



**Inshore Special Area of Conservation (SAC):
Shell Flat and Lune Deep**

Incorporating Shell Flat cSAC and Lune Deep cSAC

SAC Selection Assessment

Version 3.7

Version Control

Version date	Amendments made	Issued to
3.7 9 th September 2011	pSAC amended to cSAC following transmission to European Commission	Stakeholders 14 th September 2011
3.6 3 rd August 2011	Reference sources linked.	Re-issued to Defra.
3.5 1 st June 2011	Amendment of minor typing errors following meeting of Executive Board and Board members on 11 th May 2011.	Defra Marine Biodiversity – as Natural England's final recommendation.
3.4 10 th March 2011 (re-dated 3 rd May 2011 following correction of minor typos)	Amendment following circulation to the MPA Technical Group and UK Marine Biodiversity Policy Steering Group	James Marsden, Director Marine, for final QA. Minor typos corrected and issued to Guy Thompson, Executive Director sponsor for QA prior to issue to Executive Board for consideration 28 th March 2011. Considered by Natural England Executive Board 28 th March 2011 and deferred for further consideration. QA by James Marsden and Jim Smyllie, for issue for consideration at a meeting of the Executive Board and Board members on 11 th May 2011. Approved for submission to Defra following correction of minor typing errors.
3.3 19 th January 2011	Minor typing errors	JNCC for circulation to MPA Technical Group and Defra for circulation to UK Marine Biodiversity Policy Steering Group
3.2 14 th January 2011	Minor text amendments	Natural England Evidence team final review and QA by James Marsden, Director Marine.
3.1 15 th December 2010	Minor text amendments.	Natural England N2K Project Manager.
3.0 13 th December 2010 (Shell Flat and Lune Deep)	Incorporation of Lune Deep area (reconsulted August-November 2010). Site name change, map changes (area, boundary and nodes).	Natural England regional lead advisors.
2.2 14 th May 2010	Minor text amendments.	Natural England Executive Board. Version approved by government and information within the document submitted on data form to the European Commission.
2.1 6 th May 2010	Text amended.	Director Marine and Executive Director sponsor for QA.
2.0 29 th April 2010 (Shell Flat only)	Document revised for Shell Flat following formal consultation.	Internal review.
1.0 December 2008 (Shell Flat and Lune Deep site)	Drafted for Executive Board and submission to Defra for approval for formal consultation.	Publicly available at start of informal dialogue July 2009 and formal consultation November 2009.

1. Introduction

This document provides detailed information about the Shell Flat and Lune Deep SAC and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles.

The advice contained within this document is produced to fulfil requirements of Natural England under the Conservation of Habitats and Species Regulations 2010, relating to the conservation of natural habitat types and species through identification of Special Areas of Conservation (SACs) in UK waters (EU, 2003; EC, 2007). Under these Regulations, Natural England is required to provide advice to enable the Secretary of State and Competent Authorities to fulfil their obligations under the Regulations.

Sites eligible for designation as Special Areas of Conservation (SACs) are selected on the basis of the criteria set out in Annex III (Stage 1) to the Habitats Directive and relevant scientific information. SACs are considered only if they host a Habitats Directive Annex I habitat or Annex II species. Socio-economic factors are not taken into account in the identification of sites to be proposed to the European Commission (EC)¹.

In addition to information on the Annex I habitats, this document contains: i) a map of the site, ii) its name, location and extent, iii) the data resulting from application of the criteria specified in Annex III (Stage 1) to the Habitats Directive and iv) a glossary of terms mentioned in the text. Natural England has adhered to the format established by the EC for providing site information. This format is set out in the 'Natura 2000 Standard data form' (CEC, 1995) and prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the EC to collect standardised information on SACs throughout Europe.

¹ Following European Court of Justice 'First Corporate Shipping' judgement C-371/98 (7 November 2000)
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2. Shell Flat and Lune Deep: SAC Selection Assessment

1. Site name Shell Flat and Lune Deep	2. Site centre location Degrees, minutes and seconds: 3° 12' 45"W 53° 51' 50"N Decimal degrees: 3.21°W 53.86°N (Datum: WGS84)
3. Site surface area 10,565ha; 106 sq km (UTM Zone 30 Northern hemisphere WGS84)	4. Biogeographic region Atlantic

Note:

Shell Flat and Lune Deep pSAC was formally consulted on from November 2009 to February 2010. During the consultation new evidence came to light which significantly affected the recommended boundary for the Lune Deep part of the site. Shell Flat was submitted to the EC in August 2010, but Lune Deep was re-consulted on from August 2010 to November 2010. Following approval by Government, the EC submission for Shell Flat has been amended to include Lune Deep, using the information set out in this SAD.

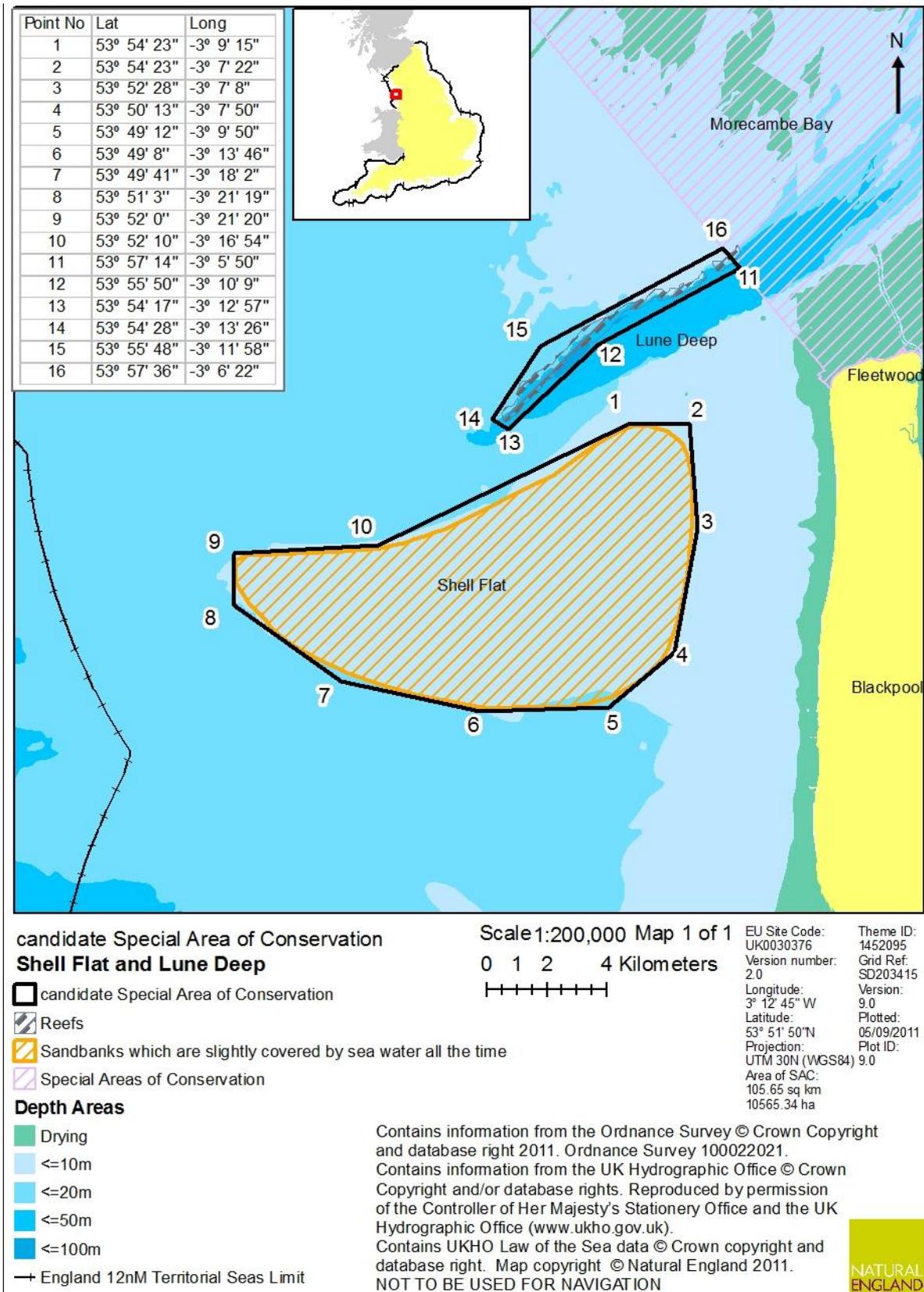
3. Interest feature(s) under the EU Habitats Directive

This site is listed for the features set out below. For further information please see European Commission, DG Environment, (2007): Interpretation Manual of European Union Habitats. EUR 27, July 2007:

http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

1110 Sandbanks which are slightly covered by sea water all the time.
1170 Reefs.

4. Map of SAC boundary²



² Larger copies of maps are available on request from Natural England, Regulatory Services, Floor 3, Touthill Close, Peterborough. PE1 1XN

5. Site summary

The site is characterised by a deep water channel (Lune Deep) and a large sandbank feature (Shell Flat) at the mouth of Morecambe Bay surrounded by shallower areas to the north and south.

5.1 Reefs

Lune Deep is located at the entrance to Morecambe Bay, and is simply a deep water channel. This feature is a narrow enclosed static bedform relict from sub-glacial ice gouging (BGS, 2005).

The reef habitat present in the area represents a good example of boulder and bedrock reef, with the largest proportions of rock found along the unique kettle hole feature known as Lune Deep. The northern edges of Lune Deep are characterised by heavily silted cobble and boulder slopes, subject to strong tidal currents with a dense hydroid and bryozoan turf (Emblow, 1992). This unique enclosed deep hole provides a contrasting habitat to the surrounding muddy communities of the Eastern Irish Mudbelt. Data from a 2004 survey show that the northern flanks of Lune Deep are composed of exposed bedrock with a rugged seabed physiography. In contrast, the southern flank consists of a smooth seabed which is a sink for muddy sands.

Much of the previous survey data for Outer Morecambe Bay was confined to the Lune Deep (Covey, 1998). The presence of stony reef, cobbles and small boulders supporting tide-swept fauna including hydroids, bryozoans, anemones and sponges was identified in MNCR diver surveys.

5.2 Sandbanks

Shell Flat sandbank runs northeast from the southern corner of the site in a blunt crescent to the south west.

The bank is an example of a banner bank, which are generally only a few kilometres in length with an elongated pear/sickle-shaped form, located in water depths less than 20m below Chart Datum (BCD). The data has identified slight sediment changes across the sandbank with the top of the bank being softer and smoother and sediment becoming rougher and harder on the northern and southern slopes (Royal Haskoning, 2008). Previous studies also found that the central crest is bound to the north and south by a more muddy (or clayey) sand sediment dominated by *Ophiuroids* (Titan Environmental Surveys, 2002).

5.3 Shell Flat and Lune Deep cSAC Annex I Habitat Comparison

This site is situated within the Irish Sea Regional Sea (Defra, 2004). Listed below are existing SACs within the Irish Regional Sea which contain reef and sandbank as a qualifying Annex I habitat. The types of reef and sandbanks present are summarised in Tables 5.1 and 5.2 respectively.

Table 5.1 Regional SACs comprising reef habitat

Site	Description of relevant qualifying features
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC	Reefs - These reefs on the north west coast of Wales are wide ranging and include an unusual series of submerged and intertidal glacial moraines. Reef types include bedrock, boulders, cobbles, pebbles, sandy rock, surge gullies and the tide-swept areas which support a diverse array of plant and animal communities. Reefs on the north coast of the Llyn are mostly biogenic (either the mussels, ascidians, or the tube worm <i>Sabellaria spinulosa</i>). Reefs formed by honeycomb worm <i>Sabellaria alveolata</i> are found south and east of Pwllheli. The Sarnau (Sarn Badrig, Sarn-y-Bwch and Cynfelyn

Site	Description of relevant qualifying features
	Patches) are very unusual shallow subtidal reefs, which extend many kilometres from the coast into Cardigan Bay.
Cardigan Bay SAC	Reefs – particularly the extensive intertidal biogenic reefs made by the honeycomb worm <i>Sabellaria alveolata</i> . Not a primary feature of the SAC.
Pembrokeshire Marine SAC	Reefs - extensive areas of intertidal and subtidal rocky reefs. The highly variable rocky seabed topography, together with the indented coastline and extreme tidal range, cause strong tidal streams, particularly around headlands, through sounds and in tidal inlets. The shallower and south-west-facing rocky reefs are exposed to severe wave action, while many others are extremely wave-sheltered. Many of the reefs extend onto the shore and provide examples of both the most exposed and the most sheltered intertidal rock communities in southern Britain. Reef habitat diversity is increased by caves, tunnels and surge gullies in both subtidal and intertidal zones.

The Shell Flat and Lune Deep site is different from the sites above as it comprises boulder reef and bedrock set in an unusual topographic feature (Lune Deep). Other glacial reef features exist within the Regional Sea area (the Sarnaus in the Lleyn Peninsula and the Sarnau SAC). However, these represent glacial deposits, whereas the Lune Deep feature represents a scoured feature.

Table 5.2 Regional SACs comprising sandbank habitat

Site	Description of relevant qualifying features
Menai Strait and Conwy Bay SAC	Sandbanks which are slightly covered by sea water all the time - including the Four Fathom Banks complex, which is a relatively rare type of subtidal sandbank in Wales, in that it is comparatively large, and is fairly sheltered from wave action but situated in an area of open coast. The sandbanks vary from stable muddy sands in areas that experience weak tidal streams to relatively clean well-sorted and rippled sand in the outer area of the bank where tidal streams are stronger. In very shallow waters, particularly in the inner shore areas, relatively species-rich sandy communities are dominated by polychaetes such as <i>Spio filicornis</i> . In some years when numbers of bivalves are high, internationally important flocks of common scoter <i>Melanitta nigra</i> have been observed to congregate in the area of the Four Fathom Banks complex to feed.
Lleyn Peninsula and the Sarnau SAC	Sandbanks which are slightly covered by sea water all the time - includes the sandbanks of Devil's Ridge, Bastram Shoal, the Tripods, and areas within and to the south of Tremadog Bay.
Cardigan Bay SAC	Sandbanks which are slightly covered by sea water all the time – colonised by a wide range of species including razor shells
Pembrokeshire Marine SAC	Sandbanks which are slightly covered by sea water all the time. Not a primary feature of the SAC.
Solway Firth SAC	Sandbanks which are slightly covered by sea water all the time - comprise mainly gravelly and clean sands, owing in part to the very dynamic nature of the estuary

The Shell Flat feature is an example of a banner bank whereas the other sandbank features described above are associated with estuaries or the sandbank complexes associated with headlands.

6. Site boundary

The boundary around the Shell Flat and Lune Deep site has been drawn using the guidance provided by JNCC (2008) and was defined through GIS modelling with further consideration against the guidelines (Appendix 1). The key parts of this guidance are that the site boundary should be defined as simply as possible with a minimum number of straight lines, and should include the minimum area necessary to ensure protection for the Annex I habitat of interest. More

complex shapes drawn more tightly around feature of interest are favoured over simple square/rectangular boundaries, to reduce the area of 'non-interest-feature' included within the site boundary. Where it is justified to protect the features of the site from the effects of mobile gear on the seabed at some distance from a vessel on the surface, a margin in proportion to the water depth may be added to the extent of the feature when defining the site boundary. The site (Shell Flat) contains Annex I sandbanks at depths of predominantly <25m BCD. Therefore, a margin of 100m was used around each sandbank feature, assuming a 4:1 ratio of fishing warp length to depth (see Appendix 1)

7. Assessment of interest feature(s) against selection criteria

A full explanation of the application of the site selection criteria can be found on JNCC's website at www.jncc.gov.uk/page-4165.

7.1 Representativity (a)

7.1.1 Reefs

Lune Deep and the area immediately to the north support mixed faunal turf communities over a cobble/rock substrate. These areas provide habitat for erect hydroids and bryozoans with some areas having erect sponges which form the biotope *Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata.

Patches of sediment were evident in much of Lune Deep, particularly in some of the deeper areas surveyed within the channel. Despite the presence of sediment, much of this area and the biota associated with this habitat can be said to be dependent on the hard substratum rather than the overlying sediment. The mixed faunal and turf communities over the majority of Lune Deep provide habitat for fauna associated with hard substrates. In this area stable boulders, cobbles and rock supported bryozoans *Flustra foliacea* and *Alcyonidium diaphanum* and the hydroids *Nemertesia antennina*, *Hydrallmania falcata*, all species which are found attached to rocks, shells or other hard substrata. The reef interests identified within and to the north of Lune Deep represent good examples of reef habitat (hard, compact substrates comprising boulders and cobbles >64mm in diameter).

The reef appears to begin along the steep northern slope of Lune Deep and progress northwards (see map). In the centre and south of Lune Deep, sediment habitats predominate and sampling indicates muddy -sand sediments with a population of *Ophiura* spp. on the surface.

The Shell Flat and Lune Deep site is graded B (good representativity)

7.1.2 Sandbanks

The key sandbank feature is the crescent-shaped sandbank at Shell Flat. Shell Flat is considered to be an excellent example of Annex I sandbank Habitat. In terms of sediment type, the bank comprises a range of mud and sand sediments from silts and clays through to coarse sands, but with the majority being very fine sands (63-125µm).

In terms of the biological community, the site specific survey (Haskoning 2008) identified species typical of sandy substrates; bivalve molluscs such as *Nucula nitidosa*, *Abra alba* and *Fabulina fibula*; and the bristle worms *Magelona johnstoni*, *Glycera alba* and *Magelona filiformis* were found in all grab samples. The site supported a generally low diversity of species, with the greatest numbers of benthic infauna to the south and east of the sandbank (Haskoning 2008).

The Shell Flat and Lune Deep site is graded A (excellent representativity)

7.2 Area of habitat (b)

7.2.1 Reefs

An evaluation of relative surface area is approximate as no accurate total extent figure is available for Annex I reef habitat for UK waters. The closest approximation available for the entire resource (bedrock, cobble and biogenic reef) in UK waters is 7,180,000 hectares. This total extent figure gives the following thresholds for the grades of this criterion (Commission of the European Community, 1995):

- A – extents between 1,077,000 and 7,180,000 ha (15-100% of total resource)
- B – extents between 143,600 and 1,077,000 ha (2-15% of total resource)
- C – extents less than 143,600 ha (0-2% of total resource)

The area of Annex I reef habitat enclosed by the site boundary is approximately 305 hectares, which is approximately 33 % of the total site area.

This site contains between 0-2% of the national Annex I reef resource and is therefore graded C for the area of habitats criteria

7.2.2 Sandbank

The area of Shell Flat Annex I sandbank habitat within the site, occupies 8,892 ha. The entirety of this habitat area is in waters shallower than 20m contour BCD.

The evaluation of relative surface area is approximate as it is not possible to calculate an accurate total extent figure for Annex I shallow sandbank habitat for UK waters. A best minimum estimate, which is currently under review, based on the mapped area of sandy sediments in less than 20m water depth, of 1,720,000 hectares has been used to assess area of habitat. This figure gives the following thresholds for the grades of this criterion (CEC, 1995):

- A – extents between 258,000 and 1,720,000 ha (15-100% of total resource)
- B – extents between 34,400 and 258,000 ha (2-15% of total resource)
- C – extents less than 34,400 ha (0-2% of total resource)

Shell Flat Annex I sandbank habitat occupies a minimum area of 8,892 ha (based on the area of sandy sediments within the 20m contour BCD). This value is equivalent to 0.52% of the UK total resource (based on the area of sandy sediments within the 20m contour, CD) and is graded C.

The actual area of sandbank feature can extend below the 20m depth contour (CEC, 2007). Therefore an additional maximum estimate of UK sandbank resource has been calculated based on the mapped area of sandy sediments in less than 50m water depth that adjoin areas of sandy sediment in less than 20m water depth. This figure of 8,010,000 hectares is an over-estimate, used to provide an additional assessment of area of habitat, and is under review. This figure gives the following thresholds for the grades of this criterion (CEC, 1995):

- A – extents between 1,201,500 and 8,010,000 ha (15-100% of total resource)
- B – extents between 160,200 and 1,201,500 ha (2-15% of total resource)
- C – extents less than 160,200 ha (0-2% of total resource)

However, as the entire Shell Flat Annex I sandbank habitat occurs in waters shallower than 20m it is deemed appropriate to use the minimum UK total resource figure for the site selection assessment.

The site contains between 0-2% of the national Annex I sandbank resource, and is graded C.

7.3 Conservation of structure and functions (c)

7.3.1 Reefs

Degree of conservation of structure

The licensed disposal site south of the eastern side of the Lune Deep (outside the cSAC) continues to receive dredged material from activities within Morecambe Bay. Despite the presence of these influences the area appears relatively unaffected by anthropogenic activities and able to support a substantial reef community. It is probable that the strong tidal currents help to distribute excess sediment and it is also likely that disposed sediments fall into the deepest parts of Lune Deep, rather than settling in significant quantities on the reef along the slopes and to the north.

The Lune Deep site is graded II (structure well conserved)

Degree of conservation of functions

The Lune Deep disposal ground and United Utilities sewage disposal pipeline located outside the Lune Deep cSAC may influence the ecological function of the habitats present within the footprint of the development, mostly in terms of water quality and sedimentation. However, the disposal activity is not new to the area and therefore the habitats and communities identified through survey would have developed with this sediment influence in place. In fact, some of the species identified here are often found in water with a sediment influence.

Based on this information, it appears that the site in general has the ability to maintain its conservation function.

The Lune Deep site is graded II (good prospects)

Overall

Given the ranking for structure, no assessment of the restoration potential, is required in accordance with EU guidance (EC 2007).

The overall grade for the conservation of structure and function criterion is grade B (good conservation value).

7.3.2 Sandbank

Degree of conservation of structure

The sandbank forms a continuous structure approximately 15km long from east to west. There is little indication of anthropogenic disturbance to the sandbank although the area has been of potential interest for wind energy development. Biological and sediment sampling from the sandbank clearly demonstrates that the sandbank feature is distinct from surrounding sediments. These parameters also exhibit a defined transition from the sandbank into the surrounding environment. This would suggest that the structure of the bank is a well established and stable feature. Furthermore, high biomass values for large, soft-bodied species (that are normally more susceptible to environmental impact) indicate that Shell Flat is relatively unpolluted (Warwick Energy, 2002).

The Lune Deep and Shell Flat site is graded I (excellent structure)

Degree of conservation of functions

There is no evidence available to suggest damage to the sandbank feature despite the area being subject to demersal fishing activity such as beam trawling. Furthermore the importance of the feature in supporting a significant scoter population (that feed on the invertebrates of the sandbank), would indicate that the functioning of the features is in good condition.

The Lune Deep and Shell Flat site is graded I (excellent prospects)

Overall

Given the highest ranking for structure, no assessment of the restoration potential, is required in accordance with EU guidance (EC, 2007).

The overall grade for the conservation of structure and function criterion is grade A (excellent conservation value).

7.4 Global assessment (d)

7.4.1 Reef

The reef habitat present is representative of Annex I reef habitat largely consisting of areas of outcropping bedrock and cobble reefs. The reef in this area is a high energy site due to the strong tidal currents running into and out of Morecambe Bay. Despite a large sediment influence in this area, the site appears to support a healthy reef community across a variety of depths.

The previous criteria establish that the site is in 'good conservation', in terms of both structure and function despite the use of the Lune Deep as a disposal ground for maintenance dredging.

The Shell Flat and Lune Deep site is graded B (good conservation value).

7.4.2 Sandbank

Shell Flat is the only sandbank feature identified within the outer Shell Flat site and is known to provide important habitat for commercial fish species and bird populations. Sandbank habitats are not particularly rare in the UK, the closest EU designated sandbanks being in the Solway Firth SAC, Menai Strait and Conwy Bay SAC.

The Shell Flat site is graded A (excellent conservation value)

7.5 Summary of scores for Stage 1A criteria

Overall the Shell Flat and Lune Deep site is considered accordingly.

	Representativity (a)	Area of habitat (b)	Structure and function (c)	Global assessment (d)
Lune Deep Reef	B	C	B	B
Shell Flat Sandbank	A	C	A	A

8. Sites to which this site is related

The Shell Flat and Lune Deep site boundary abuts Morecambe Bay SAC. It also overlaps with a Special Protection Area (SPA). These are detailed below.

Designated site	Key features
Morecambe Bay SAC	This site has been designated for a number of features including estuaries; mudflats and sandbanks not covered by seawater at low tide; large shallow inlets and bays; 1220 Perennial vegetation of stony banks; Salicornia and other annuals colonising mud and sand; Atlantic salt meadows; Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ; Fixed dunes with herbaceous vegetation; and Humid dune slacks. Reefs are also Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site.
Liverpool Bay SPA	The Shell Flat is an important feature within this SPA as it supports 50,000+) of wintering common scoter <i>Melanitta nigra</i> that feed on the submerged sandbank. This makes Shell Flat the most important site in the UK for the species.

9. Supporting scientific documentation

Scientific information on the topography, habitats and species present within the Shell Flat and Lune Deep cSAC boundary is available from a number of sources. These are listed in the table below.

For access to the documentation below please email northwest.marine@naturalengland.org.uk. It has not been possible to link these sources into the public domain.

Reference	Description
2008 Maritime and Coastguard Agency Civil Hydrography Programme survey data.	High resolution (0.5 - 2metre) Multibeam and backscatter data of the Lune Deep and surrounding area.
2008 Site surveys carried out by Envision Mapping Ltd for Royal Haskoning	Site surveys to identify Annex I habitats in the Outer Morecambe Bay area of search. The surveys comprised of side scan sonar and swathe bathymetry supported by day grabs, and subsequent drop-down-video ground truthing..
2005 COWRIE Bivalve Survey	COWRIE bivalve survey. Cefas Report for Intershell.
2004 SeaZone Solutions Ltd Bathymetric data	Digital bathymetry data from the same surveys that the seabed texture data has been sourced from.
2004 and 2007 Ormonde Energy	Grab sample data used for the final report of EIA for offshore wind farm and integrated gas field development by Gardline Environmental Ltd.
2003 British Geological Survey data	Sediment type data collected from acoustic survey of UK waters to determine seabed type.

2003 Environmental Statement - Barrow Offshore Wind Farm	Data includes diver survey with benthic sampling across the site, detailing sediment type and species found, photographs, geo-referenced jpegs.
2003 Fylde Coast Outflow for United Utilities by Halcrow	Ecological and habitat mapping studies undertaken to assess the impact of an outflow pipeline.
2002 Environmental Statement - Shell Flat Windfarm.	Two grab surveys undertaken offshore at Morecambe Bay and between Lune Deep and outer Wyre coast (no date given). The data collection involves no visual observation of habitats
2000 Fylde Coast Outflow for United Utilities by Entec	Ecological and habitat mapping studies undertaken to assess the impact of an outflow pipeline.
1993, 1998, 1999 and 2003 Cefas beam trawl 1990, 1997 & 2004 Seasearch survey	(Cefas) undertakes annual beam trawl surveys of the outer Thames Estuary, eastern English Channel, Bristol Channel and Irish Sea, to provide data used for the stock assessment of flatfish species.
1990, 1991 & 1993 MNCR diver survey	Volunteer survey carried out by experienced local diver, includes a description of the species found, habitat and sediment type, as well as any other key features.
1990-1996 National Marine Monitoring Programme (NMMP)	Two grab surveys undertaken offshore Morecambe Bay and between Lune Deep and outer Wyre coast (no date given). The data collection involves no visual observation of habitats.
1989 and 1991 UKHO seabed texture data	Micrographs in the form of jpegs that provide interpreted side-scan sonar seabed texture information.

10. Site overview and conservation interest

10.1 Reefs

The reef habitat present in the area represents a good example of boulder and rock reef, with the largest proportions of rock found along the unique kettle hole feature known as Lune Deep. The reef features present are largely in the form of boulders, as well as some outcropping bedrock. This unique enclosed deep provides a contrasting habitat to the surrounding muddy communities of the Eastern Irish Sea Mudbelt (Plates 1 and 2).

Patterns of seabed scour in the eastern end of Lune Deep indicate the prevailing transport direction of the muddy sand in the deep is towards the east and sub parallel to the coast.

Much of the previous survey data for Outer Morecambe Bay was confined to the Lune Deep (Covey, 1998). The presence of stony reef, cobbles and small boulders supporting tide-swept fauna including hydroids, bryozoans, anemones and sponges have been identified within the area. Key biotopes recorded include:

- CR.HCR.XFa - Mixed faunal turf communities;

- CR.HCR.XFa.FluCoAs - *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock;
- CR.HCR.XFa.FluHocu - *Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata; and
- SS.SMx.CMx.FluHyd - *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment.

Species collected during Cefas fish stock assessment trawl surveys (which form part of a wider national monitoring programme to assess commercially important fish stocks) included some species which are indicative of the presence of hard or mixed substrata, such as soft coral, hydroid and bryozoan.

Seven biotopes were identified from the survey work (Royal Haskoning, 2008) with two of the biotopes identified relating to reef habitat. These were concentrated within and to the north of Lune Deep. CR.HCR.XFa.FluCoA biotope was most frequently recorded and described as comprising stable boulders, cobbles & rock with *Flustra foliacea*, *Nemertesia antennina*, *Hydrallmania falcata*, and *Alcyonidium diaphanum*.

10.2 Sandbanks

This area of interest is dominated by the Shell Flat sandbank which runs northeast from the southern corner of the site in a blunt crescent. Sidescan sonar and multibeam data has not revealed any other features within the area. Grab samples show that the bank supports a similar infaunal biotope, SS.SSa.CMuSa,AlcNuc (*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment), across its surface area, dominated by *Nucula nitidosa* and *Magelona johnstoni* with some *Fabulina fibula* (Plate 3).

Site specific survey (commissioned to identify Annex I interest feature) found sediments colonised by a burrowing worms, crustaceans, bivalve molluscs and echinoderms. A total of 590 individuals of 38 species were recorded across the site, with an average of 118 individuals of 18 species recorded per grab sample. Although biomass was not measured as part of this study, the large number of individuals compared to number of species supports findings of previous studies. Cefas trawl data, COWRIE, Scottish Power grab sampling and SeaSearch diver surveys have all documented the low biodiversity, high biomass sediment communities associated with this sand and muddy sand habitat, including bivalves, polychaetes, burrowing anemones and echinoderms. Species present are typical of sandy substrates; bivalve molluscs such as *Nucula nitidosa*, *Pharus Legumen*, *Abra alba* and *Fabulina fabula* the bristle worms *Magelona johnstoni*, *Glycera alba* and *Magelona filiformis* were found in all grab samples. The site supported a generally low diversity of species, with the greatest numbers of benthic infauna to the south and east of the sandbank.

Data have identified slight sediment changes across the sandbank with the top of the bank being softer and smoother and sediment becoming rougher and harder on the northern and southern slopes (Royal Haskoning, 2008). Previous studies also found that the central crest is bound to the North and South by a more muddy (or clayey) sand sediment dominated by *Ophiuroids* (Titan Environmental Surveys, 2002).

Shell Flat is characterised by its low biodiversity and high biomass and is noted as an important foraging ground for many over wintering bird species, in particular the common scoter (*Melanitta nigra*). Surveys have identified that a large population (50,000+) of the species feed on the submerged sandbanks. This has made the Liverpool Bay area the most important site in the UK for the sea duck (www.rspb.org.uk) and consequently it forms one of the key features within the potential Liverpool Bay SPA complex.

11. Photographic plate



Plate 1: A rich faunal turf dominated by erect branching sponges on tide swept circalittoral rock



Plate 2: *Flustra foliacea* on tide swept circalittoral rock



Plate 3: Subtidal muddy sand with *Asterias rubens*

12. References

Where the reference source is publicly available, or Natural England has permission to publish it, the link to the document is shown. For reference sources not shown please email northwest.marine@naturalengland.org.uk (Accessed August 2011)

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13. Glossary

Acoustic survey A survey undertaken using remote methods to establish the topography and or seabed texture.

Anthropogenic Human-induced or resulting from human activities.

Banner Banks are generally only a few kilometres in length with an elongated pear-shaped form (Dyer and Huntley, 1999). They commonly lie in the lee of fixed obstacles such as headlands, islands, submerged rock shoals and gaps in rock ridges. They are sometimes paired on either side of the obstacle, with one larger than the other indicating a net direction of sand transport (Stride, 1982). Banner banks may also occur in areas with rapid deepening of water away from the coast and are less evident off coasts with a low offshore slope (Dyer and Huntley, 1999). Examples occur in the English Channel, Irish Sea and North Sea.

Biodiversity The full range of natural variety and variability within and among living organisms.

Biomass The weight of living matter, usually given as weight per unit area.

Biotope The physical habitat with its biological community; a term which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.

Bivalves A class of molluscs which are laterally flattened and have a shell made of two hinged valves.

Circalittoral The region dominated by sessile animals, found below the algal zone.

Crustaceans A class of invertebrates which includes crabs, shrimps and barnacles.

Demersal Organism living on or close to the sea bed.

Echinoderm A member of the phylum Echinodermata, a group of exclusively marine invertebrate animals including sea urchins, star fish and brittle stars.

Fauna Animal life in an area.

GIS (Geographic Information System) A computer-assisted system that acquires, stores, manipulates, and displays geographic data.

Grab sample A method of physical surveying to assess the seabed constituents. Sample is collected in a 'bucket' and the contents then analysed for biological / physical purposes.

Habitat The place in which a plant or animal lives.

Infauna Benthic animals which live within the seabed.

Littoral The intertidal zone.

Mollusc A phylum of invertebrates which include modern creatures such as snails, slugs, cockles, and squids.

Multibeam A marine survey technique to establish the bathymetry and identify sea bed features.

Ophiuroid Commonly known as brittle stars. Ophiuroids are a variety of marine organisms of the class Ophiuroidea, related to and resembling the starfish but having long slender arms.

Polychaete A class of marine annelid worms.

Sessile Permanently attached or fixed; not free-moving.

Side-scan sonar A geophysical instrument that uses sound waves reflected off the seafloor to image the aerial extent of different bottom types.

Sublittoral The marine zone below Mean Low Water (MLW) springs.

Trawling Towing equipment behind a vessel for commercial fishing principally for cod, plaice and sole. Bottom trawls collect demersal (living on or near the seabed) species and mid-water trawls collect pelagic (living in the water column) species. Examples of towed gears include beam trawls, dredges and trawl nets.

Zonation The division of a large area into smaller areas based on certain predetermined characteristics.

Appendix 1

Guidelines on drawing boundaries (taken from JNCC, 2008)

Shell Flat and Lune Deep SAC Selection Assessment Document Version 3.7

1 Introduction

Previous UK guidance on defining SAC boundaries states that “as a general principle, site boundaries have been drawn closely around the qualifying habitat types for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the habitat type... and to maintain sensible management units”. Further “the seaward boundaries of the sites have been drawn as straight lines, to ensure ease of identification on charts and at sea” (Brown *et al*, 1997, McLeod *et al*, 2005). The guidance presented below is an expansion of previous guidance on defining boundaries for marine SACs, specifically for sites which are not connected to the coastline, and which may be in deep water (200m to more than 1000m).

2 Guidance

Actual site boundaries will be determined on a site specific basis, following the general guidance set out below.

2.1 The habitat area of interest will be identified and mapped. In many cases in waters away from the coast, this will involve some form of modelling, such as use of seabed geological data (interpolated from seismic tracks and samples), interpreted sidescan sonar, acoustic and/or bathymetric data.

2.2 The minimum area necessary in order to ensure the essential level of protection for the Annex I habitat of interest will be defined. More complex site shapes drawn more tightly around feature of interest are favoured over simple square/rectangular boundaries (to reduce the area of ‘non-interest-feature’ included within the site boundary). However, boundaries should still be as simple as possible, using a minimum number of straight lines and vertices. Contrary to previous JNCC boundary guidance (JNCC, 2004) site boundary co-ordinates do not have to be defined by whole degrees and minutes. It is recommended that site boundary coordinates will be provided in degrees, minutes, and seconds.

2.3 Where habitat of interest occurs in a number of separate ‘pieces’ with ‘non-interest-feature’ habitat between, the preference is to include all ‘pieces’ within a site boundary to enable effective conservation of the feature of the site and to maintain its ecological function. However, where small, isolated instances of habitat occur at some distance from the main location of the habitat, these may be excluded from the site if their inclusion would result in large areas of ‘non-interest-feature’ being included within the site boundary.

2.4 The area defined under 2 above may then be extended if necessary in the following circumstances:

- i). to ensure an essential level of protection from potentially damaging activities at the site, taking into account water depth at the site and possible location of mobile gear on the seabed in relation to location of a vessel at the sea surface. Activities which are location specific, always subject to prior consent and have clear reliable methods of enforcement are already controlled under existing procedures such as licensing of these activities. Mobile activities which may affect seabed habitats, such as fishing and anchoring, are not subject to prior consent procedures and therefore need special consideration. The length of warp used by boats when trawling is largely determined by water depth. The following table gives the appropriate distance beyond the seabed extent of the habitat by which the site boundary at the sea surface may be extended (based on generalised trawl warp lengths, SERAD, 2001):

Water Depth	Ratio warp length: depth	Approx. length of trawl warp	Boundary extension to be
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			added to the habitat area of interest
Shallow waters (≤ 25m)	4:1	100m at 25m depth	4 * actual depth
Continental shelf (50-200m)	3:1	600m at 200m depth	3 * actual depth
Deep waters (200 to over 1000m)	2:1	2000m at 1000m depth	2 * actual depth

Note that the margin is incorporated as a minimum measure to reduce the likelihood of habitat damage from demersal fishing. However, these boundaries are SAC boundaries, not management boundaries. Ultimately Competent Authorities are responsible for considering which management actions might need to be taken under the Offshore Marine Conservation (Natural Habitats, &c.) Regulations to reduce the risk of damage to the features associated with human activities, whether within or outside the site boundary. As a consequence, future management measure may have different boundaries to the SAC site boundary.

- ii). For mobile habitats (for example, sandbanks), to ensure the minimum area necessary to allow conservation of the structure and functions of the habitat. Such extension will be determined on scientific understanding of the structure and functions of the habitat.