EASTERN SOLENT | COASTAL PARTNERSHIP

South Hayling Beach Management Plan

Beach Management Plan

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Non-technical Summary

The area covered by this Beach Management Plan (BMP) extends along the southern frontage of Hayling Island, Hampshire. The main focus of the beach management activities is to protect the Eastoke Peninsula from flood and coastal erosion risk but consideration is also given to the influence of beach management activities on the wider South Hayling frontage.

The existing flood and coastal protection structures include beach recharge & recycling, rock revetments & groynes, timber groynes, sloping timber breastwork and redundant concrete seawalls. The interaction between these hard defence structures, beach management and natural beach behaviour is vital to providing protection against flooding and erosion.

Currently the defences along this frontage protect approximately 1,740 residential properties, various commercial properties and extensive holiday chalets and caravan parks. The primary road network on the peninsula is also protected by the scheme.

The aim of this BMP, which has been developed utilising the best practice contained in the CIRIA Beach Management Manual (Second Edition), is to inform, guide and assist HBC in managing the beach, and to ensure that beach management continues to manage the risk of coastal flooding and erosion, whilst recognising and managing the environmental and amenity implications.

The key objective of this BMP is to manage the risk of coastal flooding and erosion by ensuring an adequate beach is maintained such that the 1 in 200 year Standard of Protection (SoP) of the scheme is retained. This BMP sets out the strategy for monitoring and intervention to maintain the beach to ensure it continues to provide an adequate SoP at Eastoke. It also includes consideration of the likely options available for carrying out Emergency Works should defences be overtopped, overwashed or even breached during a large storm event.

The monitoring and intervention strategy has been developed in the context of developing a technically, environmentally, and socially sustainable management approach for the next 5 years (the BMP review period). The strategy will align to the Shoreline Management Plan policies for the frontage that are set for the 100 year planning horizon, and which aim to 'Hold the Line' of existing defence along the length of the BMP frontage.

The BMP area has been divided into 7 Management Units (MUs). MU3 is the main nourished frontage extending along the southern Eastoke frontage. MU2 comprises a complex area of shingle barrier beach, protected partially by rock and timber structures which has been identified at strategy level as requiring a separate scheme to deliver the required SoP to the Eastoke Peninsula.

Annual beach recycling and annual beach recharge carried out as a combined operation have been identified as the preferred option for managing the Eastoke southern frontage, in line with the recommendations of the approved Eastoke Sectoral Strategy Study. Appropriate trigger levels and emergency works have also been identified to maintain the appropriate SoP along the Eastoke southern frontage after a single, or series of storm events.

In addition to identifying the required maintenance and emergency works, the BMP also recommends what further studies should be carried out to inform coastal flood and erosion risk management in this area. These are presented in the Action Plan in Section 7 of the BMP, and are primarily related to monitoring or maintenance actions. A key action is that HBC should deliver the Eastoke Point Scheme to address key erosion and flood risk issues not resolvable through beach recycling and recharge alone.

Contents

APPENDICES

GLOSSARY

Term	Definition
Alarm Level	The level before Crisis Level. This is usually a predetermined value where the monitored beach parameter falls to within range of the Crisis Level, but has not resulted in systematic failure of the function being monitored, e.g. recession of a beach crest eroding to within 10m of an asset, where it has been predetermined that an extreme storm event could result in recession of 5m. The Alarm Level in this example is therefore a 5m buffer. Increased monitoring would be required when an Alarm Level is compromised and intervention undertaken if deemed necessary. Managing Alarm Levels can be planned in advance.
Accretion	Accumulation of sediment due to the natural action of waves, currents and wind.
APO	Annual probability of occurrence.
ATT	Admiralty Tide Table.
Backwash	The seaward return of the water following the up-rush (swash) of the waves. For any given tide stage the point of farthest return seaward of the backwash is known as the Limit of backwash.
BAP	Biodiversity Action Plan. A strategy for conserving and enhancing wild species and wildlife habitats in the UK.
Barrier Beach	A sand or shingle bar above high tide, parallel to the coastline fronting a low-lying hinterland or lagoon.
Beach	A deposit of non-cohesive material (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively 'worked' by present day hydrodynamic processes (i.e. waves, tides and currents) and sometimes by winds.
Beach Bypassing	The transfer of material from areas of accretion, usually updrift of shoreline structures interrupting longshore drift, to areas of eroding shoreline downdrift.
Beach Nourishment	An overall term to describe the addition of material to areas of eroding shoreline, encompassing beach bypass, recharge and recycling.
Beach Profile	Cross-section perpendicular to the shoreline. The profile can extend seawards from any selected point on the landward side or top of the beach into the nearshore.
Beach Recharge	Artificial process of replenishing a beach with material from another source outside of the local littoral system.
Beach Recycling	The movement of sediment along a beach area, typically from areas of accretion to areas of eroding shoreline updrift.
Beach Re-profiling	The shaping of the beach profile to have a desired crest height, width or slope.
BMP	Beach Management Plan. It provides a basis for the management of a beach for coastal defence purposes, taking into account coastal processes and the other uses of the beach.
Breaching	Failure of the beach crest or other coast protection structure allowing flooding of the hinterland by tidal action.

Term	Definition
CCC	Canterbury City Council. Coastal Operating Authority as defined under the Coast Protection Act 1949 with permissive powers to provide defence against coastal erosion.
CCO	Channel Coastal Observatory. Based at the National Oceanography Centre in Southampton, responsible for the distribution of data collected through the South-East Strategic Regional Coastal Monitoring Programme.
CIRIA	Construction Industry Research and Information Association.
Climate Change	Long term changes in climate. The impact of climate change along the coast is usually associated with changes in sea level and wave climate
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by a fixation of the high water mark.
Crest	Highest point on a beach face, breakwater or seawall.
Crest level/height	The vertical level of the crest relative to mOD.
Crest width	A term adopted for the nourished frontage to describe the horizontal distance from the beach crest (where the beach slope angle drops down towards the sea) to the seaward edge of the promenade.
Crisis Level	The level at which the function being monitored, such as the stability of the beach and/or any backing structures (seawall/promenade), could be compromised and emergency remedial action becomes necessary, e.g. as in the case described under Alarm Level above, the beach crest recedes to within 4m of an asset that requires protection, where it has been predetermined that an extreme event could result in 5m of recession.
Defra	Department for Environment, Food and Rural Affairs (formerly known as MAFF)
ESCP	Eastern Solent Coastal Partnership. A partnership between HBC, PCC, GBC & FBC formed to manage the coastal flooding and erosion risk across the four Maritime Local Authorities
Environment Agency	Environment Agency. UK non-departmental government body responsible for delivering integrated environmental management including flood defence, water resources, water quality and pollution control.
Erosion	Removal of sediment due to the natural action of waves, currents & wind.
Fetch length	The distance that the wind has passed across the water in one direction (the greater the fetch, the larger the wind-driven waves will be).
Flood Zone	A geographical area officially designated subject to potential flood damage. The Environment Agency uses Flood Zone 2 and Flood Zone 3.
Gabion	Steel or plastic wire-mesh basket to hold stones or crushed rock held tightly together usually to form blocks or walls.
Geomorphology/ morphology	The scientific study of the nature and history of the landforms on the surface of the Earth and other planets, and of the processes that create them.
GIS	Geographical Information System
HBC	Havant Borough Council. Coastal Operating Authority as defined under the Coast Protection Act 1949 with permissive powers to provide defence against coastal erosion.
HISC	Hayling Island Sailing Club

Term	Definition
Hold the Line	An SMP policy to hold the existing defence line by maintaining or changing the standard of protection.
H_s	Significant wave height
Inshore	Areas where waves are transformed by interaction with the seabed.
Joint probability	The probability of two (or more) variables occurring together.
Joint Probability Analysis (JPA)	Method specifying the joint distribution of two (or more) variables.
Joint return period	Average period of time between occurrences of a given joint probability event.
LiDAR	Light Detection and Ranging. This is an airborne mapping technique which uses a laser and other instruments to measure ground elevation.
Listed Building	A building or other structure officially designated as being of special architectural, historical or cultural significance.
Locally generated (wind) waves	Locally generated short period and irregular waves created by the flow of air over water.
Longshore transport	Movement of material parallel to the shore, also referred to as longshore drift.
mCD	Elevation in metres above or below Chart Datum. Chart Datum is approximately the lowest astronomical tidal level at a given location, excluding the influence of the weather.
mOD	Metres Ordnance Datum. A universal zero point used in the UK, equal to the mean sea level at Newlyn in Cornwall.
Management Unit	The BMP frontage is split into 7 Management Units (MU's) within which slightly different management approaches are required. This includes differentiating between the main extraction & deposition areas.
Met Office	UK Meteorological Office.
MLWS	Mean Low Water Springs (-1.84m OD at Chichester Entrance)
MSL	Mean Sea Level (0.12m OD at Chichester Entrance)
Nearshore	The zone that extends from the swash zone to the position marking the start of the offshore zone.
No Active Intervention	An SMP policy where there is no investment in coastal defences or operations. This assumes that existing defences are no longer maintained and will fail over time or undefended frontages will be allowed to evolve naturally.
Offshore	The zone beyond the nearshore zone where sediment motion induced by waves alone effectively ceases and where the influence of the seabed on wave action has become small in comparison with the effect of wind.
Overtopping	Water carried over the top of a coastal defence due to wave run-up exceeding the crest height.
Overwashing	The effect of waves overtopping a coastal defence, often carrying sediment landwards.
Percolation	The process by which water flows through the interstices of a sediment. Specifically, the infiltration of water during swash into the unsaturated beach material which reduces wave run-up on the beach but which can also lead to water seepage at the landward side, potentially causing instability of the landward slope or barrier.
Policy Unit	A Policy Unit relates to the policy area defined by the Shoreline Management Plan (SMP).

Term	Definition
Ramsar	Designated under the, "Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat." 1971. The objective of this designation it to stem the progressive encroachment onto, and loss of wetlands.
Relict	Geomorphological feature formed of sediment deposited under past processes and climatic regimes.
Return Period	A statistical measurement denoting the average probability of occurrence of a given event over time.
Revetment	A sloping surface of stone, concrete or other material used to protect an embankment, natural coast or shoreline against erosion.
Scheduled Monument	Scheduled Monument: formerly referred to as Scheduled Ancient Monuments. Scheduled Monuments are nationally important archaeological sites which have been awarded scheduled status in order to protect and preserve the site for the educational and cultural benefit of future generations. The main legislation concerning archaeology in the UK is the Ancient Monuments and Archaeological Areas Act 1979. This Act, building on legislation dating back to 1882, provides for nationally important archaeological sites to be statutorily protected as Scheduled Monuments.
Scour	Permanent or temporary erosion due to waves or currents in proximity to coastal structures.
Sea level change	The rise and fall of sea levels in relation to the land level throughout geological and historic time in response to global climate and local tectonic changes.
Seawall	Structure built along the shore to prevent overtopping and / or erosion.
Sediment transport	The movement of a mass of sedimentary material by the forces of currents, waves or wind.
Significant wave height	The average height of the highest of one third of the waves in a given sea state.
SINCs	Every local authority in England has a system for identifying local sites which are of substantive nature conservation value. In Hampshire these are called Sites of Importance for Nature Conservation (SINCs). The designation helps to conserve important and distinctive habitats and species on sites that fall outside of European or national conservation designations such as Sites of Special Scientific Interest (SSSIs).
SMP	Shoreline Management Plan. It provides a large-scale assessment of the risks associated with coastal processes and presents a policy framework to manage these risks to people and the developed, historic and natural environment in a sustainable manner.
SPA	Special Protection Area. These are internationally important sites, being set up to establish a network of protected areas for birds
SSSI	Sites of Special Scientific Interest. These sites, notified by Natural England, represent some of the best examples of Britain's natural features including flora, fauna, and geology. This is a statutory designation
Standard of Protection (SoP)	The level of return period event which the defence is expected to withstand without experiencing significant failure.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.

Term	Definition
Sustainability (in coastal flood and erosion risk management)	The degree to which coastal flood and erosion risk management options avoid tying future generations into inflexible or expensive options for flood defence. This usually includes consideration of other defences and likely developments as well as processes within catchments. It will take account of long term demand for non-renewable materials.
Swash Zone / Swash	The area onshore of the surf zone where the breaking waves are projected up the foreshore / the movement of the wave up the beach face.
Swell waves	Remotely wind-generated waves (i.e. Waves that are generated away from the site). Swell characteristically exhibits a more regular and longer period and has longer crests than locally generated waves.
SWL	Still water level. The level that the sea surface would assume in the absence of wind and waves.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Toe level	The level of the lowest part of a structure, generally forming the transition to the underlying ground.
UKCP09	UK Climate Projections 2009. Research giving predictions of how future climate change may affect the UK.
UKHO	United Kingdom Hydrographic Office.
Wave climate	Average condition of the waves at a given place over a period of years, as shown by height, period, direction etc.
Wave direction	Direction from which a wave approaches.
Wave height	The vertical distance between the crest and the trough.
Wave hindcast	In wave prediction, the retrospective forecasting of waves using measured wind information.
Wave period	The time it takes for two successive crests (or troughs) to pass a given point.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water. The process by which the direction of a wave moving in shallow water at an angle to the contours is changed so that the wave crests tend to become more aligned with those contours.
Wave reflection	The part of an incident wave that is returned (reflected) seaward when a wave impinges on a beach, seawall or other reflecting surface.

1 Introduction

1.1 BACKGROUND

The Eastoke Peninsula is a densely populated area located on the south east corner of Hayling Island, the majority of which is low-lying with a history of serious flood incidents. To manage this flood and erosion risk, MAFF funded the Hayling Island Beach Replenishment Scheme (CPW 24) in 1985. Coastal processes result in the longshore transport of this nourishment material off the Eastoke frontage. The Council implements a Beach Management Plan to retain this material without which the redundant concrete seawall would again be exposed leading to a subsequent return to regular serious flooding of Eastoke, the failure of the seawall and loss of properties through the continuing erosion of the coastline.

In 2005 beach levels had deteriorated at several locations along the Eastoke frontage causing a reduction in the standard of protection. A significant storm in November 2005 resulted in overtopping of the vulnerable lengths of this frontage and flooding of a number of properties and disruption of the local transport network. This came as a stark reminder of the real and prominent risk that this area faces and the increased danger without continual management. More frequent minor overtopping also occurred during the winter in 2006.

The North Solent Shoreline Management Plan (SMP) (Ref 1.1) has confirmed a Hold the Line policy for the whole of the Southern frontage of Hayling Island. In recognition of the flood and erosion risk from both the Northern & Southern Eastoke frontages (some shared benefit areas), the Agency & HBC worked together in partnership to produce the approved Hayling Island Eastoke Sectoral Strategy (Ref 1.2) which recommends Beach Management for the Southern Frontage. The Management plan involved annual recycling, regular monitoring and periodic nourishment operations (approximately every 5 years). The works to the Northern Frontage of Eastoke were completed in 2005 raising the level of protection to 1 in 100year SOP. Havant Borough Council undertook an urgent beach nourishment operation along the southern shoreline of Eastoke from 2007 - 2009 in line with the ‘do minimum’ approach identified in the Eastoke Sectoral Strategy Study. The Council has undertaken beach recycling annually since the last nourishment operation currently in line with the ‘do minimum’ approach (also consistent with the preferred option). This has managed the significant investment made from 2007 - 2009 by DEFRA, the Environment Agency and Havant Borough Council by minimising the losses from the frontage, and prolonging the level of protection brought about by the urgent nourishment works.

The current approval has now come to an end and the Council wish to produce a new Beach Management Plan (this document) in line with current guidance. Although the main focus of beach management is in front of Eastoke the nourished material leaving the Eastoke frontage, and subsequent recovery for beach recycling, necessitates a BMP encompassing the wider Hayling frontage. The BMP will review the management of the wider frontage in line with the Strategy and the SMP and also be used to seek funding approval for the ongoing management of the earlier investment in beach recharge for the next five years.

1.2 OBJECTIVES

The key technical objectives (Ref 1.2) of the scheme are as follows:

- To reduce the risk of coastal erosion by providing protection against breaching of the defences and a reduction in coastal flooding.
- To reduce the risk of flooding from extreme surges.
- To provide clearly defined defences with good access for maintenance.
- To limit the impact of the scheme on people and property.
- To provide a scheme which is adaptable to sea level rise and climate change.
- To maintain the amenity benefit of the beach over the whole frontage for both the local population and the holidaymakers who visit the area.

The key environmental objectives (Ref 1.2) of the scheme are as follows:

- Avoid damage to human health and population and where appropriate enhance human environment (Human Health, Population).
- Protect and enhance biodiversity (Biodiversity, Flora and Fauna).
- Protect and enhance land quality (Soils).
- Protect and enhance water quality (Water).
- Protect existing infrastructure (Material Assets).
- Protect and enhance cultural heritage features (Cultural Heritage).
- Protect and enhance landscape character / visual amenity (Landscape).

The BMP aims to identify how to deliver the above objectives in the most cost effective and environmentally friendly manner with the minimum of disruption to the public and the environment. It is also important that the public are fully supportive of the proposed plan and are engaged with the development of the plan. This BMP is written to last 5 years commencing at the beginning of 2013 and ending at the end of 2017. The length of the nourished frontage covered by this BMP is 2.2km, and the wider South Hayling frontage is 8km in length. **It is proposed that this BMP is reviewed in early 2017.**

This BMP sets out the strategy for maintenance, monitoring and intervention to maintain the beach and structures to ensure they continue to provide adequate SoP along the Eastoke southern frontage. It also includes consideration of the likely options available for carrying out Emergency Works should defences be overtopped, overwashed or even breached during a large storm event threatening the low-lying urban area of Eastoke.

This maintenance, monitoring and intervention strategy has been developed in the context of selecting a technically, economically, environmentally and socially sustainable management approach for the next 5 years (the BMP review period). This strategy will align to the Shoreline Management Plan policies for this frontage that are set for a 100 year planning horizon, and which aim to 'Hold the Line' of existing defence along the length of the BMP frontage (Section 1.6.1).

The BMP also recommends what further studies may be appropriate to aid future coastal flood and erosion risk management in this area. Recommendations are contained throughout the BMP, and are identified with **bold underlined text**. These are also summarised in an Action Plan presented in Section 7.

1.3 LOCATION

This BMP covers the whole southern frontage of Hayling Island, Hampshire, extending from the Ferry Boat Inn in the West to the Hayling Island Sailing Club in the East (Figure 1.1). Although the section of beach from Eastoke Corner in the West to Eastoke Point is the only area which is actively managed the impact that the nourished material and subsequent recycling operations have on the wider Hayling Island coast line necessitate a BMP covering a wider area.

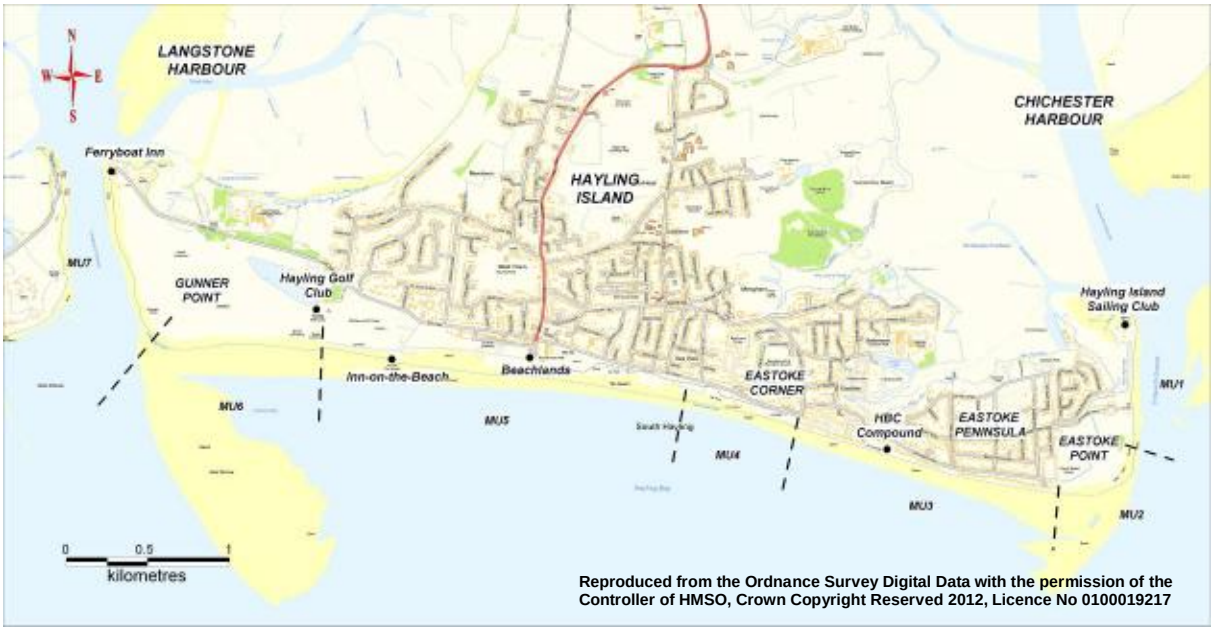

Figure 1.1- Beach Management Plan General Location Map & Management Units

The BMP area has been divided into seven Management Units (MUs) as shown by Figure 1.1. The boundaries for the MUs are based on the current management approach, and are influenced by a range a factors including coastal processes, existing structures and land ownership. A summary of the key features for each MU is provided in

Table 1.1. A map of coastal landownership is included in Appendix Z.

Table 1.1 - Summary of Management Unit features

MU	Beach	Structures	Hinterland	Landownership
1	Mixed sand and gravel barrier beach feeding into a distal spit at Black Point	Privately owned timber groynes, rock revetment and pontoon	To south of MU Sandy Point Nature Reserve (low lying)	Main landowners Hampshire County Council & Hayling Island Sailing Club
2	Dynamic mixed sand and gravel barrier beach	Rock revetment & rock groynes. Timber groynes	Sandy Point Nature Reserve (low lying)	Main landowner Hampshire County Council
3	Nourished mixed sand and gravel barrier beach	Timber groynes, buried concrete seawall, concrete splash wall to rear of promenade	Eastoke Peninsula (low lying)	Havant Borough Council
4	Mixed sand and gravel barrier beach	Timber sloping revetment, timber groynes, timber splash wall	Eastoke Corner (low lying into relic shingle ridges)	Havant Borough Council
5	Mixed sand and gravel beach	Surface water outfall, timber groynes and sloping timber revetment	Central Beachlands (relic shingle ridges)	Main landowner Havant Borough Council
6	Mixed sand and gravel beach	Timber groynes	Gunner Point (shingle ridges)	Hayling Golf Club
7	Mixed sand and gravel beach	Concrete structures, rock filled gabions, quay walls, concrete slipways	Car park & Hayling Golf Club (relic shingle ridges)	Main landowner Hayling Golf Club

1.3.1 Environmental Setting

The BMP area is within or adjacent to the following environmentally designated areas:

- Solent Maritime SAC.
- Chichester and Langstone SPA.
- Chichester and Langstone Harbours Ramsar Site.
- Chichester Harbour SSSI.
- Sinah Common SSSI.
- Langstone Harbour SSSI.
- Sandy Point Local Nature Reserve and Countryside Heritage Site.
- Southern Eastoke Frontage SINC.
- Beachlands SINC.

In addition, the following environmental designations are within 2km of the BMP area:

- The Kench Local Nature Reserve

Figure 1.2 shows the extents of the various environmental designations in relation to the BMP area. Appendix A contains further details about these designations for ease of future reference.

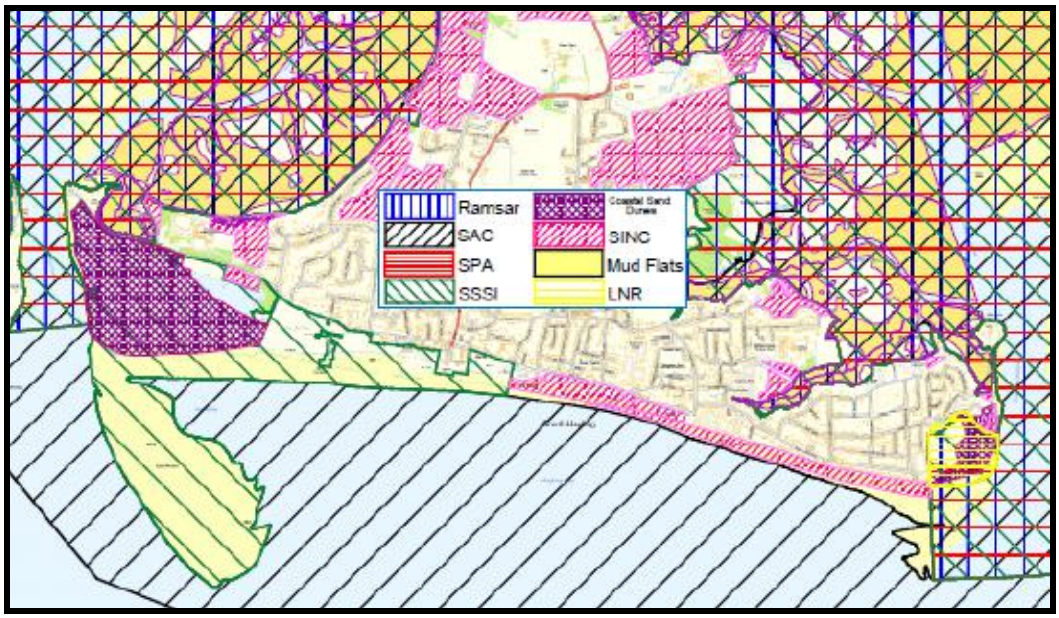

Figure 1.2 – Nature Conservation Designations around the BMP frontage

There are also a range of historic environment features and assets surrounding the study area, including Scheduled Monuments and Listed Buildings. None of these historic environment features are within or immediately adjacent to the BMP frontage. The Old Lifeboat House, Seafront, is a building of local interest located 50 metres behind the active beach, Figure 1.3 shows the location of these historic environment features in relation to the BMP study area.

Figure 1.3 - Historic Environment Features adjacent to BMP frontage

Further detail and discussion of the environmental characteristics relating to the BMP area are provided in Section 2.6.

1.3.2 History of flooding / erosion incidents

The history of flooding and erosion on the Eastoke Peninsula has arisen due to the development of an urbanised area on a low lying peninsula of land behind a retreating

shingle barrier beach. As houses were constructed behind the retreating barrier beach shore parallel defences were constructed in response to both erosion and wave overtopping (Figure 1.4).

Over time the beach levels in front of these defences continued to drop and the incidence and severity of flooding increased until the Hayling Island Beach Replenishment Scheme in 1985 (Figure 1.5). The areas liable to flooding prior to the 1985 scheme are shown in Figure 1.6, and the impact of extreme events illustrated in Plates 1.1, 1.2 & 1.3.

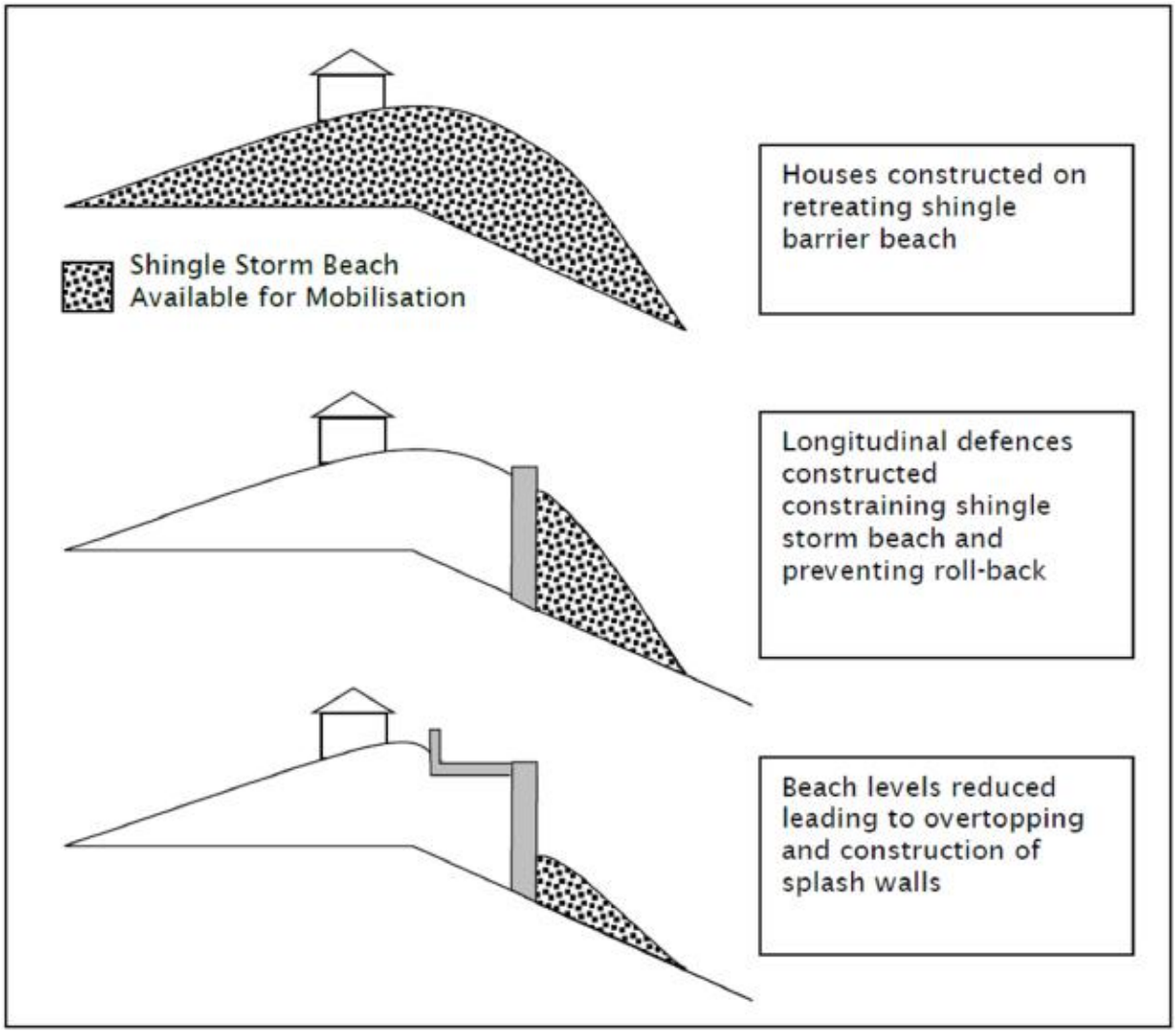

Figure 1.4 - Process of beach constraint through construction of shore parallel defences at Eastoke, Hayling Island (Ref 1.3)

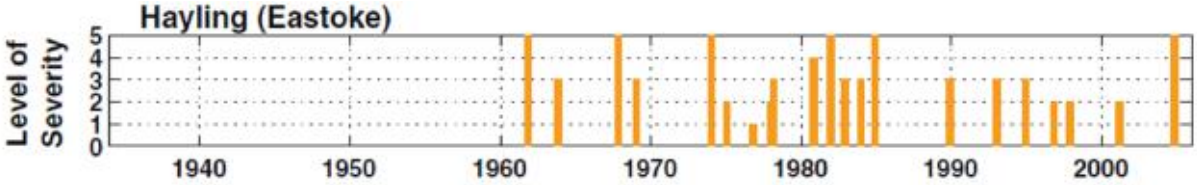

Figure 1.5 - Incidence of flooding events at Eastoke, Hayling Island (Ref 1.4). Severity is measured according to Table X.

Table 1.2 – Severity of flood events presented in Figure 1.5 (Ref 1.4)

Severity Level	Description
5	Flooding over larger areas. Significant pumping required by emergency services. Generally more than half a day disruption to homeowners and road users. More than 15 properties affected.
4	More than 5 properties affected by flooding.
3	More than 3 road affected and / or at least on property affected.
2	Some road flooding – usually localised or shallow
1	Flooding in open areas / quay areas – no real structural damage or disruption.

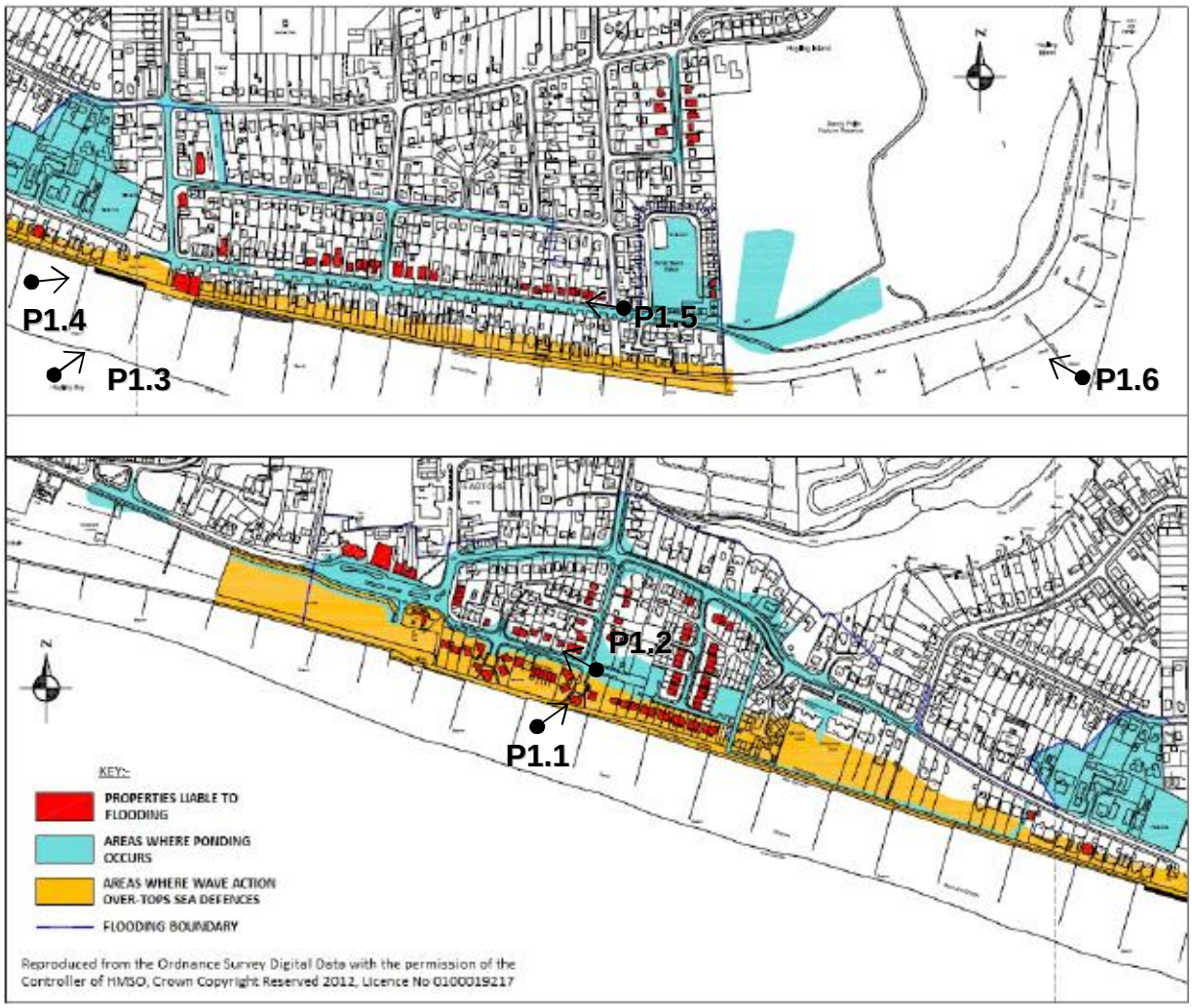

Figure 1.6 - Areas liable to flood due to wave overtopping prior to the 1985 Beach Replenishment Scheme, based on HBC Drawing No. 1007/358, March 1977. Approximate location of Plates 1.1 – 1.6 also indicated.

Plate 1.1 - Storm damage to property behind the promenade, December 1978.

Plate 1.2 - Storm damage to properties behind the seawall, December 1978.

Plate 1.3 - Wave overtopping adjacent to Creek Road car park, Pre-Beach Replenishment 1985

After the main replenishment scheme in 1985 the incidence of flooding was greatly reduced, and the flooding that has been recorded is usually associated with key erosion hotspots (Section 2.5.3) giving rise to localised flooding. The only significant flooding to occur since the construction of the nourished beach was in November 2005, when the beach was overtopped along much of South Hayling, including both nourished and unnourished sections of beach. This was an extreme event that occurred on 3rd November 2005, including very long period swell waves in combination with extreme water levels, and is discussed in further detail in Sections 2 & 3. The flooding resulting from this event was not on the same scale of those prior to the 1985 replenishment scheme but did serve as a stark reminder of the very real and prominent threat to this area from overtopping, and the likely effects if beach management were to cease.

Plate 1.4 – Eastoke Nourished frontage, groyne 19, November 3rd 2005.

Plate 1.5 - Southwood Road looking west from Bosmere Road, 3rd November 2005

1.3.3 Defence History

Since the early 1920s, the Eastoke peninsula has been increasingly developed as a residential area (Plate 1.6). The building of beach huts and bungalows commenced in the 1930s close behind the wide shingle barrier beach. However, natural retreat and loss of sediments from this beach made it necessary to build defences to protect these properties (Figure 1.7). By 1947, a concrete seawall had been constructed in front of the old Beach Club, with a timber revetment (sloping surface) and groynes adjacent to it. By 1974, the

seawall had been extended to the east and west, for a total of 2.6 kilometres. This seawall, however, did nothing to solve the fundamental causes of beach erosion, and wave reflections from its front face lowered the levels of the shingle beach, and by 1978 major repairs to the seawall were required.

Plate 1.6 - View of Eastoke Peninsula looking westwards

By the early 1980s, the Eastoke frontage was regularly overtopped by wave action, causing flooding and damage of many properties. The ageing concrete seawall was also approaching the end of its serviceable life and a failure could have led to rapid shoreline retreat and subsequent loss of properties. The frequency and severity of overtopping events was increasing annually. In an effort to reduce the damage, a rear splash wall was constructed along the entire length of the seawall. These measures did not adequately prevent regular overtopping or storm damage to properties.

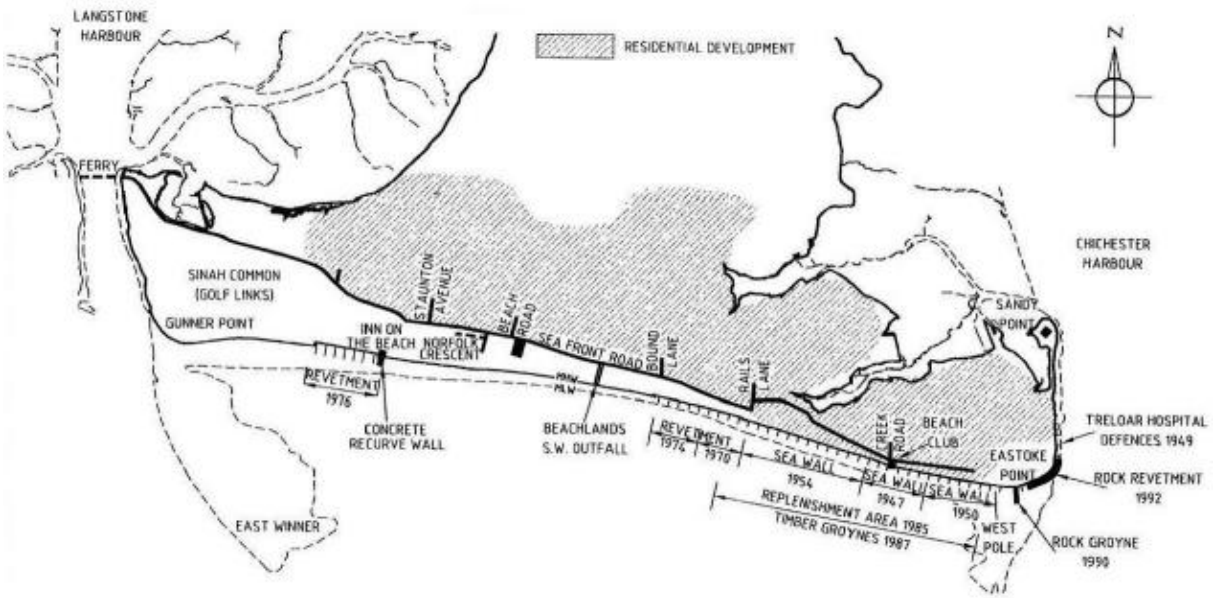

Figure 1.7 - Historic Construction of Sea Defences Around South Hayling

A major Beach Replenishment Scheme, carried out in 1985 has successfully alleviated further incidents of this nature by removing the energy of waves before it is reflected by the concrete seawall. The scheme involved importing half a million cubic metres of shingle from the Owers Bank and placing it on the beach over a length of 2.2 kilometres. Subsequently, there has been a requirement for ongoing shingle recycling to maintain the level of protection provided by the scheme design.

Such a large amount of material being injected into the sediment transport system resulted in the rapid transport of material along the frontage. In 1987, new timber groynes were built in order to try and control the transport rate along the replenished area and in 1990 a rock groyne was constructed to further reduce loss of material around Eastoke Point.

In 1992, it became necessary for emergency repairs to be carried out at Eastoke Point. These works involved the construction of 150 metres of rock revetment and rock stub groynes. These works proved to be successful and a stable beach was maintained.

The successful implementation of the 1992 Beach Management Plan has influenced the ongoing management of the coastal defences at Eastoke. Since that time the beach has been the main defence on the open frontage. The associated control structures have been maintained and replaced as required, but no changes in the form of hard defences has been carried out since the early 1990s.

Away from the nourished frontage the defences west of Inn-on-the-Beach (MU5), constructed in 1976, are reaching the end of serviceable life and a 75m section of sloping timber breastwork was removed in March 2012. This returned the beach to a more natural beach profile.

1.3.4 Current Defence Condition

The coastal assets along the entire South Hayling frontage are regularly inspected and maintained by the Eastern Solent Coastal Partnership (Section 4), and the results are stored in the ESCP coastal asset database. The locations of the groynes are shown in Appendix Y. An overview of the defence condition, including the nourished beach, is given here for each management unit, based on the latest survey results stored in the database. The condition of the defences is described according to the descriptions within the Environment Agency Condition Assessment Manual (Ref 1.5).

MU1

Generally beach levels are healthy and accreting. Various timber control structures are owned and maintained by private organisations, which are mainly in fair condition or buried beneath the beach. A rock revetment constructed around the HISC is in good condition.

MU2

The rock revetment and rock groynes around Eastoke Point are generally in good condition, with most of the structure buried by beach material. The concrete seawall, and exposed steel sheet pile to the western end of the unit are in good and fair condition respectively, but are frequently exposed by low beach levels. The original capital beach nourishment in 1985 continued east as far as the long rock groyne. The beach rapidly eroded in this area and beach nourishment alone is not capable of maintaining the required standard of protection. The timber groynes are in fair or poor condition along this section of the coast, and are supported by rock in places. The timber groynes are liable to sudden failures if beach levels drop rapidly. Groynes 4 & 7 had to undergo emergency works in March 2012 to stabilise the surrounding beach levels and remove a hazard to water users due to partial structural failures.

MU3

The nourished beach is the primary defence along this section of the frontage and overall the volume of material on the nourished frontage is healthy (Section 2.5.2). There are three key erosion hot spots along nourished frontage where the beach crest is below design standard (Figure 1.8 & Figure 2.12), which are discussed in more detail in Section 2.5.3. The old redundant concrete sea wall is buried under the nourished beach and its condition is largely unknown. The timber groynes constructed in 1987 are generally in good condition, with ongoing maintenance and repairs carried out by HBC.

MU4

The timber groynes along this section of beach are generally in good condition. The timber sloping revetment is in good condition where visible, although it remains largely buried as beach levels are currently high in front of the structure.

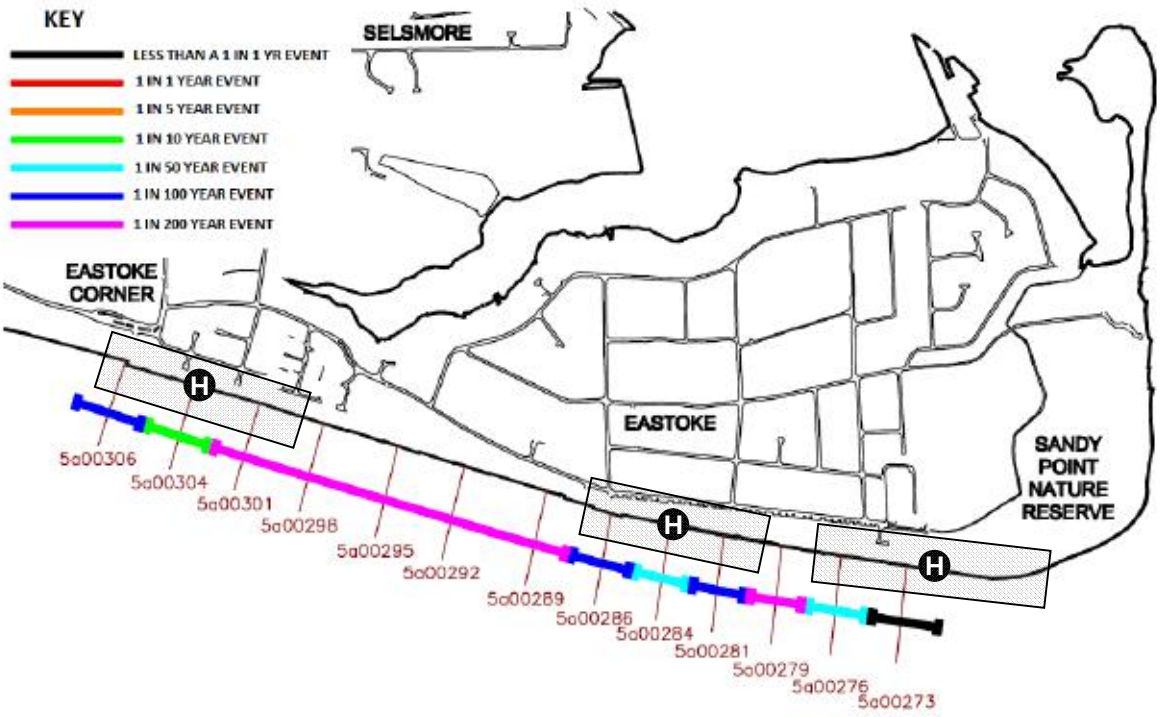

Figure 1.8 - Current condition of nourished beach, Summer 2012, and corresponding hotspot locations (Section 2.5.3)

MU5

The central Beachlands open coast has no hard defences other than a single timber groyne to the east of the unit which is in fair condition. There has been some cliffing and erosion of the beach crest in front of the Beachlands Funfair over the last 5 years, although at present the upper beach appears to have stabilised. To the west of Inn-on-the-Beach at West Beach the sloping timber breastwork is in a generally poor structural condition, and heavily dependent on beach levels infront of the structure. The visible structure has been assessed as being in fair condition overall but buried sections are known to be in a very poor condition and heavily dependent on beach levels protecting the structure toe. The adopted policy is to maintain the structure where reasonably practicable, and remove sections of the structure should they pose a threat to public safety. A 75m section at the western end was removed in March 2012 due to a significant structural failure, triggered by falling beach levels exposing the degraded lower structure.

MU6

There are three privately owned timber groynes in a poor condition in front of the Hayling Golf Course training range at the eastern end of this management unit. The overall volume of beach material in this area is increasing but there is localised erosion associated with a dynamically changing beach plan-form in front of the golf course training range (Section 2.5.2). Other than these three control structures the frontage is open beach in the lee of a significant ebb-tidal shoal, the West Winner.

MU7

This management unit contains a variety of redundant sea defences and man-made structures that are buried within the beach. Many of the structures, which are all privately

owned and maintained, were buried as pulses of material moved up the eastern flank of the Langstone Entrance channel. There is currently some localised erosion to the north of the unit, associated with the advance of a spit like feature that is gradually moving northwards up the eastern flank of the entrance channel.

1.3.5 Amenity Value

The Hayling Island coast became a popular destination for visitors from London in the post-war period, with caravans and chalets a feature within the landscape. The island continues to cater for summer trippers, resulting in an increase in the summer-time population on the island. The seafront's recreational activities include jetskiing, wind and kite-surfing, golf, skateboarding, volleyball, fishing, funfair and amusements, a light railway and sailing (Ref 1.6). The blue flag beaches are popular for general amenity, especially in the summer. More passive past times include walking, cycling, sea-bathing and eating & drinking at the pubs and café kiosks.

1.4 ISSUES

1.4.1 Flooding / Erosion Issues

There is a combined risk to properties on the Eastoke Peninsula from flooding and coastal erosion. The main issue on this frontage is flooding caused by wave overtopping of the defences be they natural beach or artificial seawall. Coastal erosion is currently being managed through ongoing beach recycling and recharge, although there are ongoing erosion issues in specific areas (Section 2.5.3).

Currently the main flood defence consists of a mixed sand and gravel beach which is maintained to a design crest height and width (Section 3.3). Problems occur when the beach is not maintained to this standard or the waves have such an intensity and/or duration that causes the crest height and width to be reduced to such an extent that overtopping occurs. This BMP will address the design height and width and also investigate the most cost effective way of maintaining the nourished beach.

1.4.2 Environmental Constraints

When undertaking beach maintenance works, there are a number of environmental issues to be addressed (refer also to Sections 1.3.1 and 2.6). The main issues to be considered are vegetated shingle, nesting birds on the open beach and the need to maintain the feed of material moving towards Black Point which is a high tide roost site.

The following environmental constraints have been identified for the BMP area:

- All works need to consider, and seek to avoid or minimise, impacts on environmentally designated sites including the Solent Maritime SAC; Chichester & Langstone Harbour Ramsar Site; Chichester & Langstone Harbour SPA; Sinah Common SSSI; UK BAP Priority habitats mudflats and vegetated shingle.
- There is currently a lack of monitoring of UK BAP Priority habitats to appraise impacts of beach management activities on these features.

1.4.3 Beach Safety and Amenity Constraints

As noted in Section 1.3.5, the whole of the frontage covered by the BMP is a popular destination for a range of amenity uses. The use of the beach varies depending on the season and facilities such as car parks and water use zoning provide a focus for amenity use and access onto the beach. The peak tourism season is between April and September.

In addition to maintaining public safety when works occur, other amenity and public safety issues exist at the site that relate to the beach and structures. These include:

- Varying beach levels could pose access and fall issues as well as create risk of undermining to the defences.
- Health and safety issues associated with the timber groynes including damaged or missing planking and jagged edges.

These issues are in part automatically resolved through the ongoing beach management activities as the design profile and associated control structures remove the risk of falls from the promenade. In addition where cliffing of the nourished material occurs reprofiling may be undertaken to remove steep drops on the beach crest (Section 5.2.1).

1.4.4 Uncertainties about Beach Processes

Despite a good level of process understanding developed for this BMP (see Section 2), there remain some process uncertainties of relevance to the future management of this frontage:

- The joint probability of extreme wave and water levels in the BMP area relating to long-period swell events.
- The impact of long-period swell waves on wave run-up and overtopping.
- The impact of long-period swell waves and bi-modal wave conditions on beach profile evolution.

The monitoring programme set out in Section 4 includes measures that aim to improve understanding of these uncertainties and research into improving wave run-up predictions is being commissioned by the Environment Agency (Ref 1.7). New Forest District Council have also been approved funding to carry out research into the impact of bi-modal wave conditions.

1.4.5 Licences, Approvals and Consents

Planning permission in accordance with the Town and Country Planning Act 1990 for the ongoing beach recycling works around Hayling has been granted for a ten year period, running until 30.09.2019, beyond the current BMP period (Appendix C). Beach maintenance works in the form of recycling and reprofiling are exempt from a Marine Licence under the Marine & Coastal Access Act 2009, so long as the activity is carried out within the existing boundaries of the works being maintained (Ref 1.8). The beach recycling works to remove the hazard to navigation seaward of MHWS at Eastoke point (Section 5.2.1) are exempt from requiring a Marine Licence as they are carried out on behalf of Chichester Harbour Conservancy (Appendix D).

The beach recharge element of the BMP operations will require different licences and consents depending on the source and delivery method of recharge material. The appropriate planning consents will be sought from Havant Borough Council once the timing and method for the operations are confirmed. A marine licence may also be required from the Marine Management Organisation, and will be sought prior to undertaking any beach recharge operations. As the recharge operations have been carried out regularly at Eastoke, the last marine-based recharge was in 2009, good procedures and guidance exist for obtaining the necessary licences, approvals & consents to carry out the works.

A Chichester Harbour Conservancy 1971 Section 45 Works Licence has been approved for the recycling operations (Appendix E). The consent is valid until 29.01.2014, and a renewal will be sought prior to the licence lapsing. The beach recharge operations fall outside of the area requiring a Works Licence.

1.5 RESPONSIBILITIES FOR MANAGEMENT

Responsibility for the management and operation of activities along the BMP frontage rests mainly with Havant Borough Council. Table 1.3 summarise the roles and responsibilities and identifies non-HBC responsibilities.

Table 1.3 - Roles and responsibilities for management and operational activities

Management Operation		Assigned Responsibility
1	Operations to maintain beach profile	Havant BC (MU3)
2	Cleaning/clearance of promenade, steps, revetment, for amenity	Havant BC
3	Cleaning/clearance of beach	Havant BC
4	All structural maintenance of promenade, seawall, revetment, timber groynes, slipways and flood gates	Havant BC / Private Ownership
5	All structural maintenance of surface water outfalls	Southern Water
6	All maintenance of access steps, ramps and slipways to beach from seawalls/revetments	Havant BC / Private Ownership
7	All maintenance of footpath and cycleways including signs for designated public footpaths and rights of way	Havant BC / HCC public RoW
8	Litter clearance	Havant BC
9	Monitoring of shingle movement (and other coastal processes)	HBC / Southeast Strategic Regional Coastal Monitoring Programme
10	Maintenance of seats, litter bins etc	Havant BC
11	Flood warning and response actions	HBC / Environment Agency
12	Emergency planning	HBC / HCC / EA

Actual ownership of the assigned responsibility for each management operation identified in Table 1.3 is in some cases held by different departments within the identified organisation. Therefore, in order to support Table 1.3 and to provide clarity on who should be contacted for each item, Appendix F provides contact details for each management operation as well as other organisations with interests in this area.

1.5.1 Monitoring

Havant Borough Council has responsibility for monitoring of the South Hayling Beach covered by this plan. Further detail on the monitoring programme and objectives is contained in Section 4.

1.5.2 Maintenance Activities

HBC are also responsible for inspecting and carrying out maintenance on the majority of the frontage from MU2 to MU5. Structures in MUs 1, 6 & 7 are inspected by the ESCP but are privately owned and maintained. **Where issues are identified in these areas the appropriate owner / maintainer is notified of the defect and any obligation to make good.**

1.5.3 Other Actions

The majority of the beach is maintained and supervised on a day to day basis by Havant Borough Council from their Beachlands Office. These activities include:

- Undertaking regular daily inspections and reporting of the beach condition from the Ferry Boat Inn (MU7) in the west to the Nature Reserve boundary (MU1) in the east to check for any hazards to the public from such items as beach cliffing, groyne deterioration and voids.
- Undertaking regular daily inspections of the Beachlands Coastal area including buildings, beach huts, lifesaving equipment, signs, litter bins, dog bins and notice boards and ensuring any defects are rectified
- Dealing with any emergency situations such as oil pollution, dangerous chemicals or canisters on the beach which may occur.

1.5.4 Responsibility for flood warning

The Environment Agency is responsible for providing flood defence warning for the South Hayling frontage through their Area Flood Warning Duty Officer (FWDO). The public are warned through the EA floodline, the EA website and by the public registering with the EA for Flood Warnings Direct.

The flood warning is passed to Havant Borough Council's Emergency Response Officer, and the HBC Duty Officer to coordinate the use of HBC's direct labour force where appropriate. The ESCP Coastal Duty Officer is also notified, and a coordinated response is developed following the procedures identified in the coastal flood risk response plan (See Section 4.6 & Appendix G).

1.5.5 Responsibility for outfalls

There is only one surface water outfall along the length of beach covered by this BMP. This is opposite Sea Grove Avenue and is a ∅1050mm pipe that outfalls surface water and storm overflow in to the sea. It is owned and maintained by Southern Water. There may be other minor outfalls that discharge surface water through the beach but these are largely buried and have not been identified individually.

1.5.6 Key Stakeholders

The following organisations are key stakeholders in the development of this BMP, and contact details are listed in Appendix H.

- **Eastern Solent Coastal Partnership**. Who are the team within HBC responsible for the development and implementation of this BMP to manage erosion and flood risk for the frontage.
- **Havant Borough Council**. Who are a major landowner of the frontage and undertake day to day management of the beach and coastal area.
- **Hampshire County Council**. Who are landowners at the eastern end of the frontage where they own the Eastoke Point nature reserve and beach frontage.
- **Hayling Island Golf Club**. Who are landowners at the western end of the frontage where they own the golf course and beach frontage
- **Hayling Island Sailing Club**. Who are landowners at the eastern end of the frontage where they own the spit and beach frontage extending up to Black Point.
- **Natural England**. Who have an overview on proposals to carry out works such as this BMP in an environmentally sensitive area.
- **Environment Agency**. Who have a strategic overview for all forms of flooding and coastal erosion, and therefore has a significant interest in the management of flood and erosion risk along the coastline covered by this BMP. They also administer the funding stream for any works to be carried out under this BMP.

1.6 LINKAGES FOR OTHER DOCUMENTS

1.6.1 Shoreline Management Plans

A Shoreline Management Plan (SMP) is a large-scale assessment of the risks associated with coastal processes and helps reduce these risks to people and the developed, historic and natural environments. Coastal processes include tidal patterns, wave height, wave direction and the movement of beach and seabed materials.

The first round of SMP's were carried out in the mid 1990's and the one covering this frontage the East Solent SMP was completed in 1997. This found that the preferred option for the eastern end of the frontage was hold the line while on the frontage around Gunner Point the preferred option was do nothing.

The current Shoreline Management Plan (SMP) covering the BMP area was completed in 2010 (Ref 1.1). This document adopted a single policy unit (5aHI05) covering the entire open

coast for South Hayling, corresponding with the extent of this BMP. The SMP policy recommended for this section of coast is to continue to 'Hold the Line' over the next 100 years. There are additional qualifying statements about allowing the coastline in key areas to evolve with minimal interference. The ESCP intend to implement this policy through increased use of beach management and removal of the existing hard defences as they reach end of life, particularly at the western end of West Beach (MU5).

1.6.2 Hayling Island: Eastoke Sectoral Strategy Study

This joint HBC & EA report (Ref 1.2) was completed in October 2006. It split the Eastoke frontage in to four sections, namely;

- Southern Frontage – Main section
- Southern Frontage – Eastoke Point
- Northern Frontage – Main section
- Northern Frontage – Bracklesham Road

For this BMP the options for the Southern frontage are relevant. The preferred option for the Southern Frontage – Main section was beach management to 0.5% SOP and for the Southern Frontage – Eastoke Point the preferred option is hold the line. Construction of the capital scheme currently under development for Eastoke Point by the ESCP is key to delivering this hold the line policy. This reinforces the need for beach management on this frontage.

1.6.3 Eastoke Point Coastal Defence Study

This report (Ref 1.9) was completed in May 2009 and specifically addressed the issues in connection with maintaining the beach profile at Eastoke Point. It did however reinforce the need for continuing management of the beach in front of the Eastoke frontage as the beach will still provide the primary sea defence at this location even after the capital scheme has been constructed.

1.6.4 Beach Management Plans

A Beach Management Plan was first adopted in 1992 (Ref 2.0). Although now expired, the objectives of this plan included:

- Continuous monitoring of the beach;
- Immediate reaction to any rapid drawdown, as waves remove material in a groyne bay (beach compartment between two groynes);
- Carry out annual beach recycling; and
- Use of material accreting (accumulating) at Central Beachlands as a source of material.

In 1999, the Council developed and approved a Beach Management Strategy Plan (Ref 2.1) that identified the most effective approach to managing the southern frontage of the Eastoke peninsula. This decision was made after considering all relevant economic, environmental and technical criteria, and this Plan has been the basis of maintaining the beaches that are the first line of defence against the threat of coastal erosion and flooding along the Eastoke peninsula.

This Plan recommended defending the frontage against a storm event with a return period (average period of time between occurrences of a given event) of 1 in 200 years, which is achieved by:

- Annual shingle recycling operations, moving shingle from areas where the beaches have accreted to depleted areas where beach widths and levels were too low; and
- An annual Coastal Management Study.

1.7 RELEVANT INFORMATION

The following provides a list of all sources of information that has been referenced in this section of the beach management plan.

Ref 1.1 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 1.2 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 1.3 **Improving Beach Management on a Nourished Beach; Morphodynamics at Hayling Island, UK**, Unpublished MPhil Transfer Report, School of Environment & Civil Engineering, University of Southampton. Moon, C.R. (2010).

Ref 1.4 **Reconstructing coastal flood occurrence combining sea level and media sources: a case study of the Solent, UK since 1935**, Natural Hazards, 59 (3), 1773-1796, Ruocco A. C., Nicholls, R.J., Haigh, I.D. & Wadey, M.P. (2011).

Ref 1.5 **Condition Assessment Manual**, Document Reference 166_03_SD01, Environment Agency (2006).

Ref 1.6 **Hayling Island Seafront Masterplan**, Havant BC (2012).

Ref 1.7 **South East Coast Beach Management Plan Programme**, Project Code IMSE100035, Environment Agency (2011).

Ref 1.8 **Marine Licensing guidance 2: Construction (including renewables) and removals,** Marine Management Organisation (2011). Internet site: http://www.marinemanagement.org.uk/licensing/documents/guidance/02.pdf. Date accessed: 1st Aug 2012.

Ref 1.9 **Eastoke Point Coastal Defence Study**, HR Wallingford (2008).

Ref 2.0 **Beach Management Plan 1992 – 1996**, Technical Report, Havant BC (1992)

Ref 2.1 **Beach Management Strategy Plan**, Technical Report, Havant BC (1999)

2 Supporting Information

This section of the BMP provides a summary of the coastal processes that affect the BMP frontage, extending along the 8 kilometre South Hayling coastline, between the Ferryboat Inn and Black Point. The aim of this summary is to provide an overview of the coastal processes affecting this frontage and the impacts of human intervention upon them. This includes an assessment of the following information regarding coastal behaviour and management:

- Water levels (tidal information, extreme water levels);
- Wave climate (typical waves, extreme waves);
- Joint probability of extreme wave and water levels;
- Climate change;
- Sediment characteristics & transport (sediments, shoreline movement, beach stability);
- Environmental characteristics;

This summary is based upon more detailed assessment undertaken in developing this BMP.

2.1 WATER LEVELS

2.1.1 Typical Tidal Levels

Tide levels for Chichester Harbour Entrance (Ref 2.1) are provided in Table 2.1. Admiralty Tide Tables are published annually which provide predictions of astronomic tides for the following year. Astronomic tide predictions are also available, from the UKHO website up to 7 days in advance (Ref 2.2). Up to date and historical tide data, which includes both astronomic and meteorological effects, can be obtained from the National Tide and Sea Level (NTSL) facility network based at the British Oceanographic Data Centre (BODC) (Ref 2.3) and CHIMET (Ref 2.4). The nearest NTSL tide gauge is located just inside Portsmouth Harbour. The CHIMET gauge is located in the outer entrance channel to Chichester Harbour.

Table 2.1 - Typical Tide Levels at Chichester Harbour (Ref 2.1)

	Tide Level	
	Chart Datum (mCD)	**Ordnance Datum Newlyn (mOD)**
Highest Astronomical Tide Level (HAT)	5.3	2.56
Mean High Water Springs (MHWS)	4.9	2.16
Mean High Water Neaps (MHWN)	4.0	1.26
Mean Sea Level (MSL)	2.9	0.12
Mean Low Water Neaps (MLWN)	1.9	-0.84
Mean Low Water Springs (MLWS)	0.9	-1.84
Lowest Astronomical Tide Level (LAT)	0.2	-2.54

The typical spring tidal range at Eastoke is 4m. There is a height difference of ±0.2m on spring tides when comparing Portsmouth tides to Chichester Harbour.

2.1.2 Extreme Tide Levels

Extreme Still Water Levels are available from the Environment Agency's Coastal Boundary Data project (Ref 2.5). A standard surge curve is also available for use in further analysis. The extreme water levels for the nearest Coastal Boundary Data grid point No. 4604 (Figure 2.1) are presented in Table 2.2. An allowance must be made for sea level rise since 2008 when using the data. The largest positive surge component measured at the nearby Portsmouth tide gauge is 1.16m, recorded on 30th October 2000.

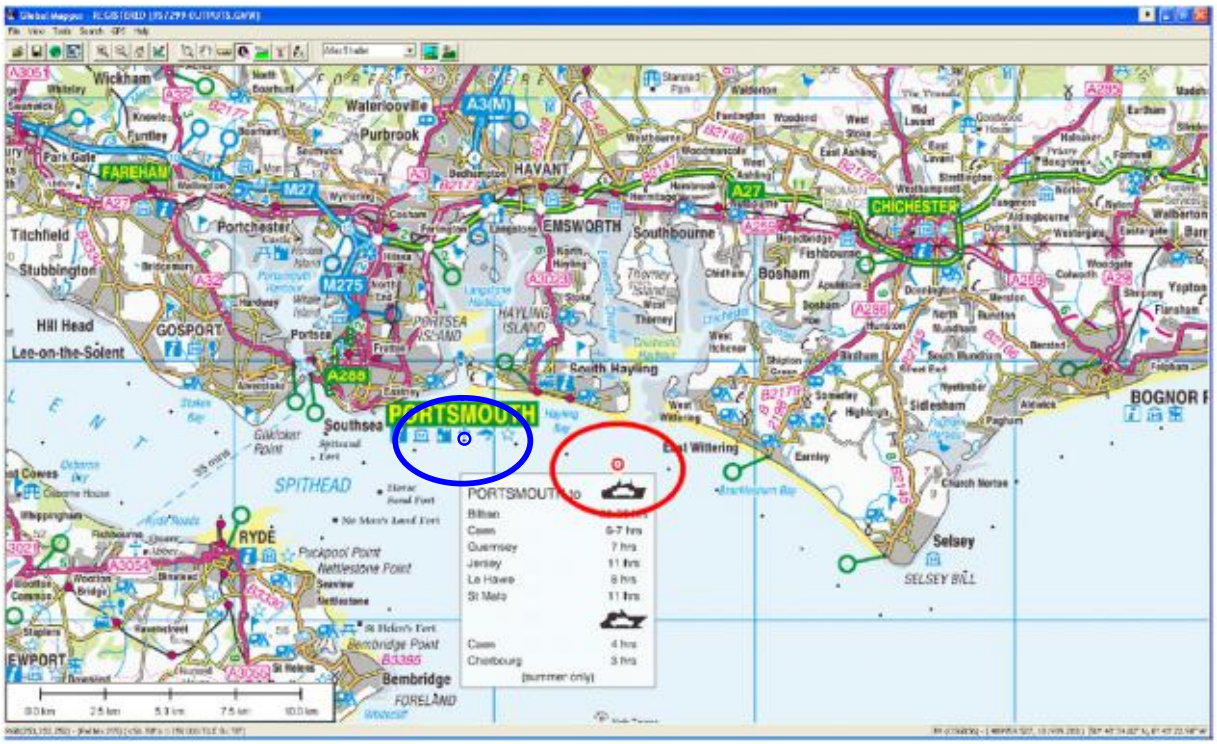

Figure 2.1- Extreme water level grid Point 4610 (circled in blue) & Point 4604 (circled in red) from Coastal Flood Boundary Conditions for UK Mainland and Islands (Ref 2.5)

Table 2.2 - Extreme water levels (Ref 2.5)

Return Period (1 in X years) [APO]	Chainage 4610		Chainage 4604	
	Water Level (mOD)	Water Level (mCD)	Water Level (mOD)	Water Level (mCD)
1 [100%]	2.65	5.39	2.75	5.49
2 [50%]	2.73	5.47	2.82	5.56
5 [20%]	2.83	5.57	2.92	5.66
10 [10%]	2.90	5.64	2.99	5.73
20 [5%]	2.97	5.71	3.07	5.81
25 [4%]	3.00	5.74	3.09	5.83
50 [2%]	3.07	5.81	3.16	5.90
75 [1.3%]	3.11	5.85	3.21	5.95
100 [1%]	3.14	5.88	3.24	5.98
150 [0.7%]	3.18	5.92	3.28	6.02
200 [0.5%]	3.21	5.95	3.31	6.05
500 [0.2%]	3.31	6.05	3.41	6.15
1000 [0.1%]	3.38	6.12	3.48	6.22
10000 [0.01%]	3.62	6.36	3.73	6.47

2.2 WAVE CLIMATE

2.2.1 Offshore Extreme Wave Climate

The published Best Practice Guidance from "Coastal Flood Boundary Conditions for UK Mainland and Islands (Ref 2.6) has been used to identify the relevant extreme (marginal) swell wave heights. The location of the grid point used is illustrated in Figure 2.2, and the outputs presented in Table 2.3 and Table 2.4.

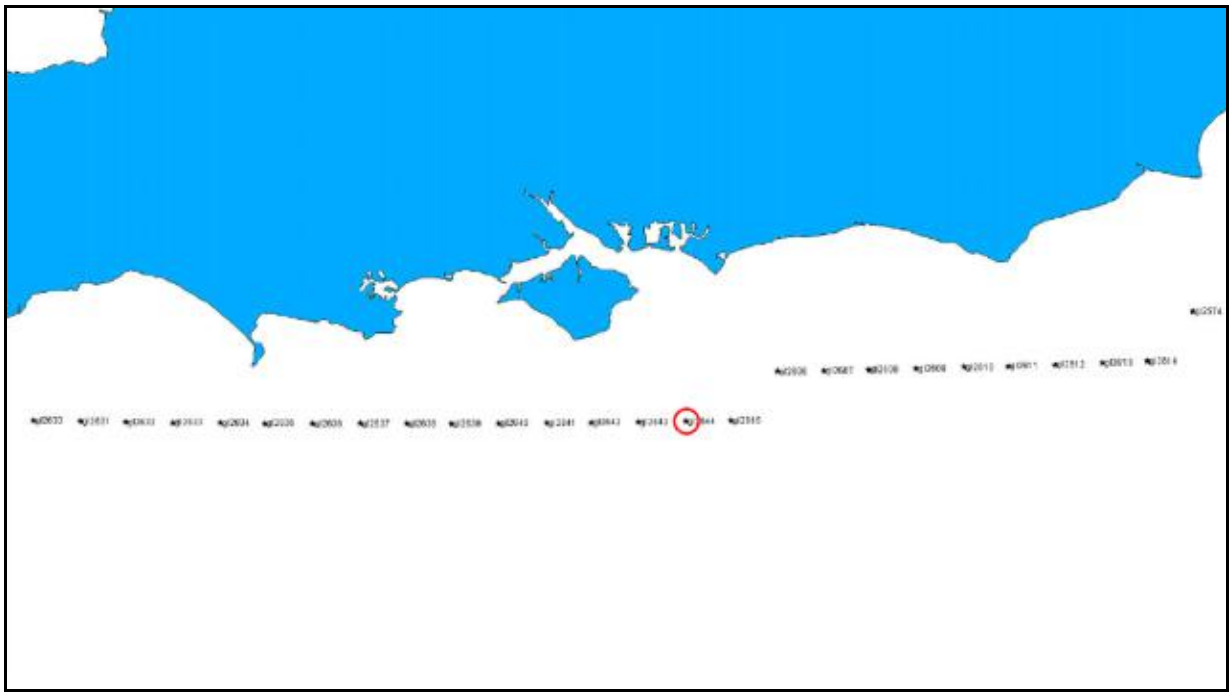

Figure 2.2 - Coastal Flood Boundary Extreme Swell Grid Point Locations

Table 2.3 - Extreme offshore swell wave heights, GL2644 (Ref 2.6)

Return Period	Swell from south (m)	Swell from south-west (m)
T1	2.09	2.52
T2	2.32	2.66
T5	2.57	2.82
T10	2.72	2.92
T20	2.84	3.02
T25	2.88	3.04
T50	2.98	3.13
T75	3.03	3.17
T100	3.06	3.2
T150	3.1	3.24
T200	3.13	3.27
T250	3.15	3.29
T300	3.16	3.31
T500	3.2	3.35
T1000	3.25	3.4

Table 2.4 – Extreme offshore swell period, GL2644 (Ref 2.6)

Wave Height (m)	T_z (seconds)					
	<8	8 - 10	10 - 12	12 - 14	14 - 16	>16
H_s <1	0.59	0.2	0.11	0.07	0.02	N/A
H_s 1-2	0.63	0.28	0.07	0.01	N/A	N/A
H_s 2-3	0.49	0.44	0.06	0.01	N/A	N/A
H_s 3-4	N/A	N/A	N/A	N/A	N/A	N/A

2.2.2 Nearshore Wave Climate

The processes of wave generation and transformation from offshore to inshore are particularly complex in the East Solent. Storm waves reaching the coast can be generated locally under winds from the southwest through to the east, or in the English Channel. Swell waves generated further afield will also penetrate the area, though heights will be modest (Ref 2.7).

The overall pattern for wave heights is a decrease in energy from east to west into the sheltered East Solent (Ref 2.8). Whitcombe (Ref 2.9) utilised a 100 to 200m resolution wave refraction model that indicated offshore waves are refracted as they enter Hayling Bay and converge on the East Winner and the banks/bars at the mouth of Chichester Harbour. Most waves along the central sector of Hayling Island approach normal to the shoreline, except when propagated across south-east and east-south-east fetch directions. Wave focusing is highest at the Eastoke frontage under swell waves approaching from the south-south-west.

Wave modelling carried out using hindcast data (based on 20 years data between 1971 and 1991) by HR Wallingford (Ref 2.10) and updated in 2006 to reflect the longer data set (Ref 2.29) predicts the following return periods infront of Hayling Island.

Table 2.5 - Predicted wave conditions adjacent to Hayling Island

Point (Ref 2.10)	Location	Depth (mCD)	Significant wave heights (m) for given return periods		
			1 year	10 year	50 year
11	Entrance to Chichester Harbour	-9.4	2.82	3.42	3.84
12	SW of West Pole, eastern end of Hayling Island	-2.0	3.61	4.34	4.83
13	Eastoke, Hayling Island	-2.0	5.19	6.45	7.31
14	West Town, Hayling Island	-2.0	3.30	4.00	4.48
15	East Winner, western end of Hayling Island	-2.0	3.83	4.71	5.32
16	Entrance to Langstone Harbour	-10	2.10	2.42	2.62

A directional Waverider buoy has been deployed off Hayling Island since July 2003 as part of the Southeast Strategic Regional Coastal Monitoring Programme, summary statistics are presented below (Figure 2.3). The wave rose of H_s and direction shows a S - SSW dominated wave climate. This matches the predominant SW winds and direction of swell waves refracting around the Isle of Wight. In March 2008 a 3.79m H_s was recorded (Ref 2.11), and a 3.33m H_s was associated with severe overtopping on 3rd November. During the November 2005 event long period waves, within a bi-modal wave climate, played a key role in overtopping the nourished beach, with a dominant wave period of over 18 seconds, in combination with a high spring tide and tidal surge.

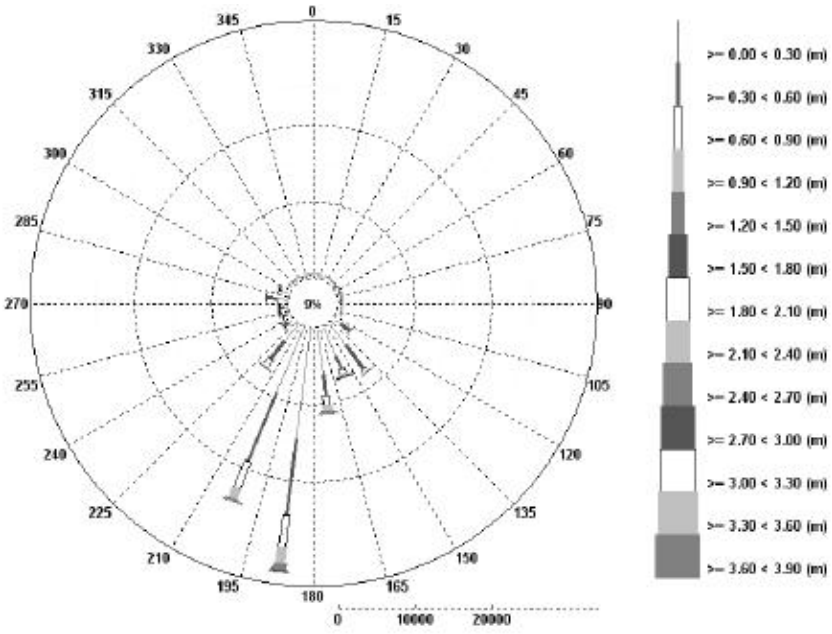

Figure 2.3 - Significant Wave Height and direction, Hayling Wave Buoy 01/07/2003 - 31/12/2011

2.2.3 Bi-Modal Wave Climate

Hayling Island has been identified as a site influenced by a bi-modal wave climate, where there is a combination of not only wind waves but swell waves also. Recent research (Ref 2.12) identifies that current methods for scheme design do not account for bi-modal conditions, implying that greater overtopping and wave run-up on beaches might be expected than traditional design advice might suggest. Such conditions were identified during the November 2005 wave overtopping event, potentially contributing to the widespread overtopping of the beach.

2.3 JOINT PROBABILITY EXTREME WAVE AND WATER LEVELS

The joint probability of wave and water levels based on the Coastal Flood Boundary Conditions (Ref 2.6) are presented below (Ref 2.13). The analysis is based on swell waves as experience has shown that most overtopping is associated with longer period wave conditions. These figures are regarded as the most applicable offshore joint probability figures available for the BMP frontage.

Table 2.6 - Joint probability of offshore water levels and wave heights (Ref 2.13)

Water Level (m AOD)	Wave Direction (°N)	
	Swell from South	Swell from Southwest
2.44	3.27	3.13
2.52	3.23	3.09
2.59	3.16	3.01
2.68	3.06	2.89
2.75	2.96	2.77
2.82	2.86	2.63
2.92	2.71	2.4
2.99	2.58	2.19
3.07	2.44	1.96
3.16	2.25	1.66
3.24	2.11	1.43
3.31	1.97	1.2

The offshore joint probability values were also transformed inshore to profile 5a00276 on the Eastoke nourished frontage (Ref 2.13).

Table 2.7 - Joint probability of nearshore water levels and wave heights (Ref 2.13)

Events	Water Level (m OD)	Offshore Waves		Results (Hs / Tp) (distance to shore)		
		Hs (m)	Tp (s)	80m	120m	160m
1:200yr swell from southwest	2.94	3.27	20	2.47 / 19.28	2.44 / 19.28	2.45 / 19.28
	3.42	2.71	20	2.45 / 19.28	2.42 / 19.28	2.42 / 19.28
	3.81	1.97	20	1.86 / 19.28	1.83 / 19.28	1.84 / 19.28
1:200yr swell from south	2.94	3.13	20	2.50 / 19.28	2.46 / 19.28	2.47 / 19.28
	3.42	2.40	20	1.33 / 19.28	2.28 / 19.28	2.29 / 19.28
	3.81	1.20	20	1.18 / 19.28	1.16 / 19.28	1.16 / 19.28

2.4 CLIMATE CHANGE AND RISK

The latest advice for adapting to climate change was issued on 1st September 2011 by the Environment Agency, Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (Ref 2.14) – from here on referred to as "EA 2011". This guidance replaces the previous advice (Ref 2.15) and includes updated sea level rise allowances for FCERM based on the UKCP09 climate change projections.

A range of scenarios are provided in the EA 2011 guidance, including low and high emissions scenarios demonstrating the range of future uncertainty. Upper end estimates have been developed based on a low probability high end scenario (UKCP09 H++ scenario) which is beyond the likely range but considered to be within physical plausibility. Based on the EA 2011 guidance the upper confidence bound (95 percentile) medium emissions scenario has been adopted as the appropriate 'change factor'.

2.4.1 Sea Level Rise

For the purpose of the BMP, long term sea level rise is secondary as the BMP only covers 5 years ahead where, based on the EA 2011 guidance a 0.027mm increase can be expected. This is within the general error margins of any of the methods employed for the joint return period analysis or beach surveys. However, for completeness the latest figures and previous predictions are compared below (Table 2.2.1 & Figure 2.2.1). For the period of the BMP (2013 – 2017) the rate of SLR predicted over 5 years is within 7mm of the previous DEFRA 2006 allowances.

Table 2.8 - Comparison of SLR predictions (mm), 1990 - 2100

	1990	2000	2010	2020	2030	2040	2050	2100
Defra Supplementary note March 2003	0	60	120	180	240	300	360	660
Climate Change Impacts October 2006	0	40	80	120	182.5	267.5	352.5	980
EA2011 Upper End Estimate	0	40	80	120	175	245	315	945
EA 2011 H++	0	60	120	180	272.5	397.5	522.5	1902.5
EA 2011 Low emission 50%	0	30	62	97	135	176	219	474
EA 2011 Medium emission 95%	0	44	93	146	204	266	332	728

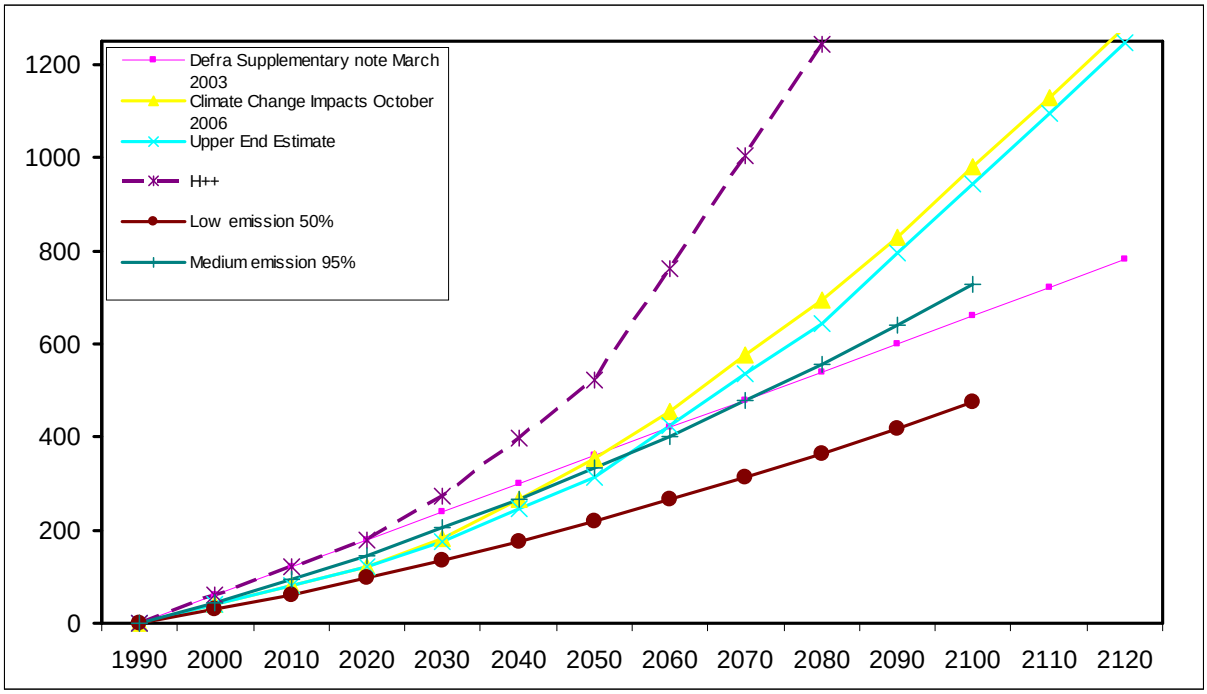

Figure 2.4 - DEFRA 2003, 2006 & EA 2011 sea level rise predictions

2.4.2 Waves

The EA 2011 guidance does not currently provide advice on a change or increase in wave climate due to climate changes, but does note,

'It is anticipated that over the next 12 months, wave climate projections will become available covering significant wave height, period and direction. When these are published this advice note will be updated to include that evidence.'

2.4.3 Change in Surge

The EA 2011 guidance suggests the addition of the following regarding surge:

	Total potential change anticipated up to the 2020s	**Total potential change anticipated up to the 2050s**	**Total potential change anticipated up to the 2080s**
Upper end estimate	20cm	35cm	70cm
Change Factor	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken

The EA 2011 guidance does recognise there is considerable uncertainty in these projections.

2.5 SEDIMENT TRANSPORT

2.5.1 Sediments

The coastline is characterised by mixed sand and gravel (shingle) beaches and a low lying hinterland. The geology of the study area comprises a mixed sand and shingle storm beach overlying Upper Eocene deposits of the Barton, Bracklesham and Bagshot beds.

Some sections of beach have been subject to human intervention measures, including hard sea defences and beach nourishment. The entire Hayling Island frontage has now benefitted from the material nourished at Eastoke as it has moved out across the wider BMP study area since the original Hayling Island Beach Replenishment Scheme in 1985. The beach contains wide ranging grades from sand to shingle sized material, with any finer material rapidly being winnowed out of the beach if placed as part of the ongoing nourishment operations.

The latest set of sediment samples were collected in 2009, on 23 different profiles around the frontage (Figure 2.5 & Appendix I). Surface samples were collected at the beach crest, MHW, MSL & MLW along each profile.

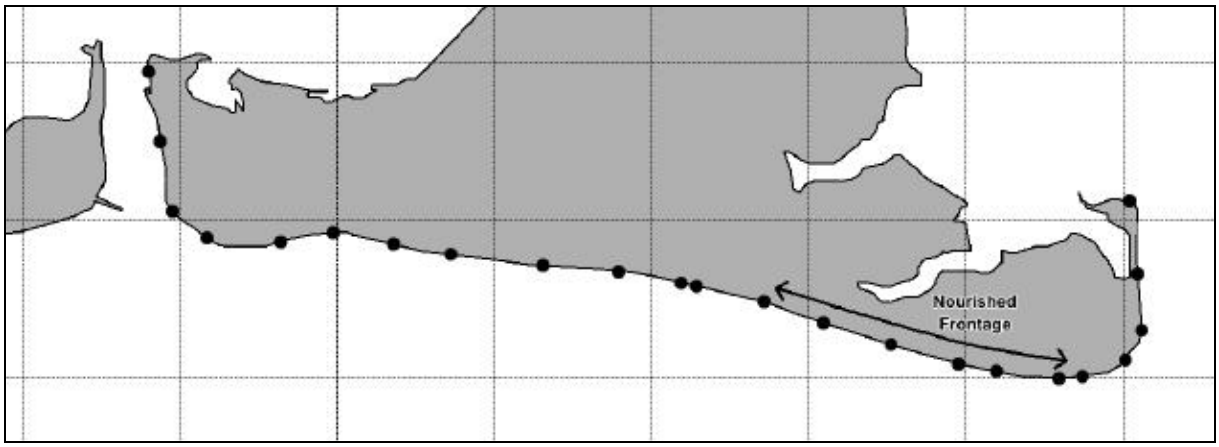

Figure 2.5 - Location of sediment samples, Hayling Island

A summary of the key statistics is tabled below (Table 2.9).

Table 2.9 - Summary particle size distribution statistics for Hayling Island

		ALL SAMPLES	NOURISHED BEACH				
			ALL	CREST	MHW	MSL	MLW
Full Sample	D_{50} (mm)	1.1	1.1	1.6	0.6	1.1	1.0
	% sand	63.9	61.5	54.6	68.5	59.5	63.4
Coarse Fraction (>2mm)	D_{50} (mm)	5.7	5.6	6.3	5.3	5.6	5.2
	D_{90} (mm)	15.8	14.9	18.1	13.4	15.6	12.6

2.5.2 Shoreline movement

(a) Overview of shoreline evolution

Several authors have published work relating to the evolution of the shoreline covering the BMP frontage, notable examples include Harlow (Ref 2.16), Whitcombe (Ref 2.9), Webber (Ref 2.17), Wallace (Ref 2.18), Defra (Ref 2.19) and most recently CCO (Ref 2.20). In summary, the present shoreline of the East Solent is a result of very active post-glacial processes of erosion and accretion, increasingly controlled by coastal defences and beach management activities over the last century. Substantial erosion and roll back of the shingle banks has occurred along the eastern frontage of Hayling Island. Concurrent accretion has occurred from the central and western parts of the frontage. This is particularly so at Gunner Point where the shoreline has moved seaward by some 200m over the last century (Figure 2.6), resulting in the development of multiple shingle ridges.

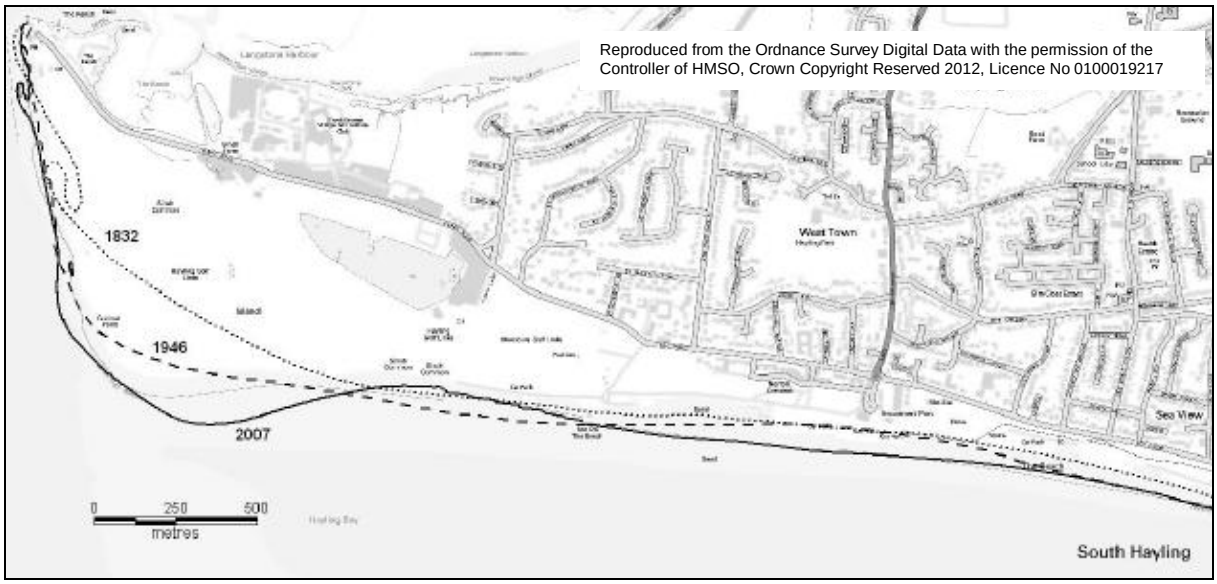

Figure 2.6 - South West Hayling Island MHW 1832 to 2007

Eastoke Point (MU2) at the eastern end of the island is historically an area of instability with major changes in size and orientation having taken place over the last century. Eastoke spit (Black Point, MU1) has grown north and changed morphology markedly in the past. The proximity of the deep water channel at the entrance to Chichester Harbour, with its rapid ebb and flood flows and the intermittent onshore transport of material from the ebb delta complicate matters to such a degree that beach changes at Eastoke Point cannot be predicted with any degree of certainty (Ref 2.10). The combination of all these processes make this an area which is very liable to rapid short term change. The Eastoke frontage (MU3 & 4) has been subject, by contrast, to a steady rate of recession.

The wide shingle beach in the central part of Hayling (MU5) has experienced steady accretion during most of the last century. The western end of the Hayling frontage has historically been an area of accretion and there are now a series of relic ridges to the landward which cover most of the Hayling Golf Course and open areas to the east (MU5 & MU6).

(b) Sediment transport pathways

A number of studies have been carried investigated the geomorphology and sediment transport around the Hayling coastline, and the adjacent Chichester Harbour tidal inlet, covering both pre- and post-nourishment periods. The SCOPAC Sediment Transport Study (Ref 2.21) provides a review of the available research up to 2004, and further detailed studies have been carried out by the Eastern Solent Coastal Partnership to improve the understanding of sediment transport off the nourished Eastoke frontage and around the wider frontage.

The main sediment transport pathways around the BMP frontage are shown below (Figure 2.7). At present the drift divide and westerly transport at Gunner Point are not present with ongoing tracer studies indicating dominant westerly transport of the upper storm beach. The Hayling open coast has a drift divide located at the centre of nourished frontage, just west of

Creek Road car park, where the natural supply of material onshore (F1, Ref 2.21) is not sufficient to maintain the beach to the required levels.

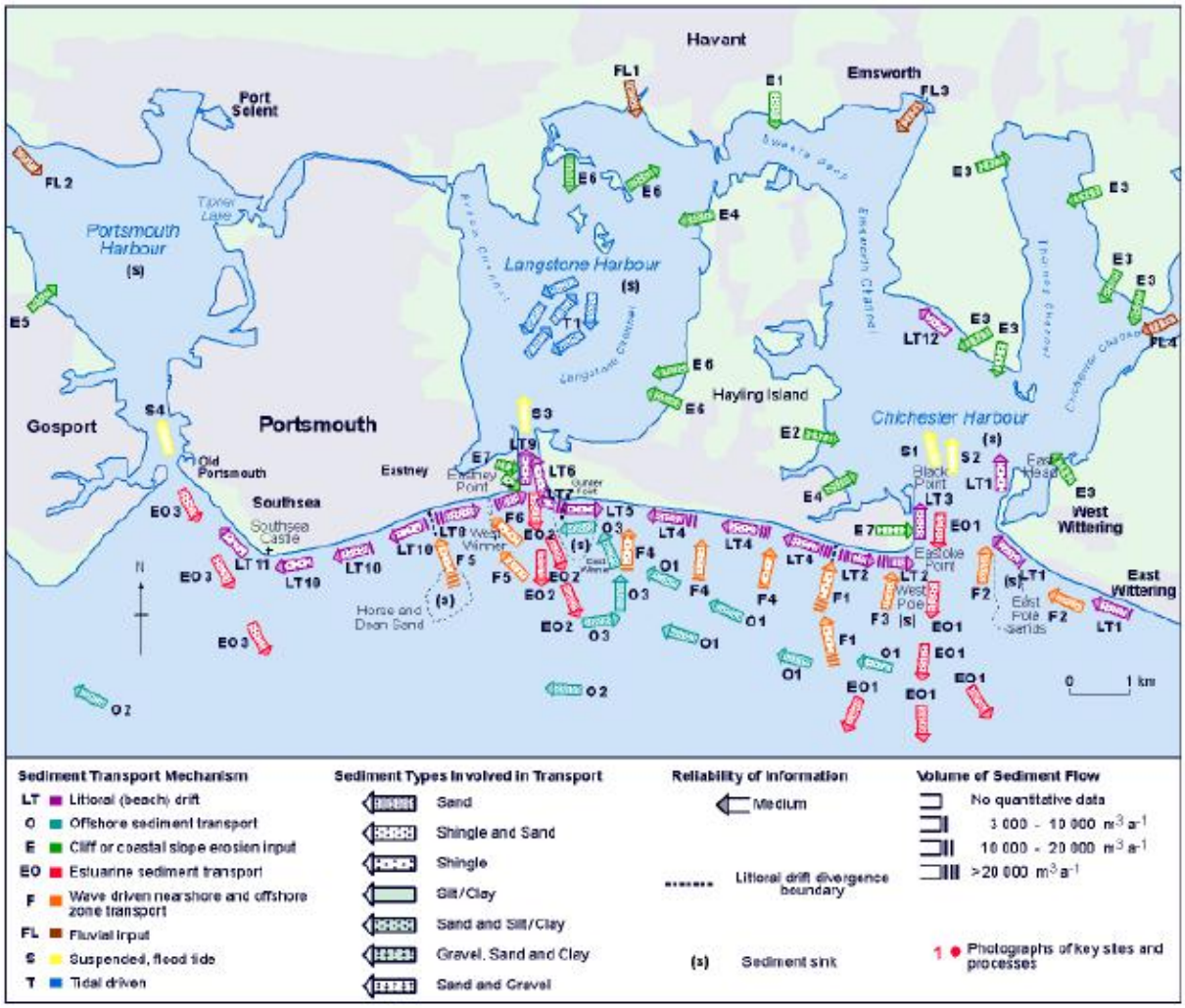

Figure 2.7 - Sediment Transport Pathways (Ref 2.21)

Beach nourishment is now the main source of beach material to the wider south Hayling frontage, and the Futurecoast Study (Ref 2.19) identified Gunner Point as a potential beneficiary of the ongoing artificial recharge and recycling operations. Indeed, Harlow (Ref 2.16) assessed this area as a potential source of material for the 1985 Hayling Island Beach Replenishment Scheme. Beach sediment is transported in both directions off the nourished frontage by wave action.

The Ness at Sandy Point appears to represent a point where the influence of wave action and strong tidal flows counteract each other. Sediment transport north past this point still occurs but a large proportion of beach material moving onto the Ness is either stored as an accumulation of material or lost into the adjacent deep water channel. There is currently ongoing accretion of sand occurring on Black Point, suggesting that the transport of shingle up toward the distal end of Eastoke spit slows due to the drop in wave energy in the harbour entrance, and limited quantities of gravel sized material are evident beyond the HISC pontoon. The sand fraction of the beach material is more mobile and continues to move past HISC onto Black Point.

To the west of the nourished frontage net westward sediment transport is dominant. At Gunner Point there have been temporary drift reversals but a deployment of tracer pebbles in 2011 confirmed the movement of material around the point and up into the harbour entrance. Once inside the harbour entrance rates of transport fall, and beach material is either lost into the deep water channel or slowly moves north towards the Ferryboat Inn.

(c) Beach cross-sectional area and volumes analysis

An analysis of beach profile change is carried out annually by the CCO (Ref 2.20), and the latest report is summarised below. The analysis takes account of the beach recycling operations, details of which are supplied to the CCO after each operation (Section 4.2.3). Based on an analysis of baseline surveys from 2004 to 2011 the eastern end of the frontage (MU1 & MU2), along Chichester Harbour entrance, has remained relatively stable with isolated reductions in CSA at profiles along the recurve. The central and eastern sections of the frontage (MU3, MU4 & MU5) demonstrate stable or accreting profiles, exhibiting gains in CSA of up to 15%. Significant erosion can be observed at the boundary of MU5 & MU6, with profiles 5a00376 and 5a00373 showing losses in CSA of more than 30%. Large amounts of accretion are evident along the recurve into the harbour entrance channel (MU7).

This analysis corresponds well with more detailed sediment budget analysis carried out by the ESCP using GPS walkover data collected annually since 2004. The analysis assesses changes in beach volume above MLWS. Figure 2.8 illustrates the general pattern of erosion and accretion around the South Hayling frontage.

Since 2004 there has been an overall increase in beach volume of 139,870 m^3 around the South Hayling frontage. Taking into account the 179,149 m^3 of recharge material introduced to the system over the same period this indicates an overall net decrease of 39,279 m^3 over the 8 year period. This equates to an average annual loss of 4,920 m^3 around the South Hayling frontage.

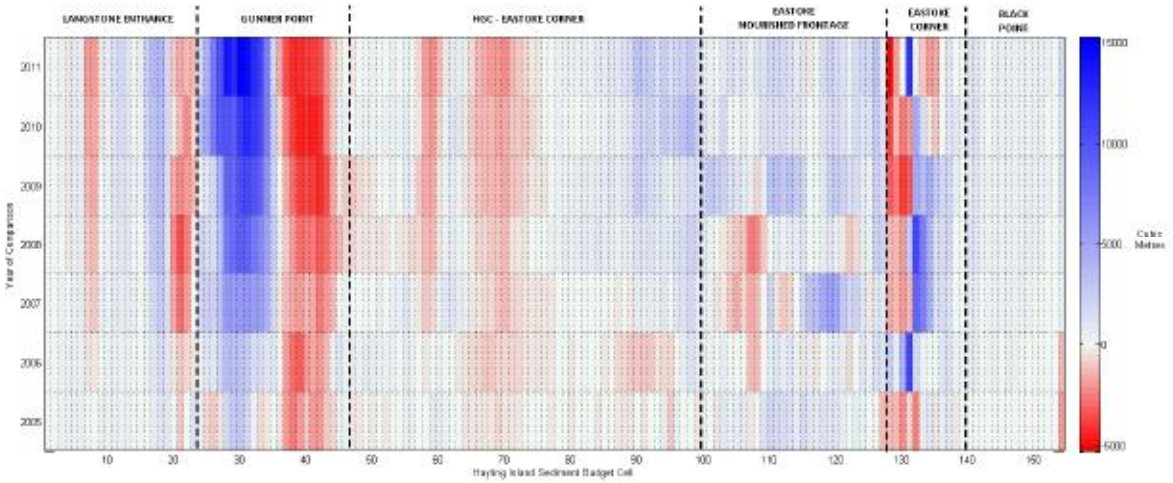

Figure 2.8 - Net volumetric change above MLWS, relative to 2004 baseline survey, based on annual GPS walkover surveys

The volume of material on the nourished frontage has increased by 26,760 m^3 over the period of analysis (Figure 2.9). This reflects a concerted effort by HBC to bring the beach up to the design standard following flooding in November 2005. This has included marine-based recharge totalling 166,155 m^3 from 2007 – 2009, and a general increase in the volume of material recycled back onto the Eastoke frontage each March (Appendix J). Expanding out to consider the current extent of the annual recycling operations (Appendix K) the volume of beach has only increased by 23,615 m^3 over the 8 year period. This indicates a slight deficit within the current extraction areas of 3,145 m^3, although over an 8 year period an annual average net loss of 395 m^3 is within the error bounds of the data being collected in the field.

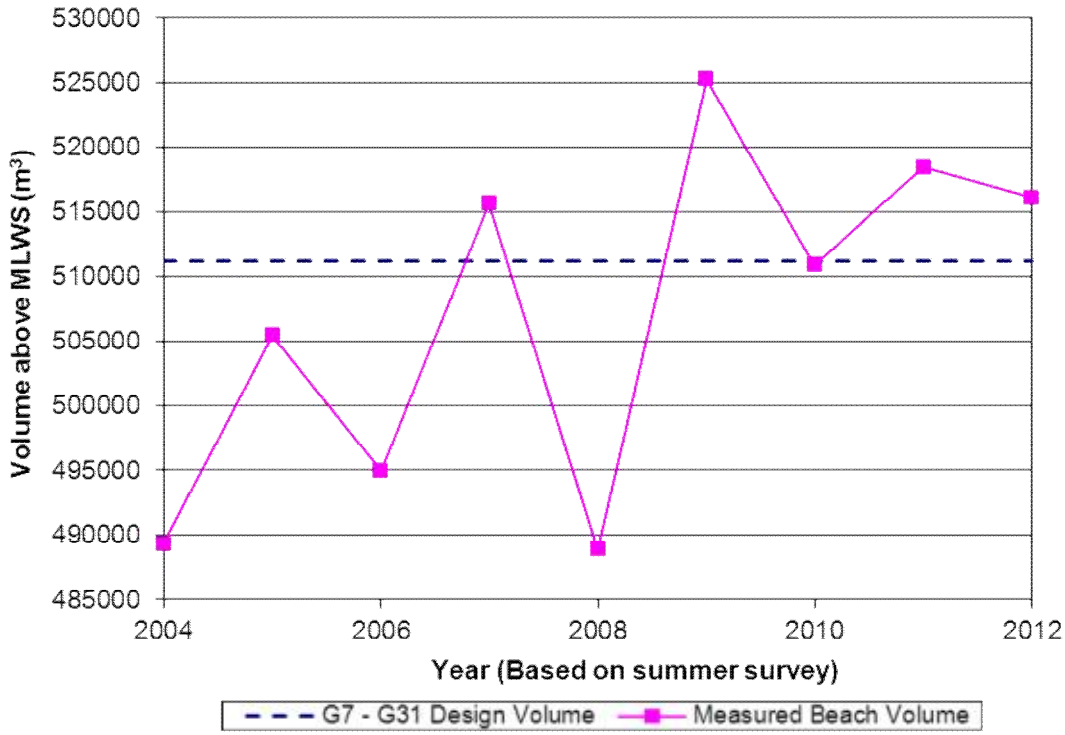

Figure 2.9 – Nourished beach volume (G7 – G31) against design volume (Section3.4) based on annual GPS walkover surveys

During the period of analysis there has been a net growth of material on Gunner Point of 92,250 m^3, confirming that Gunner Point is continuing to act as a sink of beach material on the frontage. From Gunner Point north to the Ferry Boat Inn there has been a net increase of 7,160 m^3, and from Black Point to Sandy Point there has been a net increase of 18,790 m^3.

Overall the central open beach (MU5) where extraction for recycling is undertaken has exhibited a net loss of 5,670 m^3 over the period of analysis. There is a trend for growth to the east of Beachlands and losses to the west (Figure 2.10). In 2006 & 2007 no recycling material was extracted from the open beach due to ongoing monitoring showing a sharp drop in the volume of the open beach. After the 2007 recycling operation the beach was growing in volume again and into summer 2008. Extraction from the open beach resumed in 2008, and in 2011 a total of 22,879 m^3 was extracted. After summer 2008 there has been an overall decline in volume but not as significant as in summer 2006. **Future extraction should target the areas of growth on the open frontage. If MU5 starts to exhibit significant**

overall volumetric losses then recycling extraction should be reduced again and the use of Gunner Point as a source of recycling material should be considered.

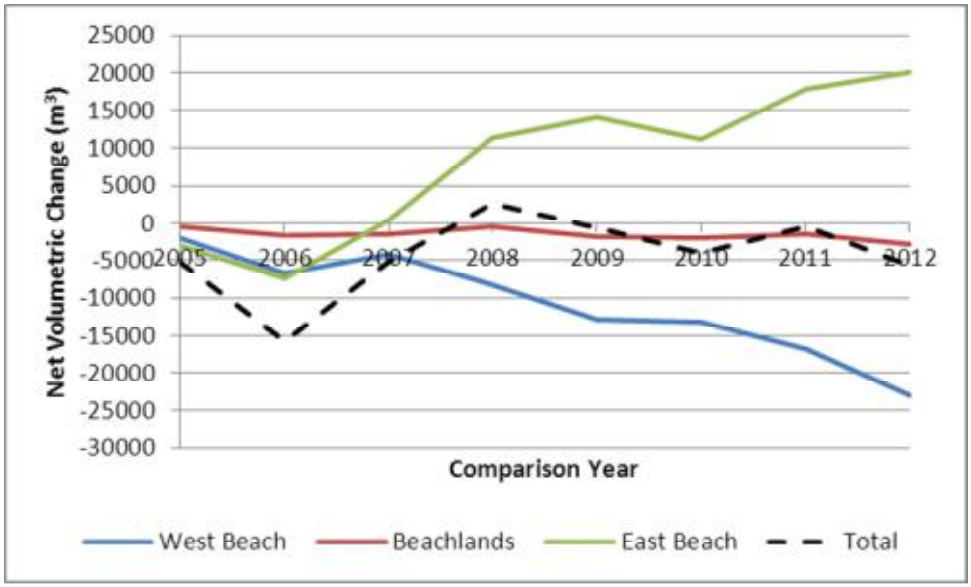

Figure 2.10 – Net volumetric change relative to 2004, central open beach

The annual losses from the nourished frontage, based on CSA and volumetric analysis, are contained in Appendix L. Analysis of beach volumes above -4m OD from 1985 to 2003 reveals net average annual losses off the frontage of 37,984m^3. Analysis of data collected since 2001 above MLWS indicates an average annual net loss of 41,825m^3. Within the data there is significant variation with net annual losses ranging from 1,650m^3 to 94,670m^3. The higher losses are generally associated with the original nourishment operation, and larger marine-based recharge operations. The average requirement for recycling material based on the fill volume required to maintain the design profile between groyne 7 and groyne 31 is 28,500 m^3, based on an analysis of the last 5 years pre-recycling topographic surveys.

Previous marine-based recharge operations have utilised the arisings from maintenance dredging of the Chichester entrance channel, being comprised of material similar in composition to the nourished beach. At present there is no requirement for the Chichester Harbour Master to undertake a maintenance dredge of the Chichester approach channel (Ref 2.22) but volumetric analysis of the most recent bathymetric data indicates there is currently 15,000m^3 of material available if a maintenance dredge were undertaken at present.

(d) Beach profile storm response

Along the nourished frontage the general post-storm response of the beach starting at the design profile is as follows:

- Rotation of profile around approx. MSL
- Upper mobile beach face lowers
- Lower mobile beach face rises
- Cliffing develops in beach crest at upper limit of runup
- If run-up exceeds crest elevation then material thrown over the beach crest and gathers on promenade to rear

- If overtopping severe then crest elevation reduced through overwashing and crest drops to 'failure' profile level, which is the height of the redundant sea wall

If the beach levels are low compared to the height of the timber groynes then long period waves have been observed to interact with the groyne, increasing run-up along the updrift side and eroding the beach crest. Initially this removes material from the beach crest leaving a cliff which blocks the wave from running up and over the crest. If conditions are severe enough then the waves overwash alongside the groynes, causing fans of beach material to be deposited on the promenade. In November 2005 the entire beach was overtopped with the areas of the nourished beach performing least well corresponding with the three erosion hot spots identified below in Section 2.5.3. It should be noted that at both Eastoke Point and Eastoke Corner the beach profile was not at the design profile prior to the storm event occurring. The beach at Eastoke Corner failed in the centre of one bay and was level with the promenade with no beach crest remaining. At Eastoke Point the last bay on the promenade (Groyne 7 – Groyne 8) actually gained a small amount of material on the beach crest, presumably benefitting from material transported alongshore from the adjacent eroding nourished bays. At the Creek Road car park and the drift divide the crest cut back markedly but did not fail completely. Significant volumes of beach material were deposited on the promenade to the rear, resulting in water levels approaching the top of the rear splash wall in places as water was unable to flow to the normal discharge points and into the drainage system in Southwood Road.

(e) Predictions of future shoreline evolution

The general pattern of erosion along the eastern section of the frontage, between the surface water outfall at Sea Grove Avenue and Eastoke Point (MU2, MU3 & MU4) is predicted to continue into the future. If nourishment were to cease this section of beach would erode, leading to the eventual collapse of the previously buried seawalls. In turn the beach would then roll back, eroding back into the Eastoke Peninsula. As the hinterland is low-lying little additional material would be supplied to the wider frontage as the beach rolled back. As the nourished frontage is the supply of material to the wider frontage cessation of nourishment activities would lead to erosion becoming prevalent around the wider frontage until a more stable plan shape was attained.

Assuming nourishment at Eastoke can balance the losses off the entire Hayling frontage then the accretionary trends identified along the central and eastern section of the frontage will continue. Within overall trend there is the potential for dynamic changes in the beach plan form associated with the influence of the East Winner, and potential temporary drift reversals around Gunner Point. This could lead to further erosion or accretion at the boundary of MU5 & MU6. Further changes in beach plan form are also anticipated in relation to the Inn-on-the-Beach and timber breastwork just to the west (Ref 2.23). If this structure were removed from the system there would be a realignment of the frontage with erosion on the central beach updrift, and accretion downdrift at the boundary of MU5 & MU6.

Recent research into the evolution of the Langstone and Chichester ebb-tidal deltas has identified the possibility of the West Pole decreasing in size in the future (Ref 2.23), in a similar manner to the West Winner (Figure 2.11). If this were to occur the rate of sediment

losses of the Eastoke nourished frontage are anticipated to increase, and the increase in wave energy could increase the risk of wave overtopping. These changes are not anticipated within the 5 year period of this BMP but ongoing monitoring is designed to detect the early signs of a decline in the West Pole (Section 4.2.4).

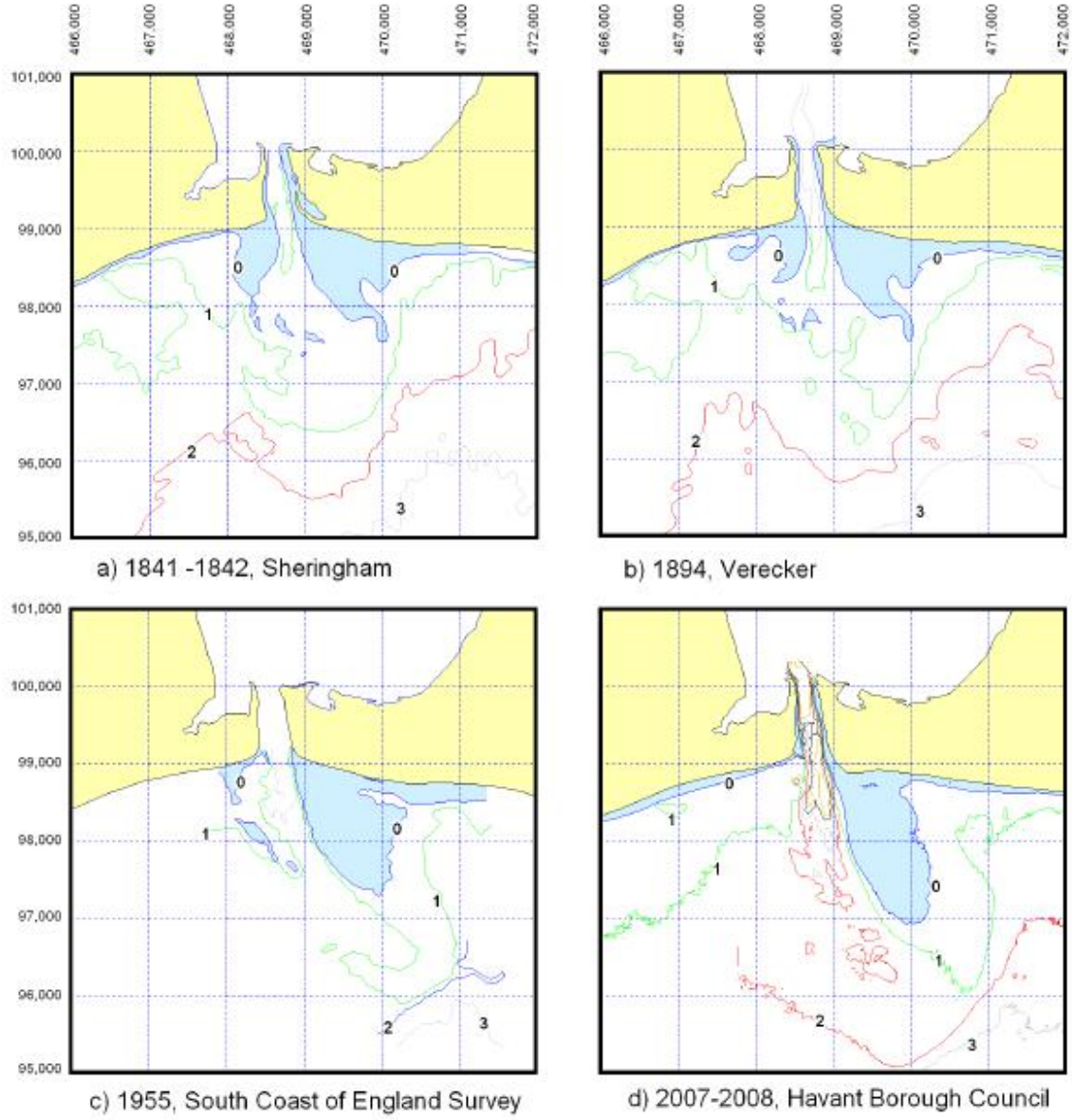

Figure 2.11 - Evolution of Langstone ebb-tidal delta morphology, 1841 – 2008. Contours shown in fathoms relative to chart datum (1 fathom = 1.8288m) (Ref 2.24)

2.5.3 Beach Stability

In general the western end of the central & western parts of the Hayling Island shoreline are largely undeveloped and have tended to accrete. This is particularly so at Gunner Point where the shoreline has moved seaward by some 200m this century, resulting in the development of multiple shingle ridges. The eastern end of the frontage has tended to erode, creating the need for intervention to manage the impact of flooding and coastal erosion. The spit at Black Point is slowly accreting and this has also resulted in operational difficulties at the Hayling Island Sailing Club.

Figure 2.12 shows the location of all the erosion hot spots (current issues), watch spots (potential issues) and other issues around the South Hayling frontage. These are discussed in more detail below.

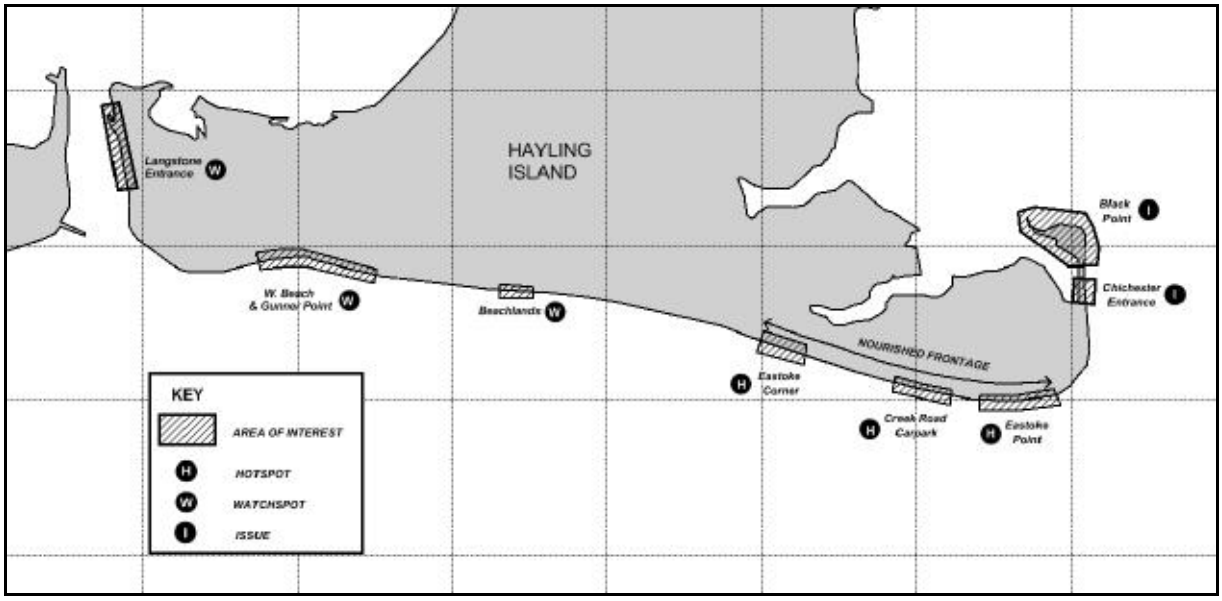

Figure 2.12 – Erosion hotspots, erosion watch spots & other issues

(a) Erosion Hot Spots

Eastoke Point

This section of coastline was identified in the Eastoke Sectoral Strategy (Ref 2.25) as requiring a separate scheme to deliver the required standard of protection to the Eastoke Peninsula. The Eastoke Point Coastal Defence Study (Ref 2.29) identifies the key reasons why beach nourishment alone is not adequate to maintain the required Standard of Protection in this area. In summary, the original nourished beach has gradually eroded away in this area and subsequent recycling has been unable to maintain beach levels. A redesign of the control structures is required to allow an adequate design profile to be maintained at the eastern end of the main nourished frontage. Beach levels are already low and minor events can trigger rapid failure of the timber groynes as they are undermined. There is a risk of a breach forming into the nature reserve during a storm event, and the Eastoke Peninsula flooding. The proposed works include construction of a sloping rock revetment and rock groynes, extending the existing rock defences onto the main nourished frontage. **HBC should deliver the Eastoke Point scheme to address the erosion, and associated flood, issues in this area.**

Eastoke Corner

The section of nourished frontage from groyne 28 west to groyne 35 is frequently below the required design level after relatively minor storm events. Shingle is regularly washed over onto the promenade and the beach crest is often eroded back to the promenade over the winter months. The proposed recycling operations will be used to bring this section of the frontage up to the 1 in 200 year design profile and maintain it there. The coarser imported

recharge material should be used to construct the beach crest and improve stability. **If the design profile cannot be maintained through annual recycling alone then further investigations into adjusting the control structures in this area should be carried out.**

Creek Road Car Park

The section of nourished frontage just east of Creek Road car park is situated over the drift divide. It has proved difficult to maintain the design profile in this area, and the beach is currently below the 1 in 200 year standard of protection before the winter months (Figure 1.8). **If the design profile cannot be maintained through annual recycling and recharge alone then further investigations into adjusting the control structures in this area should be carried out.**

(b) Erosion Watch Spots

Langstone Entrance

The beach flanking Langstone Harbour is dynamic and pulses of material periodically move up into the harbour. This section of beach is privately owned but the car park is leased to HBC. In the past small scale beach management works have been undertaken to protect the car park, and an earth embankment constructed in 1993 is currently being eroded to the north of the public car park. Material has also been removed from borrow pits on Hayling Golf Club (HGC) land and used to protect the access road adjacent to the 13th hole. Any potential beach management activities are outside of the scope of modifying the existing beach recycling operation. Works would need to be undertaken on a local scale, and most probably by private parties.

West Beach & Gunner Point

The length of beach west of Inn-on-the-Beach, extending round onto Gunner Point, has undergone rapid periods of accretion and erosion historically. The burial of the western end of the West Beach sloping timber breastwork in the 1990s was associated with a temporary littoral drift reversal in this area. Currently beach levels are low but relatively stable at present. Sections of the timber breastwork are likely to fail within the BMP period and would need to be removed from the beach on health and safety grounds. This could reduce the potential supply of recycling material thrown over the existing structure. Preliminary discussions have been held with HGC, who are suffering erosion infront of golf club land, about the extraction of material from Gunner Point. Areas of growth could provide a good source of recycling material. In turn, less material could be extracted on the central open beach improving the feed of material flowing past the vulnerable corner southeast corner of the golf course. The construction of a suitable haul road to extend the recycling operations would also help stabilise the current beach crest in this area. **If required, discussions with HGC should be re-opened about the use of Gunner Point as a potential extraction area.**

Beachlands

Erosion of the beach crest infront of the Beachlands Funfair has been an issue inside the last five years. Recently the beach crest has stabilised but the issue may re-emerge during the BMP period. Extraction on the beach adjacent to this area should take into consideration the state of the beach infront of the privately owned car park. If the area is eroding extraction from the beach face immediately downdrift of this section of the frontage should be avoided. **The owners should be notified prior to recycling operations commencing and any requests related to the works considered.**

(c) Other Issues

Black Point

General accretion at the distal spit at Black Point has caused concerns to arise in this area in the past. The operators of Sparkes Marina have commissioned investigations into the cause of a bar forming in channel north of Black Point (Ref 2.26). It appears to be the result of sand dredged from a visitors berth and deposited in the channel. Discussions have been held about incorporating any further dredging with the annual beach recycling operation. The volumes being discussed were relatively low, and land-based transport to the southern frontage was discussed. There are various environmental considerations and constraints to be considered before any works could take place. The operator has not been in contact recently but the issue could re-emerge over the period of the BMP. **Liaison with MDL Marinas should continue if requested and the possibility of incorporating some sand extraction into the recycling operations considered if requested.**

Accretion of sand on the HISC slipway has caused issues launching and recovering yachts. HBC have provided advice on this matter over a number of years and the problem is episodic. Currently HISC are experimenting with the removal of the top of a pontoon over the winter months to try and allow the sand to flow onto Black Point more freely. Discussions have been held in conjunction with the operators of Sparkes Marina about recycling sand back onto the southern frontage as part of the annual recycling operations. There are various environmental considerations and constraints to be considered before any works could take place. There has been no recent contact with HISC although the issue could re-emerge over the period of the BMP. **Liaison with HISC should be ongoing and the possibility of incorporating some sand extraction into the recycling operations considered if requested.**

Chichester Entrance

The natural movement of shingle moving up towards Black Point forms a ridge of shingle across the RNLI slipway. This prevents the RNLI from launching, and is problematic for them to clear. In previous years this material has been cleared from the area surrounding the launching area during the recycling operation and moved back onto the Southern frontage. **Clearance of the shingle ridge infront of the RNLI station should be considered prior to each recycling operation**.

2.6 ENVIRONMENT CHARACTERISTICS

The following chapter details the key environmental considerations relevant to the BMP.

2.6.1 Natural Environment

As already highlighted in Section 1.3.1, the BMP area is within or near to (within 2km of) a number of designated areas. These areas are shown on Figure 1.2. Further detail on each of the designations is presented in Appendix A.

(a) International & European Designations

There are three international or European nature conservation designations within or near to the BMP area:

- Solent Maritime SAC.
- Chichester and Langstone SPA.
- Chichester and Langstone Harbours Ramsar Site.

(b) National Designations

There are three national nature conservation designations within or near to the BMP area:

- Chichester Harbour SSSI.
- Sinah Common SSSI.
- Langstone Harbour SSSI.

(c) Non-Statuatory Local Designations

There are three local designations within the study area:

- Sandy Point Local Nature Reserve and Countryside Heritage Site, which is adjacent to Eastoke Point
- Southern Eastoke Frontage SINC, which includes the nourished beach (MU3)
- Beachlands SINC, which includes area of the open beach in MU4.

There is one local designations near to the study area:

- The Kench Local Nature Reserve, which is adjacent to MU7.

2.6.2 Landscape

(a) National Character Areas

The BMP study area lies within the South Coast Plain & Hampshire Lowlands National Character Area (NCA), and is comprised entirely of the generally open and often featureless landscape of the coastal plain.

Most of the length of the study area consists of a shingle barrier beach, bounded by two distal recurved spits adjacent to the harbour entrances. There are man-made sea defences at various locations along the frontage, with the largest natural sections of beach around Gunner Point (MU6) and central Beachlands (MU5). The beach frontage consists of shingle, a mixture of sand and gravel, overlaying Bracklesham Beds, with the foreshore dominated by sand where the influence of the ebb-tidal shoals is strongest. Urban development close to

the beach is mainly confined to the Eastoke Peninsula, with a few individual properties located within the active beach zone along the wider study area, e.g. the Inn-on-the-Beach & the Ferryboat Inn.

(b) Marine Conservation Zones

The Marine and Coastal Access Act (2009) created a new type of Marine Protected Area (MPA), called a Marine Conservation Zone (MCZ). Natural England and JNCC provided advice on how MCZs should be selected, with the government using these recommendations as a basis for selecting MCZs for designation in 2012.

MCZs will protect nationally important marine wildlife, habitats, geology and geomorphology. Sites will be selected to protect not just the rare and threatened, but the range of marine wildlife. The BMP study area lies within the Balanced Seas project (www.balancedseas.org, accessed 14/08/12), which aims to identify and recommend MCZs zones for the inshore and off-shore waters of south-east England. A number of draft MCZs have been put forward, including Selsey Bill to the east of the study area and Bembridge to the south, but the study area is not within any proposed MCZ.

2.6.3 Ecology

The UK Biodiversity Action Plan (BAP) (Ref 2.27) and the local Hampshire BAP (Ref 2.28) are the relevant biodiversity plans for the study area. This identifies a single priority BAP habitat located within the BMP area; Shingle and Sand dunes. Maritime vegetated shingle structures and sand dunes are rare and specialised habitats supporting internationally important vegetation types, several types of which are listed as priority habitats in Annex I of the EU Habitats Directive. As such, they are key habitats within the National Biodiversity Action Plan. The BMP study area is also adjacent to areas containing the following priority BAP habitats: Mudflats & Eelgrass Beds, Saltmarsh, Saline Lagoons and Coastal Wet Grassland.

Sand dunes are windblown sand formations associated with dune slacks, grassland and scrub. The larger areas of sand dunes are associated with shingle habitats, particularly shingle spits, with the most important sites in the county on the South coast of Hayling Island presenting a rich mosaic of sand dune and shingle habitats and associated species (BAP, 2003).

Hayling Island has a good range of foredune, mobile dune and fixed dune types (all acidic), dune slacks, sandy and fixed shingle beaches, and rich dune and shingle acid heath, including important moss and lichen communities. Transitions between sand dune, shingle and saltmarsh occur. These habitats are of particularly high biodiversity for their parched coastal grasslands, which may take many decades, even centuries to develop. They are, along with a site on the Isle of Wight and one in Pagham Harbour, among the botanically richest in Britain.

Vegetated shingle is a Priority BAP habitat, and as such has habitat objectives on the BARS website which are:

- Maintain total extent of coastal vegetated shingle habitat throughout the UK, and the structures, sediment and coastal processes that support them. This is a 'no net loss' target to take account of the dynamic nature of shingle. This includes the maintenance of transitions to other habitats landward and seaward.
- Achieve favourable or recovering condition by appropriate management of coastal vegetated shingle systems currently in unfavourable condition by 2010. This should achieve the retention or enhancement of populations of BAP priority species associated with vegetated shingle.
- In key locations initiate restoration of shingle communities on arable land over shingle deposits by 2015.

2.6.4 Cultural & Archaeological Heritage

The Eastern Solent coastline and adjoining harbours comprise historic landscapes which have been utilised from pre-historic periods to the present day. There are a number of cultural heritage features that lie close to the BMP area, as shown on Figure 1.3.

Successive phases of sea level rise have created the Solent and enabled archaeological deposits to be submerged and preserved. As a flooded former river valley that was drowned during the Holocene marine transgression, Chichester Harbour is known to be an area of particularly high archaeological importance.

Prehistoric Period

A prehistoric settlement has been identified at East Head and at Gutner Common on North Hayling. A thin layer of burnt material extending 23m along a low sea cliff and containing burnt flint pot boilers sealed by alluvium has been interpreted as representing prehistoric land clearance. The potential for exposing prehistoric archaeology is unknown.

Bronze Age (2000-600 BC)

In the early Bronze Age, Chichester Harbour was used for seasonal grazing as well as butchering and tanning. There is extensive evidence of Middle to Late Bronze Age settlements including farming systems and enclosures. Round houses have been found on the coastal plain at Creek Field, Hayling Island and a rare, Late Bronze Age structure comprising timbers and wattle has been found on the northern frontage of the Island. Six Middle Bronze Age palstaves were located on the east coast of Hayling in 1985. These may be associated with an urn field.

The potential for recovery of Bronze Age artefacts is unclear but this possibility must be considered.

Iron Age (600BC – AD43)

A small rise in sea levels in the Iron Age is likely to have had a significant impact on the study area. There are important links between salt workings and sites on Hayling Island including Tournebury hill fort which guarded the western part of the entrance to Chichester Harbour. There is little potential for exposing Iron Age artefacts.

Roman Period (AD43-410)

The Roman invasion of AD43 resulted in major social and economic changes. There is evidence of an early Roman military presence in Chichester and many artefacts have been

found in the area including a bronze helmet dredged from the Harbour and disparate pottery finds. The potential for the recovery of Roman artefacts is low.

Early Medieval Period (AD410-1066)

During the Early Medieval Period, there may have been trade in Chichester Harbour. Chichester was one of the five fortified sites mentioned in the Burghal Hidage, that was probably compiled in around AD919. Chichester evolved into a major town in the 10th century and increasing trade is likely to have led to the creation of a port.

Later Medieval Period (AD1066 -1550)

During this period, the landscape would have comprised villages centred on parish churches. The harbour industries would have included fishing, salt-working, boat building and oyster farming and trade would have formed a significant proportion of the Harbour's economy. Wool appears to have been an important commodity passing through Chichester Harbour during the 13th century. By the end of the 13th century, there seems to have been a period of increased flooding within the area that has been linked to growing storminess and a slight rise in mean sea level. A considerable area of land belonging to the Priory on Hayling Island was inundated during the 14th century.

In South Hayling, three salterns are known; one medieval and two post-medieval. The medieval was the largest, known as Menghams and recorded in the Doomsday book. The salterns went out of use in the 1870s and by the 1950s there was no recognisable trace of them. Due to the inundation of Chichester Harbour, the potential for exposing artefacts from this period is low.

Post Medieval (AD1550-1800) and Modern Period (AD1800+)

The area comprises a number of post Medieval and industrial features that include mills (e.g. Hayling Island Tide Mill), harbour piles, salterns in North Hayling and oyster beds. The Sexton map of 1575 is one of the earliest maps of the area and shows Hayling Island as detached from the mainland, with channels shown as extending to Chichester. Due to the inundation of Chichester Harbour, the potential for exposing artefacts from this period is low.

2.7 RELEVANT INFORMATION

The following provides a list of sources of information that has been referenced in this section of the beach management plan.

Ref 2.1 **Admiralty Tide Tables Volume 1 2012: United Kingdom and Ireland (including European Channel Ports);** United Kingdom Hydrographic Office (2011)

Ref 2.2 **EasyTide** tool at the United Kingdom Hydrographic Office website: http://easytide.ukho.gov.uk/EasyTide/EasyTide/index.aspx (Accessed 14/06/2012)

Ref 2.3 **National Tide and Sea Level Facility** at the British Oceanographic Data Centre website: http://www.bodc.ac.uk/data/online_delivery/ntslf/ (Accessed 14/06/2012)

Ref 2.4 CHIMET tide gauge website: http://www.chimet.co.uk ((Accessed 14/06/2012)

Ref 2.5 Environment Agency (2011a); **Coastal flood boundary conditions for UK mainland and islands; Project: SC060064/TR4: Practical guidance design sea levels.** February 2011.

Ref 2.6 Environment Agency (2011b); **Coastal flood boundary conditions for UK mainland and islands; Project: SC060064/TR5: Practical guidance swell waves.** February 2011.

Ref 2.7 HR Wallingford, 1997. **East Solent Shoreline Management Plan**, Volumes 1 and 2: The Open Coast. Reports EX 3441(A) and (B). Report to East Solent SMP Project Group (Lead Authority: Havant Borough Council).

Ref 2.8 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 2.9 Whitcombe, L. J., 1995. **Sediment Transport Processes, with Particular Reference to Hayling Island**. Unpublished PhD thesis, Department of Oceanography, University of Southampton, 294pp.

Ref 2.10 HR Wallingford, 1995. **Pagham Harbour to River Hamble Coastal Strategy Study, Volume 1: Pagham Harbour to Portsmouth Harbour**. Report EX 3121. Report to Pagham to Hamble Coast Strategy Group (Lead Authority: Chichester District Council), 134pp

Ref 2.11 **Annual Report 2008, Selsey Bill to Southampton Water**. Reference AR43, Southeast Strategic Regional Coastal Monitoring. CCO (2008).

Ref 2.12 Bradbury, A., **Extreme wave conditions within the SCOPAC region, 2008 - 2010**. http://www.southerncoastalgroup.org.uk/research_complete.htm#Extreme (Accessed 14/06/2012)

Ref 2.13 Royal Haskoning (2012), **Eastoke Point Coast Defence Works - Wave and Overtopping Modelling, Technical Note 9X1135.**

Ref 2.14 Environment Agency (2011c); **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities**. September 2011.

Ref 2.15 Defra (2006); **Flood and Coastal Defence Project Appraisal Guidance FCDPAG3 Economic Appraisal**; Supplementary Note to Operating Authorities – Climate Change Impacts. October 2006.

Ref 2.16 Harlow, D.A., 1980. **Sediment Processes, Selsey Bill to Portsmouth**. Unpublished PhD thesis, Department of Civil Engineering, University of Southampton.

Ref 2.17 Webber, N.B. (1979). **An Investigation of the Dredging in Chichester Harbour Approach Channel, and the Possible Effects on the Hayling Island**

Coastline. Report to Chichester Harbour Conservancy, Havant Borough Council and Francis Concrete Limited, 56pp.

Ref 2.18 Wallace, H. (1990). **Sea-level and Shoreline between Portsmouth and Pagham for the past 2,500 Years.** Privately published by the author, 61pp.

Ref 2.19 Defra (2002). **Futurecoast.** Set of three CD-ROMS produced as part of the Futurecoast preoject by Halcrow for Defra.

Ref 2.20 **Annual Report 2011, Selsey Bill to Southampton Water**. Reference AR73, Southeast Strategic Regional Coastal Monitoring. CCO (2011).

Ref 2.21 SCOPAC (2004); **Sediment Transport Study** website: http://www.scopac.org.uk/scopac_sedimentdb/index.htm (Accessed 14/06/2012)

Ref 2.22 Telephone conversation with R. Craven, CHC Harbour Master, 4th Sept 2012.

Ref 2.23 Moon, C.R. (2008). **South West Hayling Island Beach Management Study, Inception report.** HBC Technical Report CEI-2008-001.

Ref 2.24 **Improving Beach Management on a Nourished Beach; Morphodynamics at Hayling Island, UK**, Unpublished MPhil Transfer Report, School of Environment & Civil Engineering, University of Southampton. Moon, C.R. (2010).

Ref 2.25 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 2.26 **Sparkes Marina: A review of maintenance dredging, Technical Note DDM6611-01.** HR Wallingford (2011).

Ref 2.27 **Biodiversity Action Reporting System** (BARS) website (www.ukbap-reporting.org.uk, accessed 14/08/12)

Ref 2.28 **Hampshire Biodiversity Action Plan** (BAP), (http://www.hampshirebiodiversity.org.uk/hampshire%20BAP.html, accessed 14/08/12)

Ref 2.29 **Eastoke Point Coastal Defence Study**, HR Wallingford (2008).

3 Scheme Design

3.1 SCHEME DESCRIPTION

The current hard sea defences were largely constructed in the 1970s and 1980s, as discussed in Section 1.3.3, with the advent of beach nourishment commencing at Eastoke in 1985. Although the South Hayling BMP considers the wider Hayling frontage from Black Point round to the Ferry Boat the scheme is focused on delivering flood and coastal erosion protection to the Eastoke Southern Frontage. Where possible the sources of material and method of working employed during the beach recycling operations, discussed in more detail in Section 5.4, will be modified to minimise the impact on the beach outside of the Eastoke Southern frontage but there are no nourishment works currently planned outside of MUs 2 & 3. Allowing the nourished material to travel further along the frontage before recycling it back to Eastoke benefits the wider South Hayling frontage, as opposed to trapping the material on the nourished frontage and starving the adjacent sections of coastline. As such there is no scheme design for the wider frontage, rather efforts will be made to minimise any impact of the ongoing beach management activities on the wider frontage.

3.1.1 Nourished Beach

The original nourished frontage extended from Eastoke Point to Eastoke Corner, a distance of 2.2 kilometres. The losses off the nourished frontage have supplied sediment to the wider Hayling Island sediment cell, and rapid losses observed to the east lead to the construction of a terminal rock groyne in the early 1990s. The resulting downdrift erosion lead to emergency works , involving the construction of a rock revetment and stub groynes to prevent a breach forming into the Eastoke Point Nature Reserve. This serves as a good illustration of the risks associated with completely cutting off the supply of sediment leaving the Eastoke nourished frontage, and the merits of allowing material to be recycled from further along the system.

Since the original recharge operation in 1985 periodic recycling operations have been undertaken to maintain the beach levels, and are now carried out on an annual basis (Appendix J). In recent years the recycling and recharge operations have focused on the beach directly in front of the Eastoke promenade, between groynes 7 – 31 as the area east of groyne 7 (MU3) has proved difficult to maintain with beach nourishment alone. The Strategy identified the need for a separate scheme to deal with the erosion hotspot at the eastern of the nourished frontage around Eastoke Point (Section 3.1.3), which is currently being developed.

Periodic beach recharge operations have been carried out using marine-based beach recharge and smaller volumes of land-based beach recharge have also been imported in conjunction with the annual beach recycling operations. The timber groynes along the nourished frontage act to hold more material on the upper beach (Section 3.1.2), although if the groynes extend too high above the beach surface issues have arisen due to waves

reflecting up the side of the groyne, scouring out the crest by the groyne and under more severe wave conditions overwashing the beach crest.

3.1.2 Control Structures

The nourished beach relies on 32 timber groynes and a single rock groyne at the eastern end of the frontage to help retain material on the Eastoke southern frontage. All other structures on the frontage are redundant as the nourished beach now acts as the primary defence. The groynes are in generally good condition (Section 1.3.4). The section of beach covered by the Eastoke Point Scheme (Section 3.1.3) contains 8 timber groynes that are currently vulnerable to rapid failures due to the low and dynamic beach levels in this area. Replacement of the timber structure with rock groynes will help to stabilise this section of coastline, and reduce the loss of nourished material east of the frontage. It should be noted that a feed of material eastwards must be maintained to avoid erosion on the drift aligned section of beach from Sandy Point up to Black Point. As such, the rock structures are not to act as a terminal structure for the nourished beach but will slow the loss of material around Sandy Point.

3.1.3 Eastoke Point Scheme

The proposed scheme at Eastoke Point will extend the existing rock control structures westwards onto the main nourished frontage (Figure 3.1), and is designed to bring the standard of protection up to the required 1 in 200 year level in an area where beach levels are highly dynamic and presently very low. There will still be a requirement for ongoing beach management in this area, including beach recycling, but there will be a corresponding reduction in the volume of beach recycling required at the eastern end of MU3. Therefore, there will be little or no net increase in the volume of recycling activities required on an annual basis. The scheme has been designed with due regard for the ongoing beach management activities and factors such as the requirement for a haul road around Sandy Point have been accounted for in the design process.

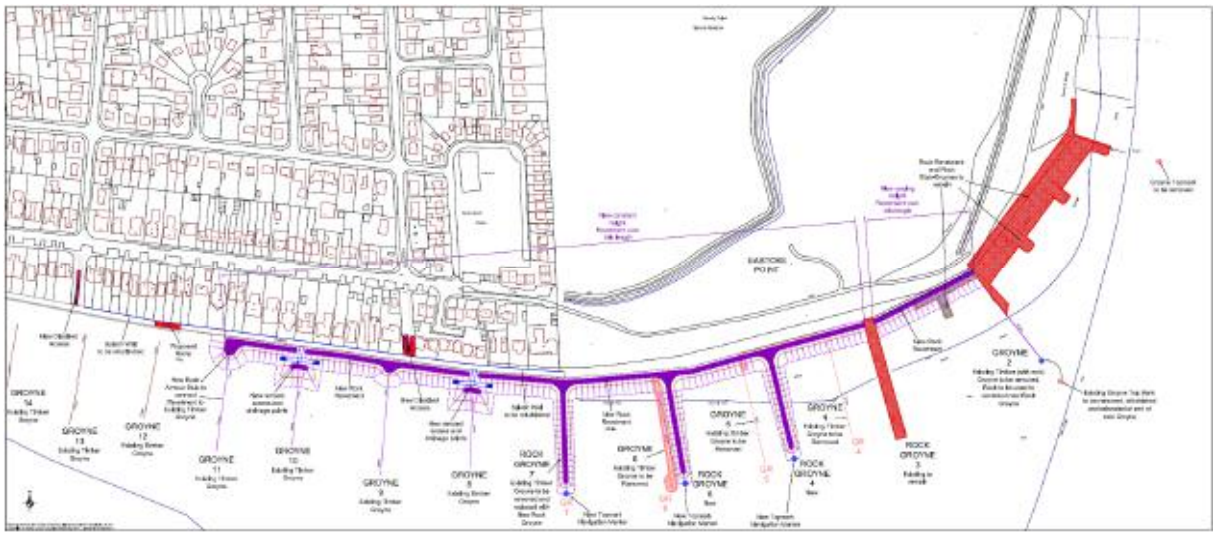

Figure 3.1 - Eastoke Point proposed scheme design

3.2 STANDARD OF PROTECTION

The Eastoke Peninsula is a large urban area, densely populated with a mixture of residential and commercial property. The assets at risk from flooding, coastal erosion and overtopping on the Eastoke peninsula are listed below:

- The primary road network on the peninsula
- 1743 residential properties
- Sparks Marina
- Sandy Point Local Nature Reserve
- Hayling Island Sailing Club
- Extensive holiday chalets & caravan parks

The Peninsula has been subject to coastal flooding on a number of occasions (1978, 1979, 1985 and recently in 2005) and flooding from an extreme surge in 1989. The key concern along the coastal frontage is that, if unmanaged, the shingle beach would erode leading to a breach causing widespread damage to properties, the loss of the main feeder road into the Peninsula and frequent flooding to the many properties constructed below Mean High Water (Appendix M).

The North Solent Shoreline Management Plan (SMP) (Ref 3.1) has confirmed a Hold the Line policy for the whole of the Southern frontage of Hayling Island (Section 1.6.1). The Eastoke Sectoral Strategy Study (Ref 3.2 & Section 1.6.2) identifies the Approved Option for the Southern Frontage: Main Section as:

> 'Hold the Line to a 1 in 200 Return Period standard of defence through beach recharge and annual recycling.'

3.2.1 Beach profile response analysis

The original 1985 design of the beach nourishment was based on constructing a beach to the same elevation as the adjacent undefended sections of coastline. The crest elevation of the 1985 scheme was increased in the winter prior to construction from 5.0m OD to 5.6m OD in response to wave overtopping observed along the open beach (Ref 3.3).

The approach currently adopted for establishing the appropriate crest width and elevation to deliver the required standard of protection for both erosion and wave overtopping is to:

- Derive joint probability of wave and water levels
- Establish critical combination (maximum crest retreat)
- Test design conditions against typical beach profiles / design options
- Test failed profile for overtopping rates using SWALLOW equations
- Establish overall overtopping discharge for each scenario tested
- Derive minimum berm dimensions for each return period

Failure of the beach profile is defined as the profile lowering to the crest of the seawall buried behind the nourished beach. The minimum design profile for a 1 in 200yr event has been updated several times since the original model runs in 1998 (Ref 3.4), with the latest key parameters (crest width & elevation) shown in Figure 3.2 (Ref 3.5). In 2009 HR amended their model results, following an update of the SHINGLE model, reducing the crest width required from an erosion perspective.

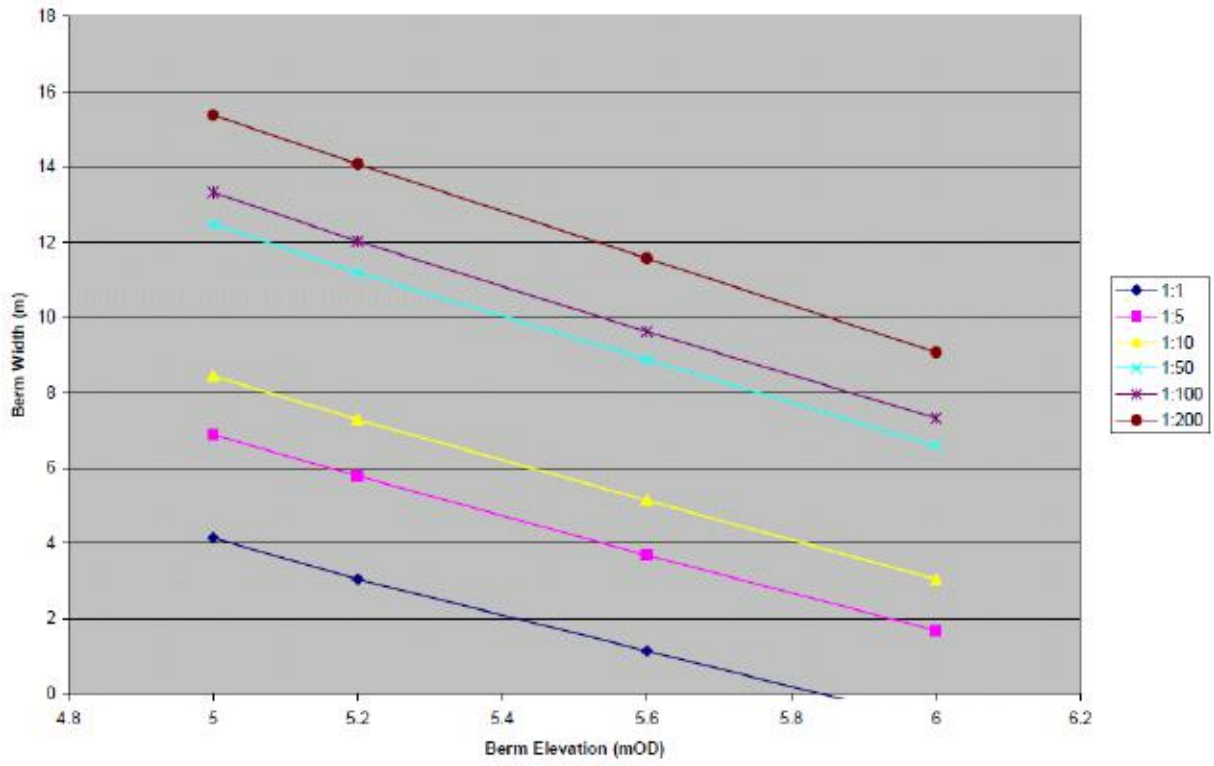

Figure 3.2 - Beach Design Profile Parameters (Ref 3.5)

3.2.2 Overtopping analysis

Various reports have assessed wave overtopping over the nourished beach (Ref 3.4, 3.6 & 3.7). The methods utilised have included the SWALLOW model, AMAZON and Eur0top Neural Network. The results of previous overtopping analysis (Ref 3.4) comparing the pre-nourishment profile and failed post-nourishment profile (crest reduced to level with old seawall) are illustrated below (Figure 3.3).

The latest work using the wave and water levels from Section 2.3 and the Eur0top Neural Network to predict overtopping over the 1 in 200 year design profile indicates average overtopping rates in the order of 7 l/s/m. There is significant uncertainty associated with this value due to the limited data available on overtopping on mixed sand and gravel beaches, and the impact of a bi-modal wave climate. As such the overtopping rates are regarded as indicative rather than absolute values.

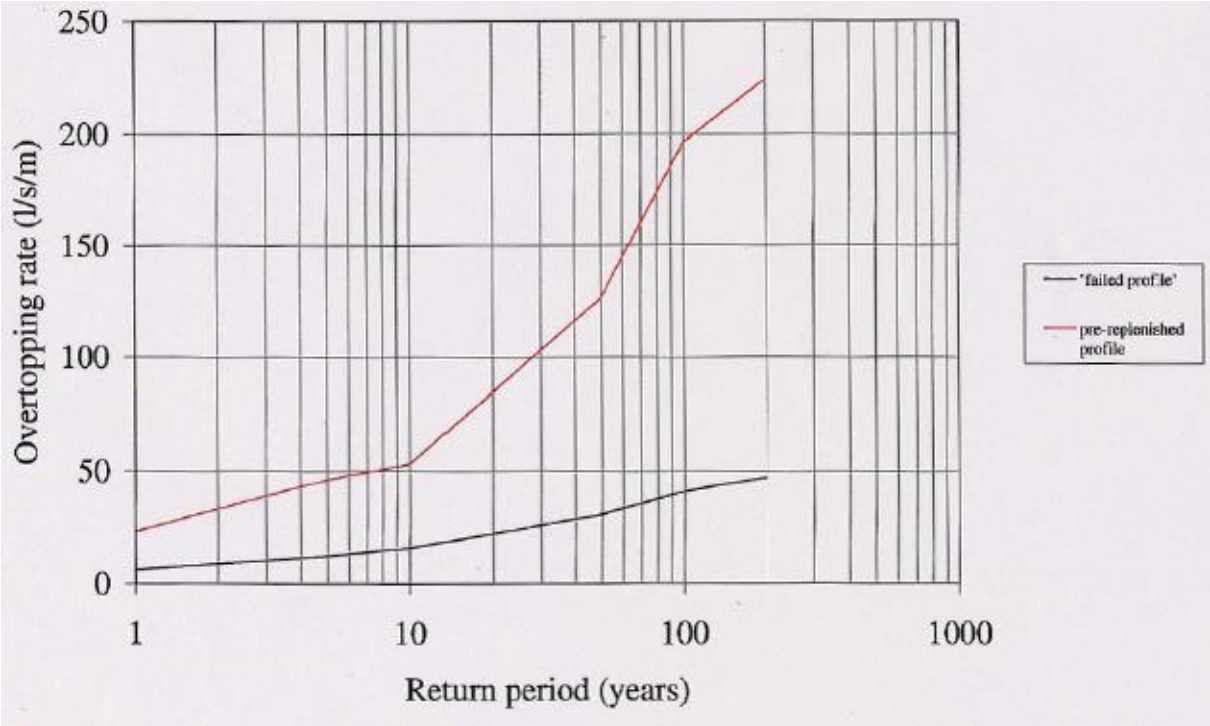

Figure 3.3 – Overtopping rate of failed and pre-nourishment profile (Ref 3.4)

3.2.3 Design Rationale

Experience gained over 26 years managing the Eastoke nourished frontage indicates that long period swell waves can overtop the beach at 5.6m ODN crest heights, doing so several times since the 1985 Hayling Island Beach Replenishment Scheme was constructed. A wider berm helps reduce this overtopping, although significant overtopping was observed in Nov 2005 over a beach at 5.6m ODN crest height and 20m width from the promenade to the crest. At Creek Road car park the crest was reduced in width by approximately 11m over a single high water. If the revised minimum crest width of 11.6m suggested in Section 3.2.1 was adopted for the frontage this would have likely resulted in failure of the beach (crest back to promenade), and an increase in overwashing. This reduced crest width reduces the resilience of the beach against repeated storm events over the winter months, increasing the likelihood of profile failure between the proposed annual beach recycling operations.

A previous version of the minimum erosion design profile (Ref 3.8) identified a minimum crest width of 18m at a 5.6m elevation for a 1 in 200 year SoP, which has been applied to the beach since 2007. The nourished beach is currently at this standard along most of the frontage (Section 1.3.4) following significant capital investment between 2007 and 2009 to recharge the frontage. The ESCP consider it appropriate to maintain a factor of safety in the beach design and continue to use the 18m crest width for the current BMP period. The beach is currently performing well and any reduction proposed to the crest width would need careful consideration. **If during the BMP period improvements in the numerical techniques available to predict beach response and overtopping, or results of the ongoing monitoring programme, suggest this crest width should be reduced then the design profile should be reassessed.**

3.3 DESIGN PROFILE

The 1 in 200 year design profile based on the design rationale in Section 3.2.3 is illustrated in Figure 3.4. A width of 18m from the beach crest to the promenade and 5.6m OD elevation are constant along the entire frontage. The rear slope varies according to the construction of the promenade and seawalls behind the nourished beach. The lower beach slopes are based on an average of several years measured beach profiles and alter along the nourished frontage. A summary of the individual design profiles is tabled in Appendix N. The design profile has been produced from Groyne 7 to Groyne 35. There is no design profile applied east of Groyne 7 as nourished material cannot currently be retained in this area. **Once the Eastoke Point Scheme is constructed appropriate design profiles must be developed to maintain the required beach levels.**

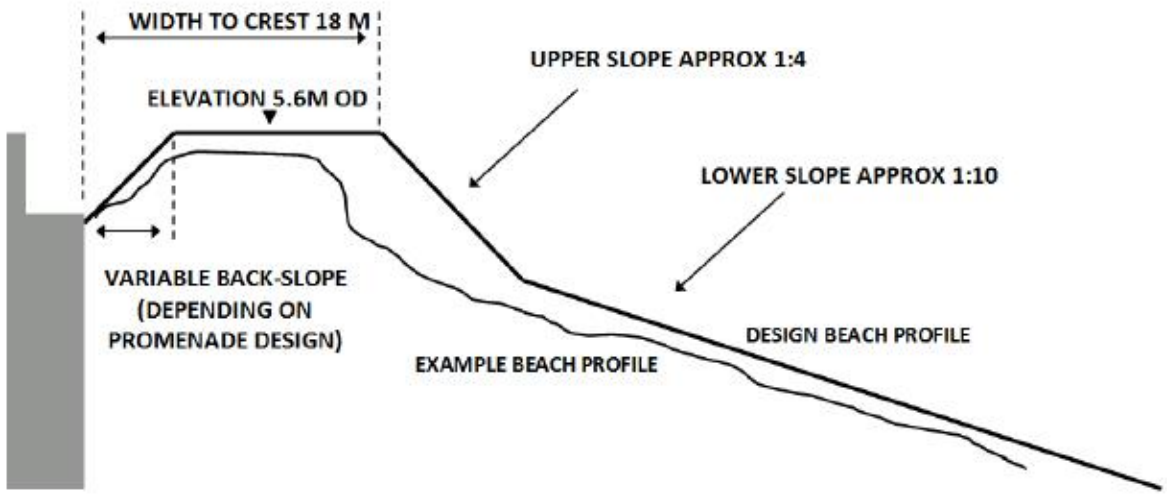

Figure 3.4 – Nourished beach design profile

3.4 DESIGN VOLUME

A design volume of 604,741 cubic metres has been calculated for the nourished frontage (Groyne 7 – Groyne 35). The design beach surface was generated from the design profiles along the nourished frontage. The volume of material between this design surface and a datum of MLWS (-1.84m OD) was then calculated for each groyne bay along the nourished frontage. A breakdown of the design volumes for each individual groyne bay is given in Appendix O. **The design volume will be recalculated once the Eastoke Point Scheme is constructed, based on revised design profiles from Groyne 11 to the existing long rock groyne.**

3.5 TRIGGER LEVELS

The application of trigger level values should not be absolute, and consideration should also be given to sea conditions at the time of the assessment. The best opportunity for beach inspections is immediately following a storm event. However, whilst beaches usually experience significant draw-down and crest width reduction during storms, they usually recover to near their pre-storm level shortly afterwards in calmer conditions. It is therefore recommended that unless further severe weather is expected, several days should be

allowed for the beach to recover following the storm before remedial actions are implemented. The trigger levels identified below are provided as a basis for assessing the requirement for emergency works etc. Each instance should be assessed on its own merits taking into account other factors such as the time until the next planned works.

There are two distinct types of triggers identified for managing the Eastoke Southern frontage; volumetric and profile based.

The volumetric thresholds are designed to ensure there is adequate material on the frontage to maintain an adequate sediment supply for the annual recycling operations used to maintain the design profile. The profile based trigger levels are designed to maintain the required standard of flood and erosion protection, and have been in place since the 1992 BMP. The two thresholds are applied independently, so for example the beach crest will still require topping up to maintain the 1 in 200 year profile even if the overall nourished beach volume is above the required standard.

Alarm

- Three or more consecutive groyne bays depleted below a 1 in 10 year standard of protection. ACTION: The area shall be monitored daily by suitable officer to assess whether the area is deteriorating or naturally regenerating (Section 4.2.5). If the area is regenerating then daily monitoring shall continue until the standard of protection is in excess of the 1 in 10 year standard.
- The overall nourished frontage volume falls within 10,000 cubic metres of the design volume (Section 3.4). ACTION: Volume of the nourished frontage to be monitored to establish if low levels result of single anomalous survey, e.g. event drawing material down below toe of surveys, or a longer term erosional trend.

Crisis

- Three or more consecutive groyne bays depleted below a 1 in 10 year standard of protection AND deemed to be deteriorating. ACTION: Emergency works identified in Section 5.3 triggered, along with the appropriate ongoing monitoring (Section 4.2).
- Nourished beach volume estimated to fall below design volume before the end of the BMP period. ACTION: Emergency works identified in Section 5.3 triggered, along with the appropriate ongoing monitoring (Section 4.2).
- Individual bay drops below 1 in 1 year SoP. ACTION: Emergency works identified in Section 5.3 triggered, along with the appropriate ongoing monitoring (Section 4.2).
- 50% of frontage falls below 1 in 100 year SoP (Section 3.3). ACTION: Emergency works identified in Section 5.3 triggered, along with the appropriate ongoing monitoring (Section 4.2).

3.6 RECHARGE SEDIMENTS

The preferred recharge material is single-sized graded 20-40mm aggregate. The material is dredged at licensed offshore sites before being landed and graded ashore. The material is therefore of a similar type and appearance to the coarser fraction of material already on the beach. This material performs well on the nourished beach, and has been used as part of previous recycling operations to armour the front face of the beach crest. Unlike dredged

material pumped directly ashore there is no loss of fines from the beach as it is reworked by wave action. The absence of sand in the material prevents the occurrence of cliffing, and improves drainage down through the beach crest.

If a maintenance dredge becomes necessary to remove the bar from Chichester entrance channel this material will be utilised rather than lost as part of the wider sediment budget feeding the Eastoke frontage. The sediment in the entrance channel is a good match to the current beach material, although losses due to fines are still estimated at 15%. This represents the fraction of material too small to remain stable within the mobile beach and are winnowed out. Suitable sources of material from licenced offshore dredge sites have previously been identified (Ref 3.8), although the estimated losses are generally higher at around 30%. **If the use of an offshore dredge site is required the suitability of the potential dredge sites will need reassessing.**

3.7 RELEVANT INFORMATION

The following provides a list of all sources of information that have been referenced in this section of the beach management plan.

Ref 3.1 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 3.2 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 3.3 **Correspondence about HIBRS initial design**, Harlow, D.H. (2012), Pers comms.

Ref 3.4 **Investigation into beach profile response and overtopping**, Letter C/H/5/0A. HR Wallingford (1998).

Ref 3.5 **Eastoke Point Coastal Defence Strategy: Investigation into minimum berm width**, Technical Note CBR3873-01b. HR Wallingford (2009).

Ref 3.6 **Pagham Harbour to River Hamble Coastal Strategy Study, Volume 1: Pagham Harbour to Portsmouth Harbour**. Report EX 3121. HR Wallingford (1995).

Ref 3.7 Royal Haskoning (2012), **Eastoke Point Coast Defence Works - Wave and Overtopping Modelling, Technical Note 9X1135.**

Ref 3.8 **Beach Nourishment 2005, Hayling Island**, Technical Note CBM5505/01. HR Wallingford (2005).

4 Monitoring Programme & Objectives

4.1 MONITORING PROGRAMME

The recommended monitoring programme incorporates the ongoing monitoring undertaken by Havant Borough Council (HBC) and the CCO under the South-East Strategic Regional Coastal Monitoring Programme (SESRCMP). It is **recommended that further beach monitoring data is collected to inform the revision of the BMP in five years time** by providing a greater level of quantitative field data to aid improved understanding of the coastal processes. This improved quantitative data may also allow improved application of analytical techniques by providing more information with which to test existing and/or develop new methods, e.g. predictions of beach responses to storm events. Table 4.1 provides an overview of the monitoring requirements over the next 5 years. Items highlighted in 'yellow' are actions already undertaken as part of the ongoing monitoring by HBC as part of the SESRCMP.

Table 4.1 - Recommended monitoring programme over the next 5 years

Monitoring Requirement	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
2 annual beach profile surveys (Spring: designated profiles; Autumn: designated/intermediate profiles)	X	X	X	X	X
Post-storm surveys (as required)	X	X	X	X	X
Pre- and Post- recycling event surveys (when recycling occurs)	X	X	X	X	X
Full beach topographic survey of frontage (summer)	X	X	X	X	X
Annual Bathymetry Survey	X	X	X	X	X
Visual walkover inspections of beach (monthly and pre-storm and post-storm as required)	X	X	X	X	X
Visual inspection regime for structures (including pre-storm and post-storm as required)	X	X	X	X	X
Detailed inspection of structures (triggered by visual inspections)	X	X	X	X	X
Tracer pebble quarterly monitoring	X	X	X	X	X
Wave data collection (Hayling Bay buoy 5km offshore)	X	X	X	X	X
Tide level data at CHIMET / Portsmouth	X	X	X	X	X
Capture of recycling events using recycling log sheets	X	X	X	X	X
Vegetated Shingle Survey	X	X	X	X	X
LiDAR survey of the entire Hayling frontage			X		
LiDAR survey of coastline adjacent to Chichester Harbour entrance	X	X	X	X	X
Aerial Photography (orthophotos).			X		
Sediment Sampling					X

4.2 BEACH MONITORING

4.2.1 Beach Topographic Survey

A full topographic survey of the beach surface is carried out annually as part of the Regional Monitoring Programme. The requirement for quarterly surveys extending over the entire South Hayling frontage and the West Wittering to East Head frontage was first introduced by English Nature in 2001, and later revised down to an annual baseline survey in 2007. This requirement was related to FEPA licence 31563/02/1 and CPA Consent Number 69814. The surveys are currently carried out using RTK-GPS rover units on backpacks. In addition beach profiles are measured using RTK-GPS on a detail pole down predetermined profiles, distributed approximately every 50m around the coastline. This survey has been carried out every summer since 2003 and provides the basis for monitoring the morphology of the Hayling open coastline. The profile data is stored in SANDS for analysis by the ESCP, and made available through the Channel Coast Observatory (CCO) website (Ref 4.1). The full topographic survey is stored as an ASCII text file and combined with LiDAR data for further analysis by the ESCP.

4.2.2 Beach Profile Surveys

Topographic beach profile surveys are carried out by the ESCP as part of the SESRCMP every Spring and Autumn. Profiles are taken at pre-defined locations around the open coast (Appendix P). Data is stored in SANDS for further analysis by the ESCP, and made available through the Channel Coast Observatory (CCO) website (Ref 4.1). Analysis of beach profile data is also undertaken by CCO and reported annually.

In addition post-storm profiles will be collected once every year along predetermined profiles as part of the SESRCMP, triggered by H_s exceeding a predetermined threshold set by the CCO. In addition **further profiles will be collected after all significant storm events** to inform the ongoing beach management response.

Pre-storm surveys could also usefully be undertaken if a forecast storm event is thought likely to result in significant impacts on the beach morphology. These pre-storm surveys could be triggered by the ESPC Flood Duty Officer as part of the procedures for issuing flood warnings (Section 4.6). Capturing pre-storm surveys as well as post-storm surveys will improve understanding of how the beach responds to storms, and could be better related to wave, tide and beach water level data.

4.2.3 Beach Recycling Logs & Survey

During maintenance works undertaken to recycle beach material (or introduce beach recharge) along the beach and to re-profile the beach (see also Section 5) beach recycling logs will need to be maintained by ESPC operations staff. The location and volume of material recycled or recharged should be supplied to the CCO after each operation. This information will allow future analysis of beach volume changes to account for beach recycling and re-profiling work and will enable the underlying natural beach movements to be identified.

Two separate beach surveys, ‘in’ (pre-recycling) and ‘out’ (post-recycling), are to be undertaken for every beach recycling operation. This will be used to establish the volume of material required along the nourished frontage before each operation and to build up a long-term picture of losses along the frontage after the works are completed.

4.2.4 Bathymetric Survey

An annual bathymetric survey will be carried out around the entire Hayling Island frontage out to a minimum of 200m beyond MLWN (Appendix Q). The requirement for quarterly surveys of the Chichester Harbour entrance and adjacent seabed was first introduced by English Nature in 2001, and later revised down to an annual hydrographic baseline survey in 2007. This requirement was related to FEPA licence 31563/02/1 and CPA Consent Number 69814. This data will be used to establish the depth at which the toe of the beach profile becomes stable, the 'closure depth'. The survey will also extend out over the Chichester ebb-tidal delta, and the East Winner to cover key areas for dredging recharge material and identifying changes that can influence the adjacent shoreline over yearly timescales. Once every five years this survey will be extended out to the 10m CD contour to continue a dataset for longer term monitoring of seabed levels in Hayling Bay and over the adjacent ebb-tidal deltas.

4.2.5 Visual beach inspections

Visual inspections are to continue along the Eastoke southern frontage, inspecting beach levels and identifying any major structural defects. Photographs are to be collected of areas where significant changes in beach levels have occurred. The timing of these surveys varies according to need, with increased frequency over the winter months. Visual inspections can also be triggered by individual storm events, or in response to reports of specific issues. Photographs collected as part of the inspections will be geotagged and stored as evidence for any subsequent beach management activities. A template for recording beach visual inspections has been developed (Appendix R).

4.2.6 Aerial Photography and LiDAR

LiDAR surveys have been flown periodically by the Environment Agency under the SESRCMP, and have recently been flown annually around the Chichester Harbour Entrance Channel. The flights should continue on an annual basis to enable the monitoring of Black Point, which is difficult to survey accurately using terrestrial survey techniques. Aerial Photography in this area is proposed to be flown every five years by the Southeast Strategic Regional Coastal Monitoring Programme to produce orthophotos. This data is available through the CCO website (Ref 4.1).

Continuation of these aerial photography and LiDAR surveys, combined with regular monitoring of beach levels, will allow future derivation of long term trends and recession rates across the BMP area.

4.2.7 Beach Sediment Tracer Surveys

The regular deployment & tracking of beach sediment tracers should continue along the Eastoke Nourished frontage, and surveys should continue around the entire South Hayling BMP frontage. In conjunction with the topographic surveys the location of the drift divide and other morphological features can be monitored, and used to inform the ongoing sediment budget analysis that is the basis for establishing recharge requirements for the Eastoke frontage.

4.2.8 Sediment Sampling

A comprehensive set of sediment samples should be collected in the Year 5 (2017) of the BMP. Sediment samples should be collected at MLW, MSL, MHW & the beach crest on the 23 profiles identified in Appendix I. This will provide a valuable dataset to establish the sediment distribution around the frontage for the next BMP period. It will also allow

comparison back to the 2009 dataset to monitor the effect of the ongoing beach management on the sediment distribution around the wider frontage.

4.3 STRUCTURE MONITORING

4.3.1 Visual Inspection

Visual Inspections of all coastal structures within the BMP area should be undertaken regularly as part of the Eastern Solent Coastal Partnerships Asset Inspection Programme.

The programme takes a risk based approach to determining the frequency of inspections to each section of the coastline. Areas of high exposure or with known vulnerable structures are inspected more frequently than more low risk areas.

For the purposes of this BMP a description of the structural monitoring undertaken along the nourished frontage is included.

The nourished frontage features a number of coastal structures, all of which are visually inspected on an annual basis and are as detailed below;

- Timber Groynes
- Timber Sloping Breastwork
- Rock Armour
- Concrete Splash Wall
- Concrete / Blacktop Promenade
- Concrete Seawall (redundant for most of the frontage)
- Steel Sheet Piles

The visual inspections are undertaken using a standardised assessment procedure in accordance with The Environment Agency's Condition Assessment Manual.

Visual Inspection data is normally recorded on site digitally using PDA handsets allowing data to be recorded under predetermined data fields to ensure continuity of the information recorded for one survey to the next. The data fields required to be gathered for each structure are detailed in the table below (Table 4.2).

Table 4.2 - Structure Monitoring Data Fields

Field	Input Requirements
Asset ID	This is pre-programmed for all existing assets
Date	Date of Inspection
Assessor ID	Assessor ID to identify person undertaking the inspection.
Condition Grade	1 – Very Good , 2 – Good, 3 – Fair, 4 – Poor, 5 – Very Poor
Worst Element Condition	1 – Very Good , 2 – Good, 3 – Fair, 4 – Poor, 5 – Very Poor
Description	Free Text, assessor to provide a description of the condition
Maintenance Urgency	A –Immediate action required B – Include on maintenance programme C – No maintenance required
Residual Life	< 1 Year, 1- 10 Years, > 10 Years
Structure Type	Armour, Apron, Bastion, Breakwater, Cliff, Embankment, Groyne, Outfall, Piling, Promenade, Revetment, Rock, Seawall, Shingle Bank, Beach, Slipway, Splash Wall, Wave Reflection Wall, Wetland/Marshland, Other, None.
Material 1	Identify Primary Construction Material: Bag, Block, Boulder, Clay, Cobble, Mass Concrete, Reinforced Concrete, Masonry, Mastic, Rock, Rubble, Sand, Shingle, Stone, Timber, Steel, other/none.
Material 2	Identify Primary Construction Material: Bag, Block, Boulder, Clay, Cobble, Mass Concrete, Reinforced Concrete, Masonry, Mastic, Rock, Rubble, Sand, Shingle, Stone, Timber, Steel, other/none.
Material Other	Identify any other significant construction materials.
Primary Asset	Yes / No – Is this structure the primary defence asset?
Photograph	Yes/No - Have photos been taken of structure showing the general condition and any specific defects?
Notes	Additional notes/comments not covered in previous fields.

Collected data is processed and uploaded to the Eastern Solent Coastal Partnerships GIS package, which then allows detailed analysis of the themed data and allows users to display the collected data graphically.

4.3.2 Detailed Inspection

In addition to the asset inspection procedure as detailed in section 4.3.1 a more detailed defect reporting process should be undertaken as required where the visual inspections highlight specific defects or structures of poor condition.

Defect Reports detail specific structural defects including likely failure modes and make assessment and recommendations as to the possible remedial options.

Visual inspections, intrusive and non-intrusive investigations can be undertaken to build on information collected as part of the original asset inspection and further advise the defect report.

Defect reports form the basis of the business case to undertake required remedial works, with the recommendations taken forward onto the maintenance plan for the area.

4.3.3 Eastoke Point Scheme

Completion of the proposed scheme at Eastoke Point may bring with it a requirement for additional monitoring of the new structures.

Any new structures constructed as part of the Eastoke Point scheme will be added to the Asset Inspection Programme and inspected as detailed in Sections 4.3.1 & 4.3.2.

Initially it is likely that visual inspections of the new structures will be undertaken more frequently that the standard annual programme. There may also be a requirement for detailed monitoring of settlement and displacement of the new rock structures in addition to the visual inspections.

Exact monitoring requirements for the new structures will be assessed on completion of the detailed design.

4.4 ENVIRONMENTAL MONITORING

4.4.1 Ecological / Habitat Surveys

Vegetated shingle surveys are already undertaken annually, and before and after major works on the beach (Appendix S). This allows haulage routes to be marked out pre-works, and any damage highlighted post-works, so that lessons can be learnt and methodology changed, if necessary. The vegetated shingle areas will change over time and by understanding the coverage, works can be better planned, and haulage routes properly laid out in order to avoid or minimise any damage.

4.4.2 Bird Surveys

Regular Bird Surveys are already undertaken in the wider harbour areas, however the beach itself is less well used for feeding, nesting or roosting. No additional bird surveys are proposed along the open coast. The Hampshire County Council Senior Ranger, who manages the Sandy Point Local Nature Reserve will be consulted before any works, to ensure the nesting pair of ringed plover that use this site are not disturbed during the breeding season.

4.4.3 Water Quality

No water quality surveys are proposed for the BMP operations, however the Environment Agency do carry out sampling within the harbours.

4.4.4 Eastoke Point Scheme

Completion of the proposed scheme at Eastoke Point may bring with it a requirement for additional environmental monitoring. **Any requirements stipulated as part of the planning and consents necessary to construct the proposed works will be incorporated into the ongoing BMP monitoring programme.**

4.5 PHYSICAL CONDITIONS

4.5.1 Sea Conditions

Wave climate is monitored at Hayling Island by a wave buoy 5km south of Eastoke (refer to Section 2.2). Continued monitoring of the wave climate from this device will provide more data to improve understanding of the wave climate approaching the nourished beach, and wider South Hayling frontage. Additional monitoring of the inshore wave climate is justified for this frontage due to the complex bathymetry influencing waves as they approach the nourished frontage, and the need to improve the understanding of wave overtopping and relative sediment losses each side of the drift divide.

A wave model should be developed for the East Solent with adequate detail around the nourished frontage to improve the understanding of sediment transport around the drift divide under various wave conditions. This will also provide information about how wave heights and overtopping vulnerability alters along the 2km nourished frontage, in turn influencing the nourishment design profile. **The temporary deployment of suitable wave monitoring equipment, e.g. AWAC, at different points along the nourished frontage should also be investigated by HBC.** This would provide calibration data for the numerical modelling, key given the complex and varying bathymetry in the nearshore zone. **This information should be related to run-up measurements collected by HBC (section 4.2) at representative locations along both the nourished and open coastline.**

Tide levels are available locally at Chichester Entrance channel (Section 2.1), immediately to the south of the Eastoke nourished frontage. The continued capture of this data is considered appropriate to inform beach management, especially as a record of surge during storm events. Tidal levels are also recorded at Portsmouth entrance channel with additional statistics, such as surge heights, generated automatically by the National Tidal and Sea Level Facility.

4.5.2 Storm Events

The rate of loss of material from the Eastoke frontage and the rate of change elsewhere along the frontage is likely to be increased during storms as a result of increased wave action. In order to understand the effect of storm events upon the beach response, **details of the storm conditions (waves and water levels) will need to be recorded** in support of the post-storm profile surveys (refer to Section 4.2.2).

4.6 WARNING & EMERGENCY PROCEDURES

The ESCP have an established coastal flood risk response procedure in place for Eastoke (Appendix G). This includes feeding information to the EA Flood Incident Duty Officer (FIDO) about the current status of the nourished beach to allow flood warnings to be adapted. The Eastoke Peninsula is covered by the following Environment Agency Flood Warning Areas:

- Hayling – Coast of Hayling Island
- Eastoke Seafront and South Hayling – Coast of Eastoke Seafront & S. Hayling
- Eastoke – Coast at Eastoke.

The existing flood warning regime is based on flood watch warning trigger levels as defined by the Environment Agency. These following levels are defined in the Environment Agency Area Flood Warning Duty Officer Procedures kept in the area incident room and held by duty officers:

- Flood Watch = 5.3m CD at Portsmouth (5.2mCD with E,SE,S,SW Winds F6+)
- Flood Warning = 5.7m CD at Portsmouth (5.2m CD if swell has been high)
- Severe Flood Warning = 5.93m CD at Portsmouth (5.73m CD if swell high and beach poor condition).

The greater level of monitoring set out in Section 4 of this BMP aims to provide improved information for future understanding the whole beach system resulting in the potential for improved accuracy of flood warnings.

It is recommended that these flood warning levels be reviewed in the future to ensure they adequately reflect developing knowledge. For example, improvements in the estimation of run-up and overtopping over nourished beaches planned as part of the current Environment Agency South-East BMP project (Ref 4.2) could alter the water levels and wave period design thresholds.

4.7 DATA

Having collected the beach monitoring data, it is important that all of the information is stored and analysed to allow decisions to be made with respect to ongoing maintenance and future management of the area covered by this BMP.

Following each scheduled beach walkover or profile survey, the information collected should be uploaded for storage and analysis to GIS and database systems that are compatible with those used by the Strategic Regional Coastal Monitoring Programme at Channel Coast Observatory, and copied to CCO as appropriate. Surveys scheduled in addition to the regional monitoring programme, e.g. pre- and post-operation walkover surveys, will be made available to CCO to enable wider use of the data via their website.

After each scheduled beach topographic & profile survey, HBC should analyse the data to assess the range of beach parameters discussed in Section 4.2. The results of this analysis should be recorded and distributed defining a summary of profile changes, volume changes, plan shape and crest width above a stated level. Assessment of beach level in relation to design profiles (in line with the trigger levels discussed in Section 3.4) should also be undertaken in order to provide a record of the logic for undertaking further beach maintenance and recycling works.

Additional beach monitoring data, obtained from sources such as the post-storm visual walkover inspections (with associated storm event data – see Section 4.5.2) or beach recycling logs (see Section 4.2.3), as well as information about the condition of structures (see Section 4.3) should also be stored in compatible databases (include photographs taken during each survey).

Following any sediment sampling the results should be stored in an appropriate format, including key information such as the position and timing of sampling. **After the scheduled sediment sampling survey, HBC should analyse the data to assess the sediment grading around the Hayling frontage.** This information will be used to improve the targeting of appropriately sized recycling material, and assess the longer-term impact ongoing recharge and recycling is having on the sediment grading around Hayling Island.

This information should be used by HBC to compile an annual beach monitoring report, recording key parameters such as crest width & height, beach volume, SoP, and summarising the beach management activities carried out over the previous year. This annual report will be used as a basis for the following years beach management activities, identifying any works required e.g. initial estimates for recycling volumes, any forthcoming structural works, etc.

This information should also be used in compiling future annual beach monitoring reports such as those produced by CCO (Ref 4.1).

4.8 RELEVANT INFORMATION

The following provides a list of all sources of information that have been referenced in this section of the beach management plan.

Ref 4.1 **Channel Coastal Observatory (CCO) website**. http://www.channelcoast.org. Accessed, 01/08/2012.

Ref 4.2 **South East Coast Beach Management Plan Programme**, Project Code IMSE100035, Environment Agency (2011).

Ref 4.3 **Flood Response Procedures**, Eastern Solent Coastal Partnership (2012)

5 Maintenance Regime

This section describes the beach maintenance works that are to be carried out over the next 5 years until the next BMP review.

5.1 MAINTENANCE PROGRAMME

5.1.1 Programme of Works

A high level programme of works is shown below (Figure 5.1). For completeness monitoring and reporting activities are shown alongside the recharge and recycling works. Over the five year period of the current BMP beach recycling and recharge is anticipated to take place annually every March, over a 4 week period. Should a maintenance dredge of the Chichester Harbour Entrance Channel be required within the 5 year period then the recharge element of the BMP works will be adjusted to use this source of material. The Chichester entrance channel is periodically dredged for navigation purposes and any material taken off-site is a loss to the sediment supply on to Hayling Island. HBC object in principal to any dredging close to the Hayling coast but will utilise the material rather than lose it from the littoral system. Any dredging works would be programmed for the summer months to minimise down-time due to adverse weather conditions.

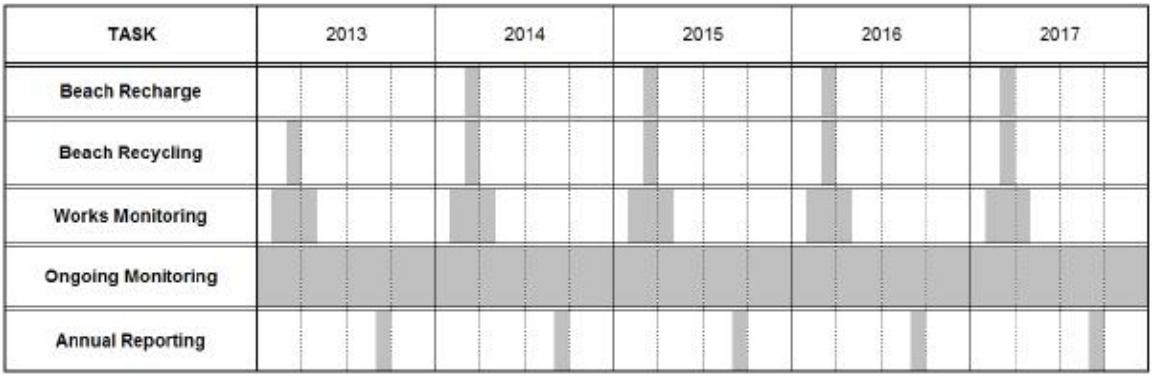

Figure 5.1 - Programme of works

Emergency beach management works may take place at other times during the year in response to low beach levels, and these works would be carried out with due regard to the trigger levels identified in Section 3.4.

5.1.2 Management & Supervision

All works carried out as part of the BMP will be managed and supervised by appropriate officers working on behalf of the Eastern Solent Coastal Partnership. The ESCP has long standing experience of managing and supervising the ongoing beach management operations on Hayling Island.

5.1.3 Transportation of Materials

The transportation of materials on and off Hayling Island to the BMP study area will be carried out in line with the appropriate conditions set out in the relevant HBC planning permission. For the ongoing beach recycling works this includes restrictions on the hours between which heavy plant can be delivered to the site compound, and the route to be used to access the compound (Appendix T). Where no conditions are stipulated due regard will be

paid to reducing the impact that any delivery to the site will have on the residents of Hayling Island. In the case of marine-based recharge the delivery of nourishment material via 'rainbowing' will necessitate 24 hour working and local residents will be warned of any potential disruption well in advance of the operation (Appendix B).

5.2 ONGOING WORKS

5.2.1 Beach

a) Beach Recharge

The potential sources and delivery methods of beach material for the planned beach recharge works at MU3, or any future works to MU2 (Eastoke Point) are presented in Table 5.1. The preferred option for the current BMP period is recharge from a land-based source, although material from the Chichester entrance channel will be used if the need for a maintenance dredge arises. The land-based option is the best value, and also improves the performance of the nourished beach due to the lack of fines. The recharge element of the works is designed to counter the net decline in overall volume on the Hayling frontage and avoid the ongoing beach management operations stripping out the surrounding beach.

Table 5.1 - Beach recharge options

Option for source of material for beach recharge	Advantages	Disadvantages	Conclusions
Recharge from land-based source	Guaranteed supply of material. Coarser grading of material improves beach performance. Able to profile material on beach crest without need to bring in additional plant. Non-weather dependent delivery. Able to procure jointly with Beach Recycling operation under Minor Works Framework. Able to import smaller volumes on an annual basis, reducing losses due to overfilling of groyne bays.	Increased vehicle movements onto Hayling. Requires stockpiling prior to placement on beach. More expensive than offshore marine-based material above approx. 45,000 cu. m. overall volume. Potential impact on transport network.	**Preferred option** (unless Chi Entrance source has to be utilised) as lower delivery risks, easier management & supervision of delivery.
Recharge form marine-based source (Chi Entrance)	Material grading closer to beach material than offshore source (reduced losses) Cheapest source of suitable recharge material.	Effectively bypassing material within littoral system so may not be as beneficial to overall HI volumes as land-based or offshore source. Not a guaranteed supply	**Over-riding option** if dredging must take place due to removal of hazard to navigation. This would need to be in combination with land-

Option for source of material for beach recharge	Advantages	Disadvantages	Conclusions
	Possibility to remove smaller volumes on an annual basis under term agreement. No impact on transport network.	of material. Disruption to residents due to 24hr working Susceptible to down-time due to poor weather conditions. Less control on placement of material as 'rainbowed' ashore.	based sources for long term management of frontage.
Recharge form marine-based source (Offshore licensed dredge site)	Guaranteed supply of material. No impact on transport network.	Higher costs make smaller annual operations unviable. Disruption to residents due to 24hr working Susceptible to down-time due to poor weather conditions. Less control on placement of material as 'rainbowed' ashore. Material grading less similar to beach material than Chi Entrance source (increased losses)	**Suitable as a source** but not preferred option.

b) Beach Recycling

The beach recycling element of the beach management activities is designed to maintain the design beach at the desired profile. Material is extracted from areas of accretion and returned to the nourished beach. There is the option to top up the recycling with additional recharge material if there is an inadequate supply at the locations identified in Section 5.4.2.

c) Beach Reprofiling

Beach reprofiling is only undertaken to remove severe cliffing along the nourished frontage, and is usually carried out as standalone emergency works. It is not to be used to push up material from the lower beach to supplement the crest. Any shortfall in material will be made up by the beach recycling element of the works.

5.2.2 Structures

This BMP only deals with the requirements to manage the beach as part of the overall defence system. Whilst interaction with these structures is discussed and considered within this BMP, the requirements for ongoing maintenance of the structures is set out in a separate maintenance plan prepared by the Eastern Solent Coastal Partnership for the structural elements along the BMP area, including the timber and rock groynes. When the Eastoke

Point Scheme is constructed the maintenance of the various rock structures will incorporated into this ongoing maintenance plan.

Routine maintenance is currently undertaken along the BMP frontage by Havant Borough Council (HBC). In summary, this ongoing maintenance comprises:

- Maintenance of beach control structures (timber groynes and revetments) in MU2, MU3, MU4 & MU5 should continue as at present to replace planks and remove sharps (for health & safety reasons). The existing beach control structures appear to be performing adequately along most of the nourished frontage. **If the beach design profile cannot be maintained to a sufficient standard during the course of the current BMP at the erosion hotspots identified in Section 2.5.3 then a more detailed analysis of the control structures in these areas will be warranted.**
- Clearing of shingle from the promenade in MU3 as required.
- Maintenance and operation of flood boards in MU3.

This existing maintenance regime of structures is to continue in the future. **Any maintenance activities should be recorded in the Structure Maintenance Log** (Appendix U). No additional maintenance activities are proposed.

5.2.3 Public Access, Amenity & Safety

Beach management activities should avoid the peak holiday season, weekends and public holidays where possible. Condition 4 of the recycling Planning Consent (Appendix C) prohibits all but emergency works on weekends and recognised public holidays. This will minimise the impact of works on beach users and will reduce the minor risk to public safety that such work would pose. In order to ensure the safety of the public whilst works are being carried out, restrictions on public access to the areas of the beach being worked on should be implemented, with alternative routes provided if possible.

Experience has shown that closing the beach entirely is likely to be impractical, and **it is suggested that a banksman is present with each machine (except articulated dump trucks in transit along the haul road), and that spare personnel along with signage are employed to direct public access to safe sections of the promenade and beach during works**. H&S risks should be assessed through a site specific risk assessment.

Information boards should be displayed whilst the works are being carried out to explain what is being done and why. This will also serve to improve public education. Appendix B contains the Communications Plan which identifies how to communicate with the public and local businesses when undertaking the beach maintenance works.

This section is not exhaustive and any works should comply with the relevant up-to-date Havant BC procedures.

5.3 EMERGENCY WORKS

It is emphasised that the application of trigger level values should not be absolute, and consideration should also be given to sea conditions at the time of the assessment. Good engineering judgement will play a large role in the decision to trigger emergency works.

If a design profile Crisis Level (refer to Section 3.4) is identified as being reached on the nourished frontage, the immediate action would be to carry out an emergency recycling operation to top up the affected area. The potential sources identified in section 5.4.2 will be assessed to establish if there is an adequate supply of recycling material. If there is an inadequate volume of material available for recycling then a decision will be made on a case by case basis for importing recharge material from a land-based source to re-establish the required standard of protection. If crisis works are undertaken and other areas of the frontage are below the 1 in 200 year SoP then an assessment will be made as to whether they will also be topped up to the design profile. The crisis works will be carried out in addition to the ongoing annual beach recycling works.

If the design volume threshold is triggered then additional land-based recycling may be required to maintain the design beach volume to the end of the current BMP period. This operation is likely to be less urgent as long as the beach crest is still in place and can continue to be combined with the annual beach recycling operations. If necessary the entire beach recycling operation could be moved, although there would need to be clear overriding justification due to the impact on various environmental constraints.

Prior to the implementation of the Eastoke Point Scheme emergency works may be required to prevent a breach forming into Sandy Point Nature Reserve. Given the difficulties of maintaining a healthy beach in this area the most likely response is likely to involve the use of rock to stabilise the area rather than beach. Any works are likely to be similar to those carried out at Sandy Point in 1992 when a sloping rock revetment and stub rock groynes were constructed to prevent a breach forming on the southeast corner of the nature reserve.

5.4 IMPLEMENTATION

5.4.1 Plant Requirements

Beach recycling will typically be carried out using a tracked bulldozer and a hydraulic excavator, with dump trucks to transport material along the frontage. Reprofiling of the beach crest to reduce cliffing will typically be carried out using a hydraulic excavator, although a tracked bulldozer could be used if available. Clearance of the promenade following storm events requires a smaller hydraulic excavator than the annual recycling operations, allowing the operator to dig close to the concrete splash wall to the rear of the promenade. This land-based plant is usually required over the winter months for reprofiling cliffing and promenade clearance, and in March for the annual recycling operation.

Beach recharge utilising a land-based source of material will use the same plant as the annual beach recycling operation. If the need arises to run a marine-based operation there is no land-based plant required, the material is ‘rainbowed’ onto the mid- to lower-beach and allowed to disperse naturally under wave action. This allows for a rapid occupation and reopening of the amenity beach to the public around each pump ashore.

5.4.2 Potential Sediment Sources

The preferred source of land-based recharge material is single-size graded 20-40mm aggregate transported to site by lorry. If the need for a navigation dredge arises in the Chichester entrance channel then this material will be utilised on the nourished frontage rather than being lost to the natural feed of material to the Eastoke frontage. Appropriate licenced offshore dredge sites will considered should the need arise, however this is not the preferred option for delivering beach management on the Eastoke frontage.

The location of potential sources of recycling material are shown in Appendix K. Additional sources of material on private land may become available during the course of the BMP, e.g. Gunner Point (MU6), and will be assessed for suitability should the opportunity arise.

The available recycling sources can be split into three areas:

a) The Ness (MU1)
b) Open Beach (MU5)
c) Behind Structures (MU4 & MU5)

<u>The Ness</u>

The first area is the "Ness" just north of the Nature Reserve at Eastoke Point. Extensive monitoring, undertaken in house by the Eastern Solent Coastal Partnership (ESCP), has shown that this area historically accumulates material carried easterly from the drift divide at Creek Road, with beach material extending out into the safe navigable channel into Chichester Harbour. Material protruding into the channel is removed to make the navigation safe and to avoid it being eroded by the ebb dominant tide and deposited on the bar across the entrance channel. Material from this area has a higher sand content and tends to cliff if left exposed on the front face of the nourished beach.

<u>Open Beach</u>

The wide shingle storm beach in the centre of Hayling Bay is a good source of material, especially the coarse berm that often forms just above MHW. The ESCP undertake surveys before any beach management operation to identify areas that have accreted over the previous year. Beach material can be extracted from the face of the storm beach and care must be taken not to reduce the berm height.

<u>Behind Structures</u>

There are two main extraction areas behind sloping revetments in the study area, one at the Coastguard station and one to the west of the "Inn on the Beach". Material is periodically thrown over the structures by storm waves and effectively removed from the sediment transport system. This material is usually coarser well sorted gravel that performs well as a front face to the nourished beach crest. This source may reduce if additional section of timber revetment fail west of the "Inn on the Beach" and are removed on health and safety grounds.

5.4.3 Sediment Volumes

Prior to each recycling and recharge operation the volume of material required on the nourished frontage must be calculated. The total volume of recharge material required over the five year BMP period has been calculated as 24,600 m^3 (Section 2.5.2), based on average net losses across the wider frontage. If annual land-based recharge is being utilised this volume will be split evenly over years 2 – 5 of the BMP period, delivering 6,150 m^3 of recharge material to the Eastoke frontage per annum.

The volume of recycling material required will calculated prior to each individual operation.

The latest topographic walkover survey of the beach will be combined with the latest LiDAR data to ensure complete coverage of the back slope of the beach and reducing edge effects in the subsequent DTM analysis. The combined point data will be used to generate a DTM of the nourished beach and compared to the nourished beach design surface. The volume of fill required to bring the nourished beach up to the design surface will be calculated and broken down into individual groynes bays. The volume of fill required will be sought from the potential sources in section 5.4.2. If there is insufficient suitable material available then additional imported material will be used to top up the recycling volume.

The volume of material available for extraction will be assessed by comparing the latest survey data compared to the previous post-operation survey. This will be used to identify areas of accretion and calculate the likely volumes of material available for extraction. The suitability of material will be assessed visually just prior to the start of any recycling operation. Due to the dynamic nature of the beach there must be some flexibility in allocating extraction targets and engineering judgement will be used on site to avoid over extraction from the beach face.

5.4.4 Access

Plant access to the beach in MU3 is via the HBC Southwood Road Compound. The currently agreed delivery route to the Compound is in Appendix T. Plant can then access the entire Hayling frontage along the crest of the beach. At the Inn-on-the-Beach (MU6) the removal of timber dragon's teeth is required to access behind the structure and further west towards Gunner Point. Material imported as part of the annual land-based beach recharge will be stockpiled at the western end of the Eastoke Corner car park prior to placement, and again access to this stockpile area requires the temporary removal of timber dragon's teeth.

5.4.5 Permissions / Consents

There is a requirement to notify Hampshire County Council a minimum of 10 working days prior to the commencement of any annual beach recycling and recharge operations (Appendix V).

A Chichester Harbour Conservancy 1971 Section 45 Works Licence has been approved for the recycling operations with various conditions attached (Appendix E). Condition VIII of the Works Licence requires at least 48 hours notice of the date and time of commencement of works to the Harbour Master.

There are 10 conditions attached to the current Beach Recycling Planning Consent (Appendix C) that must be complied with when carrying out operations.

5.4.6 Notifying Others

In line with the Communications Plan (see Appendix B), **it is recommended that explicit notification of beach works also be provided to the following organisations**:

- Natural England (in relation to nature conservation and coastal access interests).
- Hampshire County Council (as landowner)
- Beachlands Funfair (as landowner)
- Inn-on-the-Beach (as landowner)
- Hayling Golf Course (as landowner)

- Hayling Sailing Club (as landowner)

Contact details for each are contained in the Project Contact List.

5.4.7 Recording Activities

All beach management activities should be logged for inclusion in the annual Beach Management Report (Section 6.2), and a template for recording the appropriate data is included in Appendices W & X. Areas of extraction and deposition should be logged throughout any operation to allow for future consideration in any sediment budget analysis.

5.4.8 Environmental Constraints

Planned maintenance operations should avoid the period from 1st October to 28th February, unless necessary as an emergency response, as per Condition 3 of the Planning Consent (Appendix C). The Planning Consent also specifies that vegetated shingle must be demarcated with cones to avoid damage by heavy plant on the haul road.

Marine-based delivery of recharge material may have additional constraints over timings and access routes as part of the relevant consents and permissions which will be complied with once known.

5.5 RELEVANT INFORMATION

The following provides a list of all sources of information that have been referenced in this section of the Beach Management Plan.

Ref 5.1 **Beach Recycling Planning Permission 09/53949/008**, Havant Borough Council as Local Planning Authority (2009).

6 Reporting Against Objectives

6.1 REPORTING PROGRAMME

The recommended reporting programme incorporates the annual reporting of the various logs and data collected as part of the monitoring programme (Section 4) and maintenance regime (Section 5). The schedule below (Figure 6.1) identifies all of the individual logs and reports required by the BMP. Where the logs and reports are dependent on events to trigger them, i.e. storm conditions, structural maintenance or recycling operations, the timings shown are indicative. There are three reports required by the BMP; an Annual Vegetated Shingle Report, Annual Beach Monitoring Report & Annual Beach Management Report. These reports will inform the ongoing beach management activities, providing recommendations if change is required.

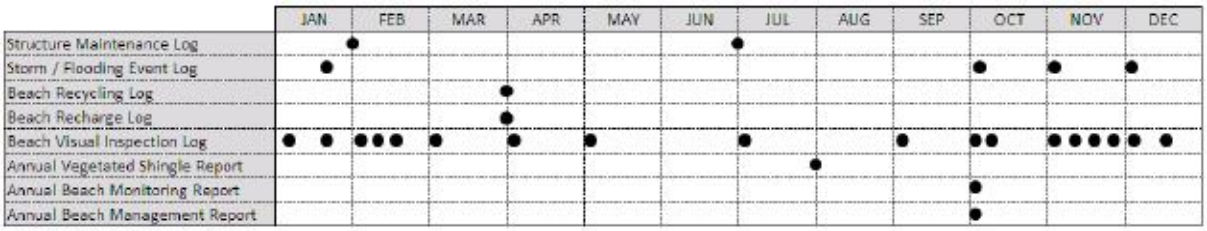

Figure 6.1 - Indicative BMP reporting schedule, assuming combined March recycling & recharge operation

6.2 ANNUAL BEACH MANAGEMENT REPORT

The Annual Beach Management Report will be produced each October to record and summarise the Beach Management activities, and their impact, if any, on the wider South Hayling frontage. The beach management activities will be placed in context by reporting of the wave climate and water levels, including any storm events, and will draw on a variety of data sources.

The report will contain the following chapters:

a) Beach management activities
b) Wave climate and water levels
c) Performance of nourished beach
d) Overall condition of South Hayling frontage
e) Changes in operational practice
f) Summary
g) Recommendations
h) Appendices

Beach management activities

This section will contain a summary of the beach management activities carried out over the preceding year. This will include a summary of any beach recharge or recycling operations as well as any maintenance carried out on the control structures.

Wave climate and water levels

This section will contain a summary of the local wave climate and water levels over the preceding year. Any significant events should be identified and discussed in more detail.

Performance of nourished beach

The performance of the nourished beach should be assessed in this section of the report. The results of the ongoing monitoring should be compared to the design beach parameters (Section 3) to establish the standard of protection afforded by the beach throughout the year. Any trends apparent in the performance of the nourished beach should also be included in this section of the report and related to the ongoing beach management activities.

Overall condition of South Hayling frontage

This section will contain a summary of the overall condition of the South Hayling frontage, drawn largely from the findings of the Annual Beach Monitoring Report (Section 6.2). It will also relate any changes to the ongoing beach management activities.

Changes in operational practices

This section will identify any changes in operational practices over the previous year. The basis for such decisions should be summarised and any background evidence included in an appendix to the report. For example, in the past recycling operations have alternated between extracting close up to the eastern wall of the Inn-on-the-Beach and leaving material piled against the structure. This change was driven by a change in ownership of the property and the owner's priorities. One owner wanted to retain material against the structure to prevent damage during stormier wave conditions, another wanted to prevent people being able to climb straight onto the front patio of the property directly from the beach. By recording such changes in the report the next beach management operation can be modified accordingly.

Summary

This section will contain a summary of the preceding sections of the report, including reference to the performance of the Beach Management Plan over the entire BMP period.

Recommendations

This section will contain any recommendations resulting from the ongoing monitoring of the beach management plan operations.

Appendices
This section will include the following items:

a) Structure Maintenance Log
b) Storm / Flood Event Log
c) Beach Maintenance Log
d) Beach Maintenance Plot
e) Beach Visual Inspection Log
f) Annual Beach Monitoring Report
g) Annual Vegetated Shingle Report

Any additional evidence, e.g. correspondence, for changes in operational practice should also be included in the appendices.

6.3 ANNUAL BEACH MONITORING REPORT

The Annual Beach Monitoring Report will be compiled in conjunction with the Annual Beach Management Report, providing an analysis of the preceding year's monitoring programme (Section 4). The report will be completed by October of each year, allowing enough time for analysis of the main summer walkover surveys of the Hayling frontage. If the results of the Regional Monitoring Programme annual report are available they can be incorporated into this report, although Annual Beach Monitoring Report is intended to be a more detailed analysis of sediment transport around the BMP frontage.

The report will include the following:

a) Beach plan-form analysis
b) Beach profile analysis
c) Beach volume and cross-sectional area (CSA) change analysis
d) Beach sediment tracer analysis
e) Sediment Budget Analysis
f) Wind, wave & water level assessment
g) Sediment sampling results

6.4 ANNUAL VEGETATED SHINGLE REPORT

This report is to be presented to the Local Planning Authority within four months of cessation of each annual beach recycling operation, as per Condition 10 of the current planning permission (Ref 6.2). The purpose of the report is to assess the impact of the ongoing operations on the local vegetated shingle habitats. Appendix S contains the appropriate guidance for compiling this report (Ref 6.2), and the appropriate surveys have been built into the monitoring programme to enable its completion on an annual basis.

6.5 RELEVANT INFORMATION

The following provides a list of all sources of information that have been referenced in this section of the Beach Management Plan.

Ref 6.1 **Guidance for producing an Annual Assessment monitoring the effects of recycling operations on vegetated shingle habitats and Sinah Common SSSI**, HBC Technical Report (2007).

Ref 6.2 **Beach Recycling Planning Permission 09/53949/008**, Havant Borough Council as Local Planning Authority (2009).

7 Action Plan

This section provides a summary of the recommendations made throughout the rest of this BMP in the form of an action plan. The action plan is presented in Table 7.1 and identifies actions by type as being either for ‘Monitoring’, ‘Maintenance’, ‘Emergency Planning’, ‘Research’ or ‘Analysis’.

It is intended that this Action Plan be used to guide future investment in this area which will ultimately enable more appropriate, effective and efficient maintenance practices to be established and implemented along the BMP area.

Table 7.1 - Action Plan

Action Type	Action Description	When by?	Related BMP Section(s)
Monitoring / maintenance	Undertake a review of this BMP	2017	1.2
Maintenance	When undertaking works along the beach, measures to ensure safe public access to the beach should be utilised. This should include the use of banksmen where appropriate, spare personnel and signage to direct the public to safe access locations and temporary diversions. This should be supported by information boards displayed during works to explain what is being done and why.	Ongoing	5.2.3
Maintenance	Where maintenance issues are identified on privately owned and maintained land the appropriate owner / maintainer shall be notified of the defect and any obligation to make good.	Ongoing	1.5.2
Maintenance	Future recycling extraction should target areas of growth on the open frontage.	Ongoing	2.5.1
Maintenance	If MU5 starts to exhibit overall volumetric losses then recycling extraction should be reduced and the use of Gunner Point as a source of material investigated.	Ongoing	2.5.1, 2.5.3
Maintenance	HBC to deliver the Eastoke Point scheme to address erosion and flood risk issues.	2013	2.5.3
Research	If the design profile cannot be maintained through annual recycling alone at Eastoke Corner then further investigations should be carried into adjusting control structures.	Ongoing	2.5.3, 5.2.2
Research	If the design profile cannot be maintained through annual recycling alone at Creek Road Car Park then further investigations should be carried into adjusting control structures.	Ongoing	2.5.3, 5.2.2
Maintenance	Beachlands Funfair owners should be notified prior to recycling operations commencing and any request relating to the works considered.	Ongoing	2.5.3
Maintenance	Liaison with MDL Marinas should continue if requested and the possibility of incorporating some sand extraction into the recycling operations considered if requested.	Ongoing	2.5.3
Maintenance	Liaison with HISC should be ongoing and the possibility of incorporating some sand extraction into the recycling operations considered if requested.	Ongoing	2.5.3

Action Type	Action Description	When by?	Related BMP Section(s)
Maintenance	Clearance of the shingle ridge infront of the RNLI station should be considered prior to each recycling operation.	Ongoing	2.5.3
Research	If during the BMP period improvements in the numerical techniques available to predict beach response and overtopping, or results of the ongoing monitoring programme, suggest this crest width should be reduced then the design profile should be reassessed.	Ongoing	3.2.3
Research	The design volume will be recalculated once the Eastoke Point Scheme is constructed, based on revised design profiles from Groyne 11 to the existing long rock groyne.	2013	3.4
Research	If the use of an offshore dredge site is required the suitability of the potential dredge sites will need reassessing.	Ongoing	3.6
Monitoring	Further beach monitoring data should be collected to inform the revision of the BMP in five years time by providing a greater level of quantitative field data to aid improved understanding of the coastal processes.	Ongoing	4.1
Monitoring	Beach profiles will be collected after all significant storm events to inform the ongoing beach management response.	Ongoing	4.2.2
Monitoring	Visual inspections are to continue along the Eastoke southern frontage, inspecting beach levels and identifying any major structural defects.	Ongoing	4.2.5
Monitoring	The regular deployment & tracking of beach sediment tracers should continue along the Eastoke Nourished frontage, and surveys should continue around the entire South Hayling BMP frontage.	Ongoing	4.2.7
Monitoring	A comprehensive set of sediment samples should be collected in the Year 5 (2017) of the BMP.	2017	4.2.8
Monitoring	Visual Inspections of all coastal structures within the BMP area should be undertaken regularly as part of the Eastern Solent Coastal Partnerships Asset Inspection Programme.	Ongoing	4.3.1
Monitoring	In addition to the asset inspection procedure as detailed in section 4.3.1 a more detailed defect reporting process should be undertaken as required where the visual inspections highlight specific defects or structures of poor condition.	Ongoing	4.3.2

Action Type	Action Description	When by?	Related BMP Section(s)
Monitoring	Any new structures constructed as part of the Eastoke Point scheme will be added to the Asset Inspection Programme and inspected as detailed in Sections 4.3.1 & 4.3.2.	Ongoing	4.3.3
Monitoring	Any environmental requirements stipulated as part of the planning and consents necessary to construct the proposed works will be incorporated into the ongoing BMP monitoring programme.	Ongoing	4.4.4
Monitoring	A wave model should be developed for the East Solent with adequate detail around the nourished frontage to improve the understanding of sediment transport around the drift divide under various wave conditions.	2013	4.5.1
Monitoring	The temporary deployment of suitable wave monitoring equipment, e.g. AWAC, at different points along the nourished frontage should also be investigated by HBC.	2013	4.5.1
Monitoring	Relate the proposed wave model, and any measured calibration data, to run-up measurements collected as part of beach profile surveys (Section 4.2).	2013	4.5.1
Monitoring	Details of storm conditions should be recorded (waves and water levels)	Ongoing	4.5.2
Analysis	After each scheduled beach topographic & profile survey, HBC should analyse the data to assess the range of beach parameters discussed in Section 4.2.	Ongoing	4.7
Analysis	After the scheduled sediment sampling survey, HBC should analyse the data to assess the sediment grading around the Hayling frontage.	Ongoing	4.7
Analysis	This survey analysis should be used by HBC to compile an annual beach monitoring report, recording key parameters such as crest width & height, beach volume, SoP, and summarising the beach management activities carried out over the previous year.	Ongoing	4.7
Maintenance	Any maintenance activities should be recorded in the Structure Maintenance Log	Ongoing	5.2.2
Maintenance	Provide explicit notification of beach works to landowners and Natural England.	Ongoing	5.4.6

APPENDICES

A – Environmental Considerations
B – Communications Plan
C – Beach Recycling Planning Consent
D – MMO exemption
E – Chichester Harbour Works Licence
F – Management contact details
G – Coastal flood risk response plan
H – Key stakeholder contact list
I – Sediment sampling locations
J – Nourishment volumes
K – Beach recycling areas
L – Annual nourished beach losses
M - Strategy Flood and Erosion extent
N – Design profile summary statistics
O – Design volumes
P – Topographic profile locations
Q – Hydrographic survey coverage
R – Visual beach inspection template
S – Planning Consent annual assessment guide
T – Plant access route to Eastoke compound
U – Structure Maintenance Log
V – HCC licence
W – Beach recycling & recharge plot
X – Beach Maintenance Log
Y – Groyne locations
Z – Coastal Landownership