ANNEX II: DETAILED ENVIRONMENTAL BASELINE
1.1 The Water Environment

The following section provides an overview of the water environment associated with the Poole and Christchurch Bays SMP2 which takes into consideration wave, tidal and coastal processes, water quality (both freshwater and marine) and key recourse activities.

1.1.3 Waves

Most waves that reach the Dorset coast have been generated by winds blowing over the Atlantic Ocean. Their size depends upon the strength of the wind, its duration (the length of time the wind has been blowing at that speed), and the fetch (the distance of sea over which the wind blows) (DCDA, 2009). Waves from the southwest have a fetch in excess of 4000 km, whereas waves from the south or east-south-east have very restricted fetch (120 km and 240 km respectively). As a result, waves generated from the southwest are able to attain greater size than those from other, less-exposed directions (DCDA, 2009).

Waves with heights over 8m have been recorded along the Dorset coast, but most waves are much smaller. The maximum wave height (H max) for a given period of time is very important for the design of coast protection and flood defence schemes, harbours, and oil and gas offshore platforms. On 14th October 1976, a wave recording buoy off Bournemouth recorded a wave with a height (H max) of 8.3m.

The SMP for Poole and Christchurch (Halcrow Maritime, 1999) provides detailed information about wave heights and energies, which are important for assessing both the movements of sediment alongshore and the wave energy to which beaches and coastal structures may be exposed. The longest wave periods for the period 1993 to 1997 (SMP) are associated with wave heights between 0.5m to 1.0m. The 1 in 50 year’s extreme initial wave heights estimated by Hydraulics Research and Halcrow Maritime (1999) for the SMP, increase towards the east of Poole Bay, with the one in 50 year nearshore wave typically ranging from three to five metres.

The effects of climate change on the wave climate of the Dorset coast is uncertain, however, given the available evidence it is likely that climate change could have both positive and negative effects (SAS, 2007), such as:

- An increase in chances of stormy winters in the North Atlantic could increase the size of waves reaching the Dorset coast;
- Increasing hurricane intensity and duration could mean larger autumn swells; and
- Changing storm tracks could potentially alter the amount of surf reaching different regions, with popular surfing areas such as the South West possibly receiving less surf.

1.1.4 Tides

Tides along the Dorset coast, vary from tides in the east with a small tidal range, to tides further west which have a larger tidal range. In general, Poole Harbour has a tidal range 0.7 m greater than Christchurch Harbour (Table 1.1), although both harbours have a double high water, which means that the water is often above mean tide level in the harbours for 16 out of 24 hours (DCDA, 2009). This results in longer standing water and gives the harbours a lagoon-like nature, and also has significant implications in tidal
flood events as floodwaters can stay high for long periods. Figure 1.1 shows the wave and tidal environment of the study area, highlighting the locations of dominant wave energy, with the areas of coastline having considerably high wave energy being around the shoreline of Christchurch Bay and Hurst Spit.

Table 1.1 Tides of the Poole and Christchurch Bays SMP2

<table>
<thead>
<tr>
<th>Location</th>
<th>Water level in metres OD</th>
<th>Tidal range at Spring Tides (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean High Water</td>
<td>Mean Low Water</td>
</tr>
<tr>
<td>Christchurch Harbour</td>
<td>+0.9</td>
<td>+0.5</td>
</tr>
<tr>
<td>Mudeford Quay</td>
<td>+0.9</td>
<td>+0.5</td>
</tr>
<tr>
<td>Bournemouth</td>
<td>+0.6</td>
<td>+0.2</td>
</tr>
<tr>
<td>Poole Harbour</td>
<td>+0.9</td>
<td>+0.3</td>
</tr>
<tr>
<td>Swanage</td>
<td>+0.6</td>
<td>+0.2</td>
</tr>
</tbody>
</table>

With regards to the rate of sea level rise (SLR) along the Dorset coast, this has been estimated to be approximately 3mm – 5mm per year, and Defra has advised that a SLR figure of 6mm per year should be used for future coast protection and flood defence proposals (DCDA, 2009). However, the SLR figure is constantly being reviewed with recent research suggesting a figure of 11mm per year be used in future coastal management proposals as the previous estimates do not allow for Greenland melt (New Scientist, 2009). The rates of sea level rise will be confirmed in the draft SMP.
Figure 1.1  Wave and Tidal Environment of the Poole and Christchurch Bays SMP2

Map courtesy of SCOPAC, 1999 (www.scopac.org.uk).
Coastal Processes

Figure 1.2 illustrates the broad movement of beach sediments, predominantly sands and gravel, along the Dorset coast including the Poole and Christchurch Bays shoreline, which is initiated by wave energy and direction (a process known as longshore drift).

In general, beach sediments traverse from west to east along most of the Dorset coast; however, it is not unusual for prolonged periods of east or southeast winds to reverse this trend. The main areas of coastal erosion and accretion associated with Poole and Christchurch Bays (Figure 1.2) is reflected in the topography of the embayments, with erosion taking place along the cliff coastlines and headlands (in particular along Christchurch Bay and Durlston Bay) and accretion associated with buried palaeo-valleys and submarine bed-rock ridges (Halcrow Maritime, 1999). Approximately 30,000 - 70,000 m$^3$/year are eroded from dominant cliff faces in the study area (SCOPAC, 2004). Other sediment sources include those of river and sea sediments. River sediments (100 - 2000 m$^3$/year) are mainly trapped in Poole and Christchurch Harbours, although beach recharging using sediment from these harbours releases sediment to the coastal system. These coastal processes are described in detail below.

Figure 1.3 illustrates the specific sediment transport processes associated with Poole Bay, which operates as a partially enclosed sediment circulation system that exports sediment eastward to Christchurch Bay and also south and southwest to the offshore seabed. The low cliffs at Double Dykes present a threat of breaching, which would result in the disconnection of Hengistbury Head from the mainland and potentially redirecting the River Avon to flow through the breach. It is unlikely that enough sediment would be available form local sources to seal the breach.

The main sediment input within Poole Bay has historically been from cliff erosion, although such input has been significantly reduced and cliff input has declined from 63,000 m$^3$/pa (>0.08mm diameter) between 1887-1932 to 44,000 m$^3$/pa between 1932-1968 (Halcrow Maritime, 1999). Relatively little sediment is stored within the thin beaches or seabed deposits of Poole Bay. Exceptions are the large accumulations of Dolphin Sand (fed by Christchurch Bay) and Hook Sand and Studland Bay in the west (SCOPAC, 2004a). A complex transport regime operates near Hook Sand and Poole Harbour entrance, in which Hook Sand may be fed from offshore sources as well as drift material entering Poole Harbour.

The main sediment input to Christchurch Bay is also from cliff erosion, with modern cliff inputs in the order of 20 - 40,000 m$^3$/a (>0.08mm diameter) with the higher figure only slightly less than previous supply despite cliff stabilisation at Highcliffe, Barton, and Milford-on-Sea (SCOPAC, 2004b). Net drift along Christchurch Bay is eastward and a number of littoral drift sub-cells are present; however, Christchurch Bay unlike Poole Bay is not a sediment circulation system as some sediment transport takes place between adjoining sub-cells (see Figure 1.4), i.e. into the West Solent.

The cliffs that back Christchurch Bay, such as those associated with Barton-on-Sea, are very prone to landsliding, and are easily eroded by the sea. Measures to limit or reduce erosion have been implemented since the mid-1880’s and take the form of cliff drainage, seawalls and groynes (see Figure 1.5). This has increased downdrift erosion. Input of all lithological types was 136,000 m$^3$/a for 1867-1932, decreasing to 84,000 m$^3$/a for 1933-68. Between 48% and 54% of all cliff input comprises sediments too fine to remain on the beach, and which are consequently transported offshore in suspension. Christchurch Bay cliffs are thus a major source of suspended sediments (SCOPAC, 2004b).
Figure 1.2  Sediment Processes along the Coastline of Dorset

Map courtesy of SCOPAC, 1999 (www.scopac.org.uk).
Figure 1.3  Poole Harbour Entrance to Hengistbury Head: Sediment Transport

Map courtesy of SCOPAC, 2004 (www.scopac.org.uk).
Figure 1.4  Hengistbury Head to Hurst Spit: Sediment Transport

Map courtesy of SCOPAC, 2004 (www.scopac.org.uk).
Christchurch Harbour is the estuary of the Stour and Avon rivers, and as such there are extensive mudflats and saltmarshes, although the upper parts of the estuary have been reclaimed, which has limited the estuary volume. The estuary is ebb dominant, which allows the estuary to be clear of sediment deposition and a maximum flow ratio is high enough to form a plume at all stages of the tide.

Poole Harbour is controlled by a large and shallow enclosed estuary with double sandy spits forming its mouth. Redistribution of sediments does occur in the harbour, as erosion takes place on undefended sections on the northern side and deposition occurs near river mouths. Regular dredging occurs of the main channel and the last capital dredging took place between November 2005 – March 2006 (1.8 million m$^3$ of sediment removed). Historically, Brownsea Island has also experienced erosion on the south shore, and as such is defended by defence structures that were installed 30 - 40 years ago; however, these structures have now failed and are in the process of being removed.

The bays associated with the Isle of Purbeck (Durlston, Swanage and Studland) have been formed by the erosion of softer material, while the erosion resistant areas have formed headlands. Durlston Head and Peveril Point are limestone, while Ballard Point and Handfast Point is chalk. There is not much intervention along this section of the coast, due to the resistant nature of the coastline. There are complex landslips at Ballard Cliffs at the northern end of Swanage Bay, with groynes in Swanage Bay and revetment in Durlston Bay. There are no strong littoral sediment drifts along this section of coast, and beach sediments are derived from erosion material from the formation of the bays. There is also little or no sediment exchange between the bays, and beach volumes have decreased as sediment is transported offshore.
1.1.6 Bathing and Shellfish Waters

Bathing water quality is assessed by standards listed in the EC Bathing Waters Directive. The Directive was adopted by the Council of European Communities in 1975 and transposed into law for England and Wales to form Bathing Waters (Classification) Regulations 1991. The Directive is concerned with the quality of bathing waters for the purposes of protecting public health and requires monitoring of microbiological parameters and a small number of physical parameters (e.g. visible oil).

There are 23 identified bathing water sites in the study area (see Figure 1.6), all of which met the strict guideline standards of the Bathing Water Directives in 2008, having excellent water quality with the exception of Christchurch Avon Beach and Friar’s Cliff, which had a good water quality rating and thus meet the mandatory standards of the Bathing Water Directive.

Designated Shellfish waters are required to meet the standards set in the EC Shellfish Waters Directive and Shellfish Hygiene Directive. Bivalve production areas are classified according to the level of treatment they require prior to their sale from A to C grade, where grade A sites require no pre-treatment and grade C sites require intensive purification. Of the five designated shellfish waters around Poole Bay, the majority were classified as Class B in 2008, in which shellfish must undergo moderate purification by relaying in cleaner water for varying lengths of time before marketing (FSA, 2008).

1.1.7 Surface and Ground Water Quality

Under the Water Framework Directive (WFD), good water quality status of rivers, lakes, groundwater and coasts is to be achieved for river basin districts in the UK by 2015. For each river basin district a River Basin Management Plan (RBMP) must be developed, which will form the achievement of water quality protection and improvement (Articles 11 and 13). The improvement of water quality of rivers will thus have a major impact on the quality of coastal waters for example, Bathing and Shellfish Waters.

For the South-West River Basin District, in particular the catchments that encompass the study area, the current water quality (based on chemical data) of the associated rivers range between moderate to high and the predicted changes by 2015 range between moderate to good. The key rivers with current high water quality classifications include the River Avon, upper reaches of the River Stour and lower River Piddle. The River Frome and lower River Stour have been classified as currently having moderate levels of water quality (see Figure 1.7). Biologically, there are a few problems with the ecology of the watercourses, with the majority having poor to good classifications for biology.

Groundwater systems associated with the lower Dorset Stour and lower Hampshire and the South West Hants Barton Group have been classified as currently having good ground water quality. The lower Frome and Piddle groundwater system has been classified as currently having poor groundwater water quality (Environment Agency, 100026380, 2008).
Figure 1.6  Bathing Waters of the Poole and Christchurch Bays SMP2
1.1.8 Diffuse Pollution

Diffuse pollution to groundwater, surface water, and coastal water comes from many sources which are generally very small individual sources that occur across a large area. Thus, they are seen individually not to affect water quality, but collectively they can have significant effects on water quality and subsequent indirect impacts on biodiversity and human beings. Diffuse pollution can result from historic and present day land uses and activities in both agricultural and urban areas.

Potential sources of diffuse pollution relevant to the Poole and Christchurch SMP2 include:

- Faecal matter and pathogens from livestock and from overloaded and badly connected drainage systems;
- Soil particles from arable and livestock farming, upland erosion, urban areas and construction and demolition sites;
Nutrient run-off from agricultural land which is one of the most important sources of nutrient enrichment of Poole Harbour and Christchurch Harbour;

- Pesticides and biocides from industrial, municipal and agricultural use, poor storage and handling, and run-off;
- Organic wastes (slurries, silage liquor, surplus crops, sewage sludge and industrial wastes) that are poorly stored or disposed of and spread to land;
- Oil and hydrocarbons, car maintenance, disposal of waste oils, spills from storage and handling, road and industrial run-off;
- Chlorinated solvents from industrial areas where the use of solvents is ubiquitous; and
- Metals, including iron, acidifying pollutants and chemicals from atmospheric deposition, abandoned mines, industrial processes etc.

1.19 Resource Use

Poole Harbour is a commercial port operation facility, and is the base port for a commercial fishing fleet providing landing and marketing facilities for boats from Mudeford and Swanage. There are approximately 100 boats based in the port, and sections of the seabed are used for the cultivation of shellfish. The harbour is also home to Europe’s largest onshore oilfield (Wytch Farm or Kimmeridge Bay Oil Field), which is located in one of the most environmentally sensitive areas of the UK. The total estimated recoverable reserves are 480 million barrels of Kimmeridge oil (see Figure 1.8), of which over 90% lie in the Sherwood reservoir, making it the sixth largest in the UK. There are no apparent effluent outputs from the operation as discharges from the site are collected and returned to the oil bearing strata to aid extraction (PHSG, 2006).

Figure 1.8 Kimmeridge Oil Shale

Photo adapted through courtesy of Alan Holiday.
In addition there is a significant area of light industry in Poole Harbour at Hamworthy & Holes Bay. The largest private sector employers in the area are Sunseeker, who construct luxury motor craft at their factory on the side of Back Water Channel. There are also a number of yacht clubs, several thousand moorings, and a MoD base along the northern side of the Harbour (PHSG, 2006).

Poole is a hugely successful destination, and tourism to Poole is estimate to bring in £170 million a year to the local economy, with Poole Harbour and the bay being popular destinations for tourists and for recreational water activities including: yachting, water skiing, windsurfing, kitesurfing, and wildfowling within the harbour. The seafront affords opportunities for a range of water-based activities including bathing, surfing and fishing, while sailing, power boating, water skiing, and windsurfing operate from Poole Harbour. Seasonal local cruises on the paddle steamers Waverley and Balmoral operate from Bournemouth Pier, as do regular trips by the Dorset Belles and the Shockwave speed boat (PHSG, 2006).

Similar to Poole Harbour, Christchurch Harbour is a popular tourist and recreational facility, and very important to the town of Christchurch in terms of its economic contribution. It offers well developed leisure boating, windsurfing, and rowing facilities; and Mudeford Quay is the key centre of the local sea fishing industry.

1.2 Geomorphology and Geology

The following section provides an overview of the geomorphology and geology of the Poole and Christchurch Bays SMP2, in particular the morphology and geological interest features associated with the cliffs along the coastline.

1.2.1 Geomorphology

The geomorphology of a coast has a direct impact upon shaping of the shoreline both in long term and short term. Changes in coastal orientation, cliff structure and surface deposits are all fundamental in understanding material sources, sediment sinks and general behaviour of the shoreline including an appreciation of those areas at risk. Figure 1.9 provides an overview of the geomorphological features of Poole and Christchurch Bay, which are described below. For a geological description including associated designations.

The plan shape of Poole Bay coastline is a log spiral formation, fixed by the presence of Hengistbury Head. The headland due to erosion during the late-Holocene was much larger and now only remains as the submerged shoal of Christchurch Ledge, extending several kilometres further southeast. Erosion of Christchurch Bay was triggered by the removal of the headland point, and thus Christchurch Bay is younger geologically than Poole Bay. The remaining headland is believed to be critical to the stable configuration of the embayments (Halcrow Maritime, 1999).

Inundation and erosion of Christchurch Bay led to the connection of a tidal channel through the western Solent to isolate the Isle of Wright. River terrace gravels released by eroding cliffs in Poole and Christchurch Bays drifted eastward to form a spit extending across part of the west Solent entrance (the ancestral Hurst Castle spit). Fine sediments were deposited and saltmarshes formed to the north east within the shelter provided by the spit. Sediment transport along the Spit has led to deposition of shingle and sand on the seabed close the Isle of Wright (Halcrow Maritime, 1999). The spit is a mobile feature and is both progressively moving north-eastward and narrowing in places.
Figure 1.9 Geomorphology of the Poole and Christchurch Bays SMP2

Map courtesy of SCOPAC, 1999 (www.scopac.org.uk).
Cliffs are the predominant geomorphological feature within the study area. From Hurst Spit to Hengistbury Head they increase in height over a distance of 9 km to Highcliffe, where they are about 30m high, before lowing to 20m between Hordle and Highcliffe, and finally descending back to the sea at Mudeford Quay. Sandy sediments of Hengistbury Head, Barton, and Hordle degrade to result in steep, relatively simple morphological forms. The Barton Cliffs are complex, being comprised of interbedded sands and clays and prone to major rotation failures and mudsliding (Halcrow Maritime, 1999). Christchurch Bay is dominated by a shingle / gravel beach in response to the geological nature of the eroded cliffs and longshore drift processes.

From Hengistbury Head to Durlston Head the cliff faces are generally larger than 15m in height. The cliffs from Hengistbury Head to Double Dykes are unprotected and exceed 30m in height. Modest rockfall failure occurs, and a major feature of these cliffs is the ironstone nodules at Hengistbury Head. The Cliffs in Poole Bay are approximately 30m high, with many areas of the cliff re-graded and drainage provided; engineering works are undertaken to mitigate against spring flows and subsequent slumping. At New Swanage, the cliffs reach over 20m high and are extensively eroded and disturbed by slumps and gullying, which may have major impacts on structures (Halcrow Maritime, 1999). Swanage Bay is formed by the erosion of soft cliffs and, in contrast, Durlston Bay is formed within the rocks of modest resistance and fronted by a rocky boulder strewn shore. The beach along Poole Bay is dominated by sand, with increasing shingle to the east.

Sand dunes along Studland Bay are a dominant feature and cover the area south of South Haven Point and extend to Studland Village. Historically, the dunes have been accreting in response to aeolian processes (movement and deposition of sands by wind) up to 3 - 4 m yr⁻¹ along the north-eastern and central part of Studland Bay, although latest data suggests that erosion of the beach and dunes is the dominant process occurring along the entire length of Studland Bay.

Present day salt marshes and lagoons are associated with the two harbours. Deposition of gravels and old alluvium and silts laid down 3000 years ago formed the present day salt marshes of Christchurch Harbour, whilst major marine transgressions associated with Poole Harbour, converted it from a lowland moorland area into a broad lagoon or estuary.

1.2.2 Geology

Geologically, the study area of the Poole and Christchurch Bays SMP2 is diverse in both solid geology and geological designations. In terms of solid geology, the coast and sea bed of the Poole and Christchurch embayment is formed principally of Tertiary sedimentary sandstones and clays with some thin cover of Quaternary sediments. Older rocks from Cretaceous and Jurassic periods form the headlands in the western extreme of the area. The Chalk forms Holdfast Point, the Wealden Beds, Swanage Bay, the Purbeck Beds, Peveril Point and Durlston Bay, and the Portland Limestone forms Durlston Head (see Figure 1.10). The soils reflect the local geology, and range from freely draining sandy loam soils, which are slightly acidic (Christchurch Bay to Poole Bay), to slowly permeable wet loamy clay soils which are slightly acidic (Swanage Bay), and shallow lime-rich soils over chalk or limestone (Swanage Bay and Durlston Bay).
Geological Sites of Special Scientific Interest (SSSIs) and Important Geological and Geomorphological Sites (RIGS) in the study area are extensive and cover the majority of cliff frontage along Christchurch Bay (and harbour), Poole Bay (and harbour), Studland Bay, Swanage Bay, and Durlston Bay. In fact, the majority of this cliff frontage has been selected as Geological Conservation Review (GCR) sites as they display sediments, rocks, fossils, and other features of the landscape that make a special contribution to understanding and appreciation of Earth science and the geological history of Britain. **Table 1.2** provides a description of the designated sites associated with the shoreline geology of the study area, which are located **Figure 1.10**.

### Table 1.2 Key Geological SSSIs and GCR Sites of the Poole and Christchurch Bays SMP2

<table>
<thead>
<tr>
<th>Management Unit</th>
<th>Geological Designation</th>
<th>Reason for Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Christchurch Bay and Harbour</strong></td>
<td>Highcliffe to Millford Cliffs SSSI  ●</td>
<td>An outstanding stratigraphic, structural, fossil, artefact (and biological) site of national importance.</td>
</tr>
<tr>
<td></td>
<td>Hurst Castle &amp; Lymington River Estuary ●</td>
<td>Hurst Castle Spit is a key site for coastal geomorphology and its a classic shingle spit which W. V Lewis based his seminal paper outlining the relationship of beach alignment to the direction of approach of, dominant waves.</td>
</tr>
<tr>
<td></td>
<td>Christchurch Harbour (which includes Hengistbury Head GCR) SSSI  ●</td>
<td>Hengistbury is a stratigraphically important bridging exposure, linking the Tertiary formations out-cropping around Poole and Christchurch Bays.</td>
</tr>
<tr>
<td><strong>Poole Bay and Harbour</strong></td>
<td>Poole Bay Cliffs ● &amp; GCR</td>
<td>Outstanding stratigraphic, fossil sites of national importance.</td>
</tr>
<tr>
<td></td>
<td>Arne SSSI ●</td>
<td>The geological exposure is one of only two sites yielding fossil plants from the Dorset Pipe Clays, of lower Eocene age. This is of considerable significance as these deposits are the probable fluvial (river-lain) facies equivalents of the marine London clay with its world famous flora.</td>
</tr>
<tr>
<td></td>
<td>Ham Common SSSI ●</td>
<td>The geological exposure is one of only two sites yielding fossil plants from the Dorset Pipe Clays, of lower Eocene age. This is of considerable significance as these deposits are the probable fluvial (river-lain) facies equivalents of the marine London clay with its world famous flora.</td>
</tr>
</tbody>
</table>
London clay with its world famous flora. 
White clays of historic interest.

Geological exposure of sedimentary cliffs for some 300 metre south of Shipstal Point.

Agglestone Grits and Corfe.

Geological exposure of sedimentary cliffs on the north shore and south shore of Brownsea Island, and a cliff near Pottery.

Studland Bay

Studland Cliffs SSSI

An outstanding stratigraphic, structural (and biological) site of national importance.

Purbeck Ridge SSSI

An outstanding stratigraphic, structural (and biological) site of national importance.

Studland & Godlingston Heaths SSSI

South Haven peninsular is a key site for coastal geomorphology and provides an excellent example of progradation of a sandy beach. It is key member of the national network of soft coastal sites.

Swanage Bay

Studland Cliffs SSSI

An outstanding stratigraphic, structural (and biological) site of national importance.

Purbeck Ridge SSSI

An outstanding stratigraphic, structural (and biological) site of national importance.

Durlston Bay

South Dorset Coast SSSI

An outstanding stratigraphic, structural (and biological) site of national importance.

Although a major concern along the coastline of the Poole and Christchurch Bays SMP2 is the increased instability of the cliffs from such causes as poor drainage management, runoff, and failed defence works, which has left cliff sections eroded and unsafe for built assets (see Figure 1.5). However, upgrading defence works and increasing cliff stability may reduce exposure of the cliffs and associated geological interest features. In addition, cliff erosion is also the main driver that maintains wildlife habitat and the natural beauty of the coast, and the current reduced erosion rates are decreasing the quality of the Geological SSSIs in the study area. For example, some SSSI units along the Highcliffe SSSI and Poole Bay Cliffs SSSI are in unfavourable condition due to inappropriate coastal management.
Figure 1.10 Geology and Associated Designations of the Poole and Christchurch Bays SMP2

Key
- SMP2 Coast
- Stratigraphy
- Argillaceous Rocks, Undifferentiated
- Chalk
- Argillaceous Rocks, Limestone, Interbedded
- Limestone
- Argillaceous Rocks, Sandstone, Interbedded
- Sandstone
- Key Geological SSSIs
- RIGS
- Sandstone, Argillaceous Rocks, Interbedded

Legend:
- RIGS
- Key Geological SSSIs
- SMP2 Coast
- Stratigraphy
- Argillaceous Rocks, Undifferentiated
- Chalk
- Argillaceous Rocks, Limestone, Interbedded
- Limestone
- Argillaceous Rocks, Sandstone, Interbedded
- Sandstone
- Sandstone, Argillaceous Rocks, Interbedded

Scale: 1:140,000

Poole and Christchurch Bays SMP2

Appendices - Draft Final Report

November 2009
1.3 The Coastal Environment

The following section provides an overview of the coastal environmental of the Poole and Christchurch Bays SMP2 which takes into consideration coastal and flood defences, landscape, land use (agriculture and settlement areas) and settlement activities such as mining, dredging and recreation.

1.3.1 Coastal and Flood Defences

The Coast Protection Act 1949 provides maritime district councils with permissive powers to carry out coastal protection works. Both the Maritime District Councils and Environment Agency have powers to carry out defence works. Protection works are promoted by the operating authorities where there is community benefit.

Figure 1.11 provides an overview of the locations and types of flood and coastal defences associated with the Poole and Christchurch Bays SMP2. The main coastal and flood defences are associated around the bays of Poole and Christchurch (and to a lesser extent Swanage/Studland Bays and Brownsea Island) and include seawalls, cliff engineering, groyne systems, gabions and beach replenishment with embankments the main line of flood defence around the harbours of the embayments.

A small amount of rock armour along with steel piled defences front the buildings on the eastern end of Brownsea Island. A defence structure was built along the south shore of Brownsea Island some 30 to 40 years ago, however, indications are that these have failed and are to be removed (T. Flux, pers. comms., 2009). The ‘defences’ at the north east end of Poole Harbour are not formally identified as sea defence.

The defences in the study area are constantly upgraded with new defences also regularly being built, for example, the construction of five new rock groynes between Branksome Chine and Branksome Dene Chine and the replenishment of 450,000 cubic metres of sand along the beaches between Shore Road and Branksome Dene Chine.

Landscape character is an important national resource that is part of our natural and cultural inheritance, widely appreciated for its aesthetic beauty, contribution to regional identity and sense of place. The recognition of coastal landscape values is therefore critical to the management of coastal defence options, since the consequences of such actions have the potential to radically change the coastal landscape.

Landscape Character Assessment (LCA) is an approach to understanding the differences between landscapes, and can serve as a framework for decision-making that respects local distinctiveness. It is a way of ‘unpacking’ the landscape and understanding how its distinctive elements contribute to sense of place. As such, LCA is a useful tool for engaging stakeholders in sustainable development. Communities, developers, farmers and land managers, landscape and planning professionals and others all have a role in identifying the characteristics that make a particular landscape unique, and using this understanding is essential in order to plan and manage landscape change.
1.3.2 Landscape

The landscape character of the Poole and Christchurch Bays SMP2 is associated with Dorset Heaths (Joint Character Area 135), New Forest (Joint Character Area 131), and South Purbeck (Joint Character Area 136) (see Figure 1.12). These landscapes are dominated by the key following characteristics:

- Exposed open landscapes;
- Undulating heath with tracts of heather, stunted pines, gorse scrub scattered birch, pine and bog vegetation;
- Blocks of conifers forming locally-prominent landmarks;
- Mosaics of heathland, farmland, woodland and scrub;
• Sparsely populated with scattered settlements and a few small villages and towns but the extensive conurbation of Poole-Bournemouth forms a major influence in the south and east;
• Fringe areas of farmland opening out to larger arable fields;
• Flat-bottomed, open valleys with floodplain pastures and willows;
• An outer edge of low, rolling hills with an irregular patchwork of pasture, woodland and dense hedges marking the transition to the chalk;
• Open, windswept Chalk cliffs and limestone plateau; and
• High historical interests, including early settlements, medieval industrial sites.

Areas of Outstanding Natural Beauty (AONB) within the Poole and Christchurch Bays SMP2 boundary includes the Dorset AONB, which covers some 44% of Dorset and stretches from Lyme Regis in the west, along the coast to Poole Harbour in the east, and north to Hambledon Hill near Blandford Forum. It covers over half of Poole Harbour, including Brownsea and the smaller islands. Outside of the harbour, the designated area ends at mean low water (see Figure 1.12).

The Dorset AONB is notable for its complex chalk, limestone and sandstone geology and rich ecology and for its scenery. The rare remaining downland and heathland are also highly important conservation habitats supporting a wide range of flora and fauna with notable rarities. The AONB includes the Purbeck Heritage Coast, which has been recognised by the award of the Council of Europe’s Diploma for the Conservation of Protected Landscapes (see Figure 1.12).

The AONB also contains many SSSIs, as well as several Sites of Nature Conservation Interest (SNCI) and National Nature Reserves (NNR) (see Figure 1.12). The AONB also contains rich prehistoric sites and field patterns, as well as the finest Iron Age fort in Europe – Maiden Castle. Dorset AONB provides a focus for recreation for residents, tourists and day visitors, and people from the growing conurbations like Bournemouth, Poole, Yeovil and further afield. With 1.35 million people living within 20 miles of the AONB boundary, pressure for recreational use is high (Dorset AONB Partnership, 2009).

1.3.3 Land Use and Settlement Activity

Areas of productive agricultural land within the study area are mainly confined to river terrace deposits boarding the floodplains of the main rivers, which discharge into Christchurch and Poole Bay and surrounding heathlands. This is shown in Figure 1.13, which presents the agricultural land classification within the study area, which reflects the suitability of land for agriculture (commensurate with the quality of the soils); Grade 1 represents excellent soil and Grade 5, very poor. The study area mainly comprises Grades 3 to 5, although the arable lands around the main embayments of Poole and Christchurch have large areas of very productive land (Grades 1 to 2) predominately associated with the river terrace deposits of the River Avon and River Stour. However, the rivers that discharge into the harbours are subject to hypernutrification from nitrates and phosphates from agricultural sources, and as such the majority of catchments have been designated Nitrate Vulnerable Zones (since 2002).
Figure 1.12  Key Landscapes of the Poole and Christchurch Bays SMP2

Key
- Area of Outstanding Natural Beauty
- National Nature Reserve
- Heritage coast
- SMP2 Coast
- Urban Area

Character Landscape:
- DORSET HEATHS
- NEW FOREST
- SOUTH PURBECK

Scale 1:140,000
Figure 1.13 Agricultural Land Classification of Poole and Christchurch Bays SMP2
The main areas of settlement in the study area are associated with the extensive urban and industrial areas of Poole and Bournemouth (see Figure 1.14). Poole has the largest number of industrial estates in South East Dorset, including the Nuffield Industrial estate, Mannings Heath, and the Arena Business Park. Industrial Estate sites are in high demand, and further developments are under construction, such as the Poole Trade Park near Tower Park and the Branksome Business centre. The National Trust also owns numerous estates/properties in the study area, including Brownsea Island in Poole Harbour, a nature reserve, the birthplace of the Scouting movement (and location of the first scout camp), and Studland Beach Nature Reserve.

Figure 1.14 Settlement areas of Poole and Christchurch Bays SMP2

Map courtesy of SCOPAC, 1999 (www.scopac.org.uk).
A network of Sewage Treatment Works (STWs) serves the communities of Poole, Lytchett Minster, and Wareham. These sites have all provided secondary treatment for many years, and treat sewage to a high standard before discharge. Wessex Water Services Ltd run these STWs, and is also responsible for maintaining sewers and outfalls (PHSG, 2006). In Christchurch, sewage is carried through a network of underground pipes and pumps to the Christchurch Wastewater Treatment Plant, where it is processed. Over 90 pumping stations pump the sewage from low areas around the town, particularly near the Avon and Heathcote Rivers. Five terminal pumping stations then pump all the flow to the Treatment Plant.

Industrial activities during the twentieth century (including mineral workings) have led to significant contamination of various sections of shoreline in the study area, for example the north shore of Poole Harbour. Toxic discharges of industrial waste have left much of Holes Bay contaminated with heavy metals, which have accumulated in the bed sediment. These metals can then accumulate in the organisms that live within the sediment and may be passed up the food chain, a process known as bioaccumulation. Many different metals have been identified, but those of particular concern are: cadmium, mercury, copper and zinc.

Dredging is a common activity, associated with the two harbours of Poole and Christchurch, to allow for the commercial shipping activities to move freely into the harbours. Between 2005 and 2006 around 1.8 million m$^3$ of material was removed from the Poole Harbour and used beneficially for beach replenishment at Poole, Bournemouth and Swanage.

In response to the coastal processes that operate in Poole Bay, the area is often used for surfing, and thus Europe’s first artificial reef is being installed at Boscombe, in Bournemouth, using large sand-filled geotextile bags. The reef is being constructed as part of the larger Boscombe Spa Village development. The reef will act as a ramp, pushing waves upwards, doubling their size and improving their quality for surfers. As a result, the number of good surfing days is expected to be doubled. The reef is also expected to enhance other water sport activities on offer including kite-surfing, windsurfing, wake-boarding, kayaking, SCUBA-diving, sailing and skim-boarding.

Other activities and commerce related to the Poole and Christchurch Bays SMP2 have been described in Section 1.19

1.4 Biodiversity

The study area of Poole and Christchurch Bays SMP2 supports a wide range of habitats and species. The natural areas present support a diversity of common and rare habitats and species, bounded by a range of coastal and estuarine habitats, the biodiversity of the study area is one of its greatest assets. The remainder of this section details biodiversity interests within the Poole and Christchurch Bays SMP2, which are of international, national, or regional and local importance.

1.4.1 International Designations

implemented in the UK through the Wildlife and Countryside Act 1981 as amended, and provides for the identification of Special Protection Area (SPAs).

The EC Habitat Regulations apply to both SAC's and SPA's and strengthen the protection afforded to sites by the Wildlife and Conservation Act of 1981, as amended, by making illegal any damage to breeding sites or nesting places of protected species. Any development within the meaning of the Conservation (Natural Habitats etc) Regulations 1994 which is likely to affect an SPA or SAC will not be permitted, unless the relevant 'competent authority' has decided, on completion of an 'appropriate assessment', that there are no alternative solutions and that the development must be carried out for imperative reasons of overriding public interest.

### 1.4.2 National Designations

The principal national designation of ecological importance is Site of Special Scientific Interest (SSSI). English Nature designates SSSI's as being "of special interest by reason of flora, fauna, or geological or physiographical features (see Section 1.2.2). SSSI's represent areas of national importance to nature conservation in the United Kingdom.

All public authorities along the coastline of the study area, including local planning authorities, have a duty under the amended Wildlife and Countryside Act 1981 to further and enhance the nature conservation interests of these sites whilst carrying out their statutory functions. This should be achieved by consulting the relevant government nature conservation advisors (in this case English Nature) for advice on whether a proposed licence or work to be undertaken directly for the authority is likely to harm the SSSI interests. If the advice is not followed, the authority must provide reasons for this in writing to the Secretary of State, and make good any damage to the site.

Table 1.3 provides a description of the national and international designations in the study area and Figure 1.15 shows where these sites are located.

**Figure 1.16** presents a summary of the environmental conditions associated with the SSSIs in the Dorset and Hampshire County which cover the Poole and Christchurch Bays SMP2. In general, both Dorset and Hampshire fall short of meeting the Public Service Agreement (PSA) target to bring into favourable or recovering (target) condition 95% of the area of Sites of Special Scientific Interest (SSSIs) in England by 2010. The sites for the SMP2 are discussed in more detail in the Appropriate Assessment.

The key activities or reasons identified by the Joint Nature Conservation Committee (JNCC) and in this report effecting designated sites that are potentially relevant to the Poole and Christchurch Bays SMP2 (excluding agricultural related activities) are:

- Water quality (though predominantly a result of agricultural activities);
- Recreational disturbance;
- Development;
- Inappropriate coastal management/coastal defence works which have had a significant impact on coastal geological SSSIs;
- Failed defences and potential impacts to freshwater and brackish habitats such (e.g. Brownsea Lagoon, The Moors SSSI and Wareham Meadows SSSI);
- Vegetation management (e.g. scrub control);
- Material extraction;
- Dumping and storage of materials; and Sea fisheries.
Potential new designations which are currently being reviewed by Natural England include the Poole Bay to Lyme Bay (SAC) site which lies off the south coast of England off the counties of Dorset and Devon. The site comprises a mosaic of four areas containing Annex I ‘reef’ and ‘sea cave’ habitat. The areas are described as (from east to west):

- Studland Bay to Ringstead Bay Reefs;
- Portland Reefs;
- Lyme Bay Reefs; and
- Watcombe to Dartmouth Reefs.

### Table 1.3 Designated Sites of the Poole and Christchurch Bays SMP2

<table>
<thead>
<tr>
<th>International Designation</th>
<th>Site Name</th>
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<tbody>
<tr>
<td>SAC</td>
<td>Dorset Heaths</td>
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<tr>
<td></td>
<td>Dorset Heaths (Purbeck &amp; Wareham) &amp; Studland Dunes</td>
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<tr>
<td></td>
<td>Isle of Wight Downs</td>
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<tr>
<td></td>
<td>Isle of Portland to Studland Cliffs</td>
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<td>River Avon</td>
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<td>South Wight Maritime</td>
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<td>Solent Maritime</td>
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<td>St Albans Head to Durlston Head</td>
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<td>The New Forest</td>
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<td>SPA</td>
<td>Avon Valley</td>
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<td>Dorset Heathlands</td>
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<td>New Forest</td>
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<td>Poole Harbour</td>
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<td>Solent Southampton Water</td>
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<td>Ramsar</td>
<td>Avon Valley</td>
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<td>Dorset Heathlands</td>
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<td>NNR</td>
<td>Hartland Moor</td>
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<td>Stoborough Heath</td>
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<td>Studland and Godlingston Heath</td>
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### National Designation

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<td>Avon Valley (Bickton-Christchurch)</td>
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<td>Belle Vue Quarry</td>
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<td>Blashenwell Farm Pit</td>
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<td>Blue Pool and Norden Heaths</td>
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<td>Bourne Valley</td>
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<td>Burton Common</td>
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<td>Canford Heath</td>
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<td>Christchurch Harbour</td>
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<td>Corfe &amp; Barrow Hills</td>
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<td>• Ham Common</td>
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<td>• Millfield Pond</td>
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<td>• Millford-on-Sea</td>
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<td>• Hengistbury Head</td>
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<td>• Stanpit Marsh</td>
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<td>• Parkstone Bay</td>
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<thead>
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<th>• Christchurch Bay</th>
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<td></td>
<td>• Poole to the Isle of Purbeck</td>
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<thead>
<tr>
<th>SNCI/SINC</th>
<th>• Greenland</th>
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<td>• Fitzworth Peninsula</td>
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Figure 1.15 Conservation Designations of the Poole and Christchurch Bays SMP2
1.4.3 Biodiversity Action Plan (BAP) Habitats and Species

The 1994 UK Biodiversity Action Plan was published by the UK Government in response to the 1992 United Nations Convention on Biological Diversity. A unique feature of the plan is that it identifies actions to be taken by a wide range of statutory and non-statutory bodies working in partnership. Some actions are taken forward geographically by local Biodiversity Action Plan partnerships; others on a UK-basis for particular habitats and species; and others by bodies with particular responsibilities, such as the Forestry Commission or Environment Agency. The spirit of the plan is very much one of cooperation and concerted action, with partners at all levels being called upon to participate in the development of policies and strategies for biodiversity conservation.

Key ‘priority’ habitats associated with the Poole and Christchurch Bays SMP2, as identified within the UK Biodiversity Habitat Plan, include the following:

- Wet woodland
- Lowland meadows
- Lowland dry acid grassland
- Lowland heathland
- Fens
- Coastal and floodplain grazing marsh
- Vegetated shingle
- Coastal saltmarsh
- Mudflats
- Sabellaria spinulosa reefs
- Seagrass beds
- Sheltered muddy gravels
- Chalk rivers
- Lowland beech and yew woodland
- Lowland calcareous grassland
- Purple moor grass and rush pastures
- Reedbeds
- Littoral and sublittoral chalk
- Maritime cliff and slopes
- Coastal sand dunes
- Maerl beds
- Mud habitats in deep water
- Sabellaria alveolata reefs
- Saline lagoons
- Sublittoral sands and gravels

The majority of the above habitats can be seen in Figure 1.17, which displays the various land cover classes associated with the study area.
Figure 1.17 Land Cover Associated with the Poole and Christchurch Bays SMP2
The results of the last UK Biodiversity Action Plan (2005) showed that 39% of priority habitats were declining and 22% were increasing. In addition, the report shows that 27% of species were declining and 11% were increasing. Although, overall more priority species are showing improved trends than in 1999 and 2002, biodiversity loss is continuing due to a wide range of activities, including:

- Construction and development;
- Agriculture, fisheries and forestry;
- Industry and commerce;
- Energy use; and
- Transport and travel.

Key international and national protected species and notable species associated with the above habitats of the Poole and Christchurch Bays SMP2 include (list is not extensive):

**International**

- Otter (*Lutra lutra*)
- Spiny Seahorse (*Hippocampus guttulatus*)
- Short-snouted seahorse (*H. hippocampus*)
- Sand lizard (*Lacerta agilis*)
- Harbour porpoise (*Phocoena phocoena*)
- Pipistrelle bats (*Pipistrellus pipistrellus*)
- Nightjar (*Caprimulgus europaeus*)
- Little Egret (*Egretta garzetta*)
- Dartford Warbler (*S. undata*)
- Freshwater white-clawed crayfish (*Austropotamobius pallipes*)
- Pink Sea-fan (*Eunicella verrucosa*)
- Shad (*allis and twaite*)
- Natterjack Toad (*Bufo calamita*)

**National**

- Water vole (*Arvicola terrestris*)
- Great crested newt (*Triturus cristatus*)
- Cetti’s Warbler (*Cettia cetti*)
- Marsh fritillary (*Eurodryas aurinia*)
- Bearded Tit (*Panurus biarmicus*)
- Badger (*Meles meles*)
- Various Plant Species (e.g. Early gentian *Gentianella anglica*)
- Various Insect Species (e.g. Scarce Blue-tailed Damselfly *Ischnura pumilo*)

1.4.4 Coastal and Freshwater Fisheries

Sustainable sea fishing within the study area is managed by the Environment Agency and Sea Fisheries District Committee (SSFDC) who monitor the fishing effort and to keep stocks at a sustainable level through local byelaws, and National and EU legislation enacted to protect coastal waters. The Environment Agency manages fisheries on all freshwaters in England, which includes all freshwater rivers and streams running into Poole and Christchurch Harbours.
Most of the commercial fishing is carried out at sea, although within Poole Harbour, around 35 species of adult finfish, 17 species of bivalve shellfish, and 11 species of decapod crustaceans have been recorded in the Harbour. The conditions and productivity of Poole Harbour are such that shellfish, eels and some fish species are found in much greater quantities within the Harbour than on the open coast. Wet fish, such as mullet, bass, flounder, sole and plaice are caught commercially using fixed, drift, seine, and trawl nets, and hand lines, whilst eels are trapped using fyke nets (PHSG, 2006). The beds of Poole Harbour are leased to grow and fatten stocks of mussels, clams, oysters and cockles, supplying fresh live shellfish to the market. In addition, there is also a major licensed fishery for wild stocks of Manila clams and a major unlicensed fishery for cockles inside Poole Harbour, both of which use mechanical means to harvest the shellfish.

Traditional fishing for crabs and lobsters dominate the sea fishing industry in the study area, although there has been considerable diversification with important trap fisheries for whelks and cuttlefish, and set net fisheries for sole, plaice and other flatfish, bass, mullet, and rays. Salmon netting at Mudeford and Christchurch has a history going back more than 900 years, and at present the beach seine fishery is carried out in lower Christchurch Harbour along the inner shore of Mudeford Sandbank. Catches consist of salmon, sea trout and a small bycatch of bass and flounder (CHG, 2008).

The harbours of the embayments play a vital role in the life cycles of several fish species, and are a migratory route for fish such as salmon (Salmo salar), sea trout (Salmo trutta), sea lamprey (Petromyzon marinus), and eels (Anguilla anguilla). Salmon and sea lamprey are protected by European legislation. Eels also run through the harbours as juveniles to reach freshwater, where they mature before returning to the sea as adults. The Environment Agency operate fish counters at Knapp Mill to monitor populations of salmon and sea trout, and 1,278 salmon and sea trout passed upstream through the counter from February 2006 to the end of January 2007. In times of low water, the harbours are important holding areas for adult and juvenile salmon. The harbour waters are believed to have significant breeding and nursery areas for fish, such as bass (Dicentrarchus labrax), thicklipped mullet (Mugil labrosus), thin-lipped mullet (Mugil capito), and pollack (Pollachius pollachius). The harbours are also important for other fish species including bullhead, roach, dace, carp and bream (CHG, 2008; PHSG, 2006).

1.5 The Historic Environment

Archaeological remains are a finite and non-renewable resource, highly fragile and vulnerable to damage and destruction. Buried remains need to be protected and managed adequately and sympathetically within new development. Preservation in-situ of archaeological features is the preferred option. In some instances, proposals for development would so adversely affect the site or setting of a Scheduled Ancient Monument or nationally important remains that the development will not be possible. In other instances it might be considered sufficient, dependent upon the relative importance of the archaeological site, to carry out a recording and make it available for exhibition to the public.

The key archaeological assets, in particular Scheduled Ancient Monuments (SAMs) and historic sites within the Poole and Christchurch Bays SMP2 study area are presented in Figure1.18. The majority of these assets are associated with the surrounding areas of Poole Bay and the Harbour, and the Isle of Purbeck Bays (Durlston, Swanage, and Studland).
Figure 1.18  The Historic Environment of the Poole and Christchurch Bays SMP2
There are areas in Poole and Bournemouth that can be identified as being of especially high archaeological potential where applications for development are particularly likely to require an archaeological programme including:

- Lower Hamworthy (Roman military site and port);
- The Stour Valley;
- Upper Hamworthy (Rockley Sands, Turlin Moor and Upton Park);
- The shores and bodies of Poole Harbour including Lytchett, Holes and Parkstone Bays; and
- The Poole Bay Littoral.

There are also several hundred listed buildings in the area of Poole and Bournemouth, whereby a building or object has been judged to be of a national architectural or historic interest.

In addition there are also Historic Parks and Gardens including: Braxton Gardens, Compton Acres, off Canford Cliffs Road, part of Coy Ponds on the boundary with Bournemouth, Poole Park, Poole Cemetery and Durlston Estate. For further information, English Heritage maintains a register of Historic Parks and Gardens, to make sure that the landscapes features and qualities are protected.

1.6 Community and Assets

The following section provides an overview of community characteristics, assets and infrastructure of the Poole and Christchurch Bays SMP2, including the influence of flooding on the local community.

The main areas of high population density in the study area are associated with the coastal urban areas of Bournemouth, Christchurch and Poole (Figure 1.19), with smaller towns and fishing villages around the coastline including Swanage, Wareham, Milford-on-Sea and Barton-on-Sea having smaller population densities. The population density of the Bournemouth Urban Area (46 km$^2$) is the second highest in the South West (after Bristol), with 3,500 people living per square kilometre and 2,125 people living per square kilometre in the Poole Urban Area (65 km$^2$). There are also resident populations on the islands within Poole Harbour, including Furzy and Brownsea, with the latter having a population of around 32 during winter, which increases in summer. There is now considerable pressure for new residential development along the SMP2 coastline, owing, in part, to the substantial inflow of retired people to the region and the continued demand for premium waterfront properties, particularly when associated with leisure facilities.

The main areas of social deprivation in the study area are associated with the urban areas of Poole and Bournemouth, which are within the 20% most deprived wards across England (Figure 1.20). The highest unemployment rate occurs in Bournemouth, with the 12 month average claimant rate, expressed as the percentage of resident working age population, being 1.8% which is higher than the South West’s (1.4%), while rates for Poole are below (1.1%). All are less than the England average rate of 2.3%.
Figure 1.19  The Social Environment of the Poole and Christchurch Bays SMP2
Community life expectancy in the Hampshire and Dorset County ranges from 77.9 to 81.3 (for males) and 82.1 to 85 (for females), which are all above the national average for England. Initiatives to promote continued healthy lifestyles for the communities of Dorset and Hampshire are a key agenda, such as the Walking the Way to Health Initiative (WHI) from the British Heart Foundation and Natural England, which aims to get more people walking in their local communities. This includes walks along coastal paths and harbour trails, and is an initiative that is being endorsed by the Borough of Poole Council.

Community assets are spread throughout the study area, although the main assets (hospitals, schools and residential homes) are predominantly found in the urban areas of Poole, Bournemouth and Christchurch. Transport infrastructure such as roads and railways are shown in Figure 1.19, and include the A35, A338 primary roads, as well as Bournemouth, Pokesdown, Christchurch, Hinton Admiral, New Milton, and Sway railway stations, which lie on the London Waterloo to Weymouth line operated by South West Trains. Limited connection to rural areas does exist in the study area in particular around the Isle of Purbeck, including Durlston, Swanage, and Studland Bays.
Bournemouth Airport located on the outskirts of Bournemouth which in 2007 handled 1.1 million passengers and was England’s 14th busiest airport.

In general, the number of community assets and properties affected by river and tidal floods varies between years, with flooding also a risk to sub-regional transport infrastructure such as roads and Network Rail. There are significant fluvial and tidal flood risks in Bournemouth, Christchurch and Poole, with between 2,000 to 4,000 properties in Christchurch at risk of flooding and up to 2,000 properties at risk of flooding in Poole. Local flooding is in response to rivers in the lower reaches of the study area being slow to react to rainfall, and this can be exacerbated by tidal events. The effect of the chalk saturation in the upper catchment also affects fluvial flooding in the lower catchment of the study area.

The influence of a coastal flood event on the community of Poole Harbour and Christchurch Harbour was highlighted during the coastal flood event in March 2008 when 1:10 and 1:25 peak tides caused the following impacts:

- Flooding of local businesses including Peugot garage, Sydenhams wood yard, units in Arthur Bray’s Yard;
- Flooding of roads including New Quay road, West Quay road, Longham Bridge, Ringwood road, Millhams road and Highways;
- Water levels in Holes Bay threatening electricity sub-stations and new developments;
- Water levels up to defences impacting upon Hamworthy Park;
- Flooding of several properties such as those at Mudeford;
- Flooding of Mobile Home Parks; and
- Flooding of Brownsea Quay.

Flood incident management is provided in the form of fluvial and tidal flood warnings to properties in Christchurch, tidal flood warnings to properties in Poole. There are Major Incident Plans containing specific arrangements for warning the public in areas particularly susceptible to flooding in Bournemouth and Christchurch.
1.7 Climate Change

1.7.1 Introduction

The South West Region Climate Change Impacts Scoping Study (SWCCIP, 2003) highlights predicted changes in climate in the South West over the next 75 years, including the following:

- Annual average temperatures in the South West are predicted to increase by 0.5 - 1.0 °C by the year 2020, 1.0 - 1.5 °C by the year 2050 and 1.5 - 2.0 °C by the year 2080;
- Average summer temperatures are predicted to increase by a much greater amount. The South West could witness a temperature increase of up to 5.0 °C over the next 75 years; and
- Annual average precipitation for the South West could decrease by as much as 15 per cent over the next 75 years. Winter averages could increase by as much as 30 per cent by 2080.

The effects of climate change are highlighted in the region’s State of the Environment Report (EA, 2006) and are summarised below:

- A northward shift of natural habitats by 50-80 km per decade;
- The drying-out of wetland habitats;
- Reduced availability of water stocks, particularly in summer, coupled with an increase in demand for water;
- A sea level rise of 20 cm by 2030 would compromise freshwater habitats, sea defences and increase the frequency of coastal flood events;
- Increases in both the amount of winter rainfall and the intensity of storms could increase the risk of flooding if these changes are not accounted for;
- A longer growing season; and
- An increase in the number of frost-free winters may significantly change land use patterns and increase the occurrence of exotic pests and diseases, as well as alter farming practices resulting in increased field run-off.

1.7.2 Scenarios

Climate change is now an accepted phenomenon and is predicted to result in significant changes to flooding in the UK in the 21st century. This is due to changes in rainfall patterns and increases in sea levels. Changes in rainfall patterns could result in changes in the intensity and frequency of storm events, and the depth and duration of seasonal rainfall. Such changes will affect catchment wetness, groundwater flows into rivers, and peak flows in watercourses and urban drainage.

Changes in sea level could result in tide-locking of watercourses draining to the sea, as well as coastal and tidal flooding.

The possible impacts of climate change on flood flows are still being investigated. The recent Office of Science and Technology Foresight report described sets of factors by which flood risk is expected to increase in the next 50 years, based on likely changes to the world economy and subsequent changes expected to greenhouse gas emissions. Those factors for the South West region of England are some of the highest in the UK.
Recent research has been completed by Defra and the Environment Agency into the impact of the latest climate change scenarios on flood flows in river catchments (UKCIP02, the UK Government Climate Impacts Programme, 2002). This has indicated the significant seasonal variation that is predicted for the UK in the 2080s. The increase in daily precipitation for the South West region is shown to be of the order of 10% to 25% during the winter season.

Additionally, there are indications that climate change will result in drier summers. The report indicates a reduction in daily summer rainfall amounts of the order of 10 to 50%, combined with more intense, stormier rainfall events (e.g. thunderstorms). These will be problematic for certain areas in the study having steep topography such as the upper River Frome and this is likely to exacerbate localised flooding problems of surface water drainage systems and the sewerage network. In addition, the problem of roads and property flooding occurring from field run-off is likely to worsen due to the lack of permeability of very dry soils.

The latest guidance given by Defra in FCDPAG4 “Flood and Coastal Defence Project Appraisal Guidance, Approaches to Risk” suggests dealing with climate change by increasing the magnitude of peak flows by up to 20%. This level of increase in flows will define the high extreme forecast for the future situation.

Also, the climate change effects for sea level rise would increase the existing risks from tidal flooding, as well as tidally-related fluvial problems. Defra currently recommend adopting 6mm per year for scheme appraisal (FCDPAG4: Economic Appraisal, 1999). The UKCIP02 report (2002) gives a range of sea level rise to 2080 of between 16cm and 76cm for the low and high emissions scenarios. Across the 110 year period that is considered in the report these represent average increases of 1.5mm and 6.9mm per year respectively, although it is likely that the sea level rise will accelerate towards the end of the period as the oceans expand. Absolute values of the estimated sea level rise to 2080 have been projected for the South West, and these are presented in Table 1.4.

The range of climate change impacts to peak river flows and potential sea level increases to be considered for the Poole and Christchurch Bays SMP2 are detailed in Table 1.4.

**Table 1.4**  Impact of Climate Change on River Flows and Sea Level (2080)

<table>
<thead>
<tr>
<th>Impact of Change</th>
<th>Peak River Flow</th>
<th>Sea Level Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>+6%</td>
<td>+160mm</td>
</tr>
<tr>
<td>Median</td>
<td>+12.5%</td>
<td>+460mm</td>
</tr>
<tr>
<td>High</td>
<td>+20%</td>
<td>+760mm</td>
</tr>
</tbody>
</table>