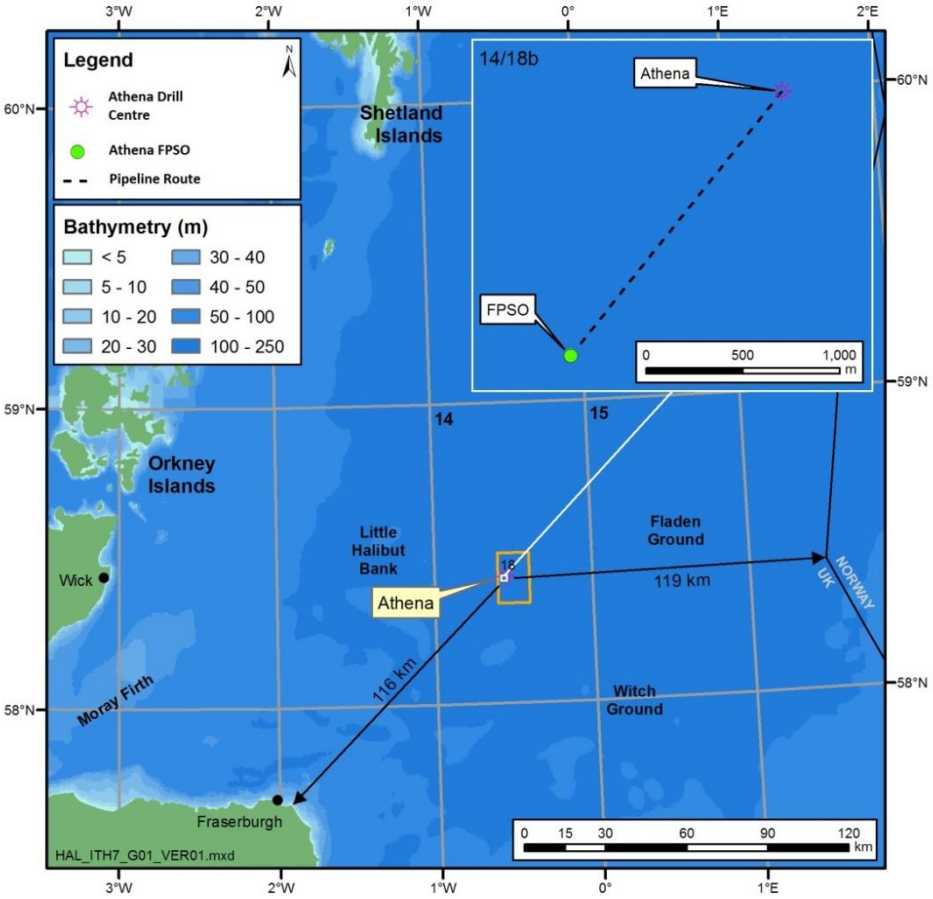
4 DESCRIPTION OF THE ENVIRONMENT

4.1 Location

The Athena Field lies in the central North Sea, some 116km from the nearest landfall at Fraserburgh on the northeast coast of Scotland and approximately 119km from the UK/Norway median line (Figure 4.1). The seabed over the Athena field was surveyed in 2006, with results reported in Gardline 2006 and 2007a; further seabed investigations took place in 2007 over a previously proposed pipeline route to the Claymore platform (Gardline 2007b).

Figure 4.1 - Athena Field Location



4.2 Seabed topography and substrates

Seabed topography

The Athena field lies on the western edge of the Fladen Ground. Water depths vary between approximately 130-150m across an area of 16km^2 centred on the field (Gardline 2007a). In this area, multi-beam mapping shows the seabed topography to be characterised by numerous pockmark features – consisting of 1-2m deep ellipsoid depressions approximately 10m in length; these decrease in diameter and depth towards the south and west of the site, and also to the far northeast (see Figure 4.4). An area of larger composite pockmarks is present within a wide, shallow trench approximately 1km to the northeast of the proposed well and manifold location (Gardline 2007a).

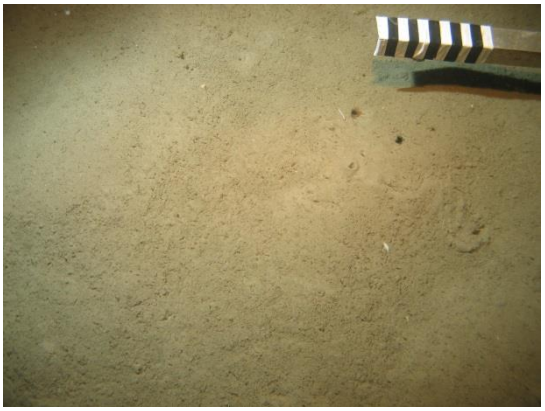
Pockmark features are likely to be present throughout the wider area (Andrews *et al.* 1990, Judd 2001).

Substrates

The seafloor of the wider area mainly consists of the Witch Ground formation: Holocene sediments dominated by poorly sorted sandy mud and muddy sand, with a generally thin layer of silt in areas of pockmark activity (Andrews *et al*. 1990). Seabed sediments in block 14/18 are classified as sandy mud. Low sedimentation rates are implied on the Fladen Ground (Andrews *et al*. 1990). At a fairly coarse resolution, Connor *et al*. (2006) describe the seabed landscape of the region as shelf mud plain, with some areas of shelf sand plain to the south and west.

Seabed sampling was carried out at eleven stations around the Athena field (Figure 4.4). Surficial sediments (≤2cm depth) were sandy mud, with little variation in characteristics between sample sites (Gardline 2007a). Mean particle size at each station ranged from 33-44µm, with an overall mean of 37.2µm for all stations combined. Sediments were poorly sorted and showed low total organic matter (<3%) and low total organic carbon (<2%) (Gardline - 2007a) A representative photograph of seabed sediments is shown in Figure 4.2. Below surficial sediments, the sequence of shallow soils consisted of very soft clay (Witch Ground formation) from 0-14m depth, underlain by stiff clay, sand and silt (Swatchway formation) from 14-26m depth (Gardline 2006).

Figure 4.2 – Typical substrate in the Athena area



Station ENV 1 photo #89

4.3 Climate and meteorology

The climate of the area is generally mild for the latitude. Strong winds, overcast skies and rain/snow are common in winter, and easterly winds may bring exceptionally cold weather. Summer months are calmer, although strong winds and rain may occur (Marshall 1997).

Fog is fairly rare in the area, and is most frequently associated with warm, moist air blowing over relatively cold seas with southeast and southwest winds (Marshall 1997). Fog conditions occur more frequently in summer than winter.

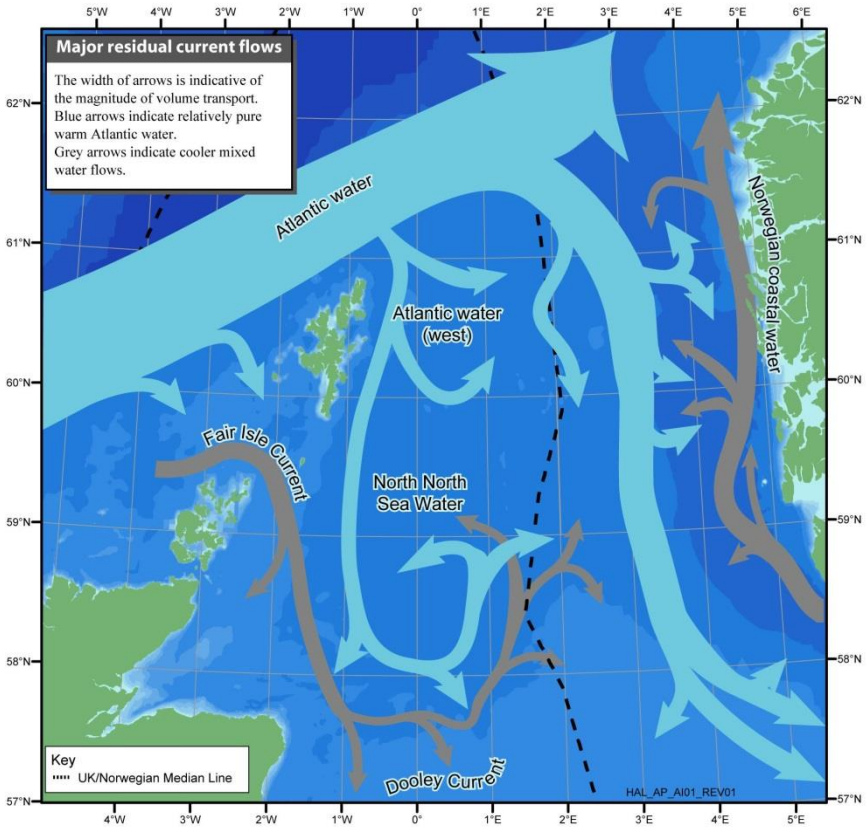
Wind

South-westerly winds dominate in autumn and winter months, with winds from the north-northeast marginally more common in spring and summer (Marshall 1997). The mean annual wind speed at 80m above sea level is 9.6-10.0m/s, ranging from 7.6-8.0m/s in summer to 12.1-12.5m/s in winter (DTI 2004). The frequency of gales (≥ Beaufort force 7) is >30% in winter and 2-4% in summer (Marshall 1997).

4.4 Oceanography and hydrography

The waters in the area are a combination of 'shelf' (34.0-35.0psu) and 'oceanic' (>35.0psu) waters - with the latter dominating to the west of the region (Connor *et al*. 2006). The area is influenced by oceanic waters entering the North Sea from the north by Atlantic inflow along the east of the Shetland Isles, and from the northwest through the Fair Isle current (Turrell *et al*. 1992) (Figure 4.3).

Figure 4.3 – General water circulation in the North Sea



After Turrell et al. (1992)

Seasonal characteristics

Surface water temperatures typically range between 6.5-7.0°C in winter and 13.5-14.0°C in summer. Bottom water temperatures typically range between 6.5-7.0°C in winter and 7.0-8.0°C in summer. Throughout most of the central North Sea, a thermocline develops during summer. This stratification of the water column generally breaks up with the onset of autumnal gales.

Tides and currents

The movement of water in the area is dominated by tidal flows running approximately north and south at peak flow. Tidal energy is fairly low, with a mean range of 1-2m and peak flow of 0.35m/s and 0.20m/s knots during spring and neap tides respectively (DTI 2004). In addition to tidal water movements, weak near-surface currents across the area flow in a northwest to southeast direction (BODC 1998). A weak, semi-permanent anti-clockwise eddy exists over the Fladen Ground (Turrell *et al*. 1992).

Waves

Swell direction predominantly ranges from the southwest to north throughout the year, with north and northwest swells most common during summer (Marshall 1997). Annual mean significant wave height is approximately 2.5m, ranging from 1.6m in summer to 3.1m in winter (DTI 2004).

Contamination of water and sediments

Shipping activity and oil exploration and production activities are the main anthropogenic sources of hydrocarbon contamination of water and sediments in the area (Ahmed *et al*. 2005, Russell *et al*. 2005). Concentrations of hydrocarbons in surface waters are generally very low offshore, compared to industrialised estuaries and coastal waters. Higher concentrations may occur in the vicinity of oil installations, but all discharges are highly regulated and generally fall to background levels within a short distance from the point of discharge (Sheahan *et al*. 2001).

Extensive sampling of seabed sediments on the Fladen Ground (from sites >5km to 2km from oil installations) has revealed substantial reductions in hydrocarbon concentrations over the period 1989-2001, where in 2001, less than 2% of sites exceeded background concentrations (50µg/g, Walsham *et al*. 2002) of Forties crude oil equivalent (Russell *et al*. 2005). It was suggested that the Fladen Ground was approaching a 'steady state' or background level of hydrocarbon contamination. Sediments in closer proximity to oil installations are likely to contain much higher hydrocarbon levels (UKOOA 2004).

Samples taken during the 2006 site survey were analysed for total hydrocarbon, n-alkane and polycyclic aromatic hydrocarbon (PAH) concentrations, along with As, Ba, Cd, Cr, Ca, Hg, Ni, Pb, V, and Zn concentrations. For all properties, sediments showed very little variation between sample sites. Mean hydrocarbon and metal concentrations in seabed samples around the Athena field are summarised in Table 4.1. Total hydrocarbon concentrations were all ≤4.0µg/g, indicating essentially uncontaminated sediments (Gardline 2007a). The n-alkane composition of the hydrocarbons suggested biogenic sources, rather than petrogenic. PAH concentrations were all similar to, or lower than, background concentrations for the North East Atlantic as suggested by OSPAR (2005). Metal concentrations were typical of clean North Sea sediments and/or below background levels for the northeast Atlantic as suggested by OSPAR (2005).

Table 4.1 – Mean hydrocarbon and metal concentrations in Athena seabed sediments

Substance	Mean concentration[1]	Standard deviation
Total hydrocarbons	3.29	0.43
n-alkanes (C_{10}-C_{37})	325.27	34.20
Pristane	22.09	11.72
Phytane[2]	<1	-
As	2.5	0.3
Ba	354	12
Cd	0.12	0.02
Cr	40	3
Ca	73091	1300
Hg	NC[3]	NC[3]
Ni	14	1
Pb	11	1
V	35	2
Zn	25	2

Notes: [1] All values are mean µg/g dry weight of all 11 sample sites combined, with the exception of n-alkanes which are ng/g dry weight; [2] Phytane concentrations were all at or below detection limits; [3] NC = not calculated due to values below detection limits. Source: Gardline (2007a)

4.5 Noise

Underwater noise is increasingly regarded as a potentially important source of disturbance for marine species, particularly marine mammals as these utilise sound for communication and foraging. The sensitivity of marine mammals to anthropogenic noise in the area was examined in an SEA 2 technical report by the Sea Mammal Research Unit, University of St. Andrews (Hammond *et al*. 2001).

Underwater noise originates from both natural (e.g. waves, rainfall, seismic events) and anthropogenic sources. The major anthropogenic source in the vicinity of the Athena field is likely to be from shipping traffic (including fishing) and, to a lesser extent, oil and gas E&P activity. Noise from shipping is roughly related to vessel size, with larger ships having larger, slower rotating propellers, which produce louder, lower frequency sounds.

4.6 Plankton

The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) was commissioned to review plankton ecology in the North Sea as part of the DTI's SEA process (Johns 2004). This review describes the composition and dynamics of the plankton community of the general area and identifies seasonal and hydro-climatic factors which can markedly affect it.

The most frequently recorded taxa in central North Sea surface waters are dinoflagellates (*Ceratium*), in line with the rest of the North Sea where there is an increasing trend of dinoflagellate dominance. The zooplankton community in the region is dominated in terms of biomass and productivity by copepods, particularly *Calanus* species, which constitute a major food resource for many commercial fish species (Brander 1992). The main calanoid copepods in the region and the wider North Sea are *Calanus helgolandicus* and *C. finmarchicus*, and significant changes in the populations of these two species have occurred in recent years (Beaugrand 2003). The copepod *Calanus finmarchicus* and euphausid *Thysanoessa* spp. may form more than 70% of zooplankton biomass in summer, forming a key linkage between primary productivity and fisheries productivity.

Plankton blooms

In the North Atlantic a phytoplankton bloom occurs in spring, followed by a smaller peak in the autumn. Initially diatoms bloom, then as nutrients essential for diatoms become depleted, other groups bloom such as flagellates bloom, followed later by dinoflagellates. Autumn gales mix the water, introducing nutrients back to the photic zone, initiating a secondary bloom of dinoflagellates. As light levels reduce later in the year, primary production is again limited. With little primary production during the winter months, nutrients rise to levels which support the spring bloom. Zooplankton abundance increases in response to greater phytoplankton abundance. However, the time-lag between phytoplankton bloom and peak zooplankton abundance is dependent on both the species composition and oceanographic conditions.

4.7 Benthos

Benthos refers to the organisms living in, or closely associated with the seabed. Below approximately 12-15m water depth in the North Sea, the benthos is dominated by animals as there is insufficient light to support plant growth. These organisms are important mediators of nutrient recycling between sediment and the water column, and are of economic importance either directly

e.g. shellfish, or as a food source of commercially important fish species. Benthic communities are traditionally considered as two groups: infauna and epifauna. The infauna live within the seabed sediment, and represent the most commonly surveyed and well-known benthic community. Epifauna live on the surface of the sediment, are generally larger in size than infauna, and may be sessile, such as sponges and hydroids; or mobile, such as echinoderms and crustaceans.

Infauna

Basford *et al*. (1990) investigated the infauna of the central and northern North Sea. Cluster analysis classified the communities of the sample sites nearest to the proposed Athena development as offshore sub-group 3, with mean environmental characteristics of 131m depth, a fairly high silt content of 40.7% by weight and an organic carbon content of 5.9mg/g. These were characterised by an infauna dominated by the *Thyasira* spp. bivalve complex, the polychaetes *Lumbrineris gracilis, Heteromastus* sp., *Phylo norvegica*, and *Ceratocephale loveni,* and the amphipod *Eriopisa elongata*. Basford *et al.*'s results were included in an ICES synoptic survey of the North Sea published by Künitzer *et al.* (1992) who included a classification analysis of all North Sea stations. This indicated that essentially all stations north of the 100m depth contour formed a single cluster typified by finer sediments and indicator species *Minuspio cirrifera*, *Aricidea catherinae*, *Exogone verugera* (polychaetes) and *Thyasira* spp. (bivalve mollusc). A second ICES synoptic survey in 2000 classified the fauna of the Fladen Ground area as a *Thyasira equalis* assemblage, found in mud to muddy sand, mainly in water depths of >100m, with *Heteromastus filiformis*, *Paramphinome jeffreysii* and *Thyasira equalis* abundant (Rees *et al*. 2007).

Macrofaunal analysis was carried out on samples taken from eleven stations around the Athena field in 2006; the locations of these are shown in Figure 4.4. The ten most abundant taxa are listed Table 4.2; all were present at all eleven stations (Gardline 2007a). The site survey revealed the benthic community present to be typical to the area and similar to that recorded in previous studies.

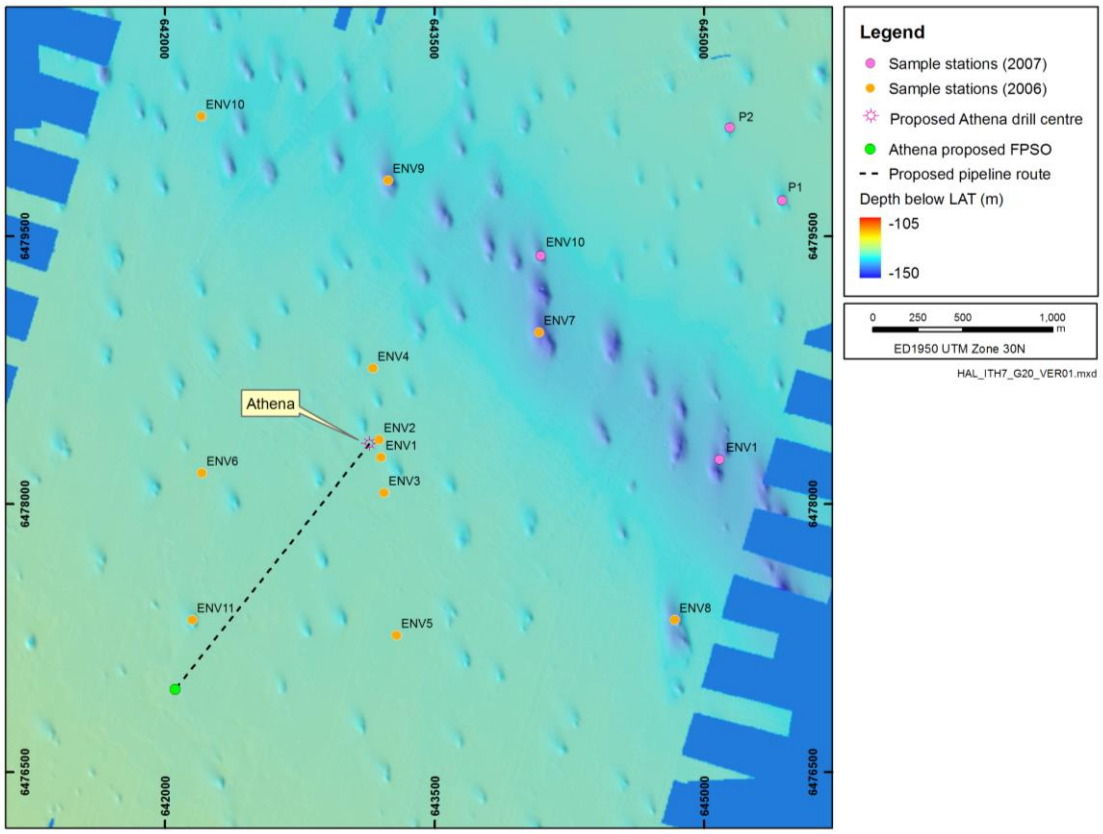
A total of 160 taxa were recorded from the eleven stations. The number of taxa at individual stations ranged from 62-83 taxa per 0.2m^2, with a mean of 74 (SD = 6.1). The number of individuals showed greater variation between stations, ranging from 579-1533 individuals per 0.2m^2, with a mean of 1077 (SD = 280.6). The distribution of individuals between the major taxonomic groups (Annelida, Crustacea, Mollusca and Echinodermata) was fairly consistent between stations, with 26 taxa occurring at every station.

Table 4.2 – Ten most abundant taxa in sediments around the Athena field

Taxa	Phylum	Total abundance[1]	Mean abundance per 0.1m^2	Standard deviation
Paramphinome jeffreysii	Annelida	3,669	167	60
Echinodea spp. juv.	Echinodermata	1,727	79	99
Mendicula pygmaea	Mollusca	1,080	49	18
Abra nitida	Mollusca	919	42	26
Paradoneis eliasoni	Annelida	464	21	11
Retusa truncatula	Mollusca	427	19	11
Diplocirrus glaucus	Annelida	290	13	6
Thyasira equalis	Mollusca	238	11	5
Spiophanes kroyeri	Annelida	222	10	6
Pholoe assimilis	Annelida	185	8	9

Note: [1] Number of individuals in 2.2m^2 of seabed sediment (2 x 0.1m^2 grabs per station, 11 stations) sieved through a 0.5mm mesh. Source: Gardline (2007a)

Figure 4.4 – Distribution of Athena survey sample/photograph stations



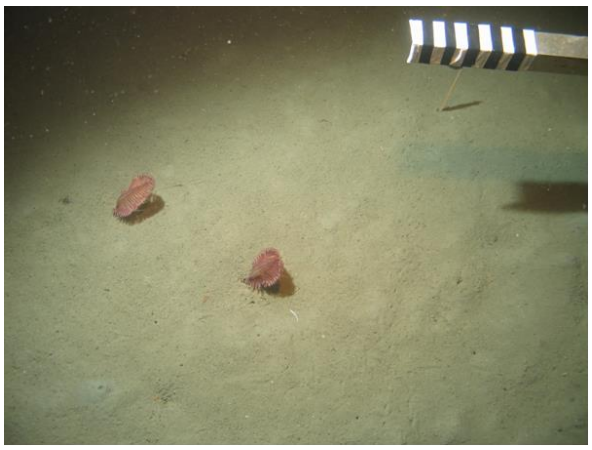
Source: Compiled from Gardline (2007a, 2007b)

Epifauna

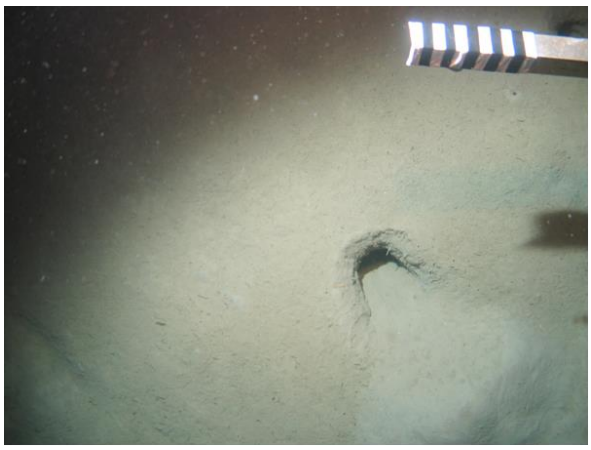
When investigating the epibenthos of the North Sea, Callaway *et al*. (2002) classified the communities in the general Athena area as a subgroup typical of waters 100-200m deep in the central and northern North Sea. These were dominated by the crustaceans *Pagurus bernhardus* and *Hyas coarctatus*, the gastropods *Neptunea antiqua* and *Colus gracilis*, the echinoderm *Asterias rubens* and the hydroid *Hydractinia echinata*. Jennings *et al*. (1999) sampled a site in 106m of water at a similar location to that described in Callaway *et al*. (2002). They classified the mobile epifauna as a 'central' North Sea sub-group, dominated by *A. rubens* and the crustaceans *Crangon allmanni* and *P. bernhardus*. Sessile epifauna belonged to a northern North Sea sub-group, dominated by the bryozoan *Flustra foliacea* and hydroid *Hydrallmania falcata*.

The site survey obtained seabed photographs from eleven sample sites around the Athena field (Gardline 2007a). Representative photos are shown in Figure 4.5, with interpretations of substrate and visible epifauna made in this ES listed in Table 4.3. The seabed was generally sandy mud, with evidence of burrowing infauna and a sparse epifauna. All stations are from the 2006 survey.

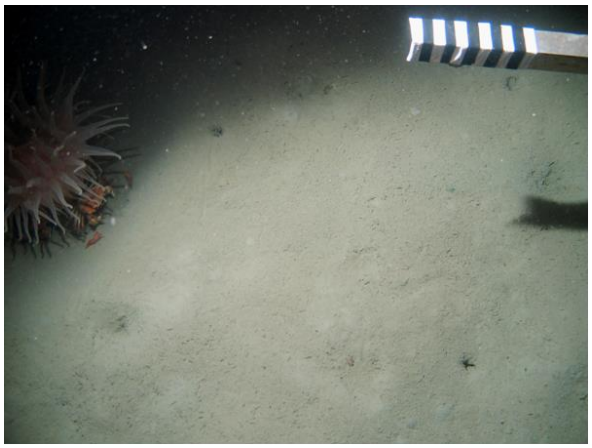
Figure 4.5 – Representative seabed photographs from Athena survey



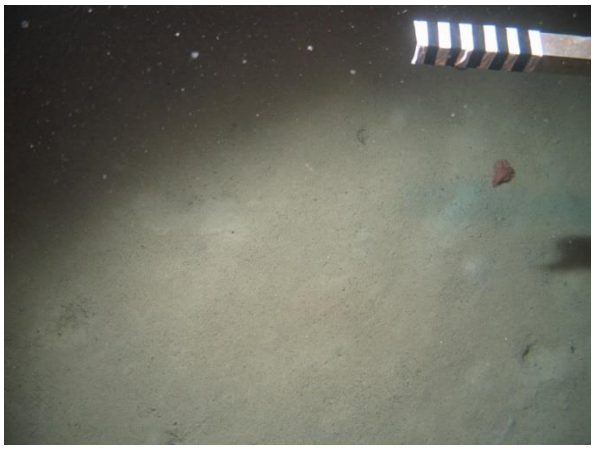
Station ENV 4 photo #140



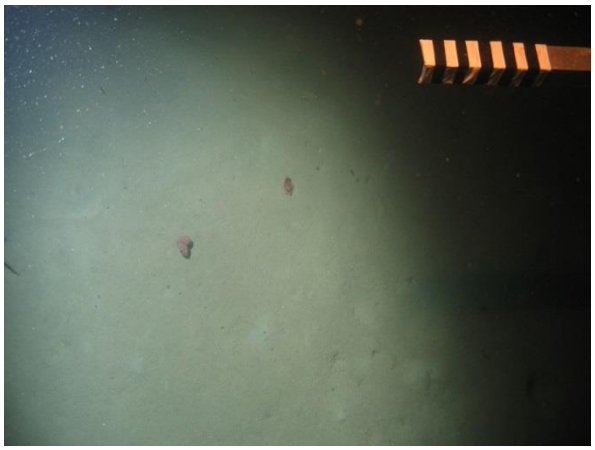
Station ENV 7 photo #49



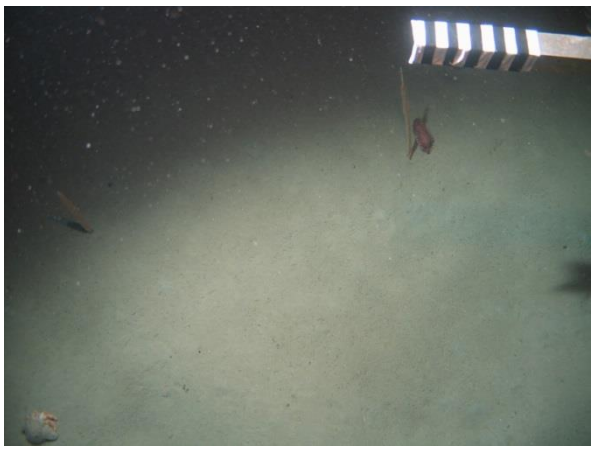
Station ENV 9 photo #68



Station ENV 5 photo #25



Station ENV 11 photo #6



Station ENV 2 photo #120

Table 4.3 – Summary of species and features visible in seabed photographs

Photo ref.	Species visible
ENV4 #140	Sandy mud with the seapens *Pennatula phosphorea* and *Virgularia mirabilis*, the serpulid worm *Ditrupa arietina*, and evidence of burrowing infauna.
ENV7 #49	Sandy mud with burrow entrance of the prawn *Nephrops norvegicus*.
ENV9 #68	Sandy mud with various small burrows and the anemone *Bolocera tuediae* with sheltering prawns and the crab *Geryon trispinosus,* and evidence of burrowing infauna.
ENV5 #25	Sandy mud with the seapen *Pennatula phosphorea,* and evidence of burrowing infauna.
ENV11 #6	Sandy mud with the seapens *Pennatula phosphorea* and *Virgularia mirabilis*, the starfish *Astropecten irregularis*, and evidence of burrowing infauna.
ENV2 #120	Sandy mud with the seapens *Pennatula phosphorea* and *Virgularia mirabilis*, the hermit crab *Pagurus bernhardus*, and evidence of burrowing infauna.

Pockmarks

As described in Section 4.2, the seabed surveys have recorded the presence of numerous pockmark features around the Athena field. It is generally believed that pockmarks are formed by the expulsion of fluid (gas or water) through seafloor sediments, and can be classified as active or inactive (in terms of fluid release) (Dando 2001).

Dando (2001) reviewed the biology of pockmarks in the UK sector of the North Sea. The species composition of pockmarks might be expected to differ to that of the surrounding seafloor due to two main factors: (1) their depression shape may result in reduced bottom current flow, enhanced sedimentation and reduced disturbance from trawling activity; (2) past or current fluid seepage may affect sediment sorting, cause cementation of some sediments, and alter geochemistry including increased concentrations of reduced compounds such as sulphide and methane. Deep and/or active pockmarks may differ in faunal composition from the surrounding seabed where the influence of the factors described above is more pronounced. Pockmarks with cemented sediment at their base may also support a more diverse epifauna associated with the presence of hard substrate and the refuge which it may provide for demersal fish such as cod (*Gadus morhua*) and ling (*Molva molva*).

If pockmarks display characteristics such as those described above, they may be considered features of conservation interest and could qualify for protection under the Habitats Directive as the Annex I habitat 'submarine structures made by leaking gases'. For these features to be afforded such protection, they must meet several criteria, including the presence of spectacular submarine complex structures sheltering a highly diversified ecosystem (Johnston *et al*. 2002) (see Section 4.12.2). However, information provided by the seabed surveys indicated that pockmark features in the Athena area do not qualify as Annex I habitat (Gardline 2007a & b).

Gardline (2007a) sampled the infauna at sites within and around several pockmark features in the Athena area (Figure 4.4). Around the proposed drilling location, grab samples revealed that the faunal community was fairly uniform across the area, with no evidence that species composition was influenced by variation in sediment chemistry (Gardline 2007a). Similarly, seabed photographs taken within and outside of pockmark features across the same area (Gardline 2007a & b) and interpreted in this ES did not identify any evidence of cemented sediments, chemosynthetic communities or variation in epifauna between pockmark and non-pockmark areas.

4.8 Cephalopods

Cephalopods are short-lived, fast growing molluscs and are important elements in marine food webs. Whales, dolphins, seals, birds and predatory fish will take large quantities of squid. As

cephalopods tend to rapidly concentrate heavy metals and other toxic substances in their tissues, they play an important role in trophic bioaccumulation of pollutants.

Among the most frequently recorded species in the central and northern North Sea are: the long-finned squids, *Alloteuthis subulata* and *Loligo forbesii*; the short finned squids, *Todarodes sagittatus* and *O. banksii*; various bobtail squids and the octopus, *Eledone cirrhosa*. Short-finned squid are powerful swimmers, typically found in open, oceanic waters and are perhaps more likely to be found offshore in waters around the Athena field than long-finned squid that are associated with coastal waters. Recent studies of the long-finned squid, *L. forbesii* suggest that individuals migrate inshore from deep waters in the winter months during the peak of spawning (Stowasser *et al*. 2004). It is not thought likely that the waters around the Athena field are of particular importance for spawning.

The main commercial cephalopod species in the central North Sea is the veined squid (*Loligo forbesii*) (Boyle & Pierce 1994). The main Scottish fishery for this species occurs in coastal waters, with a seasonal peak in catches around October and November due to aggregations of pre-breeding squid (Pierce *et al*. 1994 & 1998, Young *et al*. 2006). Evidence of egg-strings attached to creel ropes suggest that squid spawn in inshore waters (Young 2001). Although mostly caught as by-catch in UK waters, a directed fishery for *L. forbesii* has developed over the last decade in the southern Moray Firth in late summer and autumn (Young *et al*. 2006). The majority of squid catches from the North Sea around Scotland come from the Moray Firth (Pierce *et al*. 1994); the offshore waters around the proposed Athena development area are of limited commercial importance.

4.9 Fish and shellfish

Fish community

The demersal fish community of the North Sea was investigated by Callaway *et al*. (2002); including sampling at a site in approximately 100m of water close to the general Athena area. Trawling with a 2m beam trawl classified the site as part of a 'northern' North Sea group dominated by the flatfish (*Hippoglossoides platessoides*) and the hagfish (*Myxine glutinosa*). Otter trawling also lead to classification as a 'northern' group, dominated by Norway pout (*Trisopterus esmarkii*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), herring (*Clupea harengus*), plaice (*Pleuronectes platessa*) and lemon sole (*Microstomus kitt*). Pelagic species found in the area include herring, mackerel (*Scomber scombrus*) and sprat (*Sprattus sprattus*). Many of these species, abundant in the deeper waters of the central and northern North Sea, are commercially valuable.

Spawning and nursery grounds

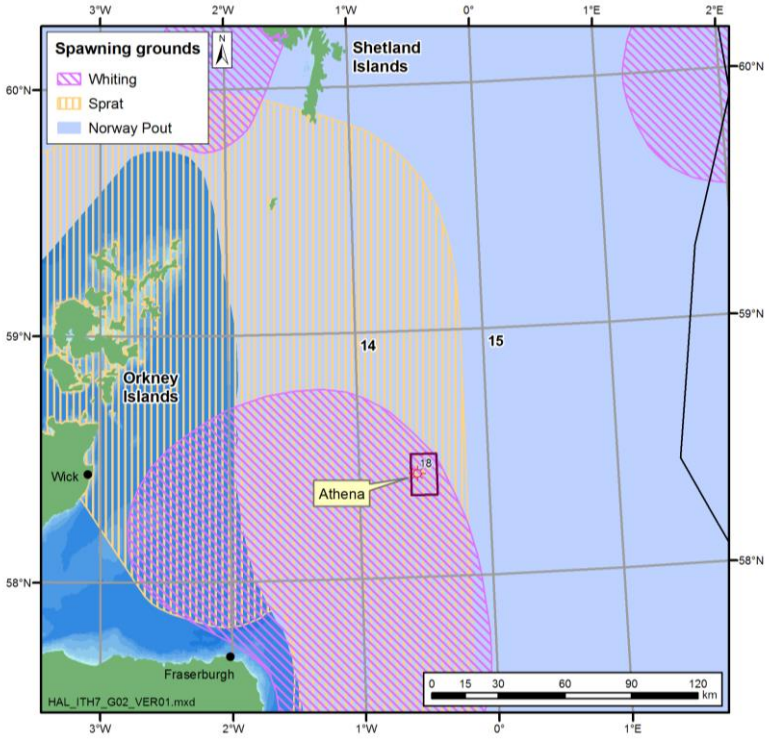
Several species of commercially important fish species use the area as spawning and/or nursery grounds, the spatial and temporal distributions of which are described by Coull *et al*. (1998). The Athena field overlaps with known spawning grounds of whiting (February-June), Norway pout (January-April) and sprat (May-August) (Figure 4.6). The area also supports known nursery grounds of blue whiting (*Micromesistius poutassou*), Norway pout and sprat (Figure 4.7). These features are dynamic, and are likely to show some degree of spatial and temporal variability (Coull *et al.* 1998). However, due to the presence of large groups of fish at spawning times and nursery areas where fish are most sensitive to disturbance, the period from February-June is a period of concern for seismic survey Block 14/18, (DECC Oil and Gas website).

Commercially exploited shellfish

The Fladen Ground supports commercially important populations of *Nephrops norvegicus* (Norway lobster) and pink shrimp (*Pandalus borealis*) (Defra 2005). The area also serves as spawning

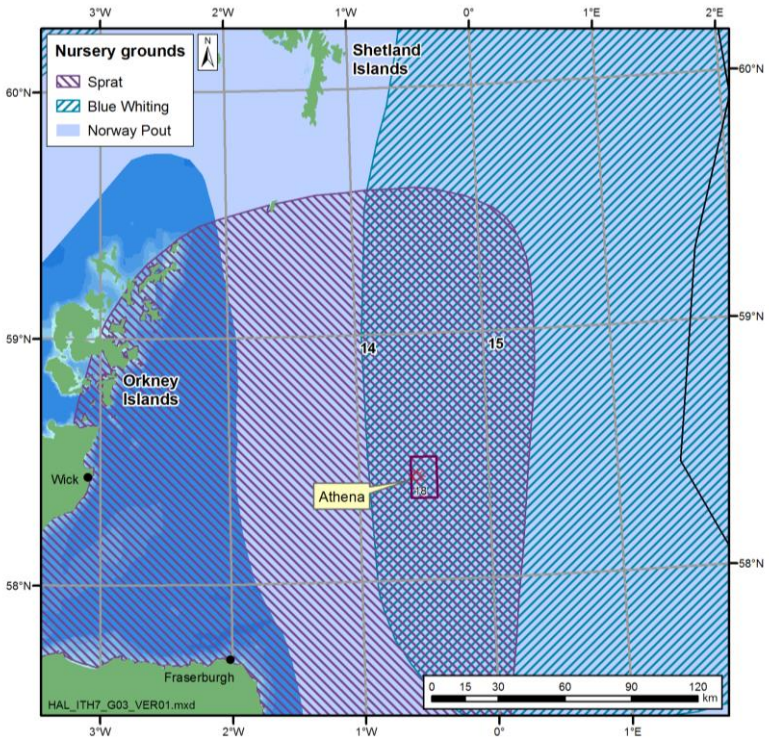
(January-December) and nursery grounds for *Nephrops* (Coull *et al*. 1998) (Figure 4.8). Small catches of scallop (*Pecten maximus*) and whelk (*Buccinum undatum*) have also been reported from the area. A variety of other mollusc and crustacean species are also present in the area.

Figure 4.6 – Fish spawning areas in the region



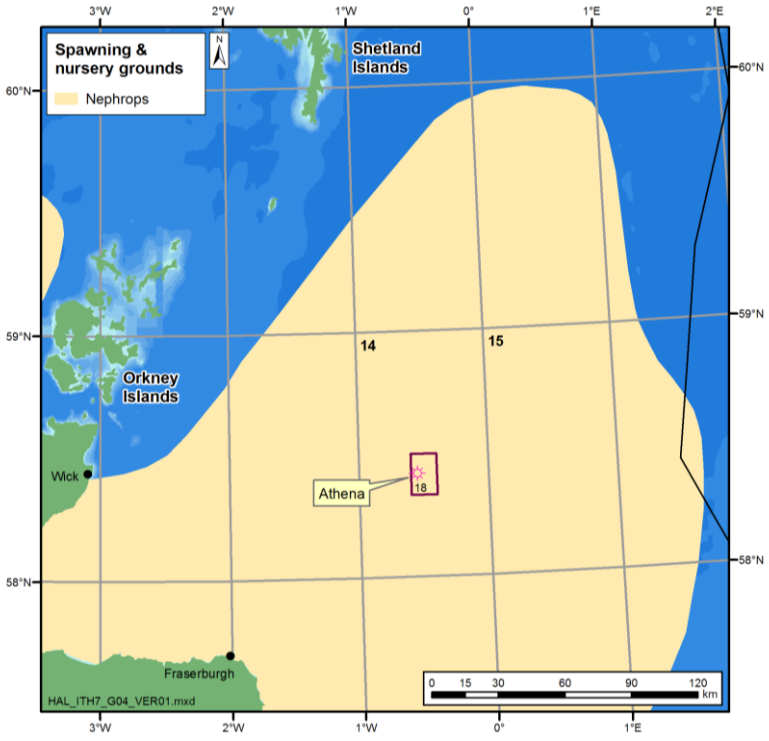
Source: Coull et al. (1998)

Figure 4.7 – Fish nursery areas in the region



Source: Coull et al. (1998)

Figure 4.8 – *Nephrops* spawning and nursery areas



Source: Coull et al. (1998)

4.10 Birds

Seabirds

The distribution of seabirds in the North Sea is described by Tasker & Pienkowski (1987) and Skov *et al*. (1995). At an annual scale, the offshore central North Sea, including the Athena area, may be considered to be of moderate importance for seabirds in the context of the North Sea as a whole. This is related to the distance from breeding colonies, and the availability of prey. The main prey of many bird species are sandeels, which burrow into sandy substrates and are not present in the fine sediments of the Fladen Ground. Fulmars (*Fulmarus glacialis*), kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) are widespread and numerous for much of the year, with gannets (*Morus bassanus*) to a lesser extent and at lower densities. Puffin (*Fratercula arctica*) and razorbill (*Alca torda*) are most abundant in late summer (July-September). Herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*) have a widespread distribution in the area, particularly in winter. Little auks (*Alle alle*) are present during autumn and winter when migrating to over-wintering grounds.

A number of seabird surveys were conducted during February and March 2008 for the DECC SEA programme, with one of the study areas located in waters close to the Athena field. Fulmar, gannet, lesser black-backed gull (*Larus fuscus*), great black-backed gull, herring gull, kittiwake, guillemot, razorbill, little auk (*Alle alle*) and puffin were commonly encountered in the survey area (Cork Ecology 2008).

The most important period for seabird activity in the area is during July-August when internationally important numbers of guillemots are present. Guillemots disperse into the North Sea from breeding colonies, forming large rafts throughout the area. Many of these are flightless due to moulting of flight feathers. Seabird density is also relatively high during March to April as birds pass through the area, on route to the internationally important breeding colonies on the east coast of Scotland, Shetland and Orkney. Table 4.4 describes key features of seabird distribution in the area throughout the year.

Table 4.4 – Summary of seabird distribution in the general Athena area throughout the year

Month	Bird distribution and abundance
January	Gulls (mostly herring and great black-backed) and fulmars are numerous in the area. Kittiwakes and guillemots are also present.
February	Guillemot and fulmar are widespread throughout the area. Kittiwakes are present, but more abundant closer to Orkney and Shetland. Adult gannets begin to return to the North Sea.
March	Guillemot, razorbill, kittiwakes and gannets are returning to breeding colonies and although numerous throughout area, they are beginning to concentrate in coastal waters, rather than offshore waters. Fulmars are numerous and herring and great black-backed gulls are also present.
April	Most birds are concentrated around breeding colonies, although in April, female birds (i.e. guillemots) may be feeding in more offshore areas than during the chick-feeding period. Puffins retain a more offshore distribution, and may be present in the area, while kittiwake distribution remains similar to that in March. Gulls that breed in the Moray Firth continue to feed at sea and fulmar and gannet are still numerous and widespread throughout the area.
May	Most seabirds begin breeding; therefore numbers offshore in the area are generally low and limited to immature birds. Kittiwakes and gannets may be present due to feeding trips up to 120km from colonies. Fulmars are also likely to be present in the area, particularly during the first half of the month.
June	Peak of breeding season. Majority of seabird sightings are in coastal areas. Offshore abundance of all species is generally low. Towards the end of June, large numbers of seabirds

Month	Bird distribution and abundance
	leave colonies and disperse out to sea.
July	Large numbers of seabirds leave colonies and disperse out to sea, particularly larger auks. These include vulnerable juvenile flightless birds. Adult auks (guillemots and razorbills) undergo a moult and are also flightless. These birds are widely dispersed across the area.
August	A peak in guillemot abundance, form part of the most important single concentration of auks in the North Sea at any time in the year. Puffins disperse into the area from breeding colonies. Kittiwakes leave colonies and move to similar areas as the larger auks. Young gannets start to leave colonies towards end of the month. Fulmar are numerous and widespread throughout the area.
September	Auks spread further out into the North Sea, and the area is still important for guillemot, razorbill and also kittiwake. Gannets disperse into the area, and great skuas can be present as they move south. Great black-backed gulls may pass through the area as they migrate. Fulmars are widespread and numerous.
October	Guillemot and razorbill are present in reduced numbers due to a southward shift in distribution. Kittiwakes are still present in fairly high numbers. Little auks arrive in small numbers in the central North Sea. Fulmars remain widespread and numerous.
November	The area remains relatively important for guillemot, although these are now widely dispersed across the North Sea. Flocks of kittiwake are found around fishing fleets on the Fladen Ground. Gulls, particularly herring gull, become more numerous and fulmar are still present as are gannets, although numbers of the latter have reduced.
December	Gulls and fulmars are numerous and little auks are present. Gannets remain present in reduced numbers. Guillemots remain numerous and widespread although concentrations can be found in more coastal waters.

Source: Tasker & Pienkowski (1987), Skov et al. (1995)

The most recent complete census of British and Irish seabird colonies, 'Seabird 2000' took place from 1998-2002 with results published in Mitchell *et al*. (2004). This describes the population size of different species in each administrative area in Britain and Ireland; Table 4.5 provides such data for regions around the entrances to the outer Moray Firth, Orkney and Shetland. All figures represent coastal breeding birds unless otherwise stated.

Table 4.5 – Breeding seabird numbers from the outer Moray Firth and Northern Isles

Species	Number of breeding birds (Seabird 2000 count (1998-2002))	Species	Number of breeding birds (Seabird 2000 count (1998-2002))
East Coast Caithness			
Fulmar Cormorant Shag Black headed gull Common gull Herring gull	20,267 (AOS) 107 (AON) 1,075 (AON) 27 (AON) 15 (AON) 3,503 (AON)	Great black-backed gull Kittiwake Little tern Guillemot Razorbill Puffin	181 (AON) 43,839 (AON) 14 (AON) 195,295 (I) 19,161 (I) 497 (AOB)
Banff and Buchan (including Troup Head)			
Fulmar Northern gannet Cormorant Shag Black-headed gull Lesser black-backed gull Herring gull	5,146 (AOS) 1,085 AOS/AON) 9 (AON) 656 (AON) 430 (AON) 10 (AON) 6,671 (AON)	Great black-backed gull Kittiwake Common tern Arctic tern Guillemot Razorbill Puffin	37 (AON) 30,599 (AON) 202 (AON) 184 (AON) 73,970 (I) 7,606 (I) 1,026 (AOB)
Shetland			

Species	Number of breeding birds (Seabird 2000 count (1998-2002))	Species	Number of breeding birds (Seabird 2000 count (1998-2002))
Common gull	2,424 (AON)	Fulmar	188,544 (AOS)
Lesser black-backed gull	341 (AON)	Manx shearwater	7 (AOS)
Herring gull	4,027 (AON)	Storm petrel	7,502 (AOS)
Great black-backed gull	2,875 (AON)	Leach's storm petrel	35 (AOS)
Kittiwake	16,732 (AON)	Gannet	26,249 (AOS/AON)
Common tern	104 (AON)	Cormorant	192 (AON)
Arctic tern	24,716 (AON)	Shag	6,147 (AON)
Guillemot	172,681 (I)	Arctic skuas	1,120 (AOT)
Razorbill	9,492 (I)	Great skua	6,846 (AOT)
Puffin	107,676 (AOB)	Black–headed gull	586 (AON)
Orkney			
Herring gull	1,933 (AON)	Fulmar	90,846 (AOS)
Great black-backed gull	5,505 (AON)	Storm petrel	1,870 (AOS)
Kittiwake	57,668 (AON)	Cormorant	412 (AON)
Sandwich tern	173 (AON)	Shag	1,872 (AON)
Common tern	125 (AON)	Arctic skua	720 (AOT)
Arctic tern	13,476 (AON)	Great Skua	2,209 (AOT)
Little tern	4 (AON)	Black-headed gull	2,854 (AON)
Guillemot	181,026 (I)	Common gull	11,141 (AON)
Razorbill	10,194 (I)	Lesser black-backed gull	1,045 (AON)
Puffin	61,758 (AOB)		

Source: Mitchell et al. (2004)
Notes: AON = Apparently Occupied Nests; AOS = Apparently Occupied Sites; AOB = Apparently Occupied Burrows and I = Individuals

Many sites in northeast Scotland, Orkney and Shetland are visited annually during the breeding season as part of the JNCC's Seabird Monitoring Programme (e.g. Mavor *et al*. 2008). Breeding numbers and success of certain 'featured species' provides an indication of the overall success of seabirds from distinct feeding niches. These include: fulmar, which feed at or near the sea surface on plankton, fish and fishery waste; kittiwakes, which feed mainly on small fish such as sandeels, taken from just below the sea surface; and common guillemots and European shags, which are diving species that are able to exploit a wider range of fish species and sizes than surface-feeders. Together, these species comprise almost half the breeding seabirds in the UK. A summary of the most recently available results are presented in Table 4.6.

Table 4.6 – Recent trends in breeding seabird numbers and success of 'featured species' from northeast Scotland, Orkney and Shetland

Species	Recent trends in breeding numbers and success
Fulmar	Moderate to large declines in numbers noted in Shetland and northeast Scotland from 2003-2004, numbers largely stable from 2004-2005 although an increase was recorded in northeast Scotland. Numbers increased in northeast Scotland and Shetland from 2005-2006, but decreased in Orkney. Breeding success was generally lower than the long-term average in 2004 and 2005, and only slightly lower than average in 2006. However, breeding success was particularly low in northern Scotland.
Kittiwake	Numbers declined in the region (and most of Britain and Ireland) from 2003-2004 to approach lowest levels since records began (1986). Overall breeding success in 2004 was also close the lowest on record, and particularly poor on Orkney & Shetland. Numbers were similar in 2005 and 2006, with a slight increase on Shetland in 2006. Breeding success increased in 2005, with the exception of northern Scotland, then declined slightly in 2006.

Species	Recent trends in breeding numbers and success
Guillemot	From 2003-2004, substantial decreases in numbers were observed at colonies in Orkney, Shetland and northeast Scotland. Breeding success in 2004 was by far the lowest on record. From 2004-2005, numbers increased or remained stable in Shetland, Orkney and northeast Scotland; breeding success in 2005 was, after 2004, the second lowest since records began. From 2005-2006, numbers were generally stable; breeding success in 2006 was, after 2004 and 2005, the third lowest since records began.
Shag	From 2003-2004, numbers in most regions declined, although increases were recorded in northern Scotland and northeast Scotland from triennial monitoring; some reductions in breeding numbers were thought to be due to non-breeding by adults, in response to low food availability. The mean breeding success in 2004 was below the long-term UK mean. Large decreases were noted in northern Scotland from 2004-2005, linked to large numbers of dead shags washed ashore in late winter/early spring of 2005. Breeding success in 2005 was below the long-term UK mean, and particularly low in Shetland and northern Scotland. From 2005-2006, numbers increased in northern Scotland and Shetland. Breeding success was low in northern Scotland, but close to the long-term mean in Shetland.

Source: Mavor et al. (2005, 2006, 2008)

Waterbirds

Coastal areas of the Moray basin, the firths and bays form an integral unit that is internationally important for wintering and passage wildfowl, as well as being important for breeding waders and other water birds. The importance of the area for water birds is reflected in the designation of a number of international conservation sites (see Section 4.12). However, as the nearest coast is some 116km from the Athena field, the potential impact of the development on these birds is considered extremely low; a brief description of sites has been included in Section 4.12.

Vulnerability to oil pollution

The vulnerability of seabird species to oil pollution at sea is dependant on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) developed by the Joint Nature Conservation Committee (JNCC) is used to assess the vulnerability of bird species to surface pollution, and considers the 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).

Seabird vulnerability to surface pollution in the Athena area is moderate to low throughout most of the year (see Table 4.7 and Figure 4.9). Vulnerability increases to very high in July/August across much of the area as birds disperse from their breeding colonies into the North Sea, and is also increased by the presence of flightless, moulting adult and juvenile auks. November also sees an increase to high/very high vulnerability across much of the area due to the arrival of large numbers of over-wintering seabirds (Stone *et al.* 1995). The JNCC have indicated that for Block 14/18, the period from July-August is a period of concern for drilling activities (DECC Oil and Gas website).

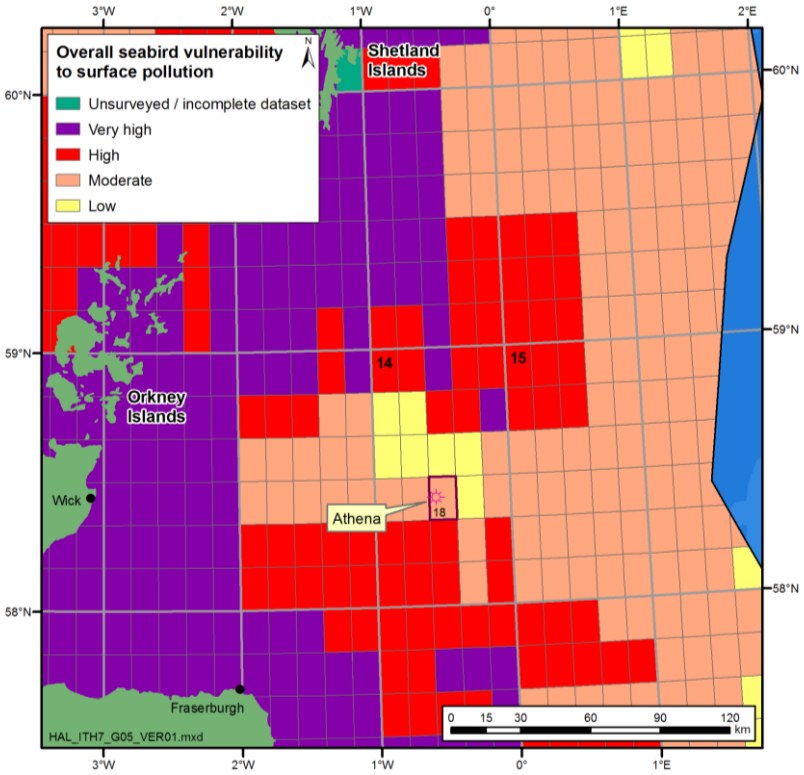
Table 4.7 – Monthly seabird vulnerability to surface pollution

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
14/12	4	3	3	4	3	4	2	2	3	3	3	3	4
14/13	4	3	3	4	3	4	2	2	3	2	2	3	4
14/14	4	3	4	4	3	4	2	3	3	2	2	3	4
14/17	4	2	3	4	3	4	1	1	2	3	3	3	3
14/18	**4**	**2**	**3**	**4**	**3**	**4**	**1**	**1**	**2**	**2**	**2**	**3**	**3**
14/19	4	3	4	4	3	4	2	2	3	2	2	3	4

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
14/22	4	2	3	3	3	3	1	1	1	3	3	3	2
14/23	4	2	3	3	3	3	1	1	1	2	3	3	2
14/24	4	2	4	4	4	4	2	1	1	2	3	3	3

Note: 1 = very high, 2 = high, 3 = moderate, 4 = low.
Source: JNCC (1999).

Figure 4.9 – Overall Seabird Vulnerability Index scores



Source: JNCC (1999)

4.11 Marine mammals

Cetaceans

The harbour porpoise porpoise (*Phocoena phocoena*) is the most common cetacean in the area; they are frequently sighted throughout the central North Sea, in both coastal and offshore waters. While seen throughout the year, peak numbers are generally recorded in summer months from June-October. Surveys in the summer of 2005 (SCANS-II 2008) showed a southerly shift in the species' distribution within the North Sea, with southern areas of the North Sea appearing more important for this species than central and northern areas. The observed difference in distribution may simply be due to interannual variation; however, recent increases in sightings of harbour porpoises from the Dutch coast and in stranding are in the southern North Sea suggest a trend (SCANS-II 2008). The species was observed in the general area in February and March of 2008 (Cork Ecology 2008).

White-beaked dolphins (*Lagenorhynchus albirostris*) are regularly encountered in coastal and offshore waters of the central North Sea. While sighted throughout the year, sightings are slightly more frequent from July-October. A survey carried out in waters close to the Athena field observed the species in February and March of 2008 (Cork Ecology 2008). Atlantic white-sided dolphin (*Lagenorhynchus acutus*) appear to be seasonally present in the North Sea, where they are

infrequently sighted in waters >10km from the coast in the northern and central North Sea from June-September.

Minke whale (*Balaenoptera acutorostrata*) are seasonally present in the area, with whales appearing to move south into the North Sea at the beginning of May and remaining present until October. During these summer months, they are well distributed (both coastally and offshore) throughout the central and northern North Sea, particularly in the west. Killer whales (*Orcinus orca*) are occasionally sighted off the east coast of Scotland, although records from offshore waters of the central North Sea are rare (Reid *et al*. 2003).

A small, seemingly resident population of bottlenose dolphins (*Tursiops truncatus*) exists off the east coast of Scotland. They typically range from coastal waters of the Moray Firth to the Firth of Forth, and are most frequently sighted within the inner Moray Firth. Occasional North Sea offshore observations may indicate that bottlenose dolphins are also distributed offshore for at least for part of the year (Reid *et al*. 2003; SMRU 2007). However, understanding of these animals' offshore distribution is poor due to limited survey effort away from the coast. Estimated population size in 1992 was 129 ± 15 (Wilson *et al*. 1999); more recent studies suggest that the current population contains a similar number of individuals to that estimated in 1992, with no clear trend apparent (Durban *et al*. 2005, Thompson *et al*. 2004 & 2006, Corkrey *et al*. in press). This species is listed in Annex II of the Habitats Directive[1], and the importance of this population, and the Moray Firth, is reflected in the designation of part of this area as a Special Area of Conservation (SAC).

The abundances of several species of small cetaceans in the central and northern North Sea were estimated from ship-based surveys carried out in 2005 as part of the SCANS-II project. Estimates are as follows: 70,897 harbour porpoise, 9,387 white-beaked dolphins, 6,187 minke whales and 19,087 *Lagenorhynchus* spp. (white-beaked and/or white-sided dolphins) (SCANS-II 2008). These figures do not include the Moray Firth or coastal waters around Orkney and Shetland.

Seals

The east coast of Scotland, Orkney and Shetland support important breeding colonies and haul-out sites for both grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals, several of which receive international conservation designations (JNCC website). Breeding grey seals also use rocky beaches and caves on the Moray Firth coast north of Helmsdale (Thompson *et al*. 1996). Harbour seals pup and moult during June-August, while grey seals moult ashore from February-March and pup over several weeks from approximately October in the central North Sea (Hammond *et al*. 2001).

Radio tracking and satellite telemetry studies of harbour seals in Scotland have revealed most foraging to take place within 40-60km of haul-out sites, with dense foraging activity occurring in waters off eastern Scotland and coastal waters surrounding Orkney and Shetland (Thompson *et al*. 1996, Hammond *et al*. 2004). However, seals were also recorded far from shore across much of the central and northern North Sea, including foraging trips to areas more than 200km from haul-out sites. This species is likely to be present in limited numbers around the Athena field and for fairly short duration. A single harbour seal was observed foraging in waters close to the Athena field in the early spring (Cork Ecology 2008).

Grey seals generally forage within approximately 40km of haul-out sites (McConnell *et al*. 1999). However, satellite tracking has revealed grey seals to occasionally embark on long journeys between different haul-out sites, spending long periods of time at sea and foraging in offshore areas (McConnell *et al*. 1999, Matthiopoulos *et al*. 2004). The waters east of the Pentland Firth and

[1] *Council Directive 92/43/EEC on the conservation of natural habitats of wild flora and fauna*

northeast of Rattray Head appear to be of particular importance to foraging grey seals (Matthiopoulos *et al*. 2004). Grey seals are therefore likely to be present around the Athena field in limited numbers and for fairly short periods of time (Hammond *et al*. 2001). Offshore foraging destinations are typically localised areas of by gravel/sand substrates – the preferred habitat of sandeels, a major prey species of grey seals (McConnell *et al*. 1999). Substrates in the Athena area are predominantly sandy mud and unsuitable for sandeels. A single grey seal was observed foraging in waters close to the Athena field in the early spring (Cork Ecology 2008).

4.12 Conservation sites

Coastal conservation sites

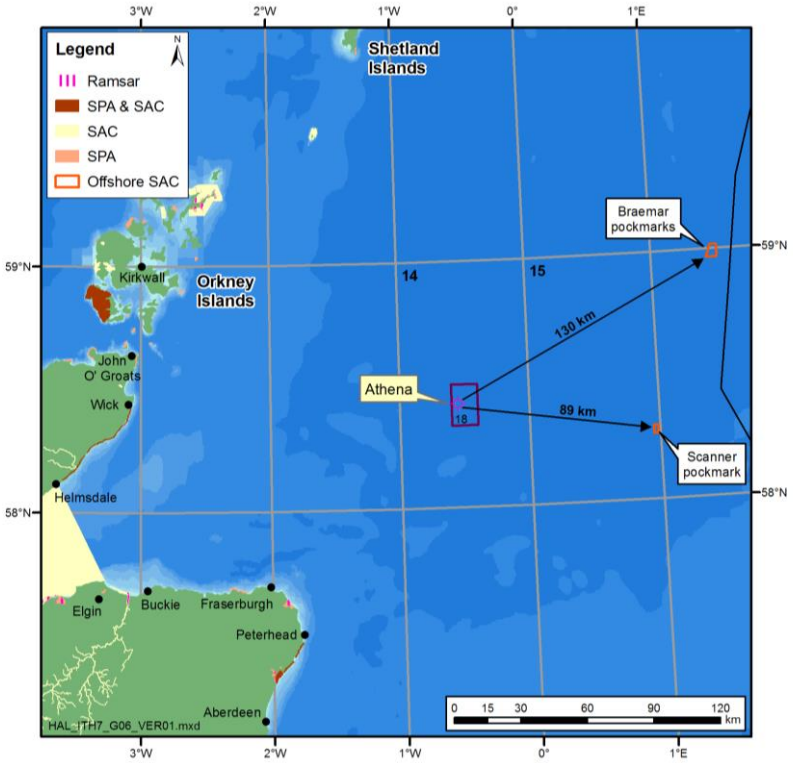
Internationally important sites

The region's coast has a variety of important habitats and species as well as bird areas which are protected under international, national and local designations. The principal European designations are Special Protection Areas (SPAs) established under Birds Directive[2], and Special Areas of Conservation (SACs) under the Habitats Directive[3]. SPAs and SACs collectively form part of the European ecological network of Natura 2000 sites. Ramsar sites are wetlands of international importance designated under the Ramsar Convention[4].

Along the northeast coast of Scotland and the coast of Orkney and Shetland there are many coastal and marine SACs, SPAs and Ramsar sites, in addition to two candidate SACs in offshore waters. These coastal sites are all at least 116km from the proposed development. International, national and locally important sites are shown in Figures 4.10-4.14.

[2] *Council Directive 79/409/EEC on the conservation of wild birds*
[3] *Council Directive 92/43/EEC on the conservation of natural habitats of wild flora and fauna*
[4] *The Convention on Wetlands of International Importance, especially as Waterfowl Habitat*

Figure 4.10 – Internationally important conservation sites



Source: JNCC website

Table 4.8 – SPA and Ramsar sites

Name	Area (ha)	Status	Summary of features
Ythan Estuary, Sands of Forvie & Meikle Loch	1016.24	SPA/Ramsar	Breeding common tern, little tern, sandwich tern Wintering pink-footed goose
Buchan Ness to Collieston Coast	208.62 + 2km extension	SPA	Assemblage qualification of international importance
Loch of Strathbeg	615.94	SPA/Ramsar	Breeding sandwich tern Wintering barnacle goose, whooper swan, greylag goose, pink-footed goose
Troup, Pennan and Lion's Head	174.2 + 2km extension	SPA	Breeding guillemot Seabird assemblage of international importance
Loch Spynie	93.62	SPA	Wintering greylag goose
Moray & Nairn Coast	2410.3	SPA/Ramsar	Breeding osprey Wintering bar-tailed godwit, greylag goose, pink-footed goose and redshank Wetland of international importance
East Caithness Cliffs	442.6 + 2km extension	SPA	Breeding peregrine, guillemot, herring gull, kittiwake, razorbill and shag Seabird assemblage of international importance
Pentland Firth Islands	170.5	SPA	Breeding Arctic tern
North Caithness Cliffs	557.73 + 2km extension	SPA	Breeding peregrine, guillemot Seabird assemblage of international importance
Switha	57.39	SPA	Wintering barnacle goose
Copinsay	125.42 + 2km extension	SPA	Seabird assemblage of international importance
Auskerry	101.97	SPA	Breeding Arctic tern, storm petrel
East Sanday Coast	1515.23	SPA	Wintering bar-tailed godwit, purple sandpiper and turnstone
Calf of Eday	238.03 + 2km	SPA	Seabird assemblage of international importance

Name	Area (ha)	Status	Summary of features
	extension		
Papa Westray (North Hill and Holm)	245.71	SPA	Breeding Arctic tern and Arctic skua
West Westray	350.62 + 2km extension	SPA	Breeding Arctic tern, guillemot
Rousay	633.41 + 2km extension	SPA	Breeding Arctic tern
Marwick Head	8.7 + 1km extension	SPA	Breeding guillemot, seabird assemblage of international importance
Hoy	9499.7 + 2km extension	SPA	Breeding peregrine, red-throated diver, great skua
Fair Isle	561.27 + 2km extension	SPA	Breeding Arctic tern, Fair Isle wren, guillemot
Sumburgh Head	39.04+ 2km extension	SPA	Breeding Arctic tern

Source: JNCC website

Table 4.9 – Special Areas of Conservation (SACs)

Name	Area (ha)	Summary of features
Sands of Forvie	734.05	Dunes
Buchan Ness to Collieston	207.52	Vegetated sea cliffs
Lower River Spey-Spey Bay	652.6	Perennial vegetation of stony banks Alluvial forests
River Spey	5729.5	Freshwater pearl mussel, sea lamprey, Atlantic salmon, otter
Culbin Bar	612.9	Perennial vegetation of stony banks, Embryonic shifting dunes and Atlantic salt meadow
Moray Firth (marine)	151321.7	Bottlenose dolphins Sandbanks which are slightly covered by sea water all the time
Berriedale & Langwell Waters	57.62	Atlantic salmon
East Caithness Cliffs	442.6	Vegetated sea cliffs
Loch of Wester	69.66	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation
Hoy	9499.7	Vegetated sea cliffs, natural dystrophic lakes & ponds, heaths, blanket bogs, petrifying springs with tufa formation, alkaline fens, calcareous rocky slopes with chasmophytic vegetation
Stromness Heaths & Coast	635.78	Vegetated sea cliffs, heaths, alkaline fens
Loch of Stenness	791.87	Coastal lagoons
Loch of Isbister	105	Neutral eutrophic lakes with transition mires & quaking bogs, otter
Faray and Holm of Faray	785.68	Grey seals
Sanday	10971.65	Reefs, sandbanks, mudflats, common seal
Fair Isle	561.27	Vegetated sea cliffs, heath
Braemar Pockmarks*	2134	Submarine structures made by leaking gas
Scanner Pockmark*	724.9	Submarine structures made by leaking gas

*Note: *Braemar Pockmarks and Scanner Pockmarks are currently candidate SACs. Source: JNCC website*

Internationally Important Bird Areas

Important Bird Areas (IBAs) are identified by Bird Life International for their importance as conservation sites of the world's birds using globally agreed criteria. IBAs are not designated sites as such do not confer protected status, but the sites are recognized as supporting internationally or nationally important numbers of breeding and/or non-breeding birds. There are several IBAs along the northeast coast of Scotland and the Northern Isles, the majority of which overlap with SPA/Ramsar sites (Figure 4.11 and Table 4.10).

Figure 4.11 – Important Bird Areas

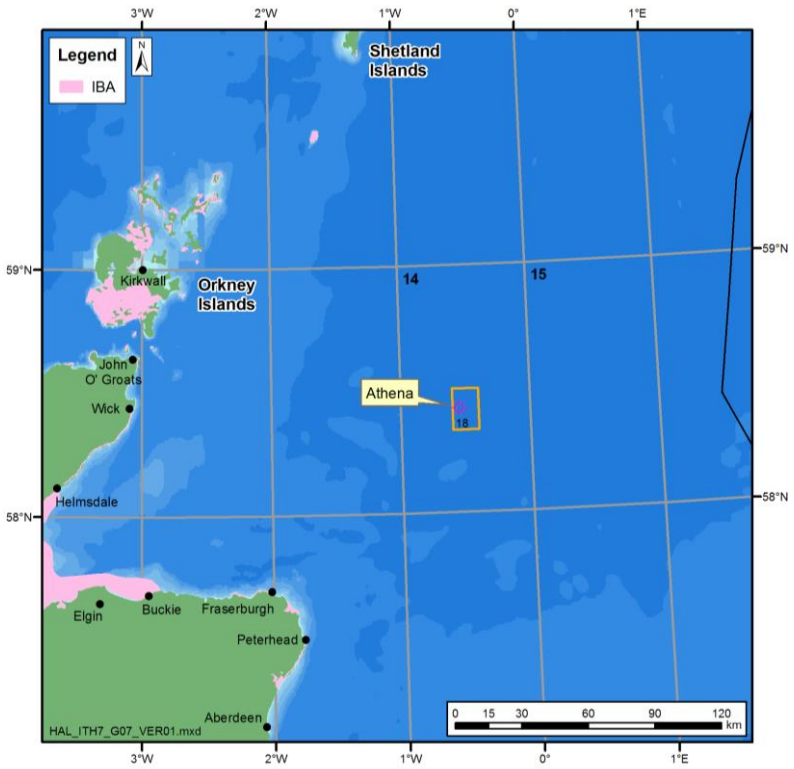


Table 4.10 – IBAs in the area

Name	Description
Ythan Estuary, Sands of Forvie and Meikle Loch	The site is important for breeding seabirds and holds up to 26,700 pairs of wintering water birds. Nationally important for breeding common eider and common tern, for wintering common eider and snow bunting, and for summer moulting assemblages of common eider.
Buchan Ness to Collieston Coast	The site holds 23,800 pairs of breeding seabirds and 28,100 pairs of breeding water birds. Nationally important for breeding herring gull, kittiwake and guillemot.
Loch of Strathbeg	The site is important for wintering wildfowl and breeding terns, and regularly holds 42,800 wintering water birds. The site is also nationally important for wintering teal.
Rosehearty to Fraserburgh coast (Sandhaven)	This site, which includes a narrow fringe of sand dunes and saltmarsh, is important for wintering waders such as purple sandpiper and turnstone.
Troup, Pennan and Lion Heads	The site holds 38,400 pairs of breeding seabirds and 36,100 pairs of breeding water birds on a regular basis. It is also nationally important for breeding herring gull and for one of only two gannet colonies on the UK mainland.
Moray basin Firths and Bays	Coastal areas form an integral unit which is internationally important for populations of wintering and passage wildfowl. Site holds 130,000 wintering and 31,000 passage water birds on a regular basis. It is also nationally important for breeding common tern and cormorant.
Caithness Cliffs	The cliffs support 127,000 pairs of breeding seabirds and 54,000 pairs of water bird on a regular basis. The site is also nationally important for breeding fulmar and cormorant.
Pentland Firth Islands	These islands are important for large numbers of breeding seabirds, holding 11600 pairs on a regular basis.
South Walls and Switha	The area is important for breeding seabirds and waders, and wintering geese
Scapa Flow	Important site for wintering water birds. Nationally important for wintering red-

Name	Description
	necked grebe, common eider, long-tailed duck and red-breasted merganser.
Hoy	The site regularly supports 56,000 pairs of breeding seabirds, plus raptors and waders, and is also nationally important for breeding fulmar, Arctic skua, Arctic tern and guillemot.
Marwick Head	The site regularly holds 26,000 pairs of breeding seabirds, and is also nationally important for breeding kittiwake.
Copinsay	The site is important for breeding seabirds, holding 16,500 pairs on a regular basis. It is also nationally important for breeding guillemot.
Mill Dam, Shapinsay	Artificial water-body nationally important breeding site for northern shoveler.
North Mainland Coast	This site is important for wintering waders, and is also nationally important for wintering long-tailed ducks and snow bunting.
Sounds around Wyre	Important site for wintering divers, nationally important for wintering common eider and long-tailed ducks.
Auskerry	The site supports large numbers of breeding seabirds, and is also nationally important for breeding Arctic terns.
South-Eastern Stronsay	Important site for breeding seabirds and wintering waders and wildfowl.
Eday	The site supports 10,700 pairs of breeding seabirds and upland species. The site is also nationally important for breeding red-throated diver, great cormorant, whimbrel, Arctic skua, guillemot, purple sandpiper.
Faray and Holm of Faray	These islands are important for breeding seabirds.
East Sanday	Important site for both wintering and breeding waders, and is also nationally important for breeding Arctic tern, wintering sanderling and snow bunting.
Rothiesholm Peninsula, Stronsay	The site holds important seabird colonies.
North Ronaldsay Coast	Nationally important for wintering snow bunting.
North Westray Coast	The site is important for breeding seabirds.
West Westray	The site regularly holds 45,000 pairs of breeding seabirds and 32,200 pairs of breeding water birds, and is also nationally important for breeding Arctic skua and razorbill.
South Westray Coast	The site is important for wintering waders.
Papa Westray (North Hill & Holm)	The site is important for breeding seabirds, and is also nationally important for breeding Arctic skua.
Rousay (Part)	The site supports an important assemblage of breeding moorland birds, including Arctic skua.
Fair Isle	The island supports large colonies of breeding seabirds, and is also important as a stop-over site for migrating birds. It holds 72,400 breeding seabirds and 21,900 breeding water birds on a regular basis, and is nationally important for breeding fulmar, Arctic skua and kittiwake. Fair Isle also has an endemic subspecies of wren.
Sumburgh Head	The site is important for its colonies of breeding seabirds.

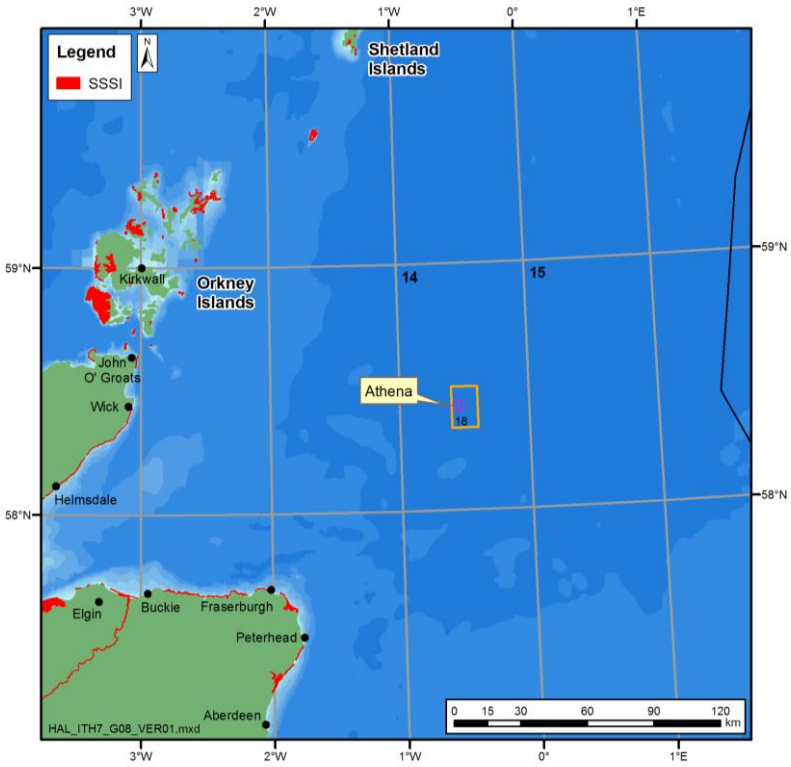
Source: BirdLife International website

Nationally and locally important sites

Sites of Special Scientific Interest

Sites of Special Scientific Interest (SSSI) are the main nature conservation designation in the UK (notified under the *Wildlife and Countryside Act 1981*) and there are a number of SSSIs along the coastline in the wider area (Figure 4.12). These sites are special for their plants, animals or habitats, their rocks or landforms or a combination of these.

Figure 4.12 – SSSI sites in the region



Source: JNCC website

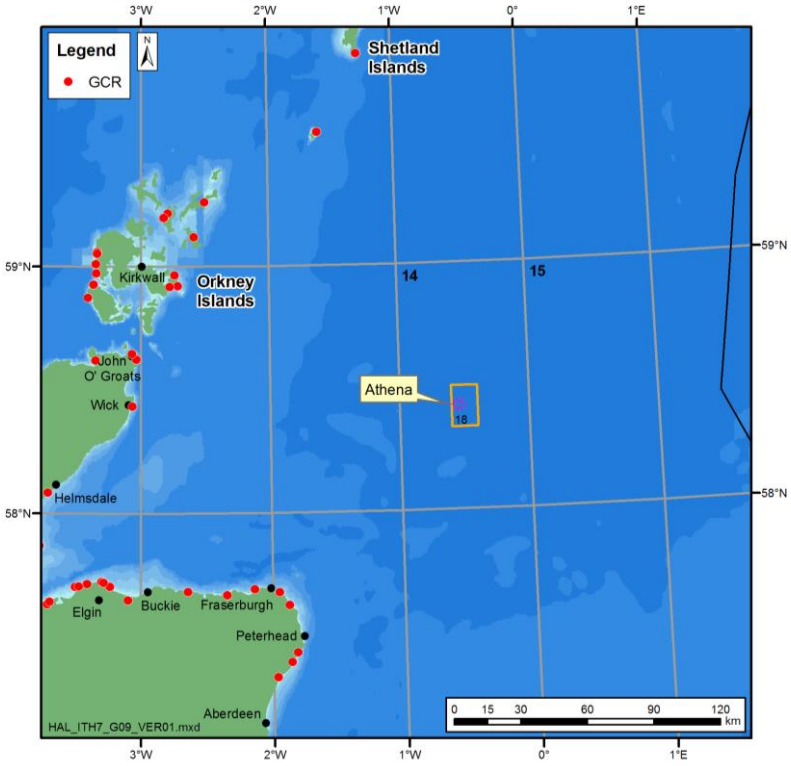
Geological Conservation Review sites

The Geological Conservation Review (GCR) was designed to identify those sites of national and international importance needed to show all the key scientific elements of the Earth heritage of Britain. GCR sites form the basis of statutory geological and geomorphological site conservation in Britain and there are numerous GCRs along the coastline of the Moray Firth, Orkney and Shetland (Figure 4.13).

Other national and local conservation sites

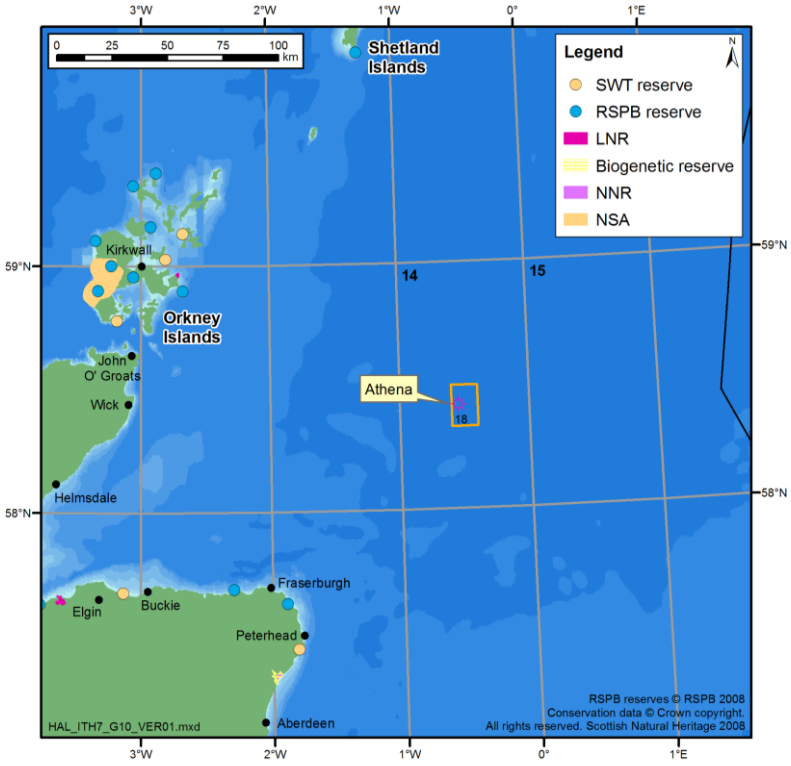
There are numerous other national and local conservation sites in and around the Moray Firth area and along the coastline of Orkney and the southern tip of Shetland (Figure 4.14). These include a number of Royal Society for the Protection of Birds (RSPB) and Scottish Wildlife Trust (SWT) reserves. These sites are mainly located on the coastline to the south and west of the Athena area, as are a number of other reserves and areas of interest: Local Nature Reserves (LNRs), National Nature Reserves (NNRs), Biogenetic Reserve and National Scenic Areas (NSAs).

Figure 4.13 – GCR sites in the region



Source: JNCC GCR website

Figure 4.14 - National and local conservation sites in the region



Marine and offshore conservation sites and species

Marine Special Protection Areas (SPAs)

Work is currently underway to identify marine SPAs, and three possible types have been recognised (JNCC website):

- *seaward extensions* to existing breeding seabird colony SPAs;
- *inshore areas* used by aggregations of non-breeding water birds outside the breeding season;
- *offshore areas* used by seabirds in feeding or any other type of aggregations

Thirty one of Scotland's seabird breeding colony SPAs has been extended to protect their adjacent marine habitats as of September 2009. The extensions go out to 1, 2 or 4km, depending on which species are protected within the existing terrestrial SPA (see Table 4.8). All these sites are a significant distance from the Athena development.

Due to its distance from land, only *offshore areas* have the potential to overlap with the proposed Athena development area. At present, no possible offshore SPAs have been identified.

Offshore Special Areas of Conservation (SACs)

The Offshore Natura 2000 Project is in the process of identifying potential offshore sites which may warrant protection. Selection criteria and potential areas which may qualify for protection, as Natura 2000 sites, are given in Johnston *et al.* (2002). An update on the selection criteria and potential areas for SACs and SPAs (Johnston *et al.* 2003) identified areas of Annex I habitat within the 12-200nm zone which could be classified into Group 1 or Group 2 depending (respectively) on the confirmation/suspicion of the presence of Annex I habitat, adequacy/inadequacy of biological information, and absence/presence of sites of such character in territorial waters (0-12nm).

There are currently no fully designated SACs in UK offshore waters (beyond 12nm) (JNCC website). However, there are seven possible offshore SACs (pSACs) which are being considered for full designation. The closest of these sites are the Scanner pockmark candidate SAC and Braemar pockmarks candidate SAC, located some 89km to the east and 130km to the northeast of the proposed development respectively (Figure 4.10). As candidate sites, these have been submitted to the EU and are under consideration for full designation.

Pockmarks may qualify as the Annex I habitat 'submarine structures made by leaking gases' if several criteria are met, including the presence of carbonate cemented sediments (Johnston *et al*. 2002). While pockmarks are present throughout the Athena area, seabed surveys have not revealed the presence of any features which may qualify as Annex I habitat (Gardline 2007a & b).

The general Athena area supports a number of Annex II species, including grey seal, harbour seal and harbour porpoise. Further research is required to clarify the offshore distribution of these species to identify any sites of particular importance. The possibility remains that offshore areas in this region may be protected in the future.

OSPAR Marine Protected Areas (MPAs)

The OSPAR Commission is currently in the process of identifying a network of Marine Protected Areas (MPAs), the designation of which will be informed by the *Initial List of Threatened and/or Declining Species and Habitats*. It is aimed to complete a joint network of ecologically coherent and well managed MPAs by 2012 that, together with the Natura 2000 network, is ecologically coherent

(OSPAR 2006a). Currently, 55 UK sites have been nominated as MPAs, all of which are currently coastal or marine SACs. The closest of these to the proposed development are the Moray Firth and several sites on the Orkney Islands (OSPAR 2006a).

There are a number of species on the OSPAR list which occur either throughout the year or seasonally in the general Athena area, including the bivalve *Arctica islandica*, cod, and harbour porpoise (OSPAR 2006b). Additionally, seabed photography has identified the presence of the listed habitat 'seapen and burrowing megafauna communities'. These species and habitat occur extensively throughout the North Sea, and no sites in the Athena area have been nominated for the MPA network at present (OSPAR 2006b).

Species of conservation concern

Several marine species occurring in the central and northern North Sea are of conservation concern. These are listed in a variety of international and national documents such as the OSPAR Initial List of Threatened and/or Declining Species and Habitats, the IUCN Red List of Threatened Species, the *Wildlife and Countryside Act 1981*, UK Biodiversity Action Plans and Annex IV[5] of the Habitats Directive. Of these species, those most likely to occur in waters around the Athena field include: cod, the bivalve *Arctica islandica*, harbour porpoise, minke whale and white-beaked dolphin (OSPAR 2006b, UK BAP website, JNCC website). Many seabirds, including puffin, guillemot, gannet, lesser black backed gull, fulmar and kittiwake are afforded some protection in UK waters. All cetacean species are protected under Annex IV of the EC Habitats Directive, while the grey and common seals are protected under Annex II. For full details of the protected status of species occurring in the central North Sea, see the documents listed above. Details may also be found in Appendix 3 of the latest Offshore SEA (DECC 2009).

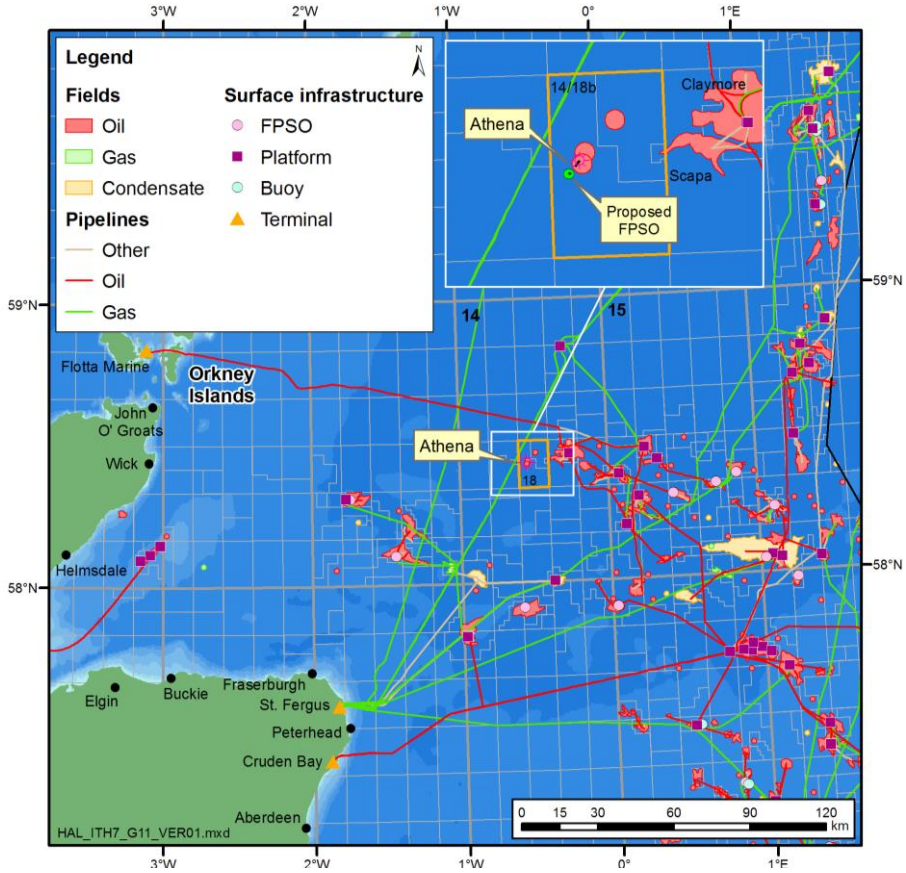
4.13 Users of the sea and offshore environment

Offshore energy infrastructure

The Athena field lies to the west of a large area with many oil fields and associated infrastructure (Figure 4.15). In Block 14/18b, 10 exploration and appraisal wells have previously been drilled, the majority of which have been plugged and abandoned. There is one unnamed oil discovery in the northern half of the Block 14/18b, and two 32" gas pipelines intersect the northwest corner of this Block. Block 14/18a also contains an unnamed oil discovery and several previously drilled exploration and appraisal wells. The neighbouring Block 14/19 contains the Claymore and Scapa fields, numerous wells and a network of pipelines focused around the Claymore platform, which lies approximately 18km east-northeast of the proposed development. The Highlander, Duart and Petronella fields, and associated wells, manifolds and pipelines lie in Block 14/20 (UK DEAL website).

[5] Animal and plant species of community interest in need of strict protection

Figure 4.15 – Oil and gas infrastructure in the region



Source: UK DEAL website

The closest offshore renewable energy development to the Athena field is the Beatrice Wind Farm Demonstrator Project. This comprises two 5MW turbines adjacent to the Beatrice field in the Moray Firth, about 150km to the southwest of the proposed development. The Crown Estate has entered Round 3 zonal development agreements for offshore wind energy generation from large area in the outer Moray Firth and off the Firth of Forth beyond 12nm of the coast. They have also recently awarded exclusivity agreements to various consortia of wind energy developers for several areas within Scottish territorial waters. The Crown Estate identified Scottish territorial waters along the north coast of mainland Scotland and around Orkney as a potential area for wave and tidal energy development and held a leasing competition in the Pentland Firth strategic area in September 2008. Leases in the area have recently been awarded.

Fisheries

Commercial fisheries in the Athena area

The Fladen Ground is an important area for commercial fisheries, particularly for *Nephrops* (Defra 2005). The Scottish fleet holds the majority of the North Sea quota for *Nephrops*, and this is frequently their highest value species landed from the North Sea (FRS 2005). The fishery is targeted by trawlers operating *Nephrops*-specific nets and is also exploited as a valuable by-catch of whitefish trawlers. The other main crustacean fishery of the Fladen Ground is that of pink shrimp (*Pandalus borealis*), exploited by Danish and UK vessels generally between March and September (Rogers *et al*. 2001, Defra 2005).

ICES rectangles are subareas of larger ICES sub-divisions, and are used for fisheries data recording and management. The proposed Athena area lies in ICES rectangle 45E9 and adjacent to 46E9,

within ICES sub-division IVa. Table 4.11 lists the live weight and first sale value of fish and shellfish landings into Scotland from 45E9 and 46E9 over the period 2006-2008.

Table 4.11 – Live weight and value of fish and shellfish taken from ICES rectangles 45E9 and 46E9, 2006-2008

Species type	2006		2007		2008	
	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)
ICES rectangle 45E9						
Demersal	961	1,121,698	936	1,137,891	808	973,113
Pelagic	2,068	532,390	103	28,929	932	302,178
Shellfish	1,298	3,457,933	1,808	5,168,905	1,583	3,970,364
Total	4,327	5,112,020	2,848	6,335,725	3,323	5,245,655
ICES rectangle 46E9						
Demersal	1,102	1,328,345	893	1,153,465	1,535	1,883,835
Pelagic	1,515	363,685	2,642	618,573	1,782	554,148
Shellfish	1,095	2,938,865	962	2,919,121	1,677	4,441,959
Total	3,712	4,630,895	4,497	4,691,160	4,995	6,879,941
Total 45E9 +46E9	**8,039**	**9,742,916**	**7,345**	**11,026,885**	**8,317**	**12,125,597**

Note: All landings into UK ports

Source: Pers. comm. McLoughlin E, Fisheries Statistics Unit, Feb 2010

Over the period 2006-2008, reported landings by UK vessels landing into Scotland for ICES rectangles 45E9 and 46E9 were dominated by demersal fish and shellfish. In 45E9, demersal fish contributed *ca*. 20-30% of weight and *ca*. 20-35% of value, while shellfish contributed *ca*. 30-65% of weight and *ca*. 70-80% of value. The weight and value of pelagic fish varied considerably from year to year, ranging from <5% of weight and <1% of value of all landings, to as much as 48% of weight and 10% of value.

In 46E9, demersal fish contributed *ca*. 20-30% of weight and *ca*. 25-30% of value, while shellfish contributed *ca*. 20-35% of weight and *ca*. 60-65% of value. Pelagic fish were of greater importance than in 45E9, although this fluctuated considerably between years; contributing *ca*. 60% of weight and *ca*. 15% of value in 2007, and 35% of weight and 10% of value in 2008.

The weight and value of landings in block 45E9 varied between 2006 and 2008 from a minimum total weight of 2,850 tonnes at a value of £6.3 million in 2007 to a weight of 3,320 tonnes with a value of £5.2 million. The value of landings increased in each year in 46E9 in line with the weight of landings from 2006-2008. The main species landed in 45E9 in 2008 were *Nephrops* (47% of total weight), herring (28%), haddock (7%) and whiting (6%). The composition of landings in 46E9 in 2008 was similar with the exception of herring (36% of total weight) which reduced the dominance of *Nephrops* and demersal fish species. In both rectangles, the value of landings was dominated by *Nephrops* (up to 75%), with herring and monkfish the next most valuable.

The composition of landings by group was very similar for both rectangles. Landings of demersal fish were dominated in weight by haddock, followed by whiting, monks, cod and saithe, although catches of haddock have dropped since 2006. Haddock, monks and whiting dominated the value of

demersal landings. Landings of shellfish were almost exclusively *Nephrops* (*ca*. 98%), with the remaining catch dominated by squid. Pelagic landings were almost exclusively herring.

Logbooks submitted by fishermen allow the seasonal pattern of fishing effort to be examined (Table 4.12). For all gears combined, effort fluctuated between years and showed considerable month-month variability. No well defined seasonal patterns in effort were observed, although spring and autumn generally showed the highest levels of effort. For 45E9, annual effort increased from 2006-2008. For both rectangles, effort was dominated by bottom trawls.

Table 4.12 – Number of days fished per month (all gears) in ICES rectangles 45E9 and 46E9 2006-2008

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ICES Rectangle 45E9													
2006	199	344	67	334	96	104	59	110	122	296	25	94	**1,850**
2007	79	103	224	236	102	164	151	174	229	345	280	183	**2,272**
2008	267	31	144	245	260	208	149	289	483	120	100	81	**2,377**
ICES Rectangle 46E9													
2006	314	161	140	224	112	272	62	82	70	119	21	133	**1,709**
2007	82	61	232	357	34	38	71	147	115	29	156	121	**1,443**
2008	272	281	410	150	485	116	24	59	466	32	70	182	**2,548**

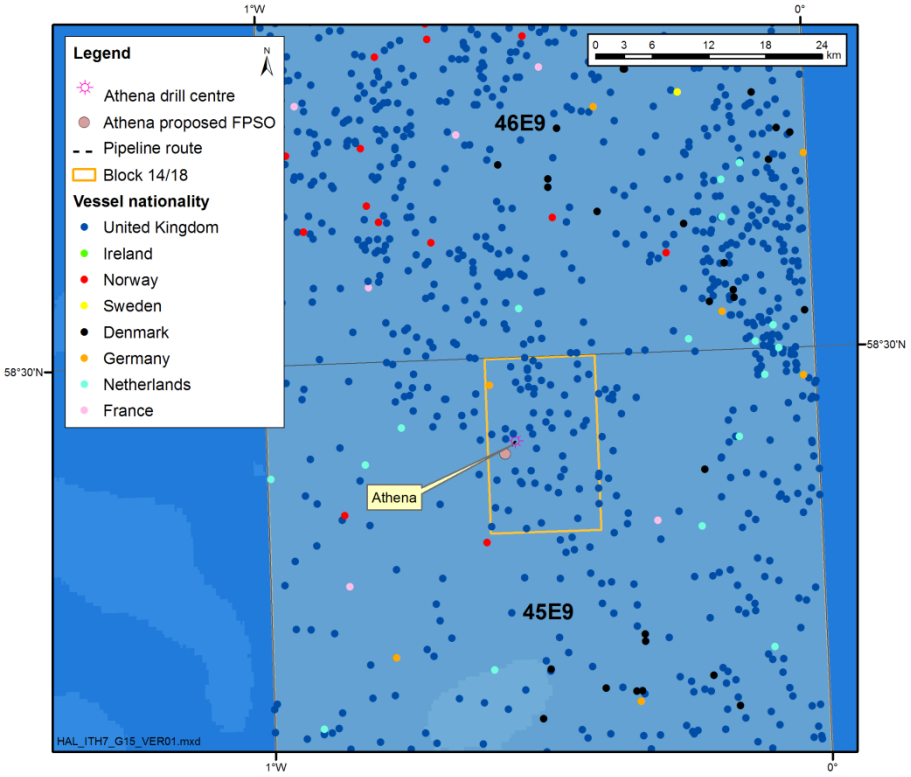
Note: Monthly fishing effort by UK vessels landing into Scotland: green = 0 – 99 days fished, yellow = 100 – 199, orange = 200-299, red = ≥300.
Source: Pers. comm. McLoughlin E, Fisheries Statistics Unit, Feb 2010

Over the period 2006-2007, the Scottish Fisheries Protection Agency (SFPA) carried out aerial surveillance patrols over 81 and 104 days in rectangles 45E9 and 46E9 respectively. In 45E9, 402 fishing vessels were observed, while 774 fishing vessels were observed in 46E9 (pers. comm. McLeod M, SFPA, June 2008). The patrols recorded the location, nationality, vessel registration number, gear type and activity of vessels (Figures 4.16 and 4.17). For both rectangles, the dominant nationality was UK (*ca*. 90%), with limited numbers of vessels from other North Sea nations present. Most vessels were fishing (>70%) or in passage. The majority were operating demersal trawls (*ca*. 90%), with a limited presence from pelagic trawlers and a few observations of industrial trawlers (sandeelers).

Mariculture

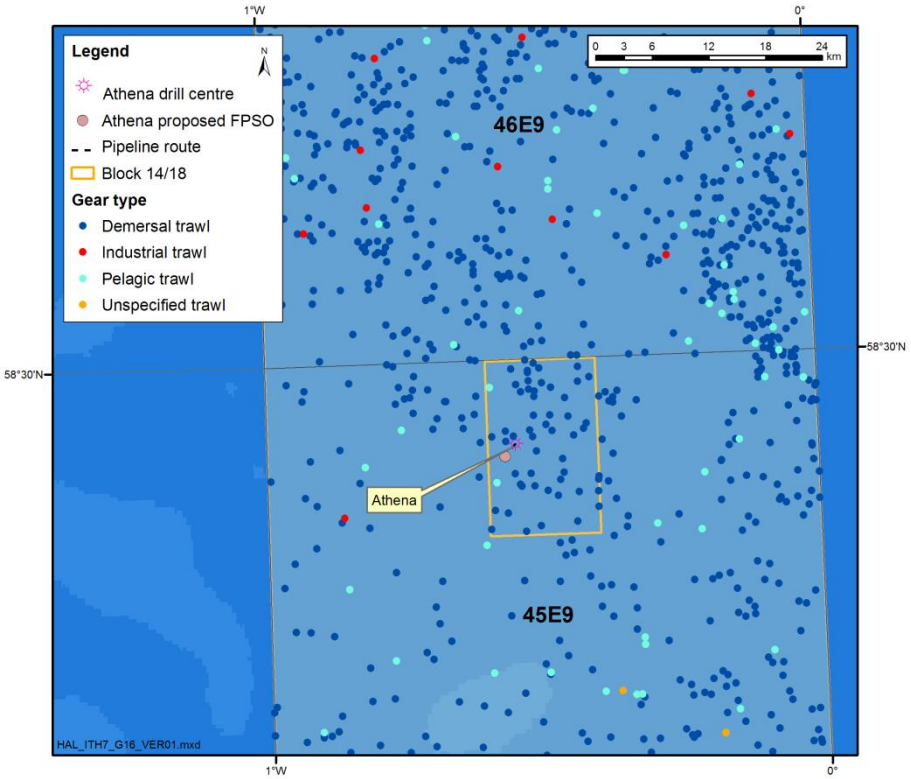
In 2008, there were several active fish and shellfish producing sites in the sheltered coastal waters of the Northern Isles, and two shellfish sites in the inner Moray Firth (FRS 2007 & 2008). However, these are at least 140km to the west of the proposed development.

Figure 4.16 – Nationality of fishing vessels (2006-2007)



Source: SFPA, June 2008

Figure 4.17 – Fishing vessel gear type (2006-2007)



Source: SFPA, June 2008

Aggregate extraction and marine disposal

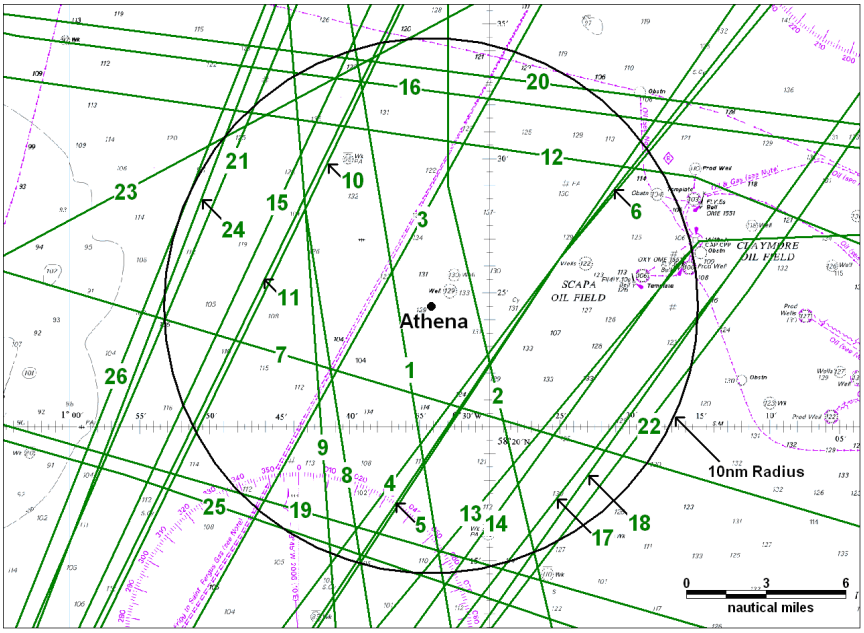
There are no licensed sites for aggregate extraction or marine disposal within the Athena area (OSPAR 2006c, Crown Estate website). The closest marine disposal sites are at least 116km away on the southern Moray Firth coastline.

Ports and Shipping

Vessel traffic

A vessel traffic study has been conducted using Anatec's UK shipping route database Ship Routes (Anatec 2010). This considered all routes passing within a 10nm radius of the proposed FPSO location; an area which also incorporates the drilling location and connecting pipeline. Twenty five routes pass within a 10nm radius of the proposed FPSO location (Figure 4.18), summarised in Table 4.13.

Figure 4.18 - Shipping routes within a 10nm radius of the proposed FPSO location



Source: Anatec (2010)

Table 4.13 - Shipping routes within a 10nm radius of the proposed FPSO location

Route no.	Description	Closest Point of Approach (nm)	Bearing (°)	Ships per year	% of total
1	Lerwick-Amsterdam Coastal*	1.2	261	9	0
2	Rotterdam-Sullom Voe*	1.7	77	50	2
3	N Norway/Russia-Aberdeen*	1.9	299	30	1
4	Beryl-Peterhead*	2.8	127	26	1
5	Aberdeen-Froysjoen	3.0	124	10	0
6	Aberdeen-Bruce b*	3.1	123	80	3
7	Kattegat-Greenland Pentland	3.4	197	20	1
8	Humber-Lerwick	4.1	261	25	1
9	Lerwick-Humber	4.4	266	20	1
10	Aberdeen-Alwyn/Dunbar*	5.8	296	338	14
11	Aberdeen-Statfjord*	6.0	295	26	1
12	Belfast-Baltic S	6.2	8	5	0
13	Peterhead-Tartan/Piper/Saltire/Claymore	6.2	129	90	4

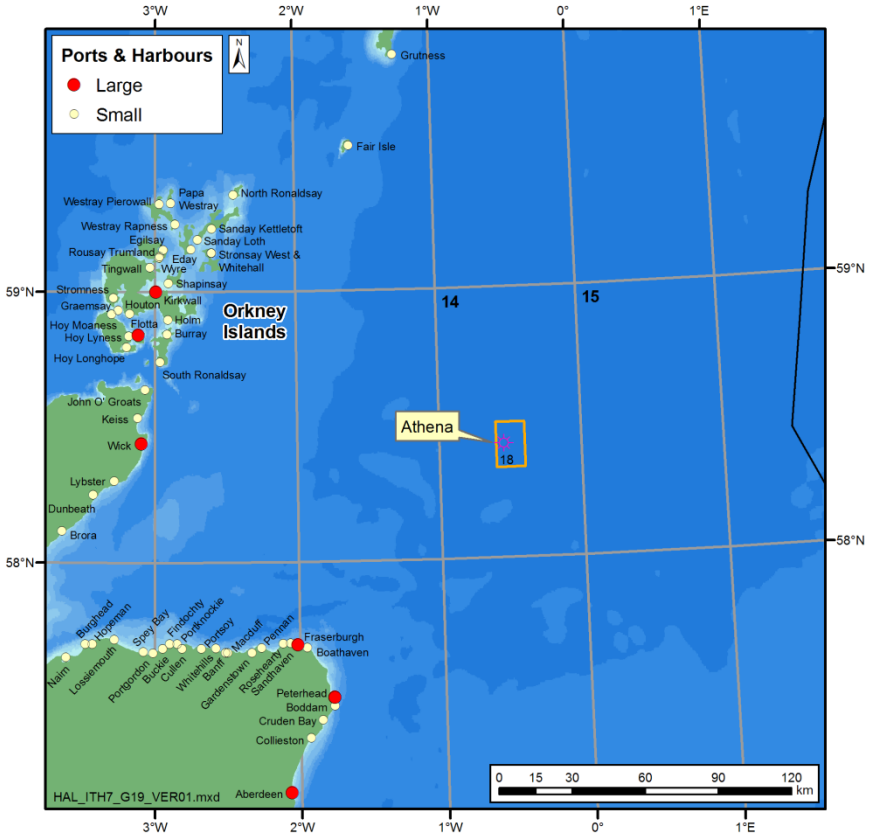
Route no.	Description	Closest Point of Approach (nm)	Bearing (°)	Ships per year	% of total
14	Aberdeen-Claymore *	6.6	126	26	1
15	Aberdeen-Ninian *	6.8	295	176	7
16	Baltic-Belfast S*	8.0	8	99	4
17	Tay-N Norway/Russia*	8.2	128	75	3
18	N Norway/Russia-Forth*	8.5	125	20	1
19	Belfast-Kattegat b	8.7	196	18	1
20	America North-Kattegat a*	8.8	7	681	28
21	Aberdeen-NW Hutton*	9.0	293	174	7
22	Aberdeen-Bruce a*	9.1	127	120	5
23	Moray Firth-Marstein*	9.1	332	25	1
24	Aberdeen-Dunlin*	9.4	291	26	1
25	Clyde-Kattegat b*	9.7	199	85	3
26	Aberdeen-Thistle*	9.9	292	222	9
Total				**2,476**	**100**

*Notes: * Two or more routes with an identical CPA and bearing have been grouped together; the description lists the sub-route with the most ships per year. Source: Anatec (2010)*

The traffic on these routes equates to an average of some seven vessels per day. Traffic is dominated by offshore and cargo vessels, with a lesser contribution from tankers and a small number of ferries. The majority of these are in the 1,500-5,000 deadweight tonnage (DWT) size categories. It should be noted that the above assessment does not include the movements of 'non-route-based' traffic such as fishing vessels, naval vessels, tugs, yachts, or other non-routine traffic.

The locations of ports and harbours on the adjacent coastline are shown in Figure 4.19.

Figure 4.19 – Ports and harbours in the adjacent region



Marine Environmental High Risk Areas (MEHRAS)

The waters off the coast of Kinnaird Head, on the northeast coast of Aberdeenshire, have been identified as a Marine Environmental High Risk Area (MEHRA) due to their environmental sensitivity and high levels of shipping activity (DfT 2006). The various wildlife, landscape and geological designations are described in Section 4.12. Shipping in the area is primarily associated with the ports of Fraserburgh and Peterhead. This area is approximately 115km southwest of the proposed development. MEHRAs have also been identified off the Aberdeenshire coastline at Newburgh, and off the south coast of Orkney in the Pentland Firth.

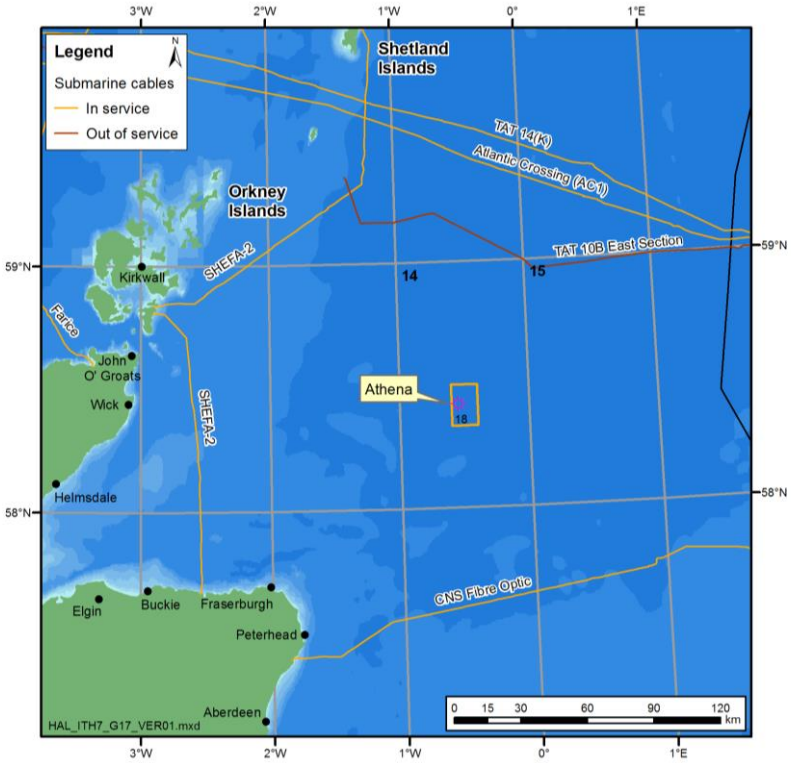
Military activity

The closest areas of Ministry of Defence (MoD) activity are several areas of the outer Moray Firth used by the Air Force for radar training, high and low-angle gunnery and air to sea or ground firing, although these do not impinge upon the Athena area.

Cables

No telecommunication cables intersect the Athena area (KISCA website). The nearest cable is the out of service TAT 10-B lying 60km to the northeast (Figure 4.20).

Figure 4.20 - Telecommunication cables in the region



Source: KISCA website

Archaeology and Wrecks

Wrecks

Approximately 127 wrecks around the UK coast are listed as protected under The Protection of Wrecks Act 1973 (58 sites), The Protection of Military Remains Act 1986 (48 sites), Ancient Monuments & Archaeological Areas Act 1979 (21 sites) (English Heritage 2006, Office of Public Sector Information website, Maritime and Coastguard Agency website). There are no protected wrecks located in the wider vicinity of the proposed development.

Information obtained from the Hydrographic Office Wreck Information Service shows that there are 10 'live' wrecks (those charted and considered to exist) within a 10nm radius of the proposed development (Figure 4.21). Those closest to the proposed development lies approximately 6.8km northwest of the drilling location, and is classified as a non-dangerous wreck of unknown origin.

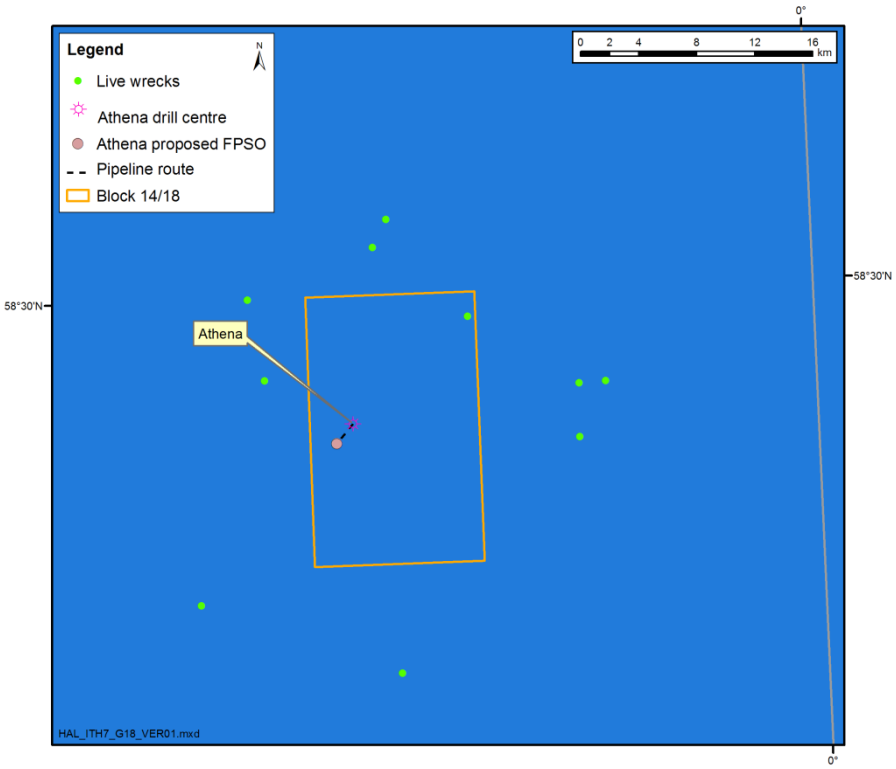
Potential sites of archaeological interest

The importance of maritime trade routes and fishing grounds in the region, past military conflicts and the treacherous nature of inshore waters, has lead 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, many more remain uncharted.

An underpinning report for DECC's SEA process (Flemming 2004) indicated that prehistoric submarine archaeological remains back to about 12,000 years ago could occur with low probability anywhere area between the northern mainland coast out to approx 1°E. It is thought that prehistoric sites from the last 5-10,000 years can survive marine transgression (see Flemming 2004).

To date, no sites or objects of archaeological importance have been identified in the Athena area. Additionally, the rig-site and pipeline route surveys have not identified the presence of any features of archaeological interest on the seabed in the proposed development area.

Figure 4.21 – Wrecks within 10nm of the proposed development



Source: Pers. com., UK Hydrographic Office, July 2007

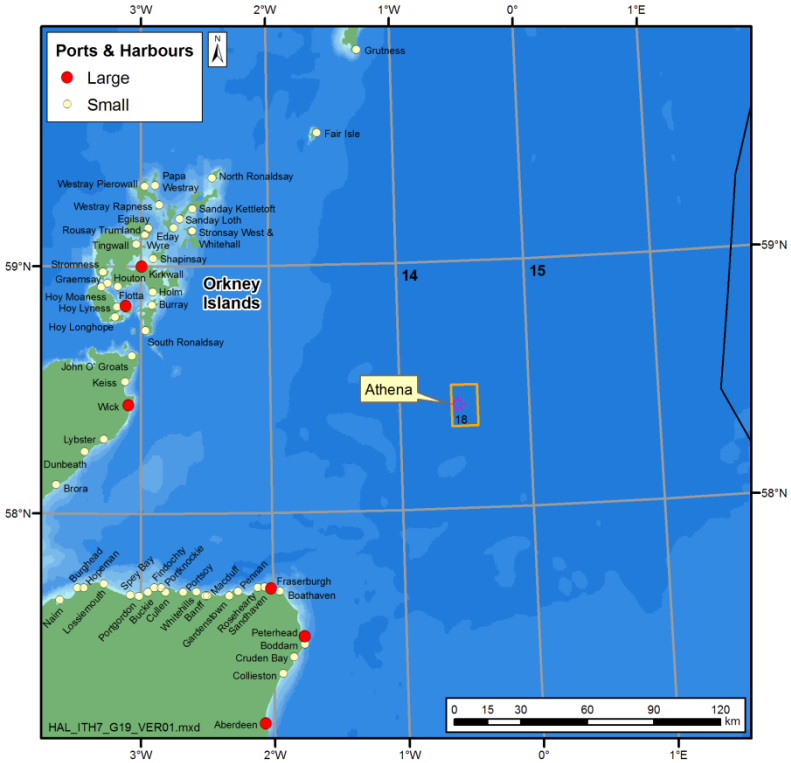
Tourism and recreation

The Athena field is distant from land and with the exception of occasional yachts in passage it is not an area of recreational use. Two ferry routes pass within 10nm of the proposed development, details of which are provided in Section 4.13.4.

Ports and harbours

The locations of ports and harbours on the adjacent coastline are shown in Figure 4.21.

Figure 4.21 – Ports and harbours in the adjacent region



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