilities, although expansion of ports (e.g. Dundee) is under way to accommodate the growing decommissioning sector and address this potential issue.

Mitigation

Mitigation is possible through yard selection and contractor audit to ensure that any effects are minimised and that the receiving/dismantling/recycling facilities, has the capacity to carry out the work. The chosen facility must first have a proven disposal track record and waste stream management process for the whole dismantling process and demonstrate their ability to deliver innovative recycling options.

Conclusion

There are impacts associated with the onshore dismantling of oil and gas infrastructure and, as the demand for facilities grow with an increasing number of North Sea installations being decommissioned, there will be potential issues of these receiving and processing facilities in terms of capacity and ability. However, the Jacky facilities are relatively small and there are suitable, existing yards in the UK capable of receiving and processing these.

6.7 Fate of materials returned to shore: recycling, reuse and disposal

Potential Impact

Of the Jacky Field facilities Ithaca intends to decommission, the following infrastructure will be recovered and returned to shore for reuse, recycling or disposal:

- Jacky WHP topsides, monopile jacket and suction piles
- MLT structure, tether and clump weight
- Pipeline and power cable tie-in spool pieces
- Protective material (mattresses, grout bags, frond mats)

The Waste Framework Directive (Directive 2008/98/EC), defines waste as "any substance or object which the holder discards or intends or is required to discard" and the responsibility for the management of this waste, lies with the producer of the waste. A basic waste management principle of the Directive is that waste be managed "*without endangering human health and harming the environment…without risk to water, air, soil, plants or animals, without causing a nuisance through noise, or odours and without adversely affecting the countryside or places of special interest*."

There is no current UK waste legislation that specifically deals with decommissioning activities, although aspects of existing waste legislation apply, for example *The Environmental Protection Act 1990*, *Controlled Waste regulations 1992 (as amended)* (Scotland only) and *Special Waste regulations 1996 (as amended)* (Scotland only).

Decommissioning the Jacky Field facilities will generate quantities of controlled waste, and as producer of this, Ithaca has the responsibility for the management of this waste. The potential principal impacts from returning material onshore for waste disposal, are the impacts associated with landfill, including use of scarce remaining (landfill) space, air quality through transport, nuisance to local communities (e.g. noise, visual impact, odour) and potential impact on groundwater through leaching; energy use and atmospheric emissions as a consequence of waste disposal are dealt with in Section 6.4 above. To

limit the quantity of waste requiring eventual landfill disposal, Ithaca will ensure appropriate waste segregation and treatment is undertaken.

Within their management system, Ithaca has existing processes and procedures in place for the management of wastes generated from their activities, including their offshore operations. These align with the Waste Framework Directive and follow the waste hierarchy principles (most to least preferred): Reduce; Reuse; Recycle; Recover and Landfill and extend to the management of waste from decommissioning activities, thereby ensuring decisions during the planning and execution of these remain consistent with the hierarchy principles.

In preparation of decommissioning, a cleaning programme was carried out and the topside production pipework and production pipeline were flushed with inhibited seawater, leaving these hydrocarbon "free" (<10mg/ml OIW). All chemicals and hydraulic fluids were decanted and sent onshore for disposal at a licensed site. NORM/LSA scale were not detected during operation of the field, and therefore not expected. However, as a precaution, Ithaca will ensure all infrastructures recovered for onshore transport will be checked for the presence of NORM.

At present, and based on current information, approximately 88% of the total installation inventory comprises ferrous metal (e.g. steel), with the remainder a mix of non ferrous metals, and plastic, all of which is being returned to shore and approximately 8% comprising of marine growth, the majority of which will be removed offshore – see below. An estimated 91% of the total installation materials recovered to shore is expected to be reused, with ~8% recycled and ~1% going to disposal (this comprising the ~2 tonnes of residual marine growth returned to shore). Based on current pipeline inventory estimates, including protective material, ~11% of the total tonnage is ferrous, with the remaining ~89% a mixture of concrete/grout/rock, non ferrous (the power cable components only) and plastic. Of the estimated planned tonnage being returned to shore, current aspirations are to reuse ~ 91% of this, which includes gabion bags, concrete mattresses and power cable clump weight with ~8% recycled and ~1% going to disposal (grout bags).

In terms of the waste hierarchy, in order to achieve the preferred option for decommissioning, Ithaca have identified a possible reuse opportunity for the topsides and monopile (along with suction piles) and the MLT and will continue to seek alternative reuse opportunities for some of the other materials to be recovered e.g. concrete mattresses. However, the final reuse options will depend on industry and market conditions.

The eventual fate of materials will in part be controlled by the type of waste and how it is regulated, and also the potential for material reuse and recycling. All waste will be documented in a waste inventory, which will be used to record the types, quantities and fate of all waste.

Marine growth

The marine growth on the Jacky structure is not extensive, amounting to *ca*. 205 tonnes with the majority (*ca*. 75%) expected to be removed offshore. This growth mainly consists of anemones, hydroids, mussels and barnacles, as confirmed in a ROV inspection survey conducted in 2013 (Harkand 2013). When recovered, this constitutes a controlled waste under the *Environmental Protection Act 1990 (as amended)* and a residual quantity (*ca*. 2 tonnes) is likely to remain on the monopile jacket and be transported back onshore, where it will be removed and disposed of.

Species on the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) list, including *Lophelia pertusa*, are not present on the Jacky WHP and therefore would not require additional measures to be undertaken during disposal.

Disposal options are likely to include landfill or composting. The decay of marine growth at the disposal location is likely to cause short-term deterioration in air quality (primarily odour). The intensity and

duration of the smell produced by decaying organisms will depend on the time of year and environmental conditions such as temperature, with dominant winds being responsible for the range and location of areas affected.

In 2013, Oil and Gas UK published results of marine growth studies carried out between 2011 and 2013. Key findings included: no evidence that non- native species occurred on North Sea oil and gas structures; onshore management of marine growth was carried out at licensed yards with marine growth management practices appropriate to local circumstances; the quantity of marine growth handled by yards surveyed was less than the estimated weights supplied by the oil and gas operators; principal disposal routes for marine growth was landfill – although identifying suitable sites close to handling yards was challenging; and odour emissions management was largely successful in mitigation through rapid removal and use of odour suppressants (Oil and Gas UK 2013).

Mitigation

The range of returnable waste generated from the jack-up, HLV, support and other vessels, will be typical to those associated with well, subsea and shipping activities. All wastes will be managed in compliance with *The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008* which prohibits the disposal of garbage to sea. The jack-up rig and vessels will maintain garbage records and hold Garbage Management Plans which detail specific waste management procedures, document the segregation and safe handling and storage of waste and waste reduction measures. Mitigation for the marine growth includes the removal of mussels from the monopile jacket prior to transfer to shore, thereby reducing onshore air quality effects (IECS 2012).

Waste will be managed consistent with the requirements for onshore disposal including the Duty of Care for waste and the *Special Waste Regulations 1996* (as amended). Transfer notes (consignment notes for hazardous wastes) will be completed for the transfer of waste to shore. All wastes generated will be segregated and stored in suitable, labelled containers onboard, and then returned to shore for appropriate disposal at licensed waste disposal sites or for approved recycling. Open skips will be netted and containers of liquid wastes will be stored in bunded areas with compatible wastes.

An inventory of items and materials on the Jacky WHP and subsea infrastructure will be made to identify the potential quantities of wastes and the options for reuse and recycling as well as items or materials which will require special handling and disposal, to ensure the waste management decisions for the decommissioning of the Jacky Field facilities are consistent with the waste hierarchy principles.

Conclusion

The overall impact of waste generated from the decommissioning of the Jacky Field facilities is considered low; the Jacky Field facilities are relatively small overall but have a large quantity of steel that can be reused (or recycled). Marine growth is not extensive; the majority of this is expected to be removed offshore rather than being returned to shore.

Ithaca will ensure appropriate waste segregation and treatment is undertaken, in order to limit the quantity of waste going to eventual landfill disposal, and will consider a waste hierarchy whereby opportunities for the reuse or recycling of equipment and materials will be maximised.

6.8 Accidental events and Major Environmental Incident (MEI)

Accidental events

Risk assessment of accidental events involves the identification of credible accident scenarios, evaluation of the probability of incidents and assessment of their ecological and socio-economic consequences. Evaluating spill risk requires consideration of the probability of an incident occurring

and the consequences of the impact. Given the nature of the activities which could take place as a result of decommissioning, the following potential sources of spill risk have been identified:

- Worst case loss of fuel inventory from a vessel (HLV, support vessel)
- Worst case loss of diesel from the rig
- Loss of chemical containment, including legacy chemicals from wells

A potential spill from the single Jacky production well is not considered to be a source of spill risk; artificial lift (ESP and water injection) was required for the Jacky production well, thereby reducing the potential for loss of any residual reservoir hydrocarbons from the Jacky decommissioning activities. A cleaning programme was carried out on the Jacky topsides and subsea infrastructure, with pipelines being left with inhibited seawater (chemicals include biocide, corrosion inhibitor), again reducing the potential loss of any residual reservoir hydrocarbons. Any remaining hydrocarbons within the pipeline and topsides will be small quantities, not removed by the cleaning process. It is unlikely that these residues would be of a quantity to generate pollution events.

It is understood that some of the chemicals contained in the shut in wells may no longer be permitted for discharge, therefore containment for onshore treatment and disposal may be necessary.

Other users of the Jacky area and transportation routes will be alerted to the decommissioning activities via publication of Notices to Mariners detailing rig and vessel positions, activities and timing and by full navigation lighting on the rig and vessels. Current information indicates that shipping density in the area is low, however a vessel traffic survey will be undertaken to inform rig siting, decommissioning planning and the wider EIA process.

All vessels and rigs to be used during well and wider facility decommissioning will have in place the relevant, current Shipboard Oil Pollution Emergency Plan (SOPEP) and/or Non-Production Installation Oil Pollution Emergency Plan (NPI OPEP), with the relevant interfacing Ithaca Plan, which would be implemented in the event of an accidental event. Further spill response resources would be available to Ithaca via contracted spill management contractors.

In the unlikely event of a diesel spill, these would rapidly spread and disperse to form a sheen on the sea surface. Diesel in not persistent and would rapidly evaporate.

Major Environmental Incidents

The publication of Directive 2013/30/EU on safety of offshore oil and gas operations (EUOSD) and *The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015* that transpose the requirements of the Directive into UK law, acknowledged the environmental element associated with Major Accident Hazards (MAH), and introduced the requirement to identify Safety and Environmental Critical Elements (SECEs), with the regulations now including a further definition of Major Accident, a Major Environmental Incident (MEI). An MEI is an incident which results, or is likely to result in, significant adverse effects on the environment and for an incident to be a MEI, this must have another safety related Major Accident as a precursor.

The Jacky Safety Case[25] identified MEHs, including a well blowout, subsea pipeline release, ship impact, and structural failure. The single production well on Jacky is currently shut in and has a downhole barrier to flow, via a safety valve (the other wells being a water injection well and a suspended

[25] The current Jacky Safety Case (SC) is being reviewed and updated in line with current legislation and the decommissioning activities and does not currently identify MEIs as the current SC predates the new Legislation. The MAH assessment and MEI will therefore be updated for the new SC.

well never completed). The surface xmas tree valves are closed and the wells maintained and tested as per Ithaca's Well Examination Scheme.

The production line has been flushed and cleaned, and is positively isolated, the Jacky WHP has a 500m safety zone, navigational lighting and has the use of the Beatrice Complex standby vessel and the Jacky WHP is a relatively new structure (installed from new in 2008).

Prior to the commencement of any offshore activities, applicable permits and consents will be applied for, and approvals sought; project specific assessments to support these applications, will include an MEI assessment.

6.9 Potential for effects on conservation sites

Potential Impact

The Moray Firth has a number of conservation sites, (SACs, SPAs and NCMPAs) designated for habitats and species; the closest of these to the Jacky area is the East Caithness Cliffs SPA and NCMPA, approximately 17km from the site. Though the surface facilities are outside of Natura 2000 site boundaries, mobile species which are qualifying features of these sites may forage in the Jacky area. For example, the Smith Bank, is important for foraging seabirds from adjacent coastal SPAs and also used by birds when moulting; an exception being black guillemot (the feature of the East Caithness Cliffs MPA), which are thought to forage ~2km from their terrestrial habitat (SNH 2016). Additionally, the offshore work undertaken along the pipeline route (e.g. vessel presence, removal of subsea deposits and pipeline sections) may have the potential to generate disturbance effects to these species.

If a proposed activity is likely to have a significant effect on a Natura 2000 site, the competent authority is required to carry out an appropriate assessment to determine if it will have an adverse effect on site integrity. This requirement is under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations, 2001* (as amended), which apply to offshore oil and gas activities (including decommissioning activities) in territorial waters and on the UK Continental Shelf.

Conclusion

Sites and species of known or potential conservation importance were considered as receptors in assessing potential effects of decommissioning the Jacky field facilities. This assessment identified only underwater noise and accidental spillage as having a theoretical interaction with Natura 2000 and other conservation sites. These were considered in above sections, relating to specific impacts and a site by site screening is given Appendix 2. The Jacky infrastructure has undergone a cleaning programme, making it hydrocarbon "free"; the cleaning and flushing programme on the topside production pipework and production pipeline has reduced the hydrocarbon content to <10mg/ml OIW. The remaining, potentially significant source of spillage is of diesel from the rig, HLV and other support vessels. While a spill of diesel would rapidly spread out to form a sheen, this will disperse naturally within hours under the prevailing weather conditions in and around the Jacky location.

Taking account of the probabilities of significant impacts being relatively low and mitigations proposed, it is concluded that significant effects on the integrity of these sites are not expected

6.10 Cumulative impacts

Consideration has been given to the cumulative effects arising from decommissioning activities in the context of all other activities taking place in the area and has followed the guidance to *The Offshore Petroleum Production and Pipe-lines (Assessment of Environmental Effects) Regulations 1999* (as amended) (BEIS 2017b) where it states:

" The assessment should also consider the impacts of other existing, consented or planned activities in the development area, and determine whether there are likely to be any significant in-combination or cumulative impacts"

DTI (2003) defined three categories of "additive" effects in the context of Strategic Environmental Assessment:

Incremental effects are considered within the EIA process as effects from licensing exploration and production (E&P) activities, which have the potential to act additively with those from other oil and gas activity, including:

- Forecast activity in newly licensed areas
- New exploration and production activities in existing licensed areas
- Existing production activities
- Forecast decommissioning activities
- "legacy" effects of previous E&P activities, post-decommissioning (e.g. unrecovered debris)

Cumulative effects are considered in a broader context, to be potential effects of decommissioning activities which act additively or in combination with those of other human activities (past, present and future); given the existing uses of the sea in and around the Jacky Field area and the decommissioning activities, the cumulative effects have the potential to arise with other activities, notably:

- Fishing
- Shipping and navigation
- Military activity
- The construction of offshore renewable projects

Synergistic effects – synergy occurs where the joint effect of two or more processes is greater than the sum of individual effects – in this context, synergistic effects may result from physiological interactions (for example, through inhibition of immune response systems) or through the interaction of different physiological and ecological processes (for example through a combination of contaminant toxicity and habitat disturbance).

Effects from decommissioning the Jacky Field facilities or accidents associated with them, which are considered to have potential to act in an incremental, cumulative or synergistic manner are summarised below.

Physical presence	**Incremental**: the jack-up will be situated over the Jacky WHP and should be sited within the existing 500m exclusion zone, resulting in no incremental loss of fishing access. The removal of the Jacky WHP and MLT will remove two 500m exclusion zones from the area, leaving only the exclusion zones relating to the Beatrice oil and gas facilities and the exclusion zones for the Beatrice wind farm during construction and operation **Cumulative**: No other significant access bans or restrictions to navigation exist in the area; the schedule for decommissioning activities may coincide with other decommissioning/development activities in the area, if this is the case, vessel synergies will be explored to minimize vessel presence. **Synergistic**: None
Physical disturbance	**Incremental**: disturbance will be incremental with that resulting from other well plug and abandonment, installation/pipeline decommissioning activities; there is the Beatrice field development in the Moray Firth which is proposed for decommissioning. However, the majority of the spatial extent of disturbance for decommissioning Jacky is limited and widely separated from Beatrice, with the only footprint overlap being the tie-in locations at Beatrice

	Alpha and Bravo. The total area affected is a small proportion of benthic habitat area. **Cumulative**: although intensity is moderate in comparison to other areas, fishing probably represents the principal source of seabed disturbance in the Moray Firth. Trawl scarring in some areas is likely to be extensive. Contribution of decommissioning activities is currently negligible. **Synergistic**: None
Emissions	**Incremental**: No significant incremental effects, in view of scale of inputs (relatively few vessels on site, for relatively short durations at a time, limited vessel overlap) and very high available dispersion. **Cumulative**: Greenhouse and acid gas emissions will be cumulative in a global context, although the contribution associated with the decommissioning activities is minor. **Synergistic**: None
Noise	**Incremental**: Jack-up rig and vessel noise would be incremental to other vessel noise in the Moray Firth and adjacent seas. However, the increment associated with short term decommissioning activities is not considered to have significant synchronous effects (i.e. additive to other acoustic disturbance at the time) or significant temporal effects (i.e. additive to previous and subsequent disturbance by seismic and other activities). **Cumulative**: Other sources of anthropogenic noise include shipping and military sources – the cumulative increment from the decommissioning of Jacky will be minor in the context of existing noise levels from shipping transiting the area. The construction (including piling) of the Beatrice Offshore Windfarm commenced in April 2017 and will continue for ~2 years; the timing of the Jacky decommissioning means that the activities will not overlap, reducing the potential for cumulative effects. **Synergistic**: No synergistic effects have been conclusively demonstrated, although military sonar noise is speculated to be a contributory factor to tissue damage observed in stranded cetaceans (e.g. Jepson *et al*. 2003). This involves much higher source levels than are expected from the decommissioning activities.
Onshore	**Incremental**: Existing yard facilities will be used to receive and process the Jacky facilities. The decommissioning activities will be incremental to existing yard work but not considered to have significant synchronous effects. **Cumulative**: An existing yard facility will have ongoing associated impacts, such as noise, traffic, dust. Jacky is relatively small compared to manned installation, and dismantling should be relatively easy and quick, compared to these other, bigger units; the cumulative impact arising from this is expected to be minor and short term. **Synergistic**: None
Accidental events	**Incremental**: The combined probability of ecologically significant oil spills from decommissioning activity in the Moray Firth is extremely low. **Cumulative**: The adjacent coasts are exposed to risks associated with oil/product tanker and other vessel traffic through the region and to adjacent ports. Some of these routes are comparatively close to shore and limited time is available for effective response measures in the case of accidents. The contribution to overall risk of the decommissioning and associated vessel activities is however, extremely small. **Synergistic**: None

Mitigation measures include optimisation of schedules and making use of vessel synergies in order to minimise interactions with other users.

Part of the work scope to disconnect and remove sections of the Jacky subsea infrastructure will be carried out within existing 500m safety zones, i.e. at Beatrice Alpha and Bravo. Ithaca would look to use existing framework agreements for the decommissioning of their subsea infrastructure, including protective material where possible and should the opportunity be available, seek to combine Jacky decommissioning activities with other development or decommissioning activities taking place in the area. The decommissioning schedule contains contingency to provide flexibility within the programme to take advantage of these opportunities if they arise.

6.11 Transboundary impacts

The UK has ratified the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo 1991) and thus an assessment is needed of the potential for the proposed activities to result in significant transboundary effects. Yard facilities for the dismantling of the Jacky infrastructure have yet to be finalised. However, it is expected that a UK based yard will be used. In addition, as Jacky is far from the nearest Median Line (UK/Norway), transboundary impacts either through the dismantling of the facilities, or emissions/waste discharges offshore are not expected to occur.

7 ISSUE MANAGEMENT AND OVERALL CONCLUSION

7.1 Introduction

Through a systematic evaluation of the Jacky Field decommissioning activities and their interactions with the environment, a variety of potential sources of effect were identified; the majority of these were of limited extent and duration and deemed minor (Section 5.2, Table 5.2). Those activities which were identified as being of potentially greater concern were assessed further in Section 6.

While predicted environmental effects from decommissioning activities are comparable with those from the decommissioning of other field facilities on the UKCS, the Jacky WHP is a relatively small installation (compared to platforms in the deeper North Sea). During the assessment process, no potential issues of concern were identified which could not be mitigated to reduce them to meet regulatory requirements and company policy.

The risk of spill has been considered and there will be preventative measures and procedures in place to minimise the likelihood of their occurrence and potential environmental damage.

7.2 Environmental management commitments

The decommissioning activities will be conducted in accordance with Ithaca's HSE policy. Ithaca's integrated management system is consistent with the ISO 14001: 2015 International Standard for Environmental Management Systems.

A number of contractors will be involved in the detailed planning and execution of the decommissioning activities, including the receiving and processing of the infrastructure onshore and Ithaca has established contractor selection and management procedures which include evaluation of HSE aspects and environmental management and compliance.

Table 7.1 below presents a summary of commitments and actions for the decommissioning activities, with responsible persons/team included.

Table 7 1 – Summary of Commitments and Actions for the decommissioning of the Jacky Field facilities

Item	Issue	Actions	Responsibility
Overall Project			
1	Environmental objectives	Ensure indicators and targets for the decommissioning project are consistent with Ithaca policy and the environmental goals are established for each of the main activities (well plug and abandon, WHP dismantle and removal, subsea infrastructure). Monitor and review performance against indicators and targets, ensuring remedial action is instigated where necessary.	HSEQ Department
2	Contractor management – offshore and onshore operations	Ensure contractor management assurance processes in place and include environmental aspects for all contracted elements of the offshore activities. Ensure all relevant licences/permits in place for receiving and processing facility	Projects/HSEQ Departments
3	Compliance assurance	Ensure a process is in place to manage the applications for and monitoring of compliance with	HSEQ Department

Item	Issue	Actions	Responsibility
		the requirements of environmental permits and consents.	
4	Decommissioning debris	Ensure any item of equipment or materials lost overboard are reported to Ithaca representative Recover all significant items of debris located	Projects/HSEQ Departments
5	Survey	Overtrawlable survey (where rock reused) and debris/clearance report(s) carried out upon completion of decommissioning activities; to include survey of seabed upon removal of suction piles to identify any depressions and/or remedial action required.	Projects/HSEQ Departments
6	Review	Ensure a post project review is carried out to assess the accuracy of EIA predictions in the context of actual impacts. Assess the extent to which commitments made in the EIA have been implemented.	HSEQ Department
Well Plug and Abandonment			
7	Rig audit	Audit of rig to be carried out to confirm systems and procedures are as required for operations in the Moray Firth (including conformance to MARPOL standards)	HSEQ Department
8	Contractor management	Monitor environmental performance during well plug & abandonment operations	Projects/HSEQ Departments
9	Environmental critical elements	Ensure rig has a register of environmentally critical equipment, and that scheduled maintenance checks are undertaken and that items are appropriately prioritised.	HSEQ Department
10	Bunkering	Bunkering to be conducted in favourable sea states, according to the rig operator's procedures and during daylight hours so far as practicable	Projects/HSEQ Departments
11	Waste procedures	Waste management and procedures to be raised at pre-operations meeting Raise expectations of waste reuse and recycling Monitoring of waste management practices and ensure appropriate documentation and record keeping	HSEQ Department
12	Non-routine and accidental events	Audits, risk assessments and mitigation assurance. Interface documents Spill prevention expectations and bunkering to be raised at pre-operations meetings	Projects/HSEQ Departments
Topside, monopile jacket and suction pile removal			
13	Heavy Lift Vessel audit	Audit of HLV to confirm systems and procedures are as required for operations in the Moray Firth (including conformance to MARPOL standards)	HSEQ Department
14	Contractor management	Monitor environmental performance during disconnection and lifting operations. Ensure appropriate lifting processes and procedures in place and adhered to.	Projects/HSEQ Departments
15	Waste procedures	Waste management, procedures and inventory to be raised at pre-operations meeting. Monitoring for NORM/Benzene Monitoring of waste management practices and ensure appropriate documentation and record keeping, including all relevant waste transport/handling documentation	Projects/HSEQ Departments
Subsea infrastructure			
16	Contractor management	Appropriate tools and procedures for disconnection and lifting of infrastructure being removed	Projects/HSEQ Departments

Item	Issue	Actions	Responsibility
17	Waste procedures	Waste management and procedures to be raised at pre-operations meeting. Monitoring of waste management practices and ensure appropriate documentation and record keeping	Projects/HSEQ Departments
Onshore			
18	Audit	Audit of waste handling facility, recycling and disposal companies if required	HSEQ Department
19	Waste procedures	Monitoring of waste management practices and ensure appropriate documentation and record keeping. Use of existing, permitted facilities. Maximize reuse and recycling of materials	Projects/HSEQ Departments

7.3 Overall Conclusion

Following the EIA, the overall conclusion of the decommissioning of the Jacky Field Facilities are:

- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant spillage of reservoir hydrocarbons or chemicals are predicted, due to the reservoir pressure, current status of the production well and topside production pipework
- Spillage of diesel from vessels (including the jack-up) are possible, but potential for this is small and the risks are mitigated as far as possible through operating procedures and spill response procedures that will be in place
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

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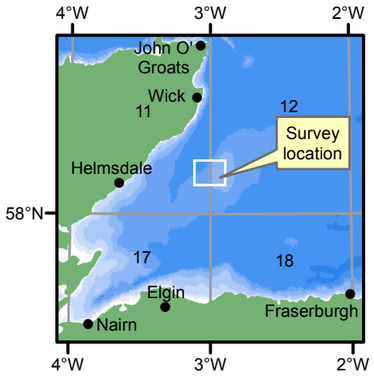


Legend

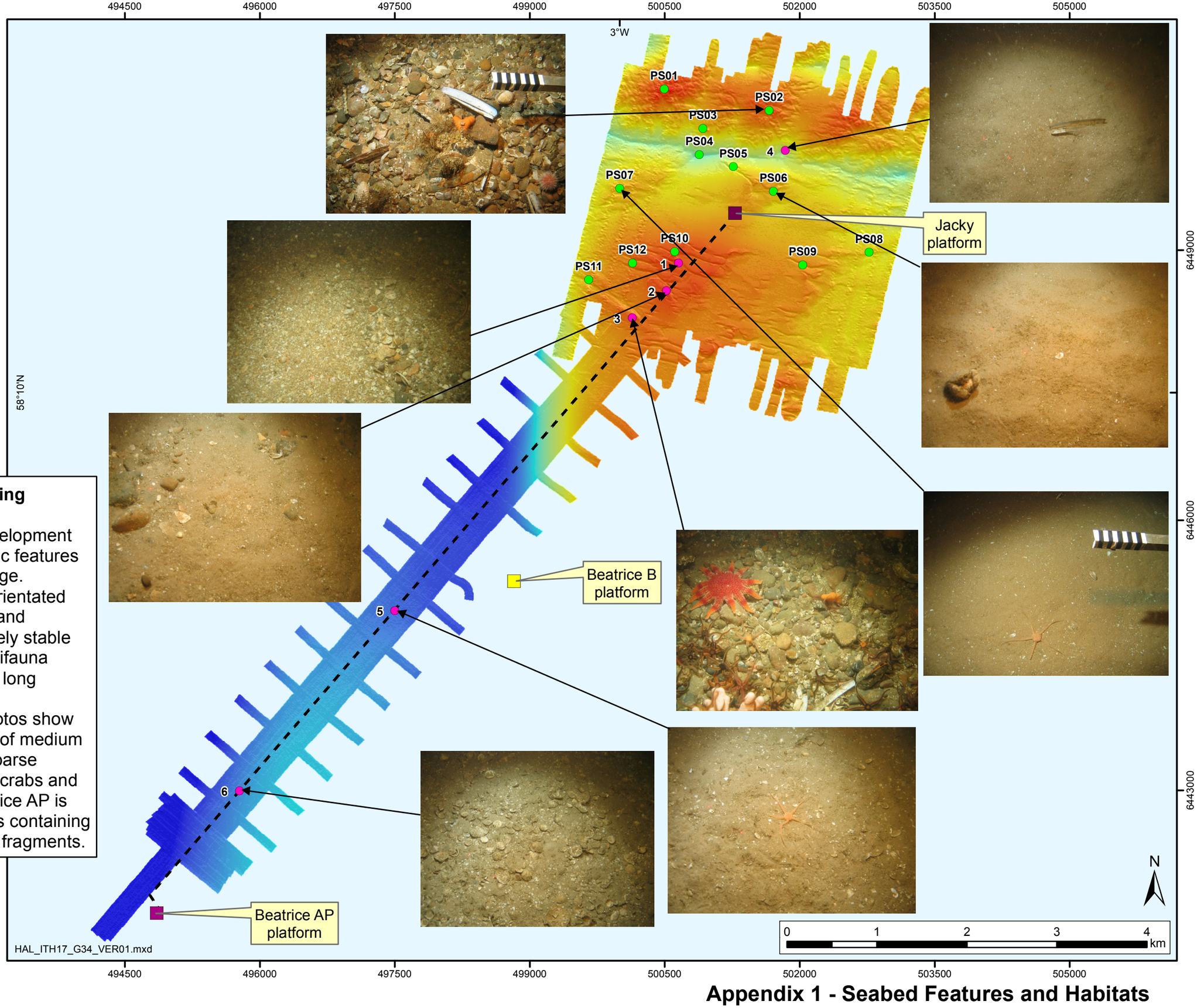
- 2007 site survey stations
- 2007 pipeline route stations

Depth in metres below LAT

-35
-47

Seabed photographs and sampling

The seafloor of the Jacky field development area shows a variety of topographic features although the depth range is not large. Notable are the shallow channel orientated east-west, areas of megarippled sand illustrated by Station 5, and relatively stable pebble and shell with extensive epifauna including solitary individuals of the long lived horse mussel Modiolus (Station 2 and Station 3). Most photos show a generally flat seabed composed of medium to coarse sands, with a typically sparse epifauna of starfish,brittle starfish, crabs and flatfish. The pipeline route to Beatrice AP is generally flat with sandy sediments containing varying amounts of shell and shell fragments.



APPENDIX 2 – NATURA 2000 CONSERVATION SITES

Introduction

As noted in Section 6.9, there is a requirement under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations, 2001* (as amended), whereby projects will be subject to appropriate assessment should a likely significant effect be identified in relation to any relevant Natura 2000[26] site in view of the site's conservation objectives. The following sections provide information relating to the qualifying features of the relevant sites identified above, followed by a high level screening of the Jacky decommissioning activities and the potential for these to result in a likely significant effect on qualifying features of relevant sites. This section, along with the EIA information already documented above, have been compiled to provide sufficient information to the Competent Authority to undertake Habitats Regulations Assessment (HRA), incorporating appropriate assessment, if required.

Relevant sites

Relevant marine and coastal conservations sites designated (or proposed for designation) under the EU Habitats Directive as Special Areas of Conservation (SACs) or under the EU Birds Directive as Special Protection Areas (SPAs) – collectively termed Natura 2000 sites – within and adjacent to the Moray Firth are shown in Figures A2.1 and A2.2 below. These sites were identified to be relevant to the Jacky decommissioning project on the basis of their location and qualifying features (i.e. with a relevant connection to the marine environment or where there was considered to be a relevant effects pathway, for example terrestrial sites designated for the freshwater pearl mussel due to its reliance on the Atlantic Salmon, or inland breeding birds that feed in coastal/marine habitats).

Summary site information for relevant SACs and SPAs is provided in Table A2.2. This information has been collated from the latest JNCC SAC[27] (version as of 14th November 2017) and SPA[28] (version as of 30th June 2017), and related SAC and SPA pages of the JNCC and SNH websites. Site conservation objectives were collated for each site[29]. The conservation objectives which relate to each of the habitats and species of the relevant sites listed in Table A2.2 are shown in Table A2.1 below.

[26] In accordance with planning policy (Scottish Planning Policy and the Marine Policy Statement), relevant sites include classified and potential SPAs, designated and candidate SACs and Sites of Community Importance (SCIs).

[27] http://jncc.defra.gov.uk/page-1461

[28] http://jncc.defra.gov.uk/page-1409

[29] Conservation objectives were obtained from the SNH SiteLink website: https://gateway.snh.gov.uk/sitelink/

Table A2.1 – Conservation objectives which relate to relevant to SPA and SAC sites

SPAs	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the specie
pSPAs	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species. This contribution will be achieved through delivering the following objectives for each of the site's qualifying features • Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term • To maintain the habitats and food resources of the qualifying features in favourable condition.
SACs	For Annex I Habitats To avoid deterioration of the qualifying habitats, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying habitats that the following are maintained in the long term: • Extent of the habitats on site • Distribution of the habitats within site • Structure and function of the habitats • Processes supporting the habitats • Distribution of typical species of the habitats • Viability of typical species as components of the habitats • No significant disturbance of typical species of the habitats For Annex II Species To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are established then maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within the site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species Additionally, for sites designated for the freshwater pearl mussel feature, to ensure the following are established then maintained in the long term: • Distribution and viability of freshwater pearl mussel host species • Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species

Figure A2.1 – Relevant coastal and marine SACs and SPAs

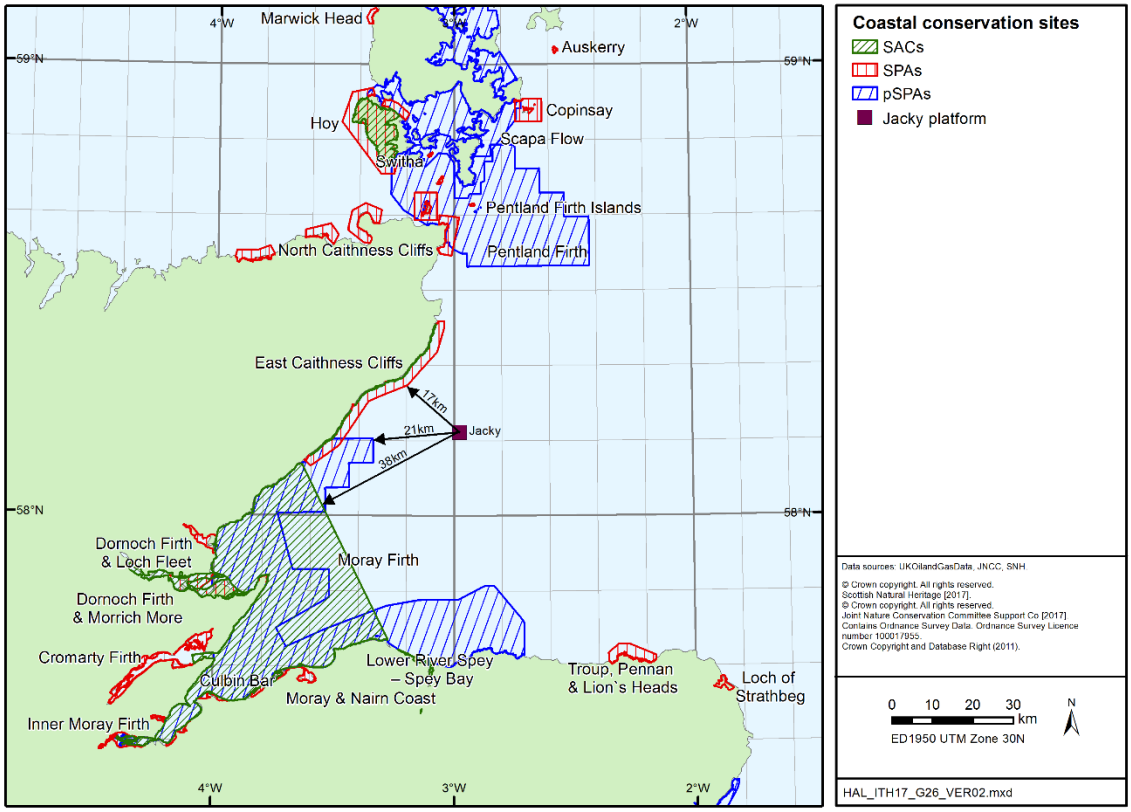


Figure A2.2 – Relevant inland SACs and SPAs

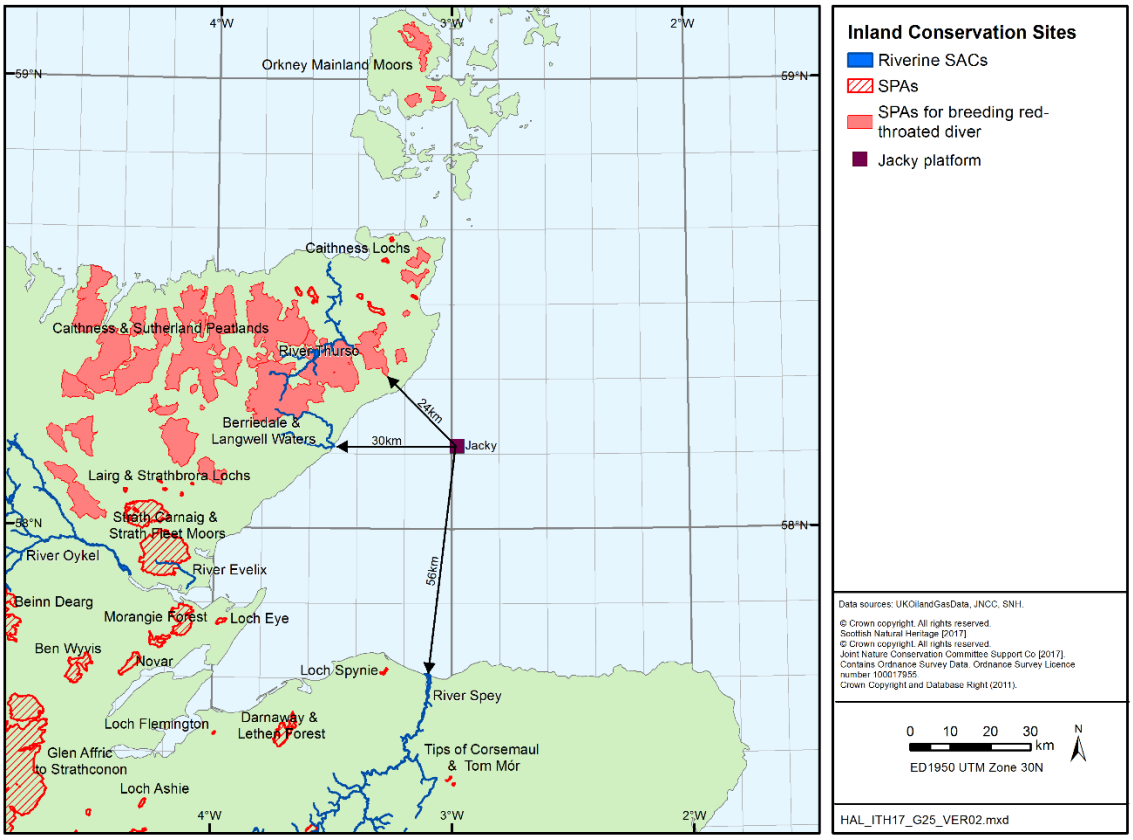


Table A2.2 – Site summary information for relevant SACs and SPAs

Name	Distance to Jacky WHP	Site features and summary
SPAs		
Auskerry SPA	97km	**Article 4.1**: Arctic tern, Storm petrel (breeding) Auskerry is a small, uninhabited low-lying island situated 5km south of Stronsay in the Orkney Islands. The shore is a mixture of rocky platforms interspersed with low cliffs and boulder/shingle beaches. The site is important as a nesting area for a number of breeding seabirds. These birds feed outside the SPA in the waters surrounding the island, as well as more distant waters.
Caithness and Sutherland Peatlands SPA	24km	**Article 4.1**: Black-throated diver, golden eagle, golden plover, hen harrier, merlin, red-throated diver, short-eared owl, wood sandpiper (breeding) **Article 4.2**: dunlin (breeding) The Caithness & Sutherland Peatlands are located across the northernmost parts of mainland Scotland. The SPA contains a large proportion of these peatlands, which form one of the largest and most intact areas of blanket bog in the world. This range of structurally diverse peatland and freshwater habitats supports a wide variety of breeding birds including internationally important populations of raptors, wildfowl and waders.
Calf of Eday SPA	115km	**Article 4.2**: seabird assemblage of international importance including: common guillemot, black-legged kittiwake, great black-backed gull, great cormorant and northern fulmar (breeding) The Calf of Eday is a small, uninhabited island located to the north of the island of Eday in the Orkney archipelago. The island has a rocky coastline with cliffs on the north and east coasts. The site is of importance as a nesting area for breeding seabirds, which feed in surrounding waters outside the SPA and use most of the island for loafing. Gulls and great cormorant nest in the dry heath and grassland areas, whilst northern fulmar black-legged kittiwake and auks nest on the cliffs.
Copinsay SPA	78km	**Article 4.2**: seabird assemblage of international importance including: common guillemot, black-legged kittiwake, great black-backed gull and northern fulmar (breeding) Copinsay lies 4km off the east coast of Orkney Mainland. It consists of the island of Copinsay and three islets (Corn Holm, Ward Holm and Black Holm). The three holms are vegetated and a storm beach connects them to Copinsay at low water. Copinsay is formed of Old Red Sandstone with the largely horizontal bedding planes providing ideal breeding ledges for seabirds (auks and black-legged kittiwake), especially on the sheer cliffs of the southeast of Copinsay which reach to over 60m. The seabirds feed outside the SPA in the nearby waters, as well as more distantly.

Name	Distance to Jacky WHP	Site features and summary
Cromarty Firth SPA	79	**Article 4.1: c**ommon tern, osprey (breeding); bar-tailed godwit, whooper swan (over winter) **Article 4.2**: greylag goose (over winter) **Article 4.2**: waterfowl assemblage of international importance including: redshank, curlew, dunlin, knot, oystercatcher, red-breasted merganser, scaup, pintail, wigeon, greylag goose, bar-tailed godwit, whooper swan (breeding) The Cromarty Firth is located in north-eastern Scotland and is one of the major firths on the east shore of the Moray Firth. It contains a range of high-quality coastal habitats including extensive intertidal mud-flats and shingle bordered locally by areas of saltmarsh, as well as reedbeds around Dingwall. The rich invertebrate fauna of the intertidal flats, with beds of eelgrass, glasswort, and *Enteromorpha* algae, all provide important food sources for large numbers of wintering and migrating waterbirds (swans, geese, ducks and waders). With adjacent estuarine areas elsewhere in the Moray Firth, it is the most northerly major wintering area for wildfowl and waders in Europe. The Firth is also of importance as a feeding area for locally breeding osprey as well as for breeding terns. Cromarty Firth SPA forms an integral ecological component of Moray Basin Firths and Bays.
Dornoch Firth and Loch Fleet SPA	59km	**Article 4.1:** osprey (breeding); bar-tailed godwit (over winter) **Article 4.2**: greylag goose, wigeon (over winter) **Article 4.2**: waterfowl assemblage of international importance including: curlew, dunlin, oystercatcher, teal, wigeon, greylag goose, bar-tailed godwit (over winter) The Dornoch Firth is located in north-eastern Scotland and is one of the two northernmost estuaries in the Moray Basin ecosystem. The Dornoch Firth and Loch Fleet SPA is one of the best examples in northwest Europe of a large complex estuary which has been relatively unaffected by industrial development, whilst Loch Fleet itself is an example of a shallow, bar-built estuary. Extensive sand-flats and mud-flats are backed by saltmarsh and sand dunes with transitions to dune heath and alder woodland. The tidal flats support internationally important numbers of waterbirds on migration and in winter, and are the most northerly and substantial extent of intertidal habitat for wintering waterbirds in the UK, as well as Europe. The Firth is also of importance as a feeding area for locally breeding osprey. Dornoch Firth and Loch Fleet SPA forms an integral ecological component of Moray Basin Firths and Bays of which it forms the most northerly component area.

Name	Distance to Jacky WHP	Site features and summary
East Caithness Cliffs SPA	17km	**Article 4.1:** peregrine (breeding) **Article 4.2**: common guillemot, herring gull, black-legged kittiwake, razorbill, shag (breeding) **Article 4.2**: seabird assemblage of international importance including: Atlantic puffin, great black-backed gull, great cormorant, northern fulmar, razorbill, common guillemot, black-legged kittiwake, herring gull, European shag (breeding) The East Caithness Cliffs SPA is located on the east coast of Caithness in northern Scotland. The site comprises most of the sea-cliff areas between Wick and Helmsdale. The cliffs are formed from Old Red Sandstone and are generally between 30-60m high, rising to 150m at Berriedale. Cliff ledges, stacks and geos provide ideal nesting sites for internationally important populations of seabirds, especially gulls and auks. The seabirds nesting on the East Caithness Cliffs feed outside the SPA in inshore waters as well as further away. The cliffs also provide important nesting habitat for peregrine. The cliffs overlook the Moray Firth, an area that provides rich feeding areas for fish-eating seabirds.
East Sanday Coast SPA	117km	**Article 4.2**: purple sandpiper, turnstone (over winter) East Sanday Coast SPA is located on the island of Sanday in the Orkney Islands of northern Scotland. The site comprises a 55km stretch of coast, and consists of both rocky and sandy sections. The coastline supports internationally important populations of wintering waders.
Hoy SPA	65km	**Article 4.1:** peregrine, red-throated diver (breeding) **Article 4.2**: great skua (breeding) **Article 4.2**: seabird assemblage of international importance including: Atlantic puffin, common guillemot, back-legged kittiwake, great black-backed gull, Arctic skua, northern fulmar and great skua (breeding) Hoy is one of the most southerly of the major islands of the Orkney archipelago in northern Scotland. The Hoy SPA covers the northern and western two-thirds of the island, which is formed of Old Red Sandstone and contains Orkney's highest hills. Most of the island is moorland, drained by numerous streams with diverse vegetation. On the west coast, Old Red Sandstone cliffs reach 339m in height and include a number of notable stacks and crags. These cliffs provide important breeding sites for a number of seabird species, especially gulls and auks, whilst moorland areas support large numbers of breeding birds, in particular great skua. Red-throated diver nest on the numerous small lochans found on the moorland. The divers and seabirds feed in the rich waters around Hoy, outside the SPA.

Name	Distance to Jacky WHP	Site features and summary
Inner Moray Firth SPA	88km	**Article 4.1**: common tern, osprey (breeding), bar-tailed godwit (over winter) **Article 4.2**: greylag goose, red-breasted merganser, redshank (over winter) The Inner Moray Firth is located to the north of Inverness in Scotland and is one of the major arms of the Moray Firth. It comprises the Beauly Firth and Inverness Firth (including Munlochy Bay) which together form the easternmost estuarine component of the Moray Basin ecosystem. The site contains extensive intertidal flats and smaller areas of saltmarsh. The rich invertebrate fauna of the intertidal flats, with beds of eelgrass, glasswort and *Enteromorpha* algae, all provide important food sources for large numbers of wintering and migrating waterbirds (geese, ducks and waders). With adjacent estuarine areas elsewhere in the Moray Firth, this site is the most northerly major wintering area for wildfowl and waders in Europe. The Firth is also of importance as a feeding area for locally breeding osprey as well as for breeding terns. The Inner Moray Firth SPA forms an integral ecological component of Moray Basin Firths and Bays.
Lairg & Strathbrora Lochs SPA	66km	**Article 4.1**: black-throated diver (breeding) The site comprises a group of eight lochs, most of which are oligotrophic on predominantly coarse, slightly acidic substrates. The flora is generally typical of such types with a restricted range of plant species, but often including patches of emergent vegetation dominated by sedges near the loch shores. Loch Dola is a mesotrophic loch with a predominantly gravel substrate and a richer aquatic flora. It has an extensive area of low-lying ground with impeded drainage adjoining to the south. This has a mixture of willow Salix spp. carr and fen vegetation which is botanically diverse. The lochs lie within two clusters. Four are situated to the north-east of Lairg and are surrounded, in whole or in part, by commercial forestry, much of which was planted in the 1980s. The remaining lochs lie in a rolling terrain of peatland and wet heath to the north of Strathbrora at altitudes of up to 310m. The site supports a breeding population of European importance of black-throated diver; monitoring between 1986-1998 has shown that the productivity of divers breeding within the site is higher than the national average. The combination of high productivity and large population size makes this site extremely important for the maintenance of the British population.
Loch Ashie SPA	117km	**Article 4.1**: Slavonian grebe (breeding) A large, open, mesotrophic loch located southeast of the Great Glen. Much of the shoreline is stony and exposed, with only small patches of emergent vegetation. Where the shore is more sheltered, small beds of bottle sedge have developed. The loch is the most important site in Britain for Slavonian grebe gathering during the pre- and post-breeding periods. In addition, the loch supports a population of breeding Slavonian grebe of European importance.
Loch Flemington SPA	93km	**Article 4.1**: Slavonian grebe (breeding) Located 8km southwest of Nairn, it is a small, shallow, eutrophic loch formed in a kettlehole situated among a suite of fluvioglacial landforms produced in the last glaciation. The loch has a limited exchange of water with no obvious outlet and supports a largely undisturbed aquatic plant community associated with eutrophic conditions, including diverse submerged and emergent vegetation and sedge fen. The loch supports an important and highly productive breeding population of Slavonian grebe.

Name	Distance to Jacky WHP	Site features and summary
Loch of Strathbeg SPA	88km	**Article 4.1**: Sandwich tern (breeding); whooper swan (over winter) **Article 4.2**: Teal, greylag goose, pink-footed goose, goldeneye (over winter) **Article 4.2**: waterfowl assemblage of international importance including: teal, greylag goose, pink-footed goose, barnacle goose, whooper swan (over winter) The Loch of Strathbeg is located in north-eastern Scotland, in Aberdeenshire, inland from Rattray Head. It is a shallow, naturally eutrophic loch with adjoining reedbeds, freshwater marshes, and Alder and willow carr. The SPA provides wintering habitat for a number of important wetland bird species, particularly wildfowl (swans, geese and ducks), and is also an important staging area for migratory wildfowl from Scandinavia and Iceland/Greenland. In summer, coastal parts of the site are an important breeding area for sandwich tern, which feed outside the SPA in adjacent marine areas
Loch Ruthven SPA	122km	**Article 4.1**: Slavonian grebe (breeding) Located about 20km south of Inverness, it is a mesotrophic loch with rocky margins and extensive stands of bottle sedge around much of the perimeter. A marshy zone is found at the west end of the loch where there is a transition from open water, through swamp and fen, to sedge-rich acidic grassland. This site is largely surrounded by birch woods and the catchment comprises habitats such as upland heath and grassland, upland mire, swamp/fen/carr, wet lowland, grassland, rivers and streams. The loch supports an important breeding population of Slavonian grebe.
Marwick Head SPA	103km	**Article 4.2**: common guillemot (breeding) **Article 4.2**: seabird assemblage of international importance including: black-legged kittiwake and common guillemot (breeding) Marwick Head lies on the west coast of the island of Mainland in the Orkney archipelago. The site comprises a 2km section of high, eroded Old Red Sandstone cliffs rising to 85m and backed by cliff-top maritime grassland. The site is of importance as a nesting area for large numbers of common guillemot and black-legged kittiwake. These species feed outside the SPA in surrounding marine areas.
Moray & Nairn Coast SPA	57km	**Article 4.1**: osprey (breeding) **Article 4.2**: greylag goose, pink-footed goose, redshank (over winter) **Article 4.2**: waterfowl assemblage of international importance including: pink-footed goose, redshank, greylag goose (over winter) The Moray and Nairn Coast SPA is located on the south coast of the Moray Firth and comprises the intertidal flats, saltmarsh and sand dunes of Findhorn Bay and Culbin Bar, and the alluvial deposits and associated woodland of the Lower River Spey and Spey Bay. It is of outstanding nature conservation and scientific importance for coastal and riverine habitats and supports a range of wetland birds throughout the year. In summer it supports nesting osprey, whilst in winter it supports large numbers of Iceland/Greenland pink-footed goose, Icelandic greylag goose and other waterbirds, especially ducks, sea-ducks and waders. The geese feed away from the SPA on surrounding agricultural land during the day. The sea-ducks feed, loaf and roost over inundated intertidal areas within the site, but also away from the SPA in the open waters of the Moray Firth. Moray and Nairn Coast SPA forms an integral ecological component of the Moray Basin Firths and Bays, of which it is the easternmost unit.

Name	Distance to Jacky WHP	Site features and summary
Moray Firth pSPA	21km	**Article 4.1**: great northern diver, red-throated diver, Slavonian grebe (over winter) **Article 4.2**: shag (breeding); scaup, eider, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser (over winter) The Moray basin is an extensive site stretching seaward from Buckie in the south to Helmsdale in the north and encompassing several different geographically separate water bodies; the Beauly Firth, the Inner Moray Firth, the Cromarty Firth, Dornoch Firth, Loch Fleet and the vast open water area in the outer Moray Firth
North Caithness Cliffs SPA	44km	**Article 4.1**: peregrine (breeding) **Article 4.2**: common guillemot (breeding) **Article 4.2**: seabird assemblage of international importance including: Atlantic puffin, razorbill, black-legged kittiwake, northern fulmar, common guillemot. The North Caithness Cliffs SPA is located on the north coast of Caithness in northern Scotland. The site comprises most of the sea-cliff areas between Red Point and Duncansby Head on the north mainland coast, and the western cliffs on the island of Stroma. Cliff ledges, stacks and geos provide ideal nesting sites for important populations of seabirds, especially gulls and auks. The seabirds nesting on the North Caithness Cliffs feed outside the SPA in the surrounding waters of the Pentland Firth, as well as further afield. The cliffs also provide important nesting habitat for peregrine.
North Inverness Lochs SPA	128km	**Article 4.1**: Slavonian grebe (breeding) A small group of mesotrophic lochans located at the northeast end of the Great Glen. They support an undisturbed aquatic plant community including extensive sedge beds. The lochs support important breeding numbers of Slavonian grebe.
North Orkney pSPA	83km	**Article 4.1**: red-throated diver (breeding); great northern diver, Slavonian grebe (over winter) **Article 4.2**: eider, long-tailed duck, velvet scoter, red-breasted merganser, shag (over winter) North Orkney proposed Special Protection Area encompasses Deer Sound, Shapinsay Sound and Wide Firth and includes the seas around the islands of Rousay, Egilsay and Wyre. The sounds around North Orkney pSPA provide numerous sheltered bays and inlets for birds to moult, roost, rest and feed. Between September and April, the sheltered sounds, firths and sandy bays in the North Orkney pSPA provide important refuges for some 5,000 non-breeding and passage birds.
Papa Westray (North Hill and Holm) SPA	130km	**Article 4.1**: Arctic tern (breeding) Papa Westray is a small island lying close to Westray in the northern Orkney islands. The island rises to 48m above sea level at North Hill and is surrounded by a rocky coastline backing onto maritime sedge heath. The Holm is a small, low-lying island of 48ha off the east coast of Papa Westray dominated by a rocky coastline and maritime grassland. The islands are an important breeding site for both Arctic tern and Arctic skua. The terns feed outside the SPA in the waters surrounding the islands.

Name	Distance to Jacky WHP	Site features and summary
Pentland Firth pSPA	41km	**Article 4.1**: Arctic tern (breeding) **Article 4.2**: seabird assemblage of international importance (breeding) Pentland Firth pSPA includes the waters of the central and eastern Pentland Firth, between the southern entrance to Scapa Flow in Orkney and the Caithness coast, and extends some 20 km east into the North Sea off John O Groats. Extensive areas of sandy/gravelly deposits in the eastern part of the pSPA support notable populations of scallops and the pSPA also encompasses spawning/nursery grounds for sandeels; are small and nutritious fish of particular value to seabirds such as Arctic terns, guillemots and Arctic skua during their summer breeding seasons when chicks require abundant supplies of high energy food.
Scapa Flow pSPA	58km	**Article 4.1**: red-throated diver (breeding); great northern diver, black-throated diver, Slavonian grebe (over winter) **Article 4.2**: European shag, eider, long-tailed duck, goldeneye, red-breasted merganser (over winter) The Scapa Flow proposed Special Protection Area (pSPA) comprises an area of 370.66 km2 in Orkney. Scapa Flow is an enclosed sea area, sheltered by Orkney Mainland to the north, Hoy, South Walls and Flotta to the west and south and Burray and South Ronaldsay to the east. The Flow is linked to the Pentland Firth on the south through the Sound of Hoxa, and to the Atlantic Ocean on the west through Hoy Sound. The site also includes nearshore waters to the east of Orkney, extending from South Ronaldsay to Deerness and including the sheltered shallow waters of Holm Sound, between Burray and East Mainland. These sheltered, shallow and productive waters support large populations of waterbirds, particularly during the winter months when frequent storms affect the surrounding North Sea and eastern Atlantic. During the summer months, Scapa Flow is an important foraging area for breeding birds, including red-throated divers which nest on small lochans on the surrounding land.
Pentland Firth Islands SPA	56km	**Article 4.1**: Arctic tern (breeding) The Pentland Firth Islands are located between the Orkney Islands and the mainland coast of northeast Scotland. They are a group of two main islands, Swona and Muckle Skerry, and a group of rocky skerries in the Pentland Firth. The islands contain a variety of habitats, including cliffs, rocky shores, maritime heath, moorland, rough grassland, marsh and open freshwater. They provide strategic nesting localities for Arctic tern which feed outside the SPA in the rich surrounding waters of the Pentland Firth.
Rousay SPA	107km	**Article 4.1**: Arctic tern (breeding) **Article 4.2**: seabird assemblage of international importance including: common guillemot, black-legged kittiwake, Arctic skua, northern fulmar and Arctic tern (breeding) Rousay is an island off the north-east coast of the Mainland in the Orkney archipelago, in northern Scotland. The site is composite and consists of two parts located at the northwest and northeast ends of the island. The site holds a diverse assemblage of breeding seabirds, including terns, auks, gulls and skuas. The nesting seabirds feed in the waters around Rousay outside the SPA, as well as further away.

Name	Distance to Jacky WHP	Site features and summary
Switha SPA	68km	**Article 4.1**: barnacle goose (over winter) Switha is a small, uninhabited, low-lying grassy island at the southern end of the Orkney archipelago in northern Scotland. It lies 2km east of South Walls (Hoy) and 2km south of the island of Flotta. Switha has a rocky coastline with cliffs along the north, east and west shores, and is almost totally covered by maritime grassland, with smaller areas of heath and bog. Switha is of importance as a winter roosting site for Greenland barnacle goose.
Troup, Pennan and Lion's Head SPA	65km	**Article 4.2**: common guillemot (breeding) **Article 4.2**: seabird assemblage of international importance including: razorbill, black-legged kittiwake, herring gull, northern fulmar, common guillemot (breeding) Troup, Pennan and Lion's head SPA is a 9km stretch of sea-cliffs along the Banff and Buchan coast of Aberdeenshire in northeast Scotland. As well as cliffs, the site also includes adjacent areas of grassland and heath, and several small sand or shingle beaches punctuate the otherwise rocky shore. The cliffs rise to 150m and provide ideal nesting sites for seabirds, which feed in the rich waters offshore and outside the SPA. Different parts of the cliffs are used by different species of seabirds according to varying ecological requirements. The site is particularly important for its numbers of gulls and auks.
West Westray SPA	119km	**Article 4.1**: Arctic tern (breeding) **Article 4.2**: common guillemot (breeding) **Article 4.2**: seabird assemblage of international importance including: razorbill, black-legged kittiwake, Arctic skua, northern fulmar, common guillemot and Arctic tern (breeding) The SPA is located on the west coast of the island of Westray, one of the most northerly of the Orkney islands. The site comprises an 8km length of Old Red Sandstone cliffs, together with adjoining areas of species-rich maritime grassland and heath. The cliffs support large colonies of breeding auks and black-legged kittiwake, whilst the grassland and heathland areas support breeding colonies of skuas and terns. The seabirds feed in the surrounding waters outside the SPA.
SACs		
River Evelix SAC	73km	**Annex II species**: freshwater pearl mussel (primary) The only remaining small east coast river in Scotland supporting a surviving functional freshwater pearl mussel population, particularly within the upper reaches of the river. Mussels have also occurred in the lower stretches of the river, but in lower numbers than upstream and with fewer juveniles were present. Pearl-fishing is thought to be the principal reason for the decreased numbers in the lower stretches; the presence of juveniles in the upper sections indicates successfully recruitment.
River Oykel SAC	87km	**Annex II species**: freshwater pearl mussel (primary); Atlantic salmon (qualifying) A long, meandering river supporting an excellent, high-quality freshwater pearl mussel population with high densities recorded at some locations, including a bed numbering several thousand individuals. Surveys have also recorded high percentages of juveniles within the population, indicating that there has been recent successful recruitment. There is also evidence of unsurveyed pearl mussel populations in deep water that may increase the conservation importance of the river.

Name	Distance to Jacky WHP	Site features and summary
River Spey SAC	57km	**Annex II species**: freshwater pearl mussel, sea lamprey, Atlantic salmon (primary); otter (qualifying) The River Spey SAC is a large Scottish east coast river. It supports one of the largest Atlantic salmon populations in Scotland, which is largely unaffected by non-native stocks. The area also provides essential spawning habitat for the sea lamprey at the northern limit of its distribution. The middle and lower reaches of the River Spey support high densities of freshwater pearl mussel. Additionally, the river is important for otter throughout its catchment.
River Thurso SAC	38km	**Annex II species**: Atlantic salmon (primary) The River Thurso is designated an SAC due to the high quality population of Atlantic salmon which it supports. It is representative of the northern limit of the species' range in the UK.
Sanday SAC	117km	**Annex I habitats**: reefs (primary); sandbanks which are slightly covered by seawater all the time, mudflats and sandflats not covered by seawater at low tide (qualifying) **Annex II species**: harbour seal (primary) Sanday is a large, low-lying island in the north-east of the Orkney archipelago. Surrounded by clear, relatively shallow water, the island has a complex coastline dominated by extensive sandy beaches and sheltered inlets, interspersed with rocky headlands. Sanday is notable for the extensive subtidal bedrock reefs that surround the island and provide a habitat for dense forests of kelp. The kelp occurs to a depth of about 20m and provides a habitat for species-rich, red algal turf communities, sponges, and ascidians. The kelp beds also provide important foraging areas for common seal Phoca vitulina. The seal colony is the largest at any discrete site in Scotland with the breeding groups representing over 4% of the UK population. The north coast of Sanday is tide-swept and appears to support a richer fauna than the south coast, with a dense bryozoan/hydroid turf, dense brittlestar and horse mussel beds lying in mixed sediment below the kelp zone. Crabs and brittlestars are common within crevices in the rock.
Moray Firth SAC	39km	**Annex I habitats**: sandbanks which are slightly covered by sea water all the time (qualifying) **Annex II species**: bottlenose dolphin (primary) The Moray Firth SAC is one of the largest marine SACs in the UK. The designated site lies west of a line between Helmsdale on the Sutherland coast and Lossiemouth on the Moray coast and includes the Beauly/Inverness Firths, and the outer reaches of the Dornoch and Cromarty Firths. The Moray Firth supports the only known resident population of bottlenose dolphin in the North Sea.
Lower River Spey-Spey Bay SAC	56km	**Annex I habitats**: perennial vegetation of stony banks, alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salison albae*)* (primary) The Lower River Spey – Spey Bay is one of the two largest shingle sites in Scotland (the other being Culbin Bar – as described above). Taken together Lower River Spey – Spey Bay and Culbin Bar form a shingle complex unique in Scotland. Lower River Spey – Spey Bay contains significant areas of both bare and naturally vegetated parallel shingle ridges. The most significant feature of the site is the complex of wet and dry vegetation types. The Lower River Spey also provides suitable habitat for a number of internationally important woodlands including alder, willow, ash and bird cherry.

Name	Distance to Jacky WHP	Site features and summary
Hoy SAC	68km	**Annex I habitats**: vegetated sea cliffs of the Atlantic and Baltic coasts, natural dystrophic lakes and ponds, northern Atlantic wet heaths with *Erica tetralix*, alpine and boreal heaths, blanket bogs* (primary); European dry heaths, petrifying springs with tufa formation (*Cratoneurion*)*, alkaline fens, calcareous rocky slopes with chasmophytic vegetation (qualifying). The island of Hoy lies at the south of the Orkney archipelago. Hoy provides important examples of internationally important heathlands, including especially well developed wet heaths and Alpine and Boreal heaths. The site has the largest high-quality examples of *Calluna vulgaris – Arctostaphylos alpinus* heath in the UK, and the community is unusually rich in lichens. Despite its island setting, the extensive blanket bog on Hoy, dominated by heather and hare's-tail cotton-grass, is akin to the more continental bogs found in the drier parts of the mainland, although more typically oceanic communities do occur locally. Lichen-rich blanket bog with *Cladonia* spp. is characteristic of higher parts of the site.
Dornoch Firth and Morrich More SAC	65km	**Annex I habitats**: estuaries, mudflats and sandflats not covered by seawaters at low tide, *Salicorna* and other annuals colonising mud and sand, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), embryonic shifting dunes, shifting dunes along the shoreline with *Ammophilia arenaria* ('white dunes'), fixed dunes with herbaceous vegetation ('grey dunes')*, decalcified fixed dunes with *Empetrum nigrum**, Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)*, humid dune slacks, coastal dunes with *Juniperus* spp.* (primary); reefs, sandbanks which are slightly covered by sea water all the time (qualifying) **Annex II species**: otter, harbour seal (primary) The Dornoch Firth is the most northerly complex estuary in the UK. Situated on the Scottish east coast, the estuary contains extensive areas of soft coastal features of international importance including saltmarshes, dunes and mudflats and sandflats. The area supports a good population of otters in what is the only east coast estuarine site selected for the species in Scotland. The estuary is also home to a significant proportion of the inner Moray Firth population of the common seal. Their numbers represent almost 2% of the UK population.
East Caithness Cliffs SAC	19km	**Annex I habitats**: vegetated sea cliffs of the Atlantic and Baltic coasts (primary) This stretch of northern Scottish coast provides a range of habitats, though lacking the extreme exposure of the some of the island sites and Cape Wrath. The cliffs are internationally important for their vegetation which includes flowering plants, herb-rich grasslands and saltmarsh plants.
Culbin Bar SAC	73km	**Annex I habitats**: Perennial vegetation of stony banks (primary), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), embryonic shifting (qualifying) Culbin Bar is one of the two largest shingle sites in Scotland. It is 7km long and has a series of shingle ridges running parallel to the coast that support the best and richest examples of northern heath on shingle. Dominant species are heather, crowberry and juniper.
Berridale and Langwell Waters SAC	31km	**Annex II species:** Atlantic salmon (primary) Berridale and Langwell Waters are designated an SAC due to the small, but high quality populations of Atlantic salmon which they support. Recent records indicate that the full range of Atlantic salmon life-history types return to the river from the sea, with grilse, spring and summer salmon all being caught.

*Note: *priority feature*

Screening consideration

The approach to the screening for potential effects follows the criteria identified in BEIS (2016) and is also informed by the assessment documented in Sections 5 and 6. Though BEIS (2016) focusses on activities associated with exploration, the temporary and short-term duration of the Jacky decommissioning activities, and their nature and scale, are not considered to be significantly greater than exploration activities. In view of the range of potential sources of effect noted in the EIA, it is regarded that the following impacts have the potential to lead to effects on the Natura 2000 sites identified:

- Physical presence and seabed disturbance during decommissioning
- Underwater noise

Note that accidental events are not planned and do not form part of the project, and are therefore not considered in the following screening. Following BEIS (2016), it is considered that there is the potential for a likely significant effect for sites which impinge on, or are within 10km of a Natura 2000 site for physical effects or within 15km of a site designated for marine mammals, migratory fish and diving birds for underwater noise (note these are conservative criteria, and that no large impulsive noise sources will be generated by the decommissioning activities). There are currently no designated or proposed Natura 2000 sites within the footprint of, or adjacent to, the Jacky WHP or associated infrastructure to be decommissioned. The closest site is the East Caithness Cliffs SPA which is *ca*. 17km from the Jacky WHP (see Table A2.2 for the distance to from the Jacky WHP to each site).

In addition to the criteria outlined above, there is the potential for mobile species which are qualifying features of the Natura 2000 sites and which move or forage beyond site boundaries to interact with the decommissioning activities. Descriptions of mobile species are included in Sections 4.9 (fish), 4.10 (birds) and 4.11 (marine mammals). Seabirds associated with coastal SPA colonies have foraging ranges which would take them within the Jacky area (see Thaxter *et al.* 2012). The presence and/or movement of vessels from and within the Jacky area during decommissioning activities could temporarily disturb foraging seabirds from relevant coastal SPA sites, however species likely to be present in offshore waters are not particularly vulnerable to disturbance by shipping (Garthe & Hüppop 2004). Disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with decommissioning activities could be possible, particularly at SPAs where species known to be particularly sensitive to disturbance, such as common scoter, are features (e.g. Moray Forth pSPA). Given the relatively small number of vessels involved, their short duration on site and the localised area of activity, predominately in areas of water depths >20m (where species such as common scoter are unlikely to be), impacts from physical disturbance are not considered to be significant.

Similarly, the wider Jacky area is known to be frequented by several marine mammal species and the adjacent coast of the Moray Firth supports important habitats for migratory fish species. The physical presence of the decommissioning activities, including the rig and vessels will be around areas of existing activity and the temporary presence of these is anticipated to cause no more than temporary and localised low-level behavioural responses similar to those induced by normal operations which have taken place in the Jacky and wider Beatrice area through field life.

Whilst individual animals which are also qualifying species of SACs and SPAs could occur within the Jacky area, the small physical footprint and temporary nature of the activities, the lack of significant physical or noise related effects in view of the selected decommissioning approach, and the likely relative low densities of features are such that the decommissioning activities are not regarded to undermine the conservation objectives of any site.