Weymouth & Portland Strategic Flood Risk Assessment

Weymouth & Portland Borough Council

July 2006

Final Report

9R7593

ROYAL HASKONING

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SUMMARY

This Strategic Flood Risk Assessment (SFRA) was produced by Royal Haskoning in July 2006 for Weymouth and Portland Borough Council. This SFRA represents the views of Royal Haskoning which have been guided by a steering group of Weymouth and Portland Borough Council Planners, Engineers and Technical Specialists and Environment Agency staff from South Wessex Area.

The content of the SFRA will be presented as a series of A1 maps outlining historic, current and future flood risk, electronic data to be used in a Geographical Information System (GIS) and a report providing background information and technical guidance for managing flood risk. Combined use of these deliverables will enable consistent and sustainable decisions to be made with respect to both current flood risk and into the future.

A SFRA is an overview of Flood Risk within a specific area and aims to provide general guidance to local authority planners, developers and other interested people, including the general public about locations where flood risk is an issue. Information regarding flood risk is important because flooding may result in loss of life and can cause distress, harm, destruction and large and expensive damage to properties. The information in a SFRA helps to guide the local planning authority in making judgements on allocating land through the planning process.

It is a Government requirement that flood risk is considered in the process of allocating land for development and recommends that sites should be allocated starting from those of lowest flood risk. This sequential process is documented in Planning Policy Statement 25 (PPS25) which will replace the Planning Policy Guidance Note 25 (PPG25) for Development and Flood Risk in August 2006. The Government aims to reduce the risks from flooding to people and the developed and natural environment by discouraging further built development within floodplain areas and promoting best practice for the control of surface water runoff.

Flooding is an issue with varying levels of severity across most of the study area with 8% of properties within the borough located in areas at risk of flooding. Significant flooding in the area is mainly caused by the overtopping of river banks, whilst less severe flooding generally in Weymouth itself, is predominantly from surface water runoff and the blockages of drains and culverts. Tidal flooding and associated rapid inundation is mainly concentrated at Chiswell on the Isle of Portland where the shingle spit of Chesil Beach can be overtopped and/or breached.

Extensive records of historical flood events exist across the area with flooding at Chiswell documented as early as November 1824. These records have been sourced from Weymouth and Portland Borough Council and also from the EA and are used in conjunction with other data such as Flood Maps detailing extents of flood risk and information about the location of defences.

As well as current flood risk, the potential effects of climate change on flooding caused by fluvial and tidal influences have also been investigated. This involves the use of increased flow rates (by 20-30%) and the effect of sea level rise on coastal areas. Some modelling was carried out in specific locations to accurately determine the extent of

future flood extents based on the topography of the land surface. The effects of increased wave height and wind speed may also be an issue for coastal areas. The modelling of these effects is outside of the scope of this study. Guidance indicates a 10% sensitivity allowance needs to be applied up to 2080. Detailed Flood Risk Assessments and further studies should encompass this information.

Information about the management of flooding has been provided with a particular focus on surface water flooding as this is a major cause of flooding incidents in the Weymouth and Portland Borough. Where appropriate and relevant, developments should use Sustainable Drainage Systems (SUDS) to control surface water before it enters the watercourse. Within a large urban area such as Weymouth the combined effect of water discharge from SUDS must also be addressed to prevent further flooding issues downstream.

A SFRA does not provide definitive conclusions regarding the flood risk to an individual property. If the SFRA indicates that a property or possible area for development is within or adjacent to a flood risk area, then a detailed Flood Risk Assessment (FRA) will be required to assess the site before any decisions can be made. The effect of large development sites on the drainage of adjacent land also needs to be considered as part of an FRA. This is achieved through the identification of Vulnerability Classifications for categories of development and the application of the relevant PPS25 Decision Flow Chart which guides the user through the process step by step to arrive at a valid recommendation. It is designed to be used in conjunction with land allocations identified as part of the Local Development Frameworks.

Flooding is an important issue which must not be ignored. In the future it is likely that flooding could occur more frequently and with more severity due to climate change. By using this SFRA, in combination with site specific Flood Risk Assessments submitted with planning applications for development or change of use, it is possible to allocate land for development in a sustainable way.

ROYAL HASKONING

CONTENTS

1 INTRODUCTION

Weymouth & Portland Borough Council (W&PBC) commissioned Royal Haskoning in January 2006 to undertake a Strategic Flood Risk Assessment (SFRA) for the areas within the boundary of Weymouth and Portland. This SFRA informs and provides evidence for part of the process W&PBC are undertaking to prepare their Local Development Framework.

This SFRA was produced in April 2006 and represents the views of Royal Haskoning, which have been guided by a steering group comprising of Weymouth & Portland Borough Council planners and engineers and the Environment Agency (EA).

1.1 What is a SFRA?

A SFRA is an overview of current and future flood risk to a particular area. This predominantly desk-based study provides details of where flooding has occurred, where there is existing risk and where there could be risk in the future. It also provides details of the defences and structures in place to reduce that risk. Using all the information provided within the SFRA, Local Authorities can make informed judgements regarding the effects potential developments could have on the existing and future flood risk in the surrounding area.

Flooding is a serious environmental hazard and is caused by an often complex interaction of rainfall and associated runoff, tidal water, climatic conditions and the potential obstruction to flows from structures. The level of flood risk in Weymouth and Portland is the product of the frequency or likelihood of flood events and their consequences. Flooding of properties causes disruption, damages, distress, harm and can result in loss of life. It is therefore very important to try and prevent any inappropriate new development taking place in an area that is at a high risk of flooding, or will increase the risk of flooding elsewhere.

Reducing the vulnerability of the Weymouth and Portland Borough to the dangers and damage caused by unmanaged floods, contributes to promoting a better quality of life, achieving some of the objectives of sustainable development and maintaining existing communities. Local planning authorities have to address the problems which flooding can cause when determining planning applications both now and in the future.

The information in a SFRA helps to guide the local planning authority in making judgements on allocating land through the planning process. It also informs the preparation of strategic policy and development control policy towards flooding and flood risk to include in the Local Development Framework. The information can be used as evidence for planning policy-making and to inform development control decisions.

The government recommends (through Planning Policy Statement Note 25 (PPS25) Development and Flood Risk) that, when drawing up or revising development plans, sites should be allocated for development starting from those of lowest flood risk. This is because the government aims to reduce the risks to people and the environment from flooding, by discouraging further built development within floodplain areas and promoting best practice for the control of surface water runoff.

1.2 Aims and Objectives

The objectives of the SFRA for Weymouth and Portland are:

- To provide a reference and policy document that will be part of the evidence base to inform the Local Development Framework and any subsequent plans.
- To ensure that W&PBC meet their obligations under the latest planning guidance (Planning Policy Statement Note 25 (PPS25) Development and Flood Risk).
- To provide a reference and policy document for use by the general public and developers to advise and provide information on their obligations under PPS 25.
- To use as a tool to inform the development control process about the potential risk of flooding associated with future planning applications and the basis for requesting specific Flood Risk Assessments, if necessary.
- To promote working partnerships between W&PBC and the EA to develop best practice and data sharing with regard to flood risk information and it's application

1.3 Deliverables

The content of the SFRA is presented in a series of A1 maps, this report and a group of Geographical Information System (GIS) data files (shapefiles) for use electronically by Weymouth and Portland Council Officers. The information shown on the A1 maps has been grouped into three categories:

a) Existing flood risk
b) Historic flood events and flood defences
c) The effects of climate change

These maps highlight areas where flooding is an issue, or could be an issue in the future, and therefore where development should be avoided.

The report provides background information on the details shown in the maps and highlights areas particularly at risk of flooding. It also provides technical information regarding the production of the SFRA and recommendations and guidance for managing future flood risk.

The shapefiles provided show the information presented on the maps in an electronic format. These can be updated when new information becomes available therefore ensuring that any decisions being made by planning officers are based on the most up-to-date information available. The maps, shapefiles and report combined will enable consistent and sustainable decisions to be made with respect to both current flood risk and into the future.

2 STUDY AREA INFORMATION

This SFRA covers an area of approximately 42km^2, with 74% of this covering Weymouth and 26% the Isle of Portland. Weymouth is situated in the centre of the Dorset Coastline, approximately seven miles south of Dorchester on the A354. Portland is situated south of Weymouth. They are joined by the narrow isthmus of Chesil Beach along which the A354 runs.

Figure 2a
Location Plan

2.1 Description of physical characteristics

The majority of significant watercourses are defined as either Main Rivers or Critical Ordinary Watercourses (COWs). Main Rivers are watercourses defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers, whilst the maintenance of ordinary watercourses is the responsibility of the Local Authority.

There are a number of main rivers within the study area; the River Wey, Pucksey Brook and Preston Brook.

The **River Wey** extends approximately 21km within the boundary of W&PBC and has a catchment area of roughly 37.4km^2 in total (although not all of this lies within the study area). The source of the River Wey is a chalk spring at Upwey, south of Dorchester. The spring is the discharge point from a confined aquifer consisting of Portland Stone and Portland Sand. The Wey Valley is a region of chalk waters. To the north of the valley, above Upwey, is the Ridge. The Ridge is a long stretch of hills with calcareous and neutral grassland. Between Broadwey and Weymouth the River Wey catchment is comprised of Kimmerage and Oxford Clays and Forest Marble, making it impermeable to rain water. There is therefore a rapid response to rainfall in this area. In addition, this problem is increased when the upper chalk catchment is also saturated.

Pucksey Brook joins the River Wey from the west before it passes through Broadwey and Nottington. Pucksey Brook has a length of approximately 2.2km inside the study area and a total catchment size of 12.11km^2. The source of the brook is by Clover Farm, south of Portesham.

The **Preston Brook** is approximately 4km east of Weymouth, is 5.3km in length and has a catchment area of 4.0km^2. Its source is just north of Preston, and it drains to Lodmoor Nature Reserve. It has a relatively small, steep catchment which is predominantly made up of chalk. Groundwater issues from Boiling Rock, near the top of the catchment, providing the baseflow to the watercourse. Upstream of Coombe Valley Road the catchment is predominantly rural, whilst downstream the catchment becomes more urbanised and is largely canalised and culverted. Balancing ponds have also been installed. Approximately 20% of the Preston Brook catchment is classified as urban. Littlemoor and Wyke Oliver tributaries join the Preston Brook through the predominantly residential area of Preston.

The River Jordan (a COW) is another influential watercourse within the study area. It is 4.7km in length and has a catchment area of 7.9km$^{2.}$ The source of the River Jordan is at Spring Bottom, just inside the study area, and it drains into the sea at Bowleaze Cove, to the east of Weymouth. The Jordan catchment can be thought of as three separate areas; the upper reach is rural with the river contained within a steep sided, but broad floodplain; the middle reach is largely urban, with the watercourse well confined into a close steep sided valley; and the largely rural lower reach down to the sea has some significant areas of floodplain.

Smaller watercourses within the study area include Broadwey Stream, Lanehouse Stream and Chafey's Stream. These are between 0.7km and 1.7km in length within the study area and have a combined catchment size of approximately 10km^2.

Weymouth is situated on an anticline of Jurassic Beds comprising distinct layers of hard and soft rocks. The more resistant chalks and Portland limestones are interspersed with the softer more eroded Oxford Clay. Portland is made up of layers of Kimmeridge Clay, Portland Sand, Portland Stone and Purbeck.

The south limb of the Weymouth Anticline is formed from the strata at Portland. This strata dips southward at an angle of approximately one and a half degrees. The Portland Stone forms a prominent hill in the north overlooking Portland Harbour and Chesil Beach, whilst in the south it descends to just above sea level at Portland Bill. Underneath the Portland Sand and Chesil Beach is a thick layer of Kimmeridge Clay. It is this layer which is the main cause of all the landslides around the northern part of Portland.

Chesil Beach (sometimes known as Chesil Bank) is a natural phenomenon which stretches 29km from Bridport Harbour (West Bay) to Chiswell in the Isle of Portland, connecting the island to the mainland, as shown in photo 2.1a. It is a pebble storm beach which faces waves produced by south-westerly winds up the English Channel from the Atlantic Ocean. The beach backs onto Chiswell in Portland, then parts of Portland Harbour until it is separated from the land by the 13km of the Fleet Lagoon. At Abbotsbury the beach is approximately 155m wide, whilst at Portland it is 182m wide. There is a generally increasing ridge height from northwest to southeast, rising to a maximum of 14m above mean sea level at Portland. This ridge acts as a natural sea defence, although it only provides approximately a 1 in 5 year standard of defence.

At present the beach is practically stationary although there is a slight retreat towards the northeast, particularly at the Portland end of the beach.

Photo 2.1a
Chesil Beach

The entire Weymouth and Portland coastline is designated as World Heritage Coast due to its geology, geomorphology and fossils which document 185 million years of earth history, along with its potential for ongoing research and its natural beauty.

The climate of Weymouth is generally mild due to the sheltered position of the town. The prevailing wind is from the south west so winters are relatively warm, with snow rarely falling. In the winter the temperature is usually around 6^0C, whilst in the summer it settles just above 20^0C. Weymouth and Portland receive less rain than most parts of the UK, with an average annual rainfall of 752mm. Weymouth and Portland receive on average 1768 hours of sunshine a year, making it one of the sunniest spots in England.

2.2 Demographics, land use and economic features

Weymouth and Portland has the highest population density in Dorset with 1154 people per square kilometre. It is split into fifteen wards; twelve in Weymouth and three in Portland, and the total population is approximately 64,400 (Weymouth ~ 51,800, Portland ~ 12,600) living in approximately 30,000 properties.

Weymouth is mainly a residential area with some large areas of agricultural land whilst Portland is a combination of residential and rural areas with small areas of, predominantly quarrying, industry. The designated Area of Natural Beauty, known as the Dorset Downs Heath and Coast covers 7.5km^2 of the study area, encompassing the settlements of Upwey and Sutton Poyntz and the upper reaches of the Wey Valley. There are also seven Sites of Special Scientific Interest (SSSI) and three Nature Reserves within the study area. These SSSI's are the Isle of Portland, Radipole Lake, Lodmoor, the South Dorset Coast, Portland Harbour Shore, Chesil Beach and the Fleet, and Studland Cliffs. The Nature Reserves are Fleet Nature Reserve close to Wyke Regis, Radipole Nature Reserve at Radipole and Southill, and Lodmoor Nature Reserve at Overcombe, as shown in photo 2.2a.

Photo 2.2a
Lodmoor Nature Reserve & SSSI

Portland harbour covers an area of approximately 16km^2. The harbour shore is a SSSI and in addition the northern shore is an intertidal zone. The whole harbour area is sheltered to the north by the mainland, to the south by Portland, to the west by Chesil Beach and to the east by four large stone breakwaters separated by the South, East and

North ship channels. The Inner Breakwater is the smallest and is attached at Balaclava Bay. The Outer Breakwater is an island which has a fort at the northern end. The North-eastern Breakwater is also an island and has a warning light at the south-eastern end, and the Bincleaves Groyne is attached to the land south of Weymouth.

3 TYPES OF FLOODING

3.1 General information

A floodplain is an area that would naturally be affected by flooding if a river rises above its banks, or where high tides and stormy seas cause flooding in coastal areas. Over hundreds of years, natural floodplains have been built on and today many towns and cities exist on floodplains. Some settlements and areas of agricultural land have flood defences in place to reduce the risk of flooding. It should be noted however that in these areas there will always be some risk (however low) of flooding.

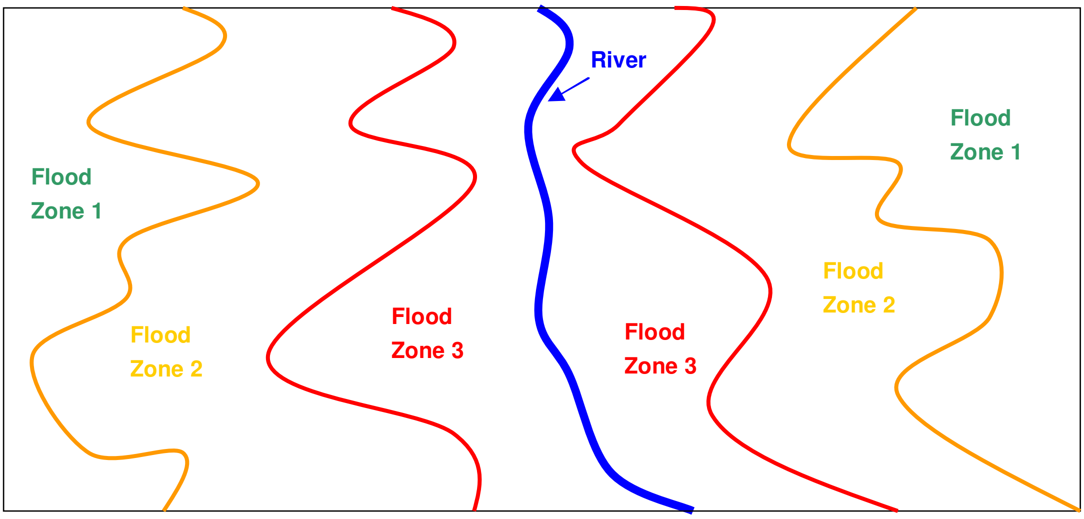
Environment Agency Flood Zones

The EA produce a Flood Map (which is updated quarterly) depicting areas where there is a high risk (Flood Zone 3) or a low-to-medium risk (Flood Zone 2) of flooding from rivers and the sea. These zones do not take into account any flood defences that could reduce the impact of flooding if there was a flood event, because the defences can be breached, overtopped and may not be in existence for the lifetime of any development. The Flood Zones cover the watercourses in the study area which have a catchment area of greater than $3km^2$ and indicate where flooding can occur at postcode level. This Flood Map can be viewed on the EA website at www.environment-agency.gov.uk.

The Flood Map is split into three areas (as indicated in figure 3.1a):

- EA Flood Zone 3 is the area that could be affected by fluvial or tidal flooding if there were no flood defences. The probability of tidal flooding in this area is at or greater than 0.5% (1 in 200 years) and the probability of fluvial flooding is at or greater than 1% (1 in 100 years). This is described as a high risk area.
- EA Flood Zone 2 shows the additional extent of an extreme fluvial or tidal flood with no defences in place. These areas are likely to be affected by a major flood with up to a 0.1% (1 in 1000) chance of occurring each year. This is described as a low to medium risk area.
- All land not in EA Flood Zones 2 or 3 are in Flood Zone 1 which has little to no risk of flooding and the probability of flooding is less than 0.1%. (See www.environment-agency.gov.uk for more detail)

Figure 3.1a
EA Flood Zone Location in relation to a watercourse



Potential Flood Risk Areas (as defined by Royal Haskoning)
Where the EA has not given a flood zone for a watercourse in the study area, for the purposes of this SFRA, we have plotted an estimate of the 1% probability (or 1 in 100 years) flood extent for the watercourse. This has been done solely using engineering judgement, without the benefit of sophisticated modelling techniques. The Potential Flood Risk Areas therefore represent data of poorer quality than the EA Flood Zones and should be treated as a guide to indicating flood risk only. Information on how the Potential Risk Areas were produced can be found in Appendix B.

3.2 Current flood risk

Flooding is an issue with varying levels of severity across most of the study area. Significant flooding in the area is mainly caused by the overtopping of river banks and tidal flooding, whilst less severe flooding in Weymouth is predominantly from surface water runoff, and the blockage of drains and culverts.

There are a number of flooding issues along Lanehouse Stream, although the majority of flooding in the area does not seem to be as a result of the stream overtopping. Most of the problems tend to be as a result of blocked drains and gullies, surface water runoff, and tidal flap valve malfunctions. There are screens in place along the stream. It is known that these screens can become blocked and cause flooding during a high flow event. The screens are subject to high maintenance, as they must be visited when heavy rainfall is predicted to ensure they are not blocked, to enable the structures to operate efficiently.

On the River Jordan the Mill Lane Leat, Preston Road Bridge and Fisherbridge Road Bridge are all critical inspection sites. At these locations silt needs to be removed on a regular basis to ensure the flow of water is not restricted as this can cause flooding problems upstream of the site. There are minor localised drainage problems along the A353 Preston Road and at Puddledocks. Other problems in this area are caused by backflow through private surface water systems and overtopping of the River Jordan during times of heavy rainfall.

Also along the River Jordan, flooding has occurred at the Waterside Holiday Park, shown in photo 3.2a, due to water backing up at the Bowleaze Coveway Road Bridge.

Photo 3.2a
Flooding at Waterside Holiday Park

Flooding has occurred at Sutton Poyntz due to obstructions at the culvert and bridge. There is a screen in place and it is designated as a critical inspection site. There is also a groundwater seepage problem on Sutton Road.

There is knowledge of flooding events in Preston. Some events were caused by heavy rainfall affecting the Preston Brook, but there are also issues regarding inadequate culverts and bridges, blocked gullies, and surface water runoff. Channel improvements and defences as part of the Preston Brook Scheme (Section 5.1) have been put in place along Littlemoor Road to try to reduce flooding in the area, in addition to a flood relief culvert at Oakbury Drive.

Flooding occurs in Littlemoor, along the Broadwey Stream. This flooding is sometimes a result of blocked screens. In addition a series of three balancing ponds have been put in place by W&PBC along Broadwey Stream. These ponds do not currently work effectively; on occasions the bottom most pond has been full whilst the other two ponds have been empty. Modifications are required to ensure the ponds are operating in the most effective way.

Problems in Broadwey, Upwey and Nottington result from water overtopping the banks of the River Wey during heavy rainfall, surface water runoff and overland flow from surrounding fields. In Weymouth and Wyke Regis inadequate culverts, drainage systems, sewer flooding and surface water runoff (primarily from roads) are the principle causes of flooding.

Coastal flooding is becoming a major issue along the Dorset coastline. Due to predicted increases in sea level rise from climate change, the importance of protection from the sea will need to be realised. Flood mitigation can be achieved through coastal protection schemes or through managed retreat programmes. In this study area, projects have already been carried out at Weymouth Harbour and Preston Beach. As the majority of Portland coastline is cliff, coastal flooding is not widespread, however it does occur at certain locations within the study area. The main location of tidal flooding in Portland is at Chiswell, where the pebble bank can fail through overtopping, breaching or by changes to its density.

3.3 Historic Flooding

Looking at historic flooding can highlight areas that are currently at risk to flooding. Historic information, as shown in figure 3.3a, has been obtained from newspaper reports, W&PBC Engineers and the EA Flood Reconnaissance Information System (FRIS). This system is a collection of geo-referenced events collated by the EA, which also highlights the source of the flooding and other key information about the event.

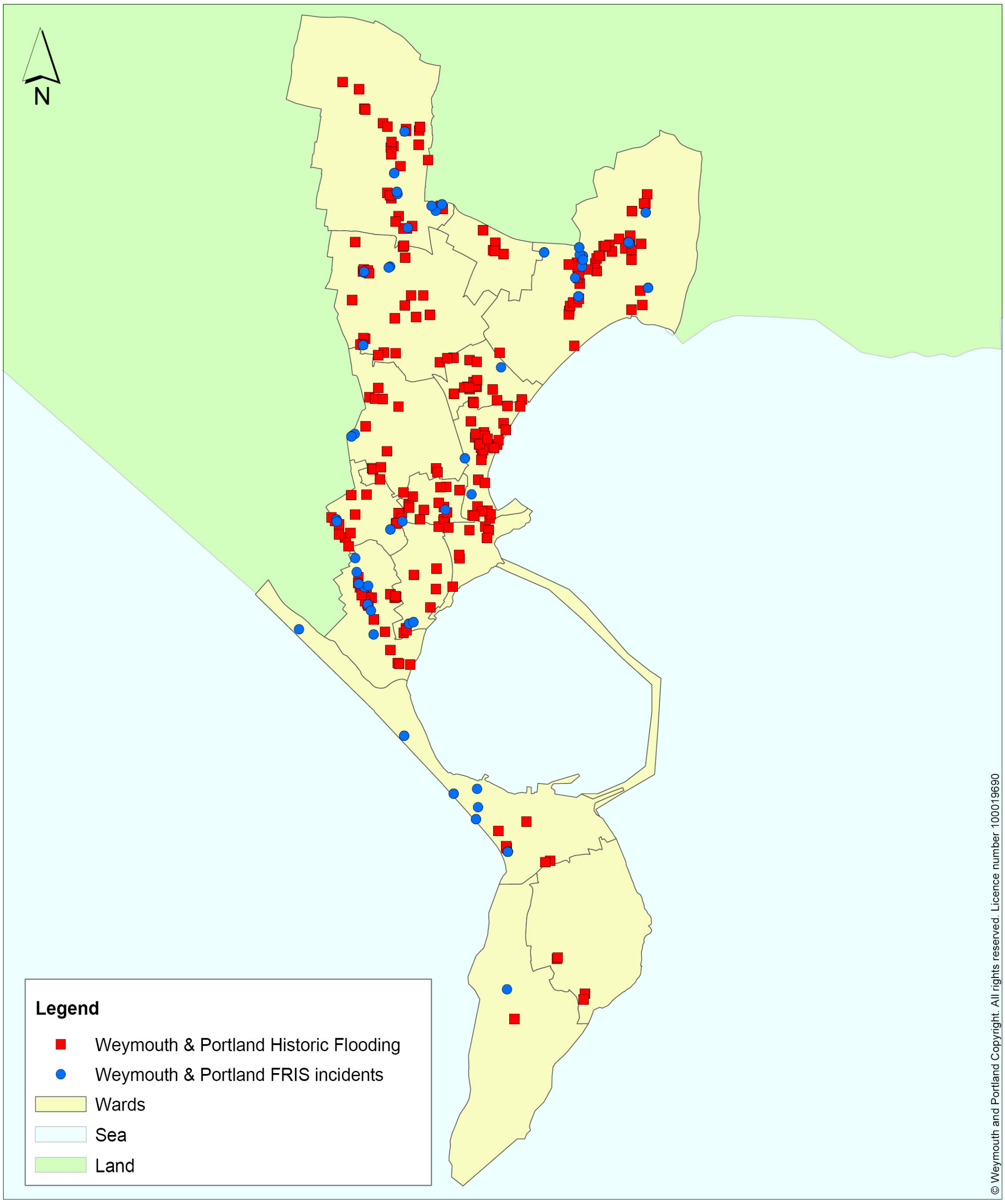
Particularly large events are described below:

22nd & 23rd November 1824

Chiswell and Chesil Beach is an area that is particularly susceptible to flooding. Occasionally, exceptionally large wave systems develop in the Atlantic and cause large, long period waves to hit the beach. This can result in overtopping or breaching of the ridge, sending enormous volumes of flood water into urban areas behind the ridge, particularly Chiswell. This rapid inundation can have disastrous effects on the people living in Chiswell. The worst recorded overtopping of the beach occurred on the 22nd

and 23rd November 1824 when a hurricane caused a storm surge. Many fishermen's cottages were destroyed, killing up to sixty people.

Figure 3.3a
Historic Flooding within Weymouth & Portland



Other extreme tidal events which have affected Chiswell include:

- February 1904,
- February 1910,
- January 1924,
- June 1938,
- December 1942,
- November 1954,

- January 1962,
- October 1976,
- December 1978
- 2nd December 2005.

24th October 1908
A very sudden, severe storm followed a summer of drought. The rain started just after 9am and rained solidly for three hours. The drainage system in Weymouth was unable to cope with the volume of water and torrents rushed through the Dorchester Road district. Streets were flooded to depths of 0.30 – 0.75m and many properties were flooded internally. The worst hit areas were Hardwicke Street, Upper and Lower Chelmsford Street, Brownlow Street, Charles Street, Walpole Street and Penny Street. In total 100mm of rain fell in approximately five hours, although the effects would have been much worse if the rain had coincided with a high tide.

18th & 19th July 1955
This event produced the highest rainfall ever recorded in the UK at Martinstown Dorset, approximately 8km away. The unprecedented intensity started after 5pm on the 18th July 1955, following weeks of very little rain. The high tide was at 19:30; therefore the release of water from Radipole Lake was reduced. In addition gullies were choked. The water level rose in parts of Weymouth to several feet, entered many properties and caused damage to Westham Bridge and other structures in the area. In total approximately 180mm of rain fell in 21 hours.

Other major rainfall events include:
- *11th and 12th July 1977* when 78mm rain fell in 12 hours. Weymouth, Westham and Wyke Regis were particularly affected by this event.
- *24th August 1977* when 54mm rain fell in 12 hours. This event is estimated to have a return period of 25 years and mainly affected areas of Weymouth and Westham.
- *30th May 1979* when 35mm rain fell in 12 hours. This event affected all parts of Weymouth and the north of Portland.
- *5th June 1983* when 53.8mm rain fell in 6 hours
- *30th December 1993* when 35mm rain fell in 24 hours but was concentrated in approximately 5 hours. This was estimated to be a 1 in 10 year event and mainly affected the River Jordan and Preston Brook, although Broadwey and Upwey were also affected.
- *10th May 2004* when a heavy, localised storm caused overland flows from the Littlesea Industrial Estate to the west.

The EA map historic flood events across England and Wales as part of their Historic Flood Mapping (HFM). The area the HFM highlighted in Weymouth and Portland is Chesil Beach at Chiswell. At the time of writing this SFRA, the Chiswell area is currently under investigation. More details can be found regarding this area in Section 3.6.

3.4 Climate change

This SFRA is intended to be used as a long-term planning document. It is therefore necessary to consider the potential impacts of climate change in terms of fluvial and tidal flood risk.

At present it is difficult to quantify how the changing climate will affect the areas currently at risk of flooding. The limits of floodplains cannot be defined precisely because floods with similar probability can arise from different combinations of event that will have different impacts. However while sea level rise and climate change could have a significant impact on levels of risk, current information would suggest that the actual areas at risk are not expected to increase significantly.

Government guidance regarding future flood risk and development is currently in the process of being updated with the release of Planning Policy Statement Note 25 (PPS25), which replaces Planning Policy Guidance Note 25 (PPG25). It is generally accepted that the South West will see a sea level rise of 5mm per year up until 2050. Annual rainfall is expected to increase by 10-15% by 2110 resulting in potential increases in peak flow of up to 20% for a given return period by 2050 and 30% by 2110. Consideration of development under PPG25 guidelines only considered a 20% increase in flows. Therefore developers will have to undertake greater measures to reduce flood risk under PPS25 than they are currently required to do. To ensure PPG25 and PPS25 requirements are met both a 20% increase and a 30% increase in fluvial flows have been considered in this SFRA.

The effects of increased wave height and wind speed may also be an issue for coastal areas. The modelling of these effects is outside of the scope of this study. Guidance indicates a 10% sensitivity allowance needs to be applied up to 2080. Detailed Flood Risk Assessments and further studies should encompass this information.

Assuming flows are increased by 20% (under current PPG25 guidance) and 30% (PPS25 guidance) as a result of climate change, new fluvial flood extents based on the existing Flood Zone 3 data have been created in certain key areas based on the LiDAR Digital Terrain Model (DTM) data. LiDAR DTM captures height information based on a 2 metre grid and was provided by the EA for the purposes of this study. The specific methodology using software tools such as ArcView GIS, Spatial Analyst and Profile Extractor is detailed in Appendix C. The locations chosen for these detailed studies were identified by locating FRIS hotspots and other known locations of high frequency flooding, the availability of suitable LiDAR DTM data and the presence of existing Flood Zone 3 data. Therefore the locations where this methodology has been applied are Nottington, Preston, Radipole and the River Jordan and the results can be seen in section 5.3.

It is beyond the scope of this SFRA to apply this climate change methodology across the whole study area. The new fluvial flood extents as derived above serve as a guide for the likely changes that could occur as a result of increased flows of 20% and 30%. It is assumed that similar lateral changes to flood extents will also occur at other locations in the study area with equivalent topography and settlement patterns. It should be noted that in the locations modelled, the 30% increase in flows results in little increase in lateral extent above the 20% increase in flows.

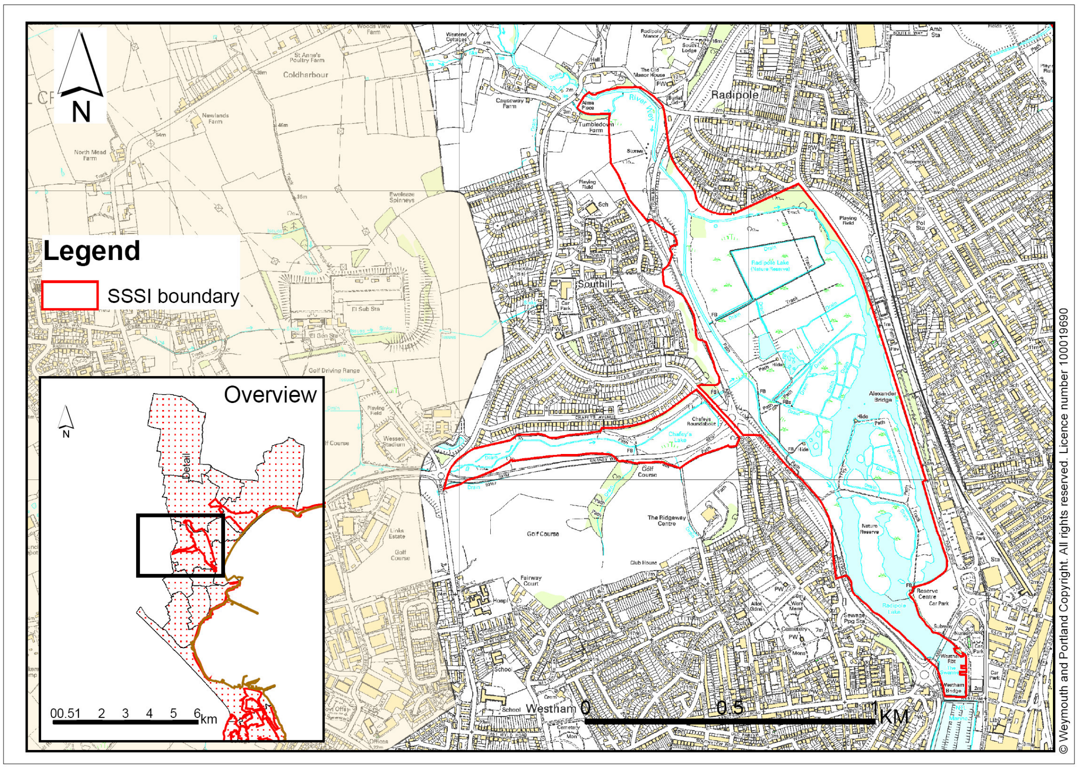
Previous studies reviewing the effect of climate change on tidal levels have been carried out for the period up to 2052 by Royal Haskoning for the whole of the South Coast on behalf of the EA. The projected levels of tidal extents and associated tidal floodplain were produced under the Level B 2002-4 South Coast tidal mapping study and assumed an annual sea level rise 5mm to allow for predicted climate change. This modelling study considered certain raised defences and associated overtopping and breaching for areas over 1 square km. The new tidal extent for 2052 is depicted on the Climate Change predictions A1 map and as a GIS shapefile.

3.5 Tidal and Coastal Risk

Areas are at risk of tidal flooding when they are low lying and adjacent to the coast or near to an estuary. Within Weymouth and Portland this includes areas such as the A354 connecting Weymouth and the Isle of Portland, Radipole Lake and Lodmoor. Where high tides, especially Spring tides combine with strong onshore winds the associated waves and spray can overtop defences causing coastal flooding and in some cases structural damage caused by the water itself or by debris within it. Areas at risk of coastal flooding include Weymouth Esplanade and properties on the Western edge of Chiswell.

Radipole Lake is a SSSI which is leased to the RSPB as a nature reserve. It has an area of approximately 0.87km^2 and is located in the centre of Weymouth, as shown in figure 3.5a. It was a tidal estuary until 1921 when Westham Bridge was constructed. This bridge acts as a tidal barrier therefore converting Radipole Lake into a freshwater lake.

Figure 3.5a
Location plan of Radipole Lake



Water enters Radipole Lake from the Chafey and River Wey catchments. It is stored in the lake then discharges via Weymouth Harbour and the marina into Weymouth Bay. Westham Bridge tidal barrier retains the water in the lake although there have been problems in the past in maintaining optimum water levels due to operational failings of the barrier. The aim is to maintain the water level between high and low tides. This provides a storage volume at times of fluvial flood and prevents the lake becoming tide locked at high tide.

There is a risk of fluvial flooding upstream of Westham Bridge due to conveyance problems when high fluvial flows combine with high tides. Hydraulic modelling carried out for the Water Level Management Plan (2001) found that the main two areas at risk from flooding caused by Radipole Lake are the Swanson's Restaurant near Westham Bridge and the RSPB visitors centre. All other areas around the lake are on high ground and therefore not at risk from fluvial flooding.

Westham Bridge is the main control of the water level in Radipole Lake. The bridge contains eight culverts; four of which have tidal flaps, and four have electronically controlled penstocks. Also in place is a timber drop board on the tidal flaps to maintain the minimum water level required by RSPB. Currently there are the following problems with this system:

- The timber drop board is very difficult to move and therefore cannot be adjusted easily when necessary.
- The condition of the drop board is deteriorating but maintenance requires work by divers and is therefore costly and dangerous.
- The penstocks can get jammed open therefore reducing the flow control.
- Saline intrusion occurs at very high tides therefore allowing sea water into the lake, producing a salt wedge, which may affect habitats in this SSSI.

Details of the settings for the penstocks and the Proposed Water Level Management Regime are given in the Radipole Lake Water Level Management Plan held by W&PBC.

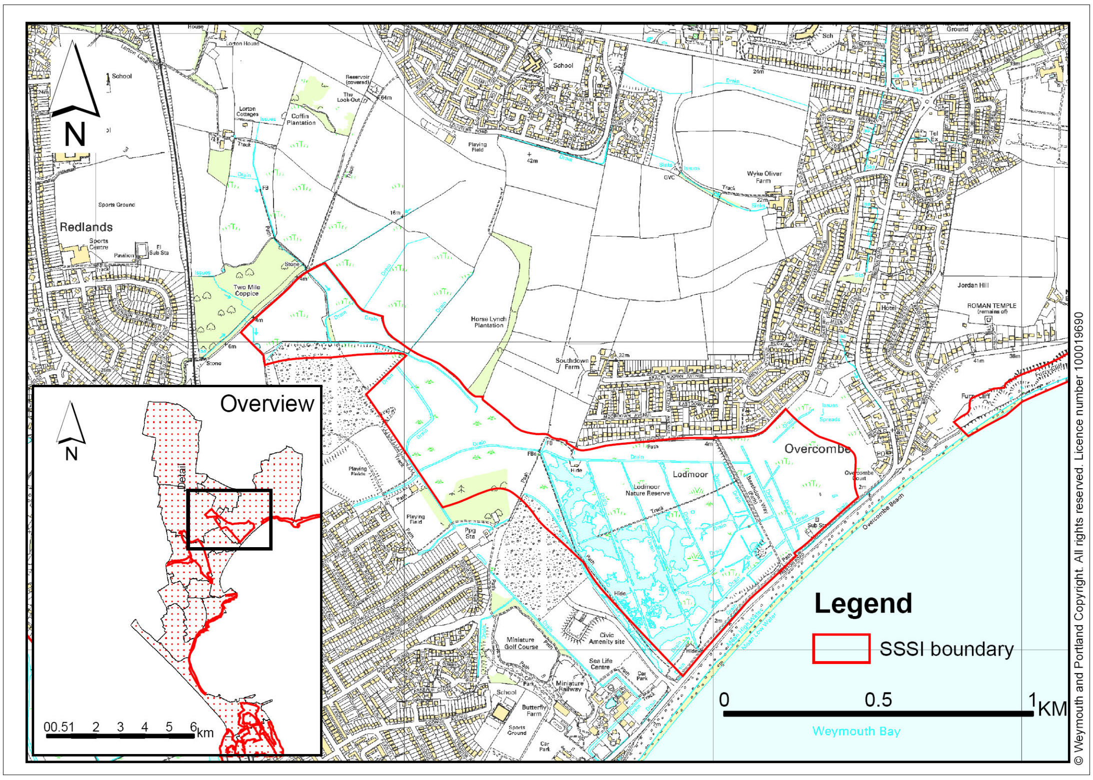
3.6 Rapid inundation zones

Potential inundation could occur where there is risk of breaching or over-topping of raised defences and in steep catchments through flash flooding generally caused by heavy rainfall and excessive surface flow. Water behind a raised defence can build up to levels higher than the surrounding land and create additional strain on the defence. This may cause it to collapse or the retained water can spill over the top rapidly inundating adjacent low lying ground. Fast flowing water or deep flooding that occurs quickly can create a risk of loss of life. Flooding from the overtopping and undermining of defences occurs along the Esplanade in Weymouth town centre causing widespread damage and disruption.

Defences are indicated on the A1 maps and the GIS shapefile layer (based on data currently available from the EA National Flood and Coastal Defence Database (NFCDD)) and can be interrogated to determine their exact locations. At present in Weymouth and Portland over 8km of defences (fluvial and tidal) are recorded as raised within NFCDD. These are found at Weymouth Harbour and Town Centre, the western edge of Radipole Lake and along the River Wey at Nottington and Upwey. Clarification should be sought from the EA as to when the coastal defences are to be updated on NFCDD to ensure that the latest information is available and represented.

Lodmoor Site of Special Scientific Interest (SSSI) covers an area of approximately 0.75km^2 immediately east of Weymouth, as shown in figure 3.6a, and is managed by the Royal Society for the Protection of Birds (RSPB). It is an area of low-lying land which is sandwiched between the shingle ridge of Preston Beach and higher ground on the edge of Weymouth.

Figure 3.6a
Location map of Lodmoor SSSI

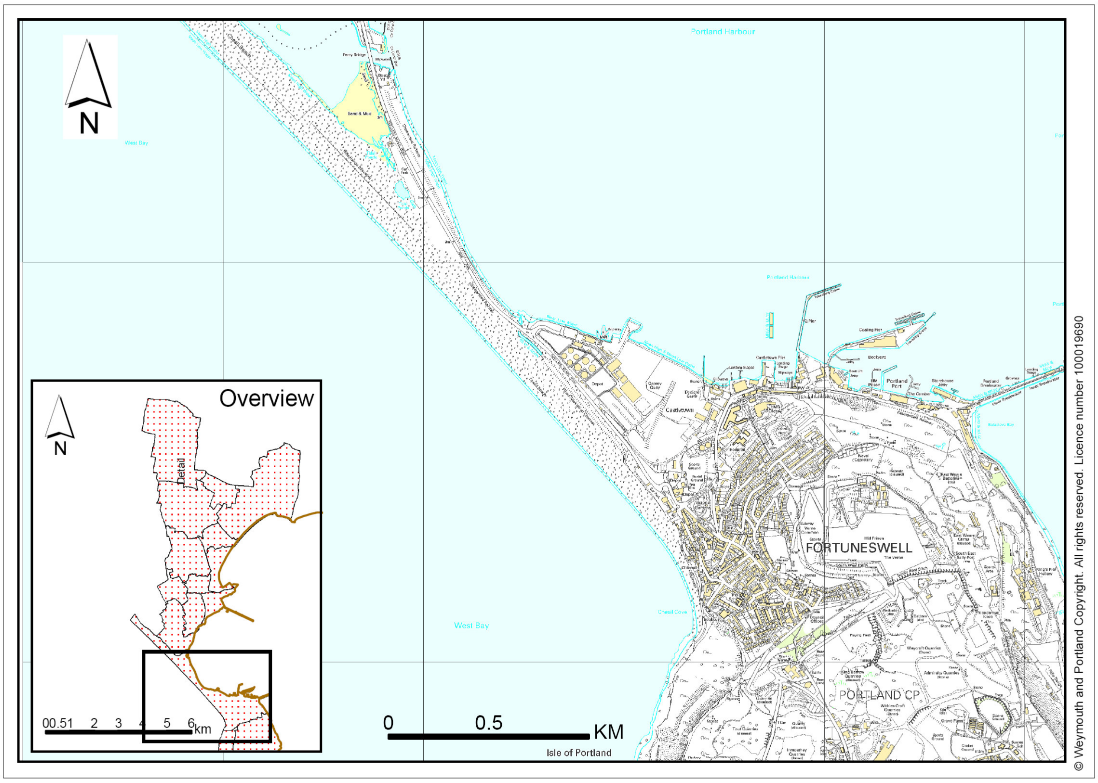


Water is known to enter Lodmoor Nature Reserve from Preston Brook, springs, drains, surface water runoff and from saline intrusion through Preston Beach. The only outflow by which water can leave the reserve is the tidal outfall in the south-east corner of the reserve, which has a tidal flap valve to prevent tidal flooding of the reserve. A study undertaken by Posford Haskoning (1998) found that the reserve was capable of discharging at least a 1 in 50 year flood event before causing road flooding.

If the defences (i.e. sea wall and shingle ridge) at Preston Beach are breached then Lodmoor and surrounding low lying areas will be at risk of rapid flooding. The risk of excessive saline intrusion into the area would then occur, which is likely to affect the ecology and biodiversity of Lodmoor and therefore the SSSI designation of this area.

Chiswell and Chesil Beach (as shown in figure 3.6b) are areas that are particularly susceptible to flooding due to large wave systems from the Atlantic. The waves produced can overtop or breach the ridge and send large quantities of flood water into the village of Chiswell.

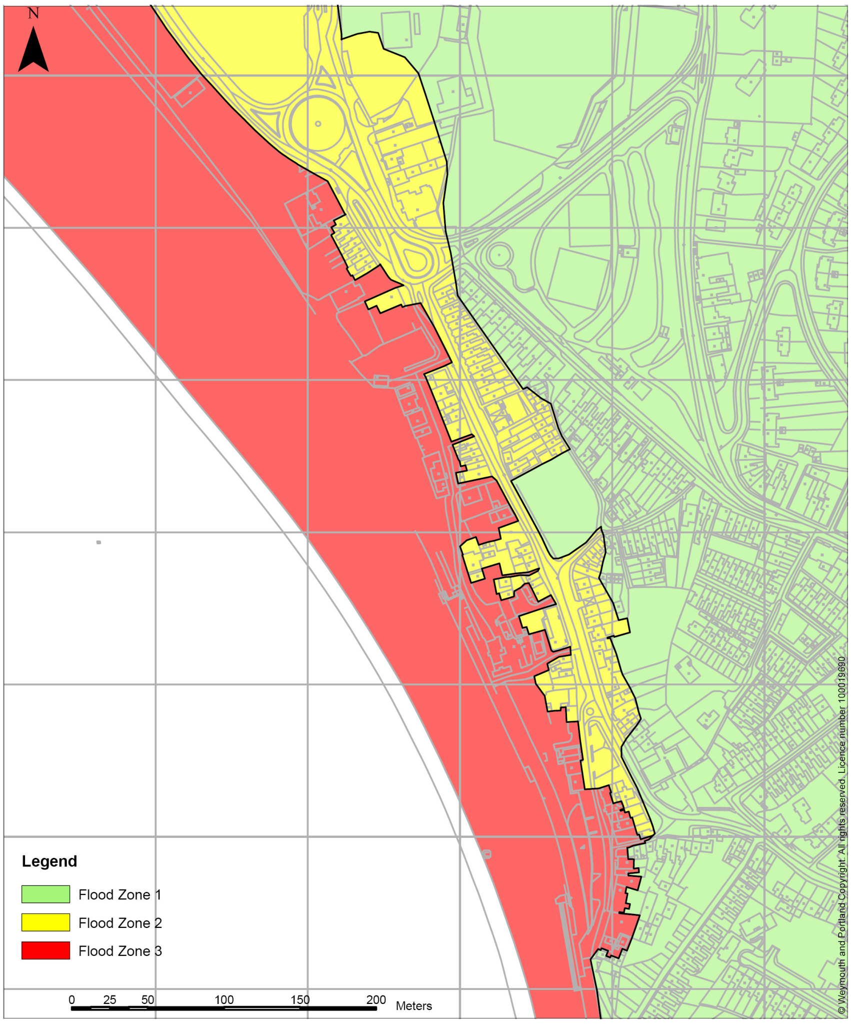
Figure 3.6b
Chesil Beach and Chiswell



Sea defences have been constructed at the Portland end of Chesil Beach to try to alleviate the overtopping and flooding problems at Chiswell and are currently built to a 1 in 5-10 year Standard of Protection. A flood drainage channel scheme designed to carry away floodwater quickly has also been constructed underneath the shingle ridge of Chesil Beach.

The main sea wall was constructed in 1959. It is comprised of two walls joined by concrete beams and stone. Work is currently being undertaken by Royal Haskoning to review the division of Flood Zones 1, 2 and 3 in this area taking account of hydraulic modelling produced by a two dimensional flow modelling technique (TuFlow) as shown in figure 3.6c

Figure 3.6c
Revised Flood Zones at Chiswell



3.7 Ground water

Flooding from groundwater occurs when water stored beneath the ground reaches the surface and is generally associated with porous rocks such as sands, gravels, limestone and chalk. Generally, ground water flooding is not a significant problem within the area of W&PBC but areas that may be vulnerable are those at the foot of the chalk escarpment (Ridge Hill, Bincombe Down, West Hill and East Hill) running along the north of the study area. Springs exist in these areas but can be seasonally affected by changes in groundwater and flows may differ substantially depending on the time of year, with some springs drying up completely during the summer months. Groundwater seepage is known to occur in Sutton Poyntz along the River Jordan.

There may also be issues with coastal erosion caused by an increase in localised groundwater. Development that leads to higher surface water flows and increased drainage requirements could over time weaken the top strata of the porous chalk cliff through an increase in the presence of groundwater resulting in cliff slippage and potential loss of land and property. Sustainable Drainage Systems (SUDS) could help to reduce this affect.

It is a requirement of PPS25 that groundwater flooding and any potential effects it has must be assessed as part of any FRA.

3.8 Sewage Treatment Works outflows and sewer flooding

In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water, known as combined sewers. These sewers can be overwhelmed by heavy rainfall, become blocked, or be of inadequate capacity, resulting in flooding of the surrounding area until the water can drain away. This is particularly a problem when a combined sewer is involved because there is then a high risk of contaminated water flooding a property internally.

Any new development needs to address the impact on the existing capacity of the sewer system and any associated sewage treatment works. Increases in discharge may lead to the overloading of receiving watercourses and consequently an increase in flood risk. It is a requirement of PPS25 that the potential of this occurring and any mitigating measures must be assessed as part of any FRA.

Specific records of sewer flooding are not available from Wessex Water for use within this study. Low lying areas such as Park District and Easton Square are susceptible to sewer flooding. Flooding has previously occurred in 1983, when two properties on Doncaster Road, Wyke Regis were flooded internally, and in 2000 when highway flooding was recorded by the EA (FRIS records) in Westcliffe Road, Weston, Portland.

4 MANAGING FLOODING

4.1 General information

The government aims to reduce the risks to people and the developed and natural environment from flooding by discouraging further built development within floodplain areas. Government guidance has been produced for local planning authorities to help them when allocating land for development in order to meet this aim. This guidance is contained in a document called Planning Policy Statement Note 25 (PPS25). In undertaking the SFRA this guidance has been examined and used to provide a robust and consistent system for assessing flood risk anywhere within the local planning authority.

The following issues concerning flood risk within the Weymouth and Portland Borough Council area have been highlighted to provide additional awareness and assistance to aid the decision process outline above.

4.2 Defences

The SFRA has identified existing defences, for example at Chesil Beach (photo 4.2a), that are maintained by the EA or W&PBC. Defences comprise a structure (or system of structures) for the alleviation of fluvial or tidal flooding. The SFRA does not identify privately maintained defences. Private walls may exist in the area but are not classed as ‘flood defences’. Furthermore, not all banks are flood defences.

Photo 4.2a
Chesil Beach Sea defence wall

Defences are designed to protect from flooding of a certain level - a standard of protection. The standard of protection is the maximum flood event that the defence can protect against before it is breached or overtopped. For example the flood relief culvert on the Preston Brook at Overcombe is stated to have a 1 in 25 year standard of protection. However it cannot be assumed that the level of defence is still at the original design standard because of changes to the way floods are estimated, the effects of climate change and deterioration of the structure.

Changes to the land use in areas near to defences can also have an effect on the standard of protection provided by the defence by changing the flow patterns of groundwater and surface water runoff. Therefore any proposed development must be closely examined during a detailed flood risk assessment to ensure that the existing and future development has the appropriate level of protection. PPS 25 suggests that the appropriate level of defence against fluvial floods should be a 1 in 100 year standard (1% probability flood) and against tidal floods should be a 1 in 200 year standard (0.5% probability flood).

The Preston Beach area is defended by a shingle storm beach backed by a concrete seawall, as shown in photo 4.2b, which extends approximately 1.4km from the rock armour terminal groyne at Greenhill (Weymouth) as far as the Overcombe Café to the north east. The defence comprises the storm beach and a paved rear slope with a concrete promenade on top, whilst a second lower concrete wall at the rear of the promenade contains any loose shingle deposited during storm events.

The wall is designed to prevent flooding to the road and Lodmoor Nature Reserve by wave action during storms, and to prevent the deposition of shingle from the original narrow beach onto the coast road during storm events whilst creating an improved amenity with beachside access.

Photo 4.2b
Preston Beach Sea wall

In addition to the hard defence, the Preston Beach Management Strategy highlights the need to carry out periodic maintenance of the mobile beach, particularly after storm events. The maintenance includes periodic recharge and the recycling of beach material along the frontage to reinstate vulnerable areas.

4.3 Surface Water and Sustainable Drainage Systems (SUDS)

Flood risk from surface water flooding is of concern within the study area. A number of flood incidents have occurred within the area caused by surface water alone, or in combination with river flooding. Some of these events are highlighted on the maps as recorded by the EA (FRIS). The EA Flood Zone Maps do not show flood risk due to surface water flooding.

Urban developments can have a big effect on the quantity and speed of surface water runoff. By replacing vegetated ground with buildings and paved areas, the amount of water being absorbed into the ground is severely reduced, therefore increasing the amount of surface water present. This additional surface water increases the demand on drainage systems in built up areas. Traditional drainage systems are designed to get rid of the water as quickly as possible to prevent flooding in the built up area. This can cause problems, particularly downstream, by altering the natural flow patterns of the catchment. In addition, water quality can be affected due to pollutants from the built up areas being washed into the watercourse. One technique which can reduce this problem is the use of Sustainable Drainage Systems (SUDS).

Sustainable Drainage Systems (SUDS) are techniques designed to control surface water runoff before it enters the watercourse. They are designed to mimic natural drainage processes, along with treating the water to reduce the amount of pollutants getting into the watercourse. They can be located as close as possible to where the rainwater falls and provide varying degrees of treatment for the surface water, using the natural processes of sedimentation, filtration, adsorption and biological degradation.

SUDS are more sustainable than traditional methods because they can:

- Manage the speed of the runoff
- Protect or enhance the water quality
- Reduce the environmental impact of developments
- Provide a habitat for wildlife
- Encourage natural groundwater recharge.

In addition, they can be used to create more imaginative and attractive developments and are designed so that less damage is done, than conventional systems, if their capacity is exceeded.

Surface water management using SUDS can be implemented at all scales and in most urban settings, ranging from hard-surfaced areas to soft landscaped features, even if there is limited space. Most techniques use infiltration but even if the area has little or no infiltration SUDS can still be used in the form of green roofs, permeable surfaces, swales and ponds.

SUDS are made up of one or more structures built to manage surface water runoff, and used in conjunction with good site management. There are five general methods:

a. **Prevention** – this can involve minimizing paved areas, replacing tarmac with gravel, rainwater recycling, cleaning and sweeping, careful disposal of pollutants, and general maintenance.

b. **Filter strips and swales** – these are vegetated surface features that drain water more slowly and evenly off impermeable areas. Swales (figure 4.3a) are long shallow channels whilst filter strips (figure 4.3b) are gently sloping areas of ground. Both of these mimic natural drainage by allowing rainwater to run in sheets through vegetation, slowing and filtering the flow.

Figure 4.3a - Cross-section of a Swale

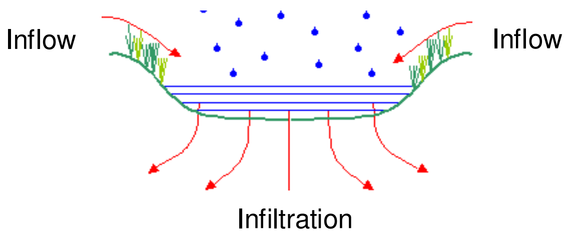
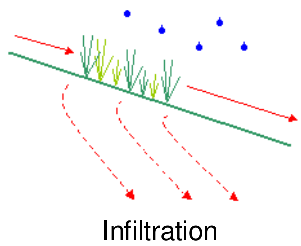


Figure 4.3b - Cross-section of a Filter Strip



c. **Permeable surfaces and filter drains** – these are devices that have a volume of permeable material below ground to store surface water. Runoff flows to this storage area via a permeable surface.

d. **Infiltration devices** – these enhance the natural capacity of the ground to store and drain water. They include soakaways, infiltration trenches and infiltration basins. See figure 4.3c.

e. **Basins and ponds** – these are areas for storage of surface runoff e.g. floodplains, wetlands, and flood storage reservoirs. They can be designed to control flows by storing water then releasing it slowly once the risk of flooding has passed. See figure 4.3d.

Figure 4.3c - Cross-section through an Infiltration Basin

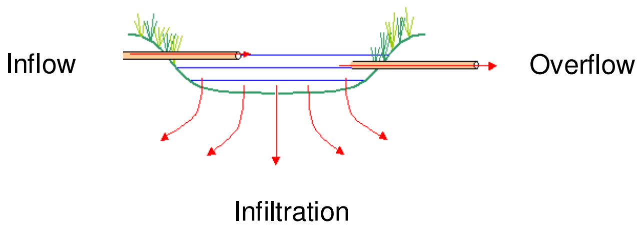
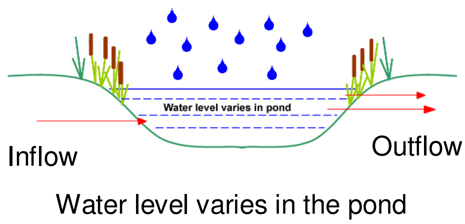


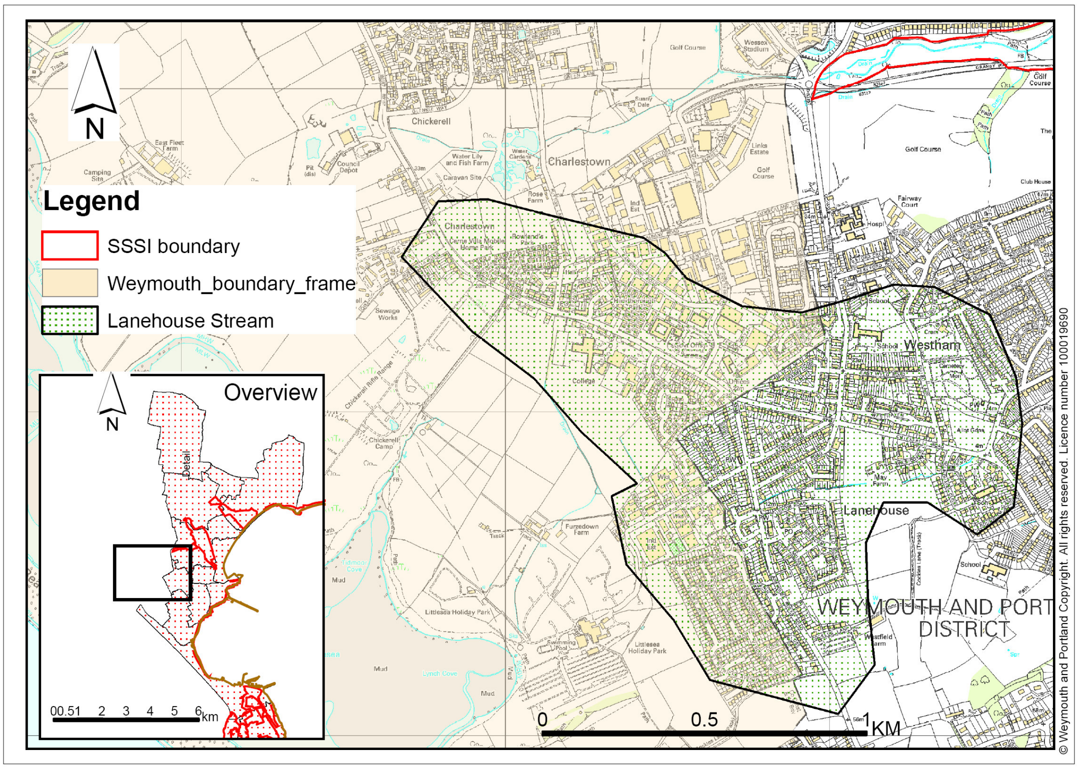
Figure 4.3d - Cross-section of a Pond



Flooding from surface water is known to be an issue in the Lanehouse Stream area and affects several houses on Overbury Close. This flooding is due to overland flows from the Littlesea Industrial Estate following heavy, localised storms. A flood risk assessment was undertaken by Royal Haskoning in June 2005 to investigate the existing capacity of the Lanehouse Stream and its structures downstream of Lanehouse Rocks Road. Following the study, predictions can be made regarding the downstream effect of any improvements to drainage works in the area, with the aim to reduce the risk of internal property flooding.

The Lanehouse Stream catchment, as shown in figure 4.3e, is a small, urban catchment, covering 1.16km^2. The stream is a mixture of culverted and open-channel sections. As the watercourse flows downstream it is joined by a number of surface water sewers, some of which drain the Littlesea Industrial Estate and the large residential area of Lanehouse.

Figure 4.3e
Location map of Lanehouse Stream



A hydrological study was carried out, followed by HEC-RAS hydraulic modelling. The HEC-RAS modelling highlighted the insufficient capacity of the culverts downstream of Lanehouse Rocks Road. New developments therefore need to implement Sustainable Drainage systems (SUDS) to minimise the affect of the development on the downstream flood risk and to ensure the problem is not moved downstream.

4.4 Managed retreat and river erosion

Managed Coastal Retreat is concerned with planning for the potential threat of rising sea levels by looking at the options available to protect the coastline. In some areas it may not be suitable to build bigger flood defences to protect against flood risk associated with rising sea levels and increased wave action. It may even be necessary to remove some defences, especially on eroding cliffs to allow for the provision of extra material such as sand and silt for the sea to deposit elsewhere by natural processes. Managed coastal retreat may also mean setting back sea walls so that beaches, salt marshes and other natural features can help in defending from the sea.

An example of coastal erosion can be seen at Newton's Cove (figure 4.4a). A coastal protection scheme was undertaken to protect and enhance the SSSI and local built environment.

Figure 4.4a
Newton's Cove coastal protection scheme

As a large proportion of the study area is coastline, in the future, managed coastal retreat may become a relevant planning issue for Weymouth and Portland. At present there are no known plans for managed coastal retreat in Weymouth and Portland Borough Council and due to the shoreline topography it is an unlikely option in the foreseeable future. However PPS25 notes that development in Flood Zone 3 or close to eroding cliffs should avoid coastal areas which will, or may in the future, be needed for managed coastal retreat.

More information on the risk of cliff erosion can be found in the Lyme Bay Shoreline Management Plan and the Portland Bill to Durlston Head Shoreline Management Plan, both of which are held by W&PBC.

In considering the influence of geomorphological processes on flooding within a catchment it is essential to consider the whole river corridor, including the river floodplain where it exists. Transfers of water and sediment typically occur between rivers and associated floodplains during high flow events, and form part of the natural function of the river system. Floodplain connectivity refers to the degree to which river and floodplain processes are inter-related in this way, and is important for the functioning of many wetland habitats. As long and linear systems, rivers act as corridors for the movement of sediment, fish and other wildlife. The degree to which a river forms a continuous corridor has a strong influence on the natural functioning of the river system.

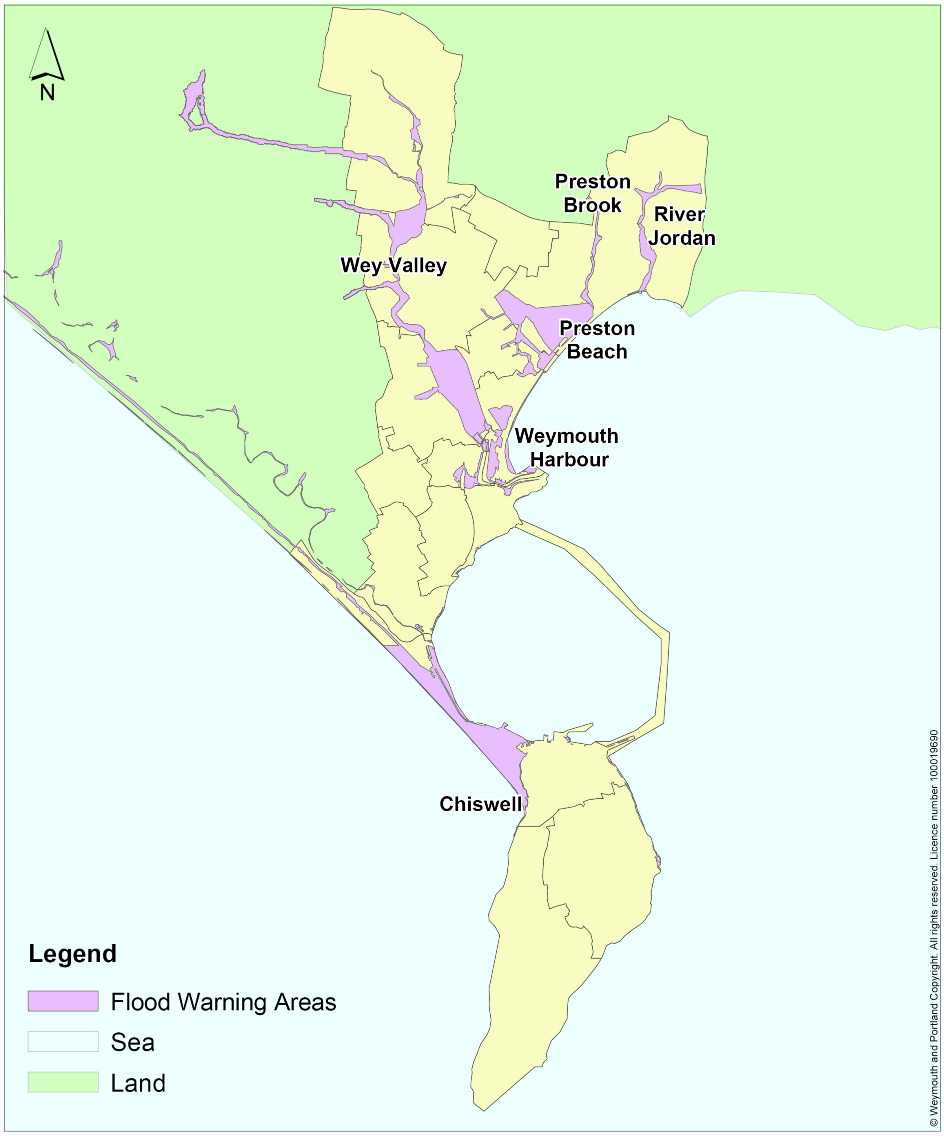
Flood defences within the W&PBC area have been constructed to reduce fluvial and tidal flooding. Fluvial floodplain connectivity is disrupted by raised defences in the lower reaches of the River Wey modifying the natural function of the floodplain in this area. As existing fluvial defences are isolated and localised in small settlements they are not likely to significantly limit fluvial floodplain connectivity at the catchment-scale.

As well as cliffs and beaches eroding, rivers can naturally change their course. Although no specific high risk areas have been identified in this SFRA, planners and developers should be aware that the course of rivers can change over time. Looking at County Series (1890 onwards) Ordnance Survey mapping can help identify where river erosion is a risk, by comparing the course of the river then and now. Such maps can be found in the Local Records Office. Where potential river erosion may occur this should be investigated as part of a FRA particularly if it could cause developed land to become at risk of flooding in the future.

4.5 Flood warning

The EA are responsible for flood watches and flood warnings across the whole of England and Wales. Flood warnings are broadcast by television and radio services and are also available on the EA website. Within the study area the designated flood warning areas are as shown on figure 4.5a.

Figure 4.5a
Map of flood warning areas in Weymouth and Portland



Warnings are provided for designated flood warning areas either directly or indirectly. The indirect system is based around the internet and the Floodline dial-up-and-listen service, where members of the public and other parties can obtain current flood warning information for their area. The Floodline number is 0845 988 1188 and the website address is www.environment-agency.gov.uk/subjects/flood/floodwarning. Flood warnings are also broadcast by television and radio services.

The direct warning service requires people in at risk properties in designated flood risk areas to register their telephone number with the EA under the Floodline Warnings direct scheme. They can then receive automatic warning messages if a flood is likely.

Flood warnings can be very difficult to accurately predict particularly when catchments respond rapidly to rainfall. For example the River Wey is a flashy catchment with increases in development and associated surface water flows making it one of the most difficult catchments to predict in terms of flood warning in the South Wessex Area. On the Wey, the risk has been known to rise from below Flood Watch to above Severe Flood Warning in less than an hour.

Applicants for any proposed development which takes place in EA Flood Zone 3, which is not in an existing designated flood warning area, should assess the potential for such a service in conjunction with the EA and make provisions for such within any FRA, in order to meet PPS 25 requirements.

Safety and evacuation procedures should also be addressed for developments within EA Flood Zone 3 and for civil infrastructure within Flood Zone 2 such as schools and hospitals. Provisions such as refuges, safe access and exit routes (which are above flood levels) should be incorporated into the design of such sites. Access for emergency vehicles will also need to be considered.

Emergency planning in the area is currently covered by W&PBC in their generic incident plan for the whole of Weymouth. Any major development within the urban areas of Weymouth and Portland should consider the impact of new development on the existing plan. It should be ensured that the procedures can be applied to the new development or modified if necessary, in conjunction with Dorset County Council and the EA.

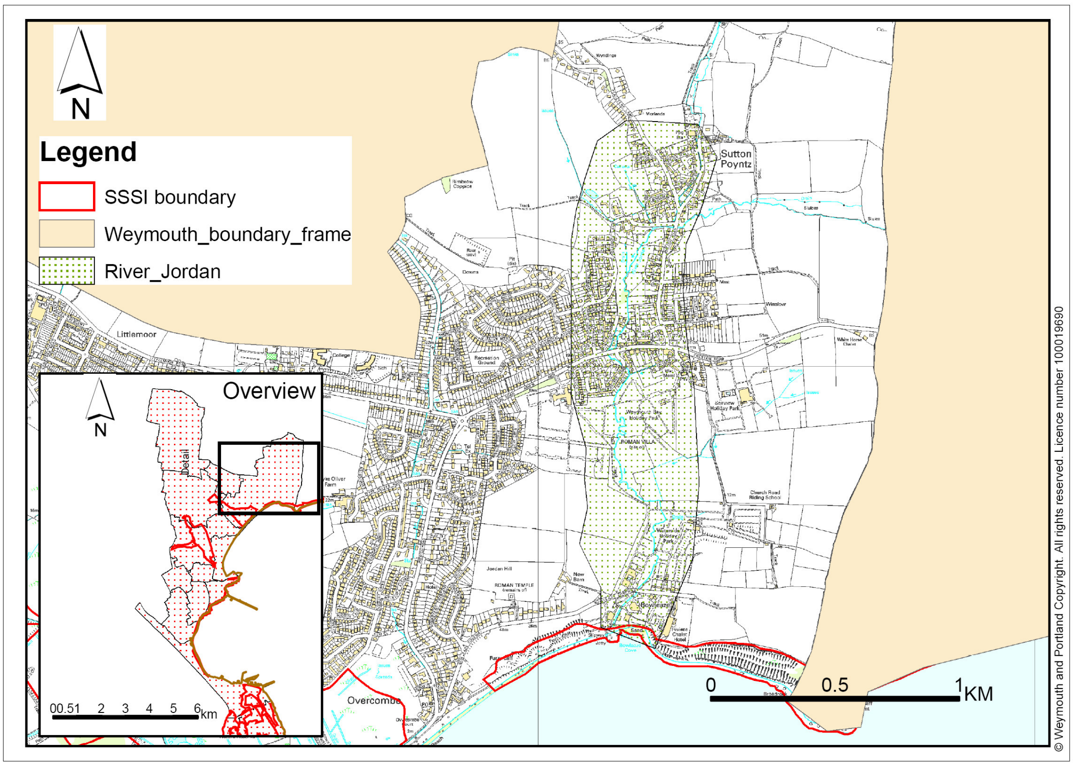
5 AREAS AT RISK OF FLOODING

5.1 Vulnerable areas

Areas sensitive to flooding have been highlighted by historic records of flooding from both W&PBC and the EA and by the information detailed on the EA Flood Zone maps. These areas are identified on both the A1 paper plans and the GIS shapefile layers. Flooding can be caused by overtopping of river banks, surface water runoff, tidal flooding and blockages of drains and culverts within W&PBC. Flood damage to properties largely results from conveyance issues where existing channels are not of sufficient capacity to cope with high flows due to heavy rainfall and increased surface water runoff mainly through urbanisation. Specific areas where this is known to be a problem are the Esplanade in Weymouth town centre, along the River Jordan, as shown in figure 5.1a, and the Preston Brook, as shown in figure 5.1b.

Following the commission of a feasibility study for the River Jordan, a hydrological assessment was carried out, including hydraulic modelling using HEC-RAS software. These studies highlighted areas where water overtops the bank due to inadequate culverts (Mission Hall Lane, Sutton Poyntz), bridges (Fisherbridge) and drainage systems or locations where a number of significant flows converge (Sutton Road Bridge). In addition, the study indicated areas where the drainage systems are overwhelmed due to rapid runoff (Puddledock Lane) causing overland flow. A range of options to reduce the damage caused by flooding were determined and are currently under investigation.

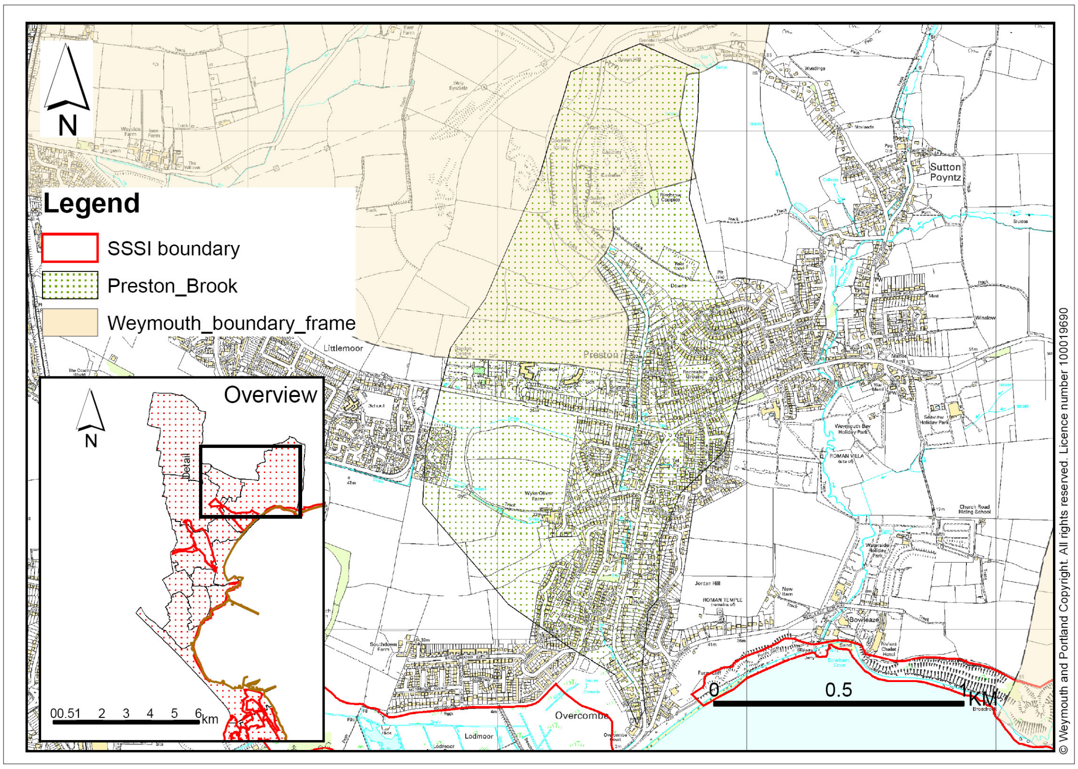
Figure 5.1a
Location plan of River Jordan Feasibility study area



The flooding of properties is known to occur along Preston Brook at numerous locations and is caused by three mechanisms; direct watercourse flooding, overland flooding and surface water flooding. The majority of the problems in this area are caused by blocked or inadequately sized culverts. The watercourse flows through residential gardens; therefore encroachment of vegetation has reduced the capacity of the watercourse in this area and maintenance has been difficult due to the lack of access to private properties. Debris easily becomes lodged across the screens and bridges during even moderate events.

A number of flood defences have been put in place, including a balancing pond on the Littlemoor Stream tributary and a flood bank adjacent to Abbeyfields on Wyke Oliver Road. The balancing pond would be capable of attenuating a 1 in 50 year flow if there was a fully operational screen and discharge structure installed.

Figure 5.1b
Location map of Preston Brook Flood Alleviation Scheme



HEC-RAS hydraulic modelling was used to estimate peak water levels along the Preston Brook for a range of flows to determine the viability of flood alleviation options which resulted in channel improvements, raising the standard of protection to 1 in 25 years for properties within the study area.

5.2 Current levels of flood risk

Only a small proportion of the population of W&PBC are currently at high risk of fluvial or tidal flooding. The majority of properties at risk are coastal properties that suffer tidal flooding, whilst only a very small number of properties are at risk from fluvial flooding.

The maps that accompany this report highlight that there are other sources of flooding, such as surface water flow, within the study area which affect additional properties.

Chart 5.2a shows the percentages of the population which live within either EA Flood Zone 2 or 3. It should be noted that the chart does not consider other sources of flooding.

Chart 5.2a
Proportions of the population at risk of fluvial or tidal flooding

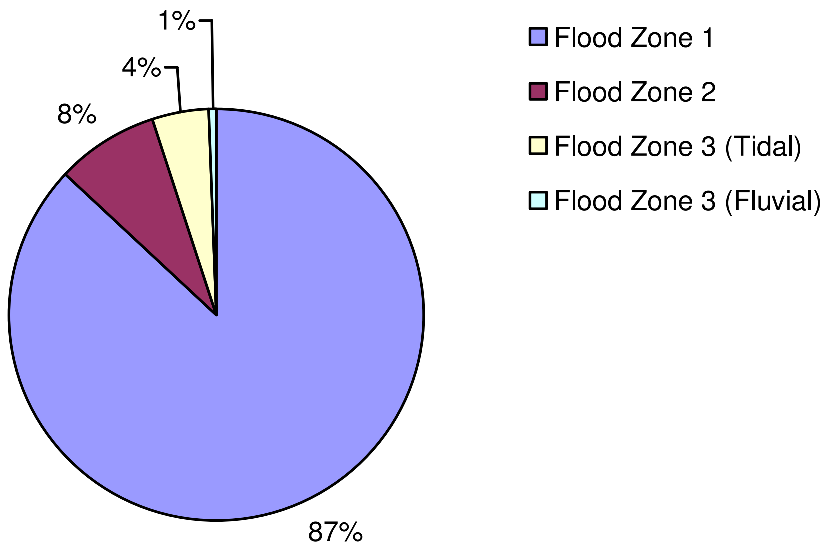


Table 5.2a highlights the main urban wards within Weymouth and Portland where properties are located within EA Flood Zone 3. The table indicates the approximate number of properties at risk, and the primary sources of flooding.

Table 5.2a
The number of flooded properties within wards of Weymouth and Portland

Ward*	No. of properties	No. of properties in EA FZ3	Percentage of properties within EA FZ3	Main sources of flooding
Melcombe Regis	3482	1056	30.3	Tidal flooding
Preston	2403	134	5.6	Tidal and fluvial flooding due to heavy rainfall, surface water runoff with inadequate bridges and culverts leading to backing up.
Underhill	1762	121	6.9	Tidal flooding due to severe weather

Ward*	No. of properties	No. of properties in EA FZ3	Percentage of properties within EA FZ3	Main sources of flooding
Weymouth East	1987	84	4.2	Tidal flooding
Westham East	1768	41	2.3	Tidal flooding with some problems of fluvial flooding
Upwey & Broadwey	1616	29	1.8	Fluvial flooding due to runoff from fields and heavy rainfall
Radipole	1582	16	1.0	Tidal flooding due to drainage problems
Wey Valley	1460	13	0.9	Fluvial flooding due to the River Wey overflowing
Westham North	2388	1	0.04	Tidal and fluvial flooding due to runoff and the River Wey overtopping
Wyke Regis	2472	1	0.04	Tidal flooding combined with surface water runoff and inadequate drainage

* The wards are shown on the location plan – figure 2a.

With reference to historic flooding events there are approximately 120 properties, representing 0.4% of the total number of properties within ten metres of a known historic flood event and 725 properties (2.4%) within twenty metres.

5.3 Climate change results

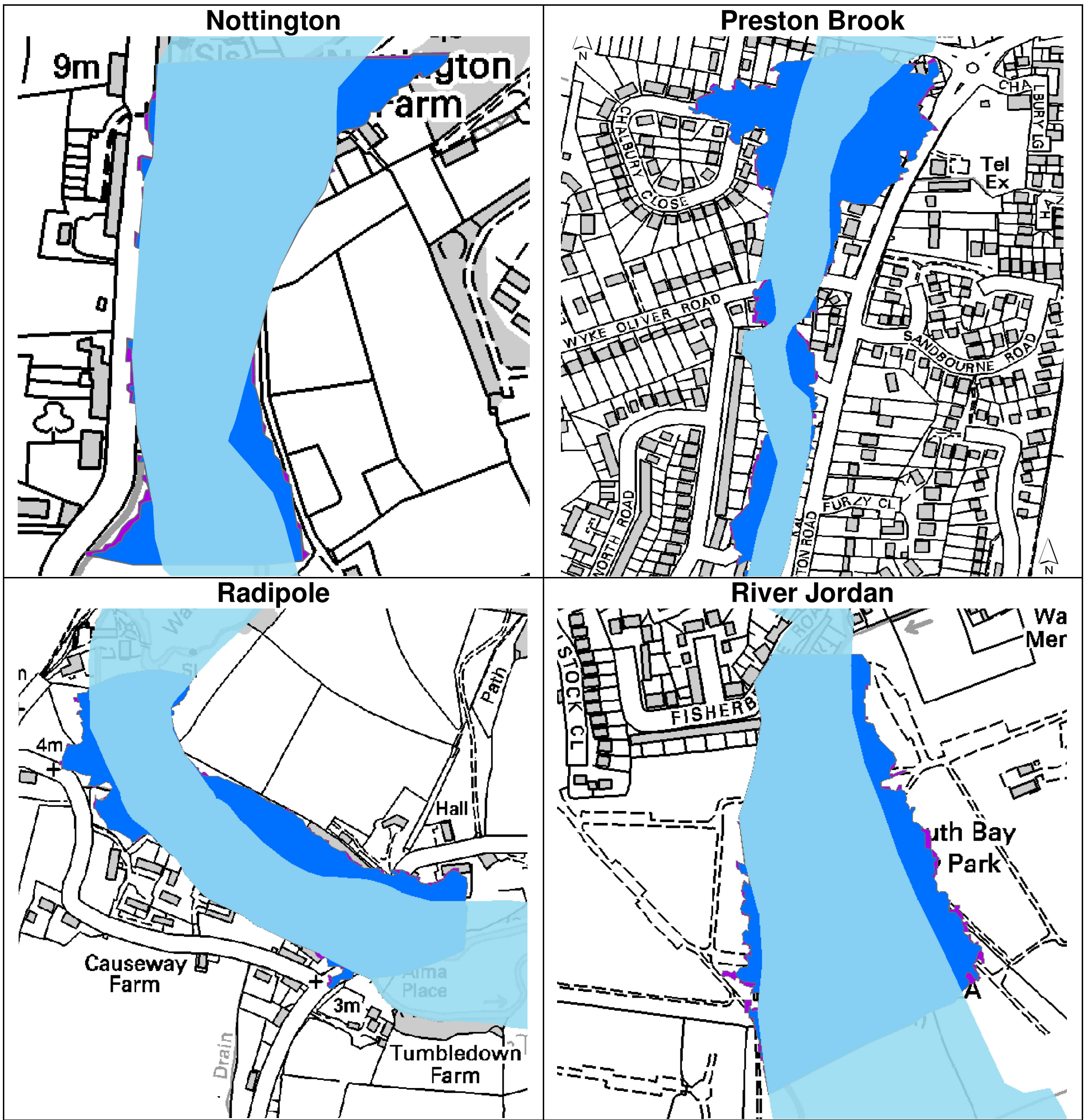
Lateral changes to existing flood extents and the increases (if any) in numbers of properties affected due to 20% and 30% increases in flows, as a result of climate change and the guidance available from PPS25, are given in table 5.3a below. The new fluvial flood extents (shown in figure 5.3a) were based on the existing Flood Zone 3 data and have been created in certain key areas using the LiDAR Digital Terrain Model (DTM) data.

Table 5.3a
Lateral changes to flood extents and properties affected due to fluvial climate change

Area	Fluvial Climate change statistics			
	Lateral extent changes (m) due to increased flows:		Number of additional properties affected due to increased flows:	
	20% increase	30% increase	20% increase	30% increase
Nottington	3-15	3-18	0	0
Preston Brook	20-45	20-47	41	42
Radipole	13-28	13-31	1	1
River Jordan	11-16	11-19	0	0

The specific methodology is detailed in Appendix C. The locations chosen for these detailed studies were identified by locating FRIS hotspots and other known locations of high frequency flooding, the availability of suitable LiDAR DTM data and the presence of existing Flood Zone 3 data. The only area where significant numbers of properties are affected due to climate changes is at Preston Brook where the number of properties in the new flood extent has doubled from those in EA Flood Zone 3. It should be noted that the lateral increases in extents for the 30% increase in flows does not vary significantly from the lateral extents for the 20% increase in flows.

Figure 5.3a
New flood extents taking into account the predicted affects of climate change



Legend

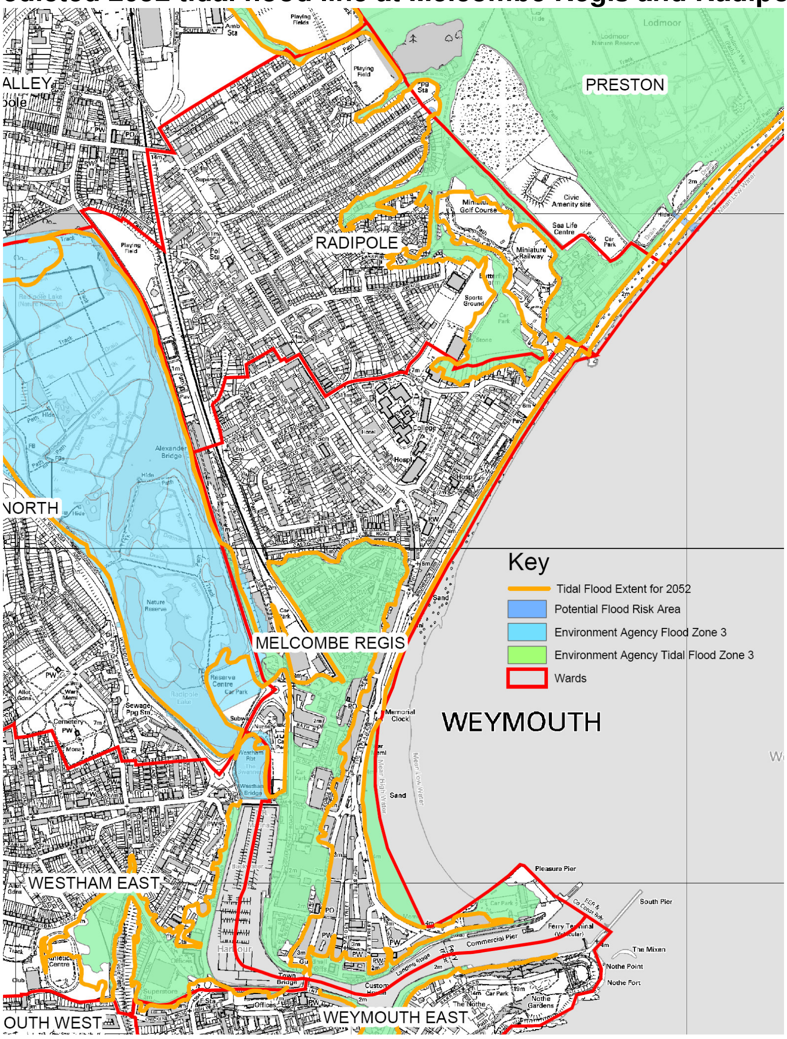
- Current Flood Zone 3
- Extents from a 20% increase in flows
- Extents from a 30% increase in flows

The predicted affects of a 5mm sea level rise are shown in table 5.3b below. The main areas where there could be a significant increase in the number of properties affected are Melcombe Regis and Radipole. This is mainly due to the effects of tidal inundation due to climate change in the low lying areas of Radipole Lake and Lodmoor Nature Reserve.

Table 5.3b
Number of properties affected by the predicted tidal climate change

Ward	Number of properties currently in EA Tidal FZ3	Number of additional properties affected by 2052	Percentage increase in properties affected
Melcombe Regis	1052	327	31.1
Underhill	121	0	0
Weymouth East	84	5	6.0
Westham East	40	2	5.0
Radipole	16	20	125
Wyke Regis	1	0	0

Figure 5.3b
Predicted 2052 tidal flood line at Melcombe Regis and Radipole



6 DATA AND MAPPING

6.1 Data collection

To produce this SFRA data have been collected from both the EA and W&PBC.

Data collected from the EA include:

- EA Flood Zone mapping
- EA data on flood defences (NFCDD)
- EA Historic Flood Map
- Flooding Incidents recorded by the EA (FRIS)
- Tidal Flood Extent for 2052 (based on the predicted sea level rise of 5mm to allow for climate change)
- Flood warning areas and flood watch areas
- LiDAR DTM data
- Chiswell Flood Zone data

Data collected from W&PBC:

- Ordnance survey mapping at 1:10,000 scale
- Aerial photographs
- Historic flooding incidents recorded by W&PBC
- Known flooding problems and observations as recorded by W&PBC
- W&PBC boundary
- W&PBC proposed and existing defences

As part of the study, we produced the following GIS based data

- Potential Flood Risk Areas (section 3.1)
- Limited new flood extents (as discussed in section 6.3.2) based on existing EA Flood Zone 3 and climate change predictions (section 5.3 and Appendix C)

We also produced the following guidance documents:

- PPS25 Decision Flow Charts (Appendix D)
- Guidance for developing housing in a flood resistant manner (Appendix E)

6.2 Data quality

The quality of the flood related data collected and produced varies due to the source and age of the data. In addition, some areas have been carefully mapped using hydraulic modelling, whilst other areas are less precise. For that reason a cautious approach has been taken in this SFRA, using the best data available at the time of writing.

Each data set has been given a data quality suffix reflecting the views of Royal Haskoning about the quality and accuracy of the data when considering flood risk, as detailed in Appendix A. This is to help planning officers, developers and members of the public judge how to use the data when considering flood risk and the need for further study.

Improvements may be made to the data and therefore the data collected must be updated regularly to ensure that the most up-to-date and accurate data are used to guide any decisions regarding flooding and flood risk. Where data is not available for the SFRA, it has been necessary to make assumptions based on professional experience, local knowledge and recorded literature. The least reliance is placed on those cases where only assumptions based on engineering judgement is available. The latter category should be used with particular caution. For this reason, whilst information is shown on the maps in a relatively precise way, it is not possible to be completely certain from the outputs of this SFRA that any individual property, particularly those near the boundaries of zones of risk, is definitely within that risk zone.

6.3 Mapping

The following sets of A1 maps have been produced to accompany this report:

- Existing flood risk areas
- Climate Change predictions
- Historic flood events and locations of defences

Each map covers a 5x5 kilometre area. The maps help to class land into different categories of current and future flood risk and are to be used as an aid when considering sites for development. It must be noted that these maps are part of a strategic analysis of the flood risk and should not be used to make decisions regarding flood risk to individual properties.

6.3.1 Existing flood risk

These maps show the EA Flood Zones 2 and 3 as well as the RH defined Potential Flood Risk Areas generally found in the upper catchments upstream of the current EA Flood Zone 3 extents.

The mapping of flood risk is helpful in the SFRA process as it shows where flooding could occur, and therefore where potential new developments should be carefully considered before giving planning permission. Where possible, the type of flooding e.g. fluvial, tidal or a combination has been shown on the map to highlight the problems that occur in each area.

Most of the EA Flood Zones have been defined using hydrological and hydraulic models and mapped using detailed information on the topography of the ground. It should be noted that the Flood Map is re-issued by the EA every quarter. This is to ensure the latest flood maps are being used. However no issue was released in December 2005 therefore the September 2005 issue of the Flood Maps has been used to create the mapping of flood risk in the first published printed maps.

6.3.2 Climate Change

The A1 maps show the current flood extents (EA flood zones 2 & 3) along with the predicted tidal flood extent for 2052. This extent was produced under the Level B 2002-4 South Coast tidal mapping study by Royal Haskoning. It assumes an increase in sea level of 5mm annually and considers certain raised defences and associated overtopping and breaching for areas over 1 square km.

The exact changes to EA fluvial Flood Zone 3 extents due to climate change have not been carried out for the whole study area. Therefore the new extents are not depicted on the A1 maps. From the localised studies carried out using LiDAR DTM data, an average increase in the EA Flood Zone 3 lateral extent of between 9 and 32 metres is predicted for a 20% increase in flows until 2050 and a further 2 metres for a 30% increase in flows until 2110.

It is beyond the scope of this SFRA to apply this climate change methodology across the whole study area. The new fluvial flood extents as derived above serve as a guide for the likely changes that could occur as a result of increased flows of 20% and 30%. It is assumed that similar lateral changes to flood extents will also occur at other locations in the study area with equivalent topography and settlement patterns.

As an approximation, land which lies between the boundaries of EA Flood Zones 2 and 3 and is closer to the boundary of EA Flood Zone 3 than EA Flood Zone 2 should be treated as being within EA Flood Zone 3 for the purposes of guiding planning officers about the possible affects of climate change. The effects of climate change also need to be considered with regard to Potential Flood Risk Areas following a pragmatic but cautious approach to take account of their uncertainty. As a guideline, possible flood risk should be considered for land within a 10m lateral distance and 2m height of the Potential Flood Risk Areas. However, any development within or close to EA Flood Zone 3 and/or a Potential Flood Risk Area should undertake a site specific Flood Risk Assessment which considers in detail the possible effects of climate change.

6.3.3 Historic flood events

One method to investigate flood risk is to look at the areas which have flooded in the past. The flooding can be from a range of sources e.g. fluvial, tidal, surface water runoff, groundwater or a combination, although the majority of events indicated on the maps are from fluvial, tidal or surface water runoff.

Where the information is of good quality, the map shows the area which is thought to have flooded. This information has been provided by the EA in the form of Historic Flood Mapping. Where there is no information about the extent and exact location of the flooding, the map is marked with a dot-symbol indicating the flood event. This information has been provided by W&PBC Engineers. It should be noted that this dot-symbol does not mean that flooding happened at this exact point, but that flooding did occur in the general location. This information can be used for assessing future flood risk, particularly for small catchments or urban areas where repeat flooding occurs, but there is little mapping or other data to substantiate the risk.

6.3.4 Defences

The map shows the location of existing flood defences maintained by either the EA or W&PBC. This is useful for a number of reasons:

- This allows planners, developers and the general public to put the potential flood risk into context, especially where historic flooding and flood defences are shown in the same location; the historic flooding may have occurred before flood defences were in place.
- Knowing where flood defences are can indicate areas where flood risk may be reduced, although further investigation regarding the standard of protection that is currently afforded by the defence will be required.
- By referring to the current Standard of Protection, areas of floodplain which are classed as defended can be incorporated into development plans as part of an FRA.

Where there are no defences, the floodplain can be defined as functional or natural floodplain i.e. an area that can store water which has overtopped river banks in times of a flood. This floodwater can then drain away through watercourses. A general principle of PPS25 is to maintain a constant amount of functional floodplain. Providing defences will therefore reduce the amount of functional floodplain

The blue lines on the map show the location of assets that the EA have recorded to date on NFCDD as flood defences. The pink dot-symbols and lines on the map indicate the approximate area where there are flood defence systems that W&PBC have installed or have planned for the near future.

6.3.5 Geographical Information System (GIS)

A Geographical Information System (GIS) is a computer-based system for using data that is spatially referenced. This means the information can be viewed on electronic maps, where the maps also provide links to the underlying database and attribute information about the graphics displayed on the maps. The data sets that have been collected to undertake the SFRA have either been supplied in a GIS format, or have been adapted to a GIS format from hardcopy data by Royal Haskoning.

The information is provided to W&PBC in ESRI shapefile format to be integrated within their own corporate GIS system Axis2000. This will allow users to view additional GIS layers such as development sites and designations within the context of the SFRA datasets. In addition, users will be able to carry out appropriate analysis as assessment using both sources of data to quickly locate areas and assess flood risk at potential development sites.

By using a GIS based system, staff at W&PBC can add to the existing datasets keeping records up to date and link to the latest data such as the updated Flood Zone datasets supplied quarterly from the EA. Therefore the SFRA GIS project becomes a fluid and adaptable information source that is not referenced to a set point in time like hardcopy maps and can always be made into hardcopy as and when required.

7 SFRA USER GUIDANCE

This SFRA is a strategic overview of flood risk throughout the Weymouth and Portland area. In accordance with Government planning policy flood risk within the area has been categorised into three flood risk zones – Zone 1 (Little or no risk), Zone 2 (Low to medium risk) and Zone 3 (Medium to high risk). This categorisation into zones is intended to give an indication only of flood risk at any particular location within the area and is not intended to represent a detailed assessment of the flood risk appertaining to any particular building or piece of land within the study area. It is to be noted that the all maps (paper and GIS based) included as part of this SFRA show only the extent of Zones 2 and 3, that is any areas not assessed as lying within a Zone 2 or Zone 3 are deemed to be Zone 1 as described in section 3.1.

The Government aims to reduce the risk from flooding to people and the developed and natural environment by discouraging development within areas at medium to high risk of flooding. Government guidance has been produced for local planning authorities to help them when allocating land for development in order to meet this aim.

The current guidance is contained in Planning Policy Guidance Note 25 -Development and Flood Risk (PPG25). The current PPG25 guidance is under review and a new Planning Policy Statement 25 (PPS25) has been issued in draft format, and is due to be published in Autumn 2006. The key planning objectives and decision making principles remain essentially unchanged, however the risk based sequential test (section 7.2) has altered.

Therefore, this SFRA is intended to be used by planners and developers alike to assess the suitability of any particular site to support or not a particular type of development. This is subject to the level of flood risk, the vulnerability of the proposed usage and the extent to which the combination of other factors and mitigation might exempt the development from the application of this guidance (i.e. flood risk would not be a reason for refusal at planning).

The assessment, whether for the purpose of producing a Local Development Plan, assessing the flood risk of an existing property or parcel of land comprises of 3 stages:

- Flood Risk Vulnerability Classification (Table D2 PPS25)
- Sequential Test through the use of PPS25 Decision Flow Charts (Appendix D)
- Exception Test (where needed)

7.1 Flood Risk Vulnerability Classification

Prior to the Sequential Test a flood risk classification which groups land uses, infrastructure and buildings into five categories of vulnerability needs to be carried out to assign one of five vulnerability criteria to the proposed development site(s). A summary of these classifications, with examples of the elements which lie within them, are outlined in table 7.1a below.

Table 7.1a
PPS 25: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	
1.Essential Infrastructure	Essential Transport and Strategic Utility Infrastructure (Only allowed for in exceptional circumstances where need outweighs the risk)
2. Highly Vulnerable	E.g. Emergency services stations and command centres required for operation during flooding and Emergency dispersal points Electricity generating power stations and sub-stations. Hospitals and Residential institutions e.g. care homes.
3. More Vulnerable	E.g. Buildings used for: dwelling houses; drinking establishments; nightclubs; and hotels. Non-residential institutions (excluding hospitals)
4. Less Vulnerable	E.g. Buildings used for shops; financial, professional etc Land and buildings used for holiday or short-let caravans and camping. Transport infrastructure.
5. Water-compatible Development	E.g. Flood control infrastructure. Water and sewage treatment plants and pumping stations Docks, marinas, wharves and navigational facilities Ship building, dockside fish processing and compatible activities requiring a waterside location. Water-based recreation and tourism.
Note *a) This classification is based on advice from EA on flood risks to people and the need of some uses to keep functioning during flooding.* *b) Buildings with combined activities should be placed in the higher of the relevant classes of flood risk sensitivity.* *c) Some elements of classifications are subject to a specific warning and evacuation plan.*	

7.2 The Sequential Test

The Government expects local planning authorities to apply a risk based approach to the preparation of development plans and their decisions on development control through the revised sequential test. Developers should also look for guidance from this test and bear it in mind when considering developments. When creating or revising policies in development plans and in considering applications for development, local planning authorities should give priority in allocating or permitting sites for development, starting from lowest flood risk. Attention should also be paid to the sub-divisions, a and b, in Zone 3. The assessment of developments within high risk areas are no longer assessed under PPS25, in terms of developed areas (PPG25 3a) or undeveloped and sparsely populated areas (PPG25 3b) as this sub division of categories has been removed. Functional floodplain remains as a category in its own right.

The Sequential Test is central in determining the suitability of land for development in flood risk areas and should be applied at all levels of the planning process. It aims to guide decision-makers to allocating new developments to areas with the lowest probability of flooding (Zone 1) and to account for vulnerability where sites have to be placed in higher risk areas. The Sequential Test should be applied by local authorities in land allocation for spatial plans and by developers wishing to develop sites which are at risk from fluvial or tidal flooding. Additionally this type of approach should be used in areas at risk from other forms of flooding.

Table 7.2a
PPS25: Planning response to sequential characterisation of flood risk

Flood zone	Appropriate planning response
1 Low Probability Annual probability of flooding: River, tidal & coastal <0.1%	There are no constraints due to fluvial, tidal or coastal flooding. The zone is suitable for all land uses listed under the Flood Risk Vulnerability Classification. A brief Flood Risk Assessment (FRA) is required for development sites of 1 hectare and above. It must consider their risk from flooding by other sources and their potential to increase flood risk at other locations due to additional hard surfaces and surface water run-off. Further detail may be required for problem sites. Developers and local authorities should seek to reduce the overall flood risk level in the area through the form and layout for the development and alleviate potential for flooding increases affecting other locations through sustainable drainage techniques.
2 Medium probability Annual probability of flooding: River 0.1- 1.0% Tidal & coastal 0.1- 0.5%	Suitable for most development, with Highly Vulnerable (see table 7.1a) uses allowed only with a passed Exception Test. An FRA is required and should consider the vulnerability to risk from flooding by other sources and over the lifetime of the development, the potential to increase flood risk at other locations including depth and speed of flow due to additional hard surfaces and surface water runoff to any neighboring properties and demonstrate that residual flood risks have been acceptably accounted for. Developers and local authorities should seek to reduce the overall flood risk level in the area through the form and layout for the development and alleviate potential for flooding increases affecting other locations through sustainable drainage techniques.
3a High Probability Annual probability of flooding, with defences where they exist: River 1.0% or greater Tidal & coastal 0.5% or greater	Only Water-compatible and less vulnerable uses of land and essential infrastructure (see Table 7.1a) are appropriate in this zone. More vulnerable and essential infrastructure uses of land (see Table 7.1a) need to pass the Exception Test (see below). An FRA is required for all development proposals and should cover the same considerations as outlined above for Flood Zone 2. Developers and local authorities should cover the elements stared for Flood Zone 2 above in reducing flood risk and alleviating flooding as well as relocating existing development to land in lower flood zones.
3b Functional Floodplain Annual probability of flooding, with defences where they exist: River 1.0% or greater Tidal & coastal 0.5% or greater. Land where flood waters are allowed to flow and be stored.	**Only** water-compatible uses and essential infrastructure (see Table 7.1a) allowed in this zone. Essential infrastructure must pass Exception Test and be of a design and construction which; remains operational during flooding, does not reduce the net size of floodplain storage, impede the water flow or increase flood risk elsewhere. An FRA must accompany all development proposals and should cover all of the considerations outlined above for Flood Zone 2. Developers and local authorities should cover the elements stared for Flood Zone 2 and 3a above.

Notes:
(a) All risks relate to the time at which a land allocation decision is made or an application submitted. The EA will publish maps of these flood zones. Flood zones should be identified from the EA flood data ignoring the presence of flood defences. Local planning authorities should, with the EA, identify those areas currently protected by defences and the standard of protection provided by those defences.
(b) Development should not be permitted where existing sea or river defences, properly maintained, would not provide an acceptable standard of safety over the lifetime of the development, as such land would be extremely vulnerable should a flood defence embankment or sea wall be breached, in particular because of the speed of flooding in such circumstances (see paragraph 69 below).

In applying the sequential test, local planning authorities should consult and take the advice of the EA on the distribution of flood risk and the availability of flood defences in their areas. Flood defences for most new housing developments should be designed and constructed to protect against a flood with an annual probability of 1% for fluvial flooding and 0.5% for coastal flooding (for a period of 50 years). Commercial and industrial development should aim to achieve the same minimum standard of defence.

As part of this SFRA, PPS25 Decision Flow Charts have been produced using the information given in the sequential test (table 7.2a). The flow charts can be followed by planning officers, potential developers and members of the public to assess at a strategic level the flood risk to a piece of land. They clearly indicate whether a piece of land would require a specific and detailed Flood Risk Assessment to be provided with a planning application and are designed to provide a robust and consistent system for assessing flood risk anywhere within W&PBC. The PPS25 Decision Flow Charts can be found in Appendix D. There is a flow chart for each of the Vulnerability Classifications given in table 7.1a.

7.3 The Exception Test

In circumstances where the Sequential Test has been applied, and possible development locations cannot be found in zones of lower probability of risk, then the Exception Test can be applied as indicated on the PPS25 Decision Flow Charts. The Exception Test should only be used under specific circumstances where the wider aims of sustainable development need to be addressed. When required the decision-makers should apply the Exception Test at the earliest possible stage of the planning process. It should be applied to all Local Development Documents (LLD) as well as all planning applications with the exceptions of domestic extensions and householder developments. To satisfy the Exception Test the development must:

- Make a positive contribution to sustainable communities and development objectives of the relevant LDD.
- Be on developable brownfield land, unless no reasonable alternative options exist.
- Have a flood risk assessment accompany the application. The FRA must demonstrate that the residual risks of flooding to people and property (including the likely effects of climate change) are acceptable and can be satisfactorily managed.
- Make a positive contribution to reducing or managing flood risk.

The Exception Test should be used in locations with extensive areas liable to flooding or areas where restrictive designations such as landscape and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONB) and Sites of Special

Scientific Interest (SSSIs) reduce the amount of available land for the sustainable development required.

7.4 Additional guidance

As part of this SFRA certain properties will fall within a Flood Zone or Potential Flood Risk Area. This information is not meant to alarm residents of W&PBC, but provides a warning to prepare for potential flooding should it happen. Flooding could happen at almost any time, but in any individual year the risk of a flood may be low. The EA publishes advice on dealing with flood risk and installing preventative measures. The advice can be obtained by contacting Floodline on 0845 988 1188 or through the EA website at www.environment-agency.gov.uk. Individuals and developers should also consider their responsibilities for what to do to reduce the flood risk to themselves and others, their property and the people who use it. Guidance is provided in Appendix F for developing housing in a flood resistant manner.

8 RECOMMENDATIONS AND CONCLUSIONS

Flooding is an important issue which must not be ignored. In the future it is likely that flooding could occur more frequently and with more severity due to climate change. By using this SFRA, in combination with site specific Flood Risk Assessments submitted with planning applications for development or change of use, it is possible to allocate land for development in a sustainable way. For example, new housing developments in areas at an unacceptable risk of flooding could be restricted and guided towards areas of lower risk and functional floodplain could be maintained or improved through areas at high risk of flooding.

1) Every application for development or change of land use must be considered by planning officers in terms of its potential flood risk using the GIS information supplied as part of this study. This is because:

    a) There are a range of potential sources of flood risk within W&PBC including fluvial and tidal influences, surface water runoff, channel obstructions and ground water.
    b) Most areas within W&PBC have the potential to be at risk of flooding from at least one of these sources or have the potential to increase flood risk elsewhere.
    c) Although a site may already be developed, a proposed change in land use may not be suitable for that site, or may increase flood risk elsewhere.
    d) Climate change may increase areas at risk of flooding over time. Land should be allocated today in a way which will be sustainable in the future.
    e) Where development is proposed behind existing flood defences it should not be assumed that the standard of protection originally designed for is the same as what would be found today, using updated flood estimation techniques.

2) The data and information contained within this SRFA constitutes the best available data at the time of writing. Some GIS datasets are periodically updated and it is advised that W&PBC update these accordingly. Details of the datasets to update can be found in Appendix A. This will ensure that decisions are made by W&PBC using the best available data at all times.

3) Land which is found to be unsuitable for certain types of development (residential) due to flood risk, may still be suitable for other uses, for example environmental and recreational areas. The PPS25 guidance in conjunction with the PPS25 Decision Flow Charts (Appendix D) can be used to suggest suitable alternative land uses.

4) If the site has potential flood risk, Vulnerability Classifications (section 7.1) must be applied and the relevant PPS 25 Decision Flow Chart (Appendix D) should then be used to test whether the land is suitable for the development proposed, and if so, whether a specific Flood Risk Assessment is required. This is to be completed by the developer.

5) If a specific Flood Risk Assessment is required, this must be submitted with the planning application. Planning officers, developers and the general public should consult the PPS25 best practice advice and refer to sections 3 and 4 which cover types of flooding and management of flooding.

6) All site specific Flood Risk Assessments must be considered by the EA as part of the planning consultation process. It is recommended that EA comment is taken seriously and applied wherever possible.

7) The Strategic Flood Risk Assessment should be used in testing general locations for strategic growth and site specific allocations in the Local Development Frameworks being produced by the Local Planning Authorities. This includes investigating the impact of proposals for new development in the vicinity of, and particularly upstream of, areas sensitive to flooding (where there have been past flood events).

8) The Local Development Frameworks, through their policies, justification and proposals, should make clear the implications for development and regeneration particularly regarding town centres in areas of high flood risk, including where there is risk of rapid inundation and reflect the guidance in this SFRA. This will need to reflect any programmes and proposals, or otherwise, for providing or improving flood defences.

9) This SFRA is a working document that will require updating in the future in order to fulfil changes to Government guidance and recommendations from the EA. As Local Development Framework policies should reflect the guidance in this SFRA they will need to be reviewed as and when the SFRA is updated.

9 REFERENCES

- *Chiswell Strategic Flood Risk Assessment,* (2006), Royal Haskoning
- *Dorset Rural Profile*, (December 2002)
- *Planning Policy Guidance Note 25: Development and Flood Risk (PPG25),* (July 2001), DTLR
- *Environment Data book*
- *Lanehouse Stream Flood Risk Assessment, Final Report*, (June 2005), Royal Haskoning
- *Level B 2002-4 South Coast tidal mapping study*
- *Lodmoor Site of Special Scientific Interest Water Level Management Plan, Deposit Copy,* (October 2002), Royal Haskoning
- *Lyme Bay and South Devon Shoreline Management Plan*, (June 1998), Posford Duvivier
- *Portland Bill to Durlston Head Shoreline Management Plan*, (June 1998)
- *Portland Census Town Profile* (2005)
- *Preston Beach Weymouth – Volume 1 Interim Beach Management Plan*, (October 2001), Posford Duvivier
- *Preston Brook Flood Alleviation Scheme – Project Appraisal Report, Final Report*, (April 2003), Royal Haskoning
- *Proposed Modifications, Weymouth & Portland Local Plan Review*, (June 2005), Weymouth & Portland Borough Council
- *Proposed Planning Policy Statement 25: Development and Flood Risk (PPS 25),* (2005), ODPM Publications
- *Radipole Lake Site of Special Scientific Interest Water Level Management Plan*, *Deposit Copy* (September 2001), Royal Haskoning
- *River Jordan Feasibility Study – Report on Economics* (October 2005), Black & Veatch
- *River Jordan Feasibility Study – Report on Hydraulics* (October 2005), Black & Veatch
- *River Jordan Feasibility Study – Report on Hydrology* (October 2005), Black & Veatch
- *River Jordan Feasibility Study – Stage 1 Report* (November 2005), Black & Veatch

- *Teignbridge District Council Strategic Flood Risk Assessment*, (October 2005), Royal Haskoning

- *Weymouth Census Town Profile* (2005)

Websites

- www.ciria.org/flooding/reducing_the_impact.htm

- www.ciria.org/suds

- www.dorsetforyou.com

- www.environment-agency.gov.uk

- www.soton.ac.uk/~imw/portnew.htm

- www.weymouth.gov.uk

10 GLOSSARY OF TERMS

Catchment	The area contributing surface water flow to a point on a drainage or river system (the area drained by that river, including areas away from the watercourse network). Can be divided into sub-catchments.
EA Flood Zone 1	Little or no risk
EA Flood Zone 2	Low to medium risk. Probability of fluvial flooding is 0.1 – 1% and probability of tidal flooding is 0.1 – 0.5%
EA Flood Zone 3	High risk of flooding. Probability of fluvial flooding is 1% or greater and probability of tidal flooding is 0.5% or greater.
EA Flood Zone 3a	Developed areas of Flood Zone 3.
EA Flood Zone 3b	Functional floodplains of Flood Zone 3.
Environment Agency (EA)	Non-departmental public body responsible for the delivery of government policy relating to the environment and flood risk management in England and Wales.
Flood Defence	A structure (or system of structures) for the alleviation of fluvial or tidal flooding.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk Assessment	Considerations of the flood risks inherent in a project, leading to the development of actions to control, mitigate or accept them.
Floodplain	Any area of land over which water flows or is stored during a flood event, or would flow but for the presence of flood defences.
Fluvial	Pertaining to a watercourse (river or stream).
GIS	Geographical Information System. A computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that are spatially referenced.
Groundwater	Water occurring below ground in natural formations (typically rocks, gravels and sand).
HEC RAS	Hydraulic modelling software.
Hydraulic model	A computerised model of a watercourse and floodplain to simulate water flows in rivers to estimate water levels and flood extents.
Lagoon	A pond designed for the settlement of suspended solids or storage of excess river flow.
Main River	Watercourses defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Potential Flood Risk Area	The possible extent of flooding along watercourses that have not been covered by the EA Flood Zones.
PPG25	Planning Policy Guidance 25 for Development and Flood Risk.
PPS25	Planning Policy Statement 25: Development and Flood Risk.
Probability	The likelihood of an event occurring.

Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Sheet runoff	The flow of water across the land surface which can occur when the rainfall rate exceeds the infiltration capacity of the soil.
Standard of protection	The level of flood that a defence is designed to protect against before it is outflanked or overtopped.
Surface Water Runoff	Water flowing over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sustainable Drainage Systems (SUDS)	A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.
Topography	The shape and form of the land, in terms of hills, steepness of slopes, or flat land

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Appendix A - Data Sources & Data Quality

DATA SOURCES AND DATA QUALITY SUFFIX

Data Quality

All data that has been collected and produced for use in this study has been assigned a data quality suffix. This makes it easy to distinguish between qualities of data so that the need for future updates can be prioritised, and the reliability of the mapping can be judged easily. The Data Quality Suffix (DQS) system is described realistically in Table 1.

Table 1
Data Quality Suffix System

Data Quality Suffix	Description
A	Best of breed, no better available, unlikely to be improved upon in the near future.
B	Data with known deficiencies, to be replaced as soon as improved data is available
C	Gross assumptions, not made up but deduced from experience or related literature
D	Heroic assumptions, no reliable data sources available or found, data based on engineering judgement.

Datasets

Table 2
Information on source and quality of datasets used

Dataset	Notes	Source	Data Quality
10K Basemaps	Large scale full colour raster backdrop mapping giving detail such as fences, field boundaries, road names and buildings. Supplied in edge matched 5kmx5km tiles to create a seamless data layer. Visible up to a scale of 1:10000.	W&PBC	B
Aerial photos	Coverage supplied by GetMapping from October 2003 at a resolution of 25cm. Supplied in edge matched 10kmx10km tiles to create a seamless data layer. Visible up to a scale of 1:20000.	W&PBC	B
Contour Mapping	5m contours derived from 5m resolution Digital Terrain Model (DTM) supplied by Intermap. A DTM has had vegetation, buildings and other cultural features digitally removed using TerrainFit® software to derive terrain elevations based on measurements of bare ground contained in the original radar data. The vertical measures given are accurate to an average of 0.5m. Visible up to a scale of 1:10000. Filenames: • 5mcontour.shp	W&PBC	B

Environment Agency Flood Zone 2	Indicative of natural undefended floodplain (i.e. without defences) at the 1:1000 year event for fluvial and tidal data. Indicates whether flooding will be an issue in an area. Currently climate change not considered. Used to guide planning consultations and to raise awareness of flood risk. There is no attribution to distinguish between fluvial/tidal/fluvial and tidal. *Currently update quarterly by direct Local Authority supply from the Environment Agency (EA)* Filenames: • FLOOD_ZONE_2.shp	EA	B
Environment Agency Flood Zone 3	Indicative of natural undefended floodplain (i.e. without defences) at the 1:100 year event for fluvial data and at the 1:200 year event for tidal data. Indicates whether flooding will be an issue in an area. Currently climate change not considered. Used to guide planning consultations and to raise awareness of flood risk. There is an attribution to distinguish between fluvial/tidal/fluvial and tidal. *Currently update quarterly by direct Local Authority supply from the EA.* Filenames: • FLOOD_ZONE_3.shp	EA	B
Environment Agency Historic Flood Map	The maximum extent of all recorded flood outlines combined together taking into account the presence of defences. Derived from flood event outlines. This data is updated based on reconnaissance work after flood events. Filename: • HFM.shp	EA	B
Flooding Incidents recorded by Environment Agency	Different sources of flooding for geo-referenced features affected by flood incidents. Derived from the EA Flood Reconnaissance Information System (FRIS) maintained by Dorset Area office. *W&PBC may wish to request an annual update of this data from the EA Dorset Area office to keep this up to date.* Filename: • Weymouth_&_Portland_Incidents.shp	EA	C
Flooding Incidents recorded by W&PBC	Information taken from historic flooding maps held by W&PBC. Filename: WPBC_Historic_Flooding.shp	W&PBC	D

FRIS Properties	Geo-referenced dataset highlighting properties known to have flooded internally. Derived from the EA Flood Reconnaissance Information System (FRIS) maintained by Dorset Area office. *W&PBC may wish to request an annual update of this data from the EA Dorset Area office to keep this up to date.* Filename: • W&P_FRIS_Properties.shp	EA	C
NFCDD Defences	A defence is a natural or constructed entity which retains, stores or channels water. It is a component of a flood defence system that protects an area from flooding from a river, estuary and/or the sea e.g. weirs, groynes and provides a locality with its standard of flood defence. This data has been sourced from the EA National Flood and Coastal Defence Database (NFCDD) as maintained by the Dorset Area office. Whilst confidence in the quality of the fluvial defence data is high work is currently being planned for the improvement of coastal defence data. *This dataset is currently not complete. W&PBC may wish to liaise with EA Dorset Area Office to ensure the dataset is up-to-date.* Filename: • W&P_Flood_Defences.shp	EA	B
Potential Flood Risk Area	Indicative of natural undefended floodplain (i.e. without defences) at the 1:100 year event for watercourses not mapped by the EA. These generally tend to be small watercourses and in the upper reaches of the catchment. Used to guide planning consultations and to raise awareness of flood risk. Low confidence. Filename: • Potential_Flood_Risk_Area.shp	RH	D
W&PBC Boundary	Weymouth & Portland Borough Council Boundary supplied by Ordnance Survey Boundary Line. • boundary.shp	W&PBC	A
W&PBC Defences	Proposed and existing defences as identified by W&PBC. This is not a complete inventory of information. *W&PBC may wish to update this layer as and when further details of existing and proposed defence schemes become available.* Filename: W&PBC_Defences.shp	W&PBC	D

W&PBC Defences (detail)	Outline detail of certain existing W&PBC Defences. *W&PBC may wish to update this layer as and when further details of existing and proposed defence schemes become available.* Filenames: • W&PBC_Defences_detail.shp	W&PBC	A
W&PBC Notes & Observations	Notes with geo-referenced locations produced from meetings between W&PBC and RH. More detailed lines have been produced where accurate information is known and flow routes have been plotted in select locations. Filenames: • W&PBC_notes&observations.shp • W&PBC_notes&observations_lines.shp • WPBC_direction_of_floods.shp	W&PBC	C
Tidal Flood Extent for 2052	Projected levels of tidal floodplain for 2052 for South coast. Produced under Level B 2002-4 South Coast tidal mapping study by Royal Haskoning. Considers certain raised defences and associated overtopping and breaching for areas over 1 square km. Filename: • W&P_fp_50yrs.shp	RH	B

Appendix B - Methodology for mapping potential flood risk areas

ROYAL HASKONING POTENTIAL FLOOD RISK AREA METHOD

Flood zones have been produced by the Environment Agency for all the main rivers and some of the ordinary watercourses in the Weymouth & Portland Borough Council area, leaving the smaller watercourses with no mapped floodplain.

To give a rough idea of the Potential Flood Risk Areas for these smaller watercourses, we developed a simple method to represent the possible extent of flooding.

This method used site visits, LiDAR DTM data, 2m contour mapping (created by RH from LiDAR) and engineering experience to indicate an approximate boundary for a 1% probability (1 in 100 years) fluvial event.

It must be noted that this boundary is an estimate. Any development proposed within or near to the boundary of a Potential Flood Risk Area requires a detailed FRA to determine a more accurate flood extent, taking into account climate change.

The rules used to produce this boundary were:

- Assume that in rural areas the floodplain will extend approximately 1m from the river (average floodplain extent for rural watercourses of this nature in relatively low risk locations)
- Assume that in urban areas the floodplain will extend approximately 2m from the river. (average floodplain extent for urban watercourses of this nature taking into account the increased potential risk to property and assets)
- At bridges and other constrictions the flow will back up slightly on the upstream side of the bridge.
- In very steep areas the flood boundary will not be drawn as the flow will be significantly constrained by the topography.

Appendix C - Methodology for mapping climate change

METHODOLOGY FOR CALCULATING FLOOD EXTENTS WITH CLIMATE CHANGE

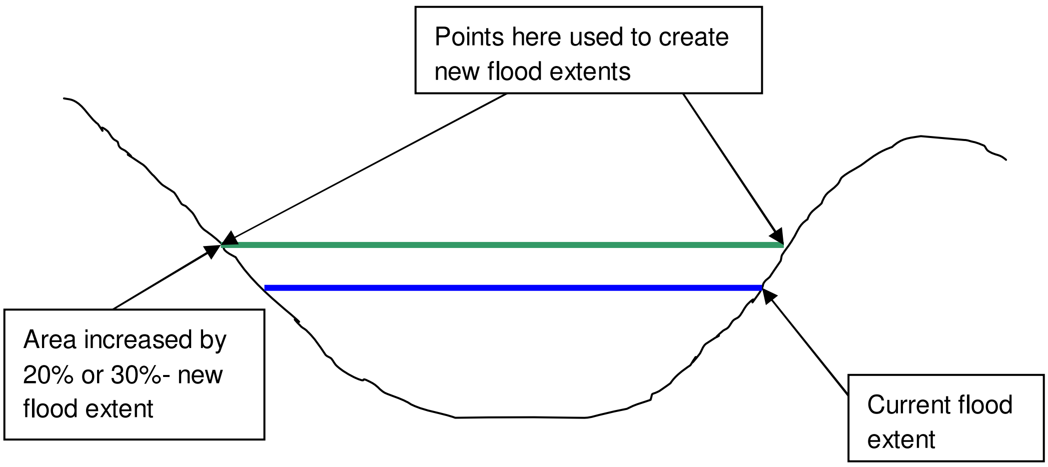
This document sets out a methodology prepared by Royal Haskoning for the calculation of new flood extents based on an increase in flow of 20% and 30% as a result of climate change.
It requires the use of existing flood extent information such as Flood Zone 3 data from the Environment Agency (EA) and high resolution DTM data such as LiDAR.

This methodology has been developed for ArcView 3.2a and requires the following extensions and scripts:

- Spatial Analyst extension
- 3D Analyst extension
- XTools extension
- Lidar Tools extension (including Profile Extractor)
- Createtransects.ave

Method:

1	Identify the watercourse features (and associated flood extents) that are to be used for the assessment. Clip the data down to the relevant areas if required. One method to do this is to create a density map (using spatial analyst) from flood events such as the EA FRIS (Flood Reconnaissance database) and determine a suitable density threshold level to use to define areas of study.
2	Prepare the watercourse data by checking if it is digitised in the direction of flow with each separate named tributary saved as a polyline or multi-polyline. Using the script createtransects.ave create the cross sections (as graphics) at 90 degrees to each watercourse spacing the sections at 50m (urban areas) or 100m (rural areas). The length of each cross section should be sufficient to cover the estimated new flood extent and 200-500m is suggested (this can be trimmed back later) Using the xtools extension save these graphics as a shapefile.
3	Prepare the cross section shapefile by assigning each cross section with a unique ID (a numeric value based on the shapefile index is sufficient). Also add columns for the cross section level and the level plus climate change.
4	Using Profile Extractor and LiDAR data calculate the height at which the cross section crosses the existing flood extent for both left and right banks, which may not be the same for each bank due to differences in scale when the mapping was first carried out. Calculate the average height and record in the level column. The length of the cross section may need adjusting based on the topography especially if the banks are raised either side of the channel. As the existing flood extent may have been produced without the use of LiDAR data some of the levels identified may need adjusting to prevent the watercourse flowing uphill.
5	It can be assumed for the purposes of this study that gradient, roughness and velocity will remain constant for an increase in flow. Therefore using Q=VA where Q=Flow, V=Velocity and A=Area an increase of 20%

	or 30% in flow is equivalent to an increase of 20% or 30% in area respectively. Therefore the increase in depth can be determined from the new area and how it fits the LiDAR data. If this is not possible the height could be determined by dividing the increase in area by the width (x) of the current flood extent $h=\frac{0.2A}{x}$ or $h = \frac{0.3A}{x}$ However this method is less satisfactory as it will assume a rectangular area of increase and not take account of increases at the channel sides.
6	Using the initial average level obtained from the LiDAR determine the cross sectional area produced when water fills the channel to this depth. Calculate what value a 20% or 30% increase in area will give and then try different incremental levels to produce the nearest value to this area. Record the level against each cross section in the climate change column. Repeat for all cross sections.
7	Using the climate change levels produce a TIN of the cross section data and use this to 'flood' the LiDAR information to produce an indication of flood extents. Map these new flood extents into a shapefile to produce a new flood extent outline for the selected areas.
8	Carry out a visual check followed by manual adjustment to the new flood extents to verify and look for any situations where the new flood extent may be below the original Flood Zone 3 extent due to the horizontal issues noted in 4 above. 

Appendix D - PPS25 Decision Flow Charts

ROYAL HASKONING

Appendix E - Guidance for developing housing in a flood resistant manner

GUIDANCE FOR DEVELOPING HOUSING IN A FLOOD RESISTANT MANNER

PPS 25 states that development situated in EA Flood Zones 2 or 3 may be required to be built using flood resistant construction.

Exterior Construction

There are several measures to improve flood resistance of a wall using mortar, sealants and fillers. These measures include applying waterproof sealant to the outside face (ideally a breathable sealant), raising the level of the damp proof course, injection of fillers, closing cavities and ensuring there are no cracks or voids in the brickwork.

Excluding water will help reduce damage to the internal fabric of the building and its contents. If water does enter the house, flood resistant building materials will reduce the effects of the water and can reduce the cost of repairs.

Interior Construction

One of the most effective ways of reducing the impact of flooding is to raise the floor level of the property above expected flood levels. If this is not practical, another is to have flooring that can withstand being under water. Chipboard flooring is likely to be damaged by floodwater, so more resistant materials such as treated floorboards, WBP plywood, screed or tiles will be more suitable in flood risk areas. Fixtures that cannot be removed before a flood and might be damaged by exposure to water, such as carpets, parquet and laminate wooden floors should be avoided.

Where internal flooding cannot be avoided, some form of drainage of the water immediately post flood is recommended. In addition to protecting flooring, utility supplies should also be protected so that they can still be used in the event of internal property flooding.

- Electricity
  If there is sufficient space, the meter and fuse box should be positioned at a level which is higher than the expected flood level.
  Modern wiring is not usually affected by flooding, but long immersion may result in the need to replace wiring. Moving the ground floor ring main cables to first floor level could be considered with drop down cables to ground floor sockets. Sockets should also be raised to an appropriate height above flood levels. A further consideration is to have the house wired so that the ground floor main can be switched off, leaving the supply to the upper floors still available.

- Gas supply
  As gas meters can be affected by floodwater it is worth considering raising meters above the expected flood levels. Provision should be made for purging gas supply pipes through the installation of appropriate valves and drain points.

- Central heating systems
  Gas and oil fired boilers and associated pumps and controls should preferably be installed above the maximum expected flood level. Pipe insulation below the expected flood level should preferably be replaced with closed cell insulation. If new

heating is being installed, pipework routes should be made easily accessible to allow pipes to be maintained and washed down following flooding.

- Water supply
  Water pipework insulation can be replaced with flood resistant closed cell material below the expected flooding level.

- Telephone and cable services
  Suppliers of the relevant services should be consulted on suitable installation methods in areas liable to flooding. Where possible, incoming telephone lines and internal control boxes should be raised above the expected flood levels.

- Oil storage tanks
  Oil tanks can be damaged during floods and can cause pollution. To avoid this it should be ensured that the tank is anchored down so that it does not float. In addition the oil feed from the tank should incorporate a stop valve at the end nearest the tank so that the tank contents will not be lost if the tank moves and the pipe breaks.

The information above is a summary of the CIRIA Advice Sheets. All the advice sheets, and further guidance for homeowners and developers, can be downloaded from www.ciria.org/flooding/reducing_the_impact.htm