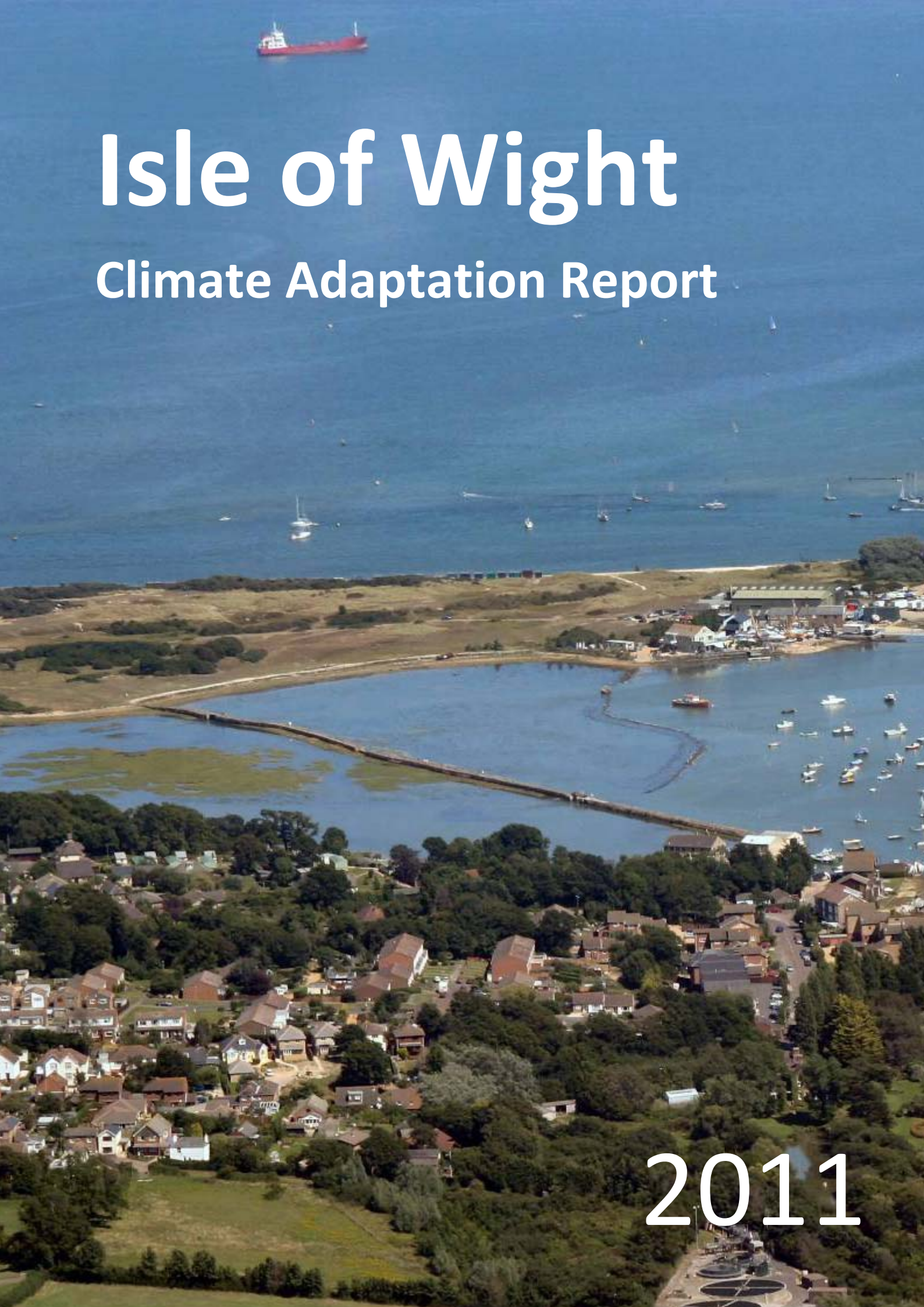
Isle of Wight

Climate Adaptation Report



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Isle of Wight Climate Adaptation Report

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1 Executive Summary

Climate Change and its potential impact on daily life and public services is likely to become an issue of great significance for every community. This was formally recognised by the Isle of Wight Council when it signed the Nottingham Declaration on Climate Change in November 2007. The local authority continues to take steps to mitigate for its own contribution to increasing global temperatures by managing carbon emissions, but it is clear that it must also learn to adapt essential public services to the discernible and predicted changes in the Island's climate and weather patterns. After consultation with Council officers, service managers and the public the principal risks to Island life stemming from changes to the climate have been identified. This document details key objectives and options for adaptation which will help to ensure a stable and prosperous future for the Island.

Successful adaptation requires input and action from all: individuals, communities, businesses and the public sector. This report therefore details adaptation measures which can offer to organisations and individuals guidance consistent with the strategic direction of Council efforts.

We all need to be informed enough and persuaded sufficiently of the need to adapt homes and businesses, understand and have confidence in emergency procedures and know where the vulnerable individuals in our neighbourhood live. We need a better understanding of the threats to wellbeing, travel and routine that will come with a changing climate and we will all face difficulties, in the short and long term, if we fail to prepare.

Isle of Wight Climate Adaptation Report Overview

The **principal risks** to the Island from climate change have been identified as:

- Impact of fluvial flooding and extreme weather events on communities.
- Impact of sea level rise, flooding and coastal erosion on the built environment and land use.
- Impact on communities and businesses of water shortages caused by drought conditions.
- Threats to human health due to new environmental conditions.
- Limited capability of Island species and habitats to adapt to a changing climate and extreme events.
- Economic instability caused by lack of sufficient adaptation particularly within agricultural sector.
- Impact on infrastructure and transport threatening business continuity.
- Impact of extreme events on continuity of Island's energy supply.
- Impacts of extreme weather on cross Solent supply chain: food, fuel, medicine.

The **adaptation actions** deemed as most critical to the safety of Island residents and continuity of public services are:

- Conduct climate vulnerability mapping to identify priority at-risk sites, settlements, developments and properties across the Island.
- Continue to monitor the state of the Island's coastline, coastal infrastructure and community.
- Introduce appropriate climate change adaptation fully in all new and reviewed Isle of Wight Council strategic policies and programmes, and minimise future risk through effective implementation.
- Increase awareness amongst communities of how a changing climate will affect daily life and how they might adapt and prepare for sustained disturbance to routines and the acute impacts of extreme weather events.
- Develop a freely accessible Island-wide resource of comprehensive information and expertise on climate adaptation.

2 Introduction

The Isle of Wight has a unique landscape with historical, conservational and archaeological importance; it is home to over 138,000 residents and is a holiday destination for as many as 2.5 million others each year. The Island is exposed to wind and wave attack from the Atlantic and has a soft underlying geology leaving the coastline vulnerable to erosion.

Medina Estuary

As the understanding of our warming climate increases and the impacts this will have on the Island's population, industry and future are recognised, the demands for consequent impacts on public safety to be addressed will grow, as will the need to prevent damage to the Island's infrastructure and economy.

2.1 Climate Adaptation

Adaptation focuses on altering behaviour through researching ways to reduce the impact of a changing climate and then taking sufficient action to make a difference.

Mitigation against climate change addresses the causes of our warming climate, reducing the GHG (greenhouse gas) concentration in the atmosphere by limiting the amount of anthropogenic emissions. Continued efforts to reduce the levels of greenhouse gases in our atmosphere are of course very important in the fight against climate change but protection against the likely impacts of a changing climate on the Island are essential.

Weathering the Change community event

The effects of climate change on the economy could be devastating. The Stern Review[1] which was presented in 2006 studied the impacts of climate change on the economy of the UK. The report warned of the potential that climate change holds in

1 Stern, N. (2006) The Economics of Climate Change: The Stern Review, Cambridge Press, Cambridge.

disrupting the economic and social activity of the country on a scale which can be compared to the economic depression of the early twentieth century. Lord Stern stresses throughout the report the dangers of delaying and ignoring the impacts of climate change suggesting that there is a risk that if action is not taken, this change could result in global GDP (gross domestic profit) being cut by 20%. He suggests that the worst effects of climate change could be avoided with an average annual investment of just 1% of GDP.

2.2 Purpose and Objectives

This report has identified the main risks the Island faces, many of which we are now aware of and prepared for. Where gaps have been identified this report suggests adaptation measures to ensure the health and well-being of Island residents and economy. This report draws on an evidence base of national and local studies on the effects of climate change and weather. In addition the Isle of Wight Extreme Weather Study[2] provides quantitative assessment of the disruption caused by extreme events and can be used as a tool to estimate the further cost and disruption likely to result from increased extreme weather. During the development of the Isle of Wight Adaptation Plan comprehensive consultations were undertaken with public service providers and other expert bodies. The objectives of this report are as follows:

- To provide an overview of why and how the climate is changing globally, nationally and locally.
- To summarise the impacts associated with a changing climate on the Isle of Wight, as set out by the Isle of Wight Impacts report[3] and detail the main risks posed by a changing climate.
- To recommend adaptation measures and to equip the Island with the necessary facts to manage extreme weather events and reduce the amount of disruption caused.

2 Isle of Wight Extreme Weather Study (2010), Natural Enterprise, Available: http://www.eco-island.org.uk/change_island/climate_change/adaptation/extremeweatherstudy.aspx

3 Isle of Wight Climate Impacts Report (2010) Natural Enterprise, Available: http://www.eco-island.org.uk/climate%20change/isle_of_wight_climate_impacts_report_issue_2.pdf

3 Climate Change

It is important to stress the natural variations which have occurred over the last millennia which may have contributed to the changing climate. The following theories have been proposed:

Milankovitch cycles[4]: Changes in the position of the Earth relative to the Sun have been found to have a significant impact on the temperature of the Earth's atmosphere. The distance of the Earth from the Sun influences the amount of solar radiation which enters the Earth's atmosphere. The angle which the Earth is tilted towards the Sun influences the surface area of the Earth which is exposed to solar radiation; with the greater the exposure is the greater the absorption.

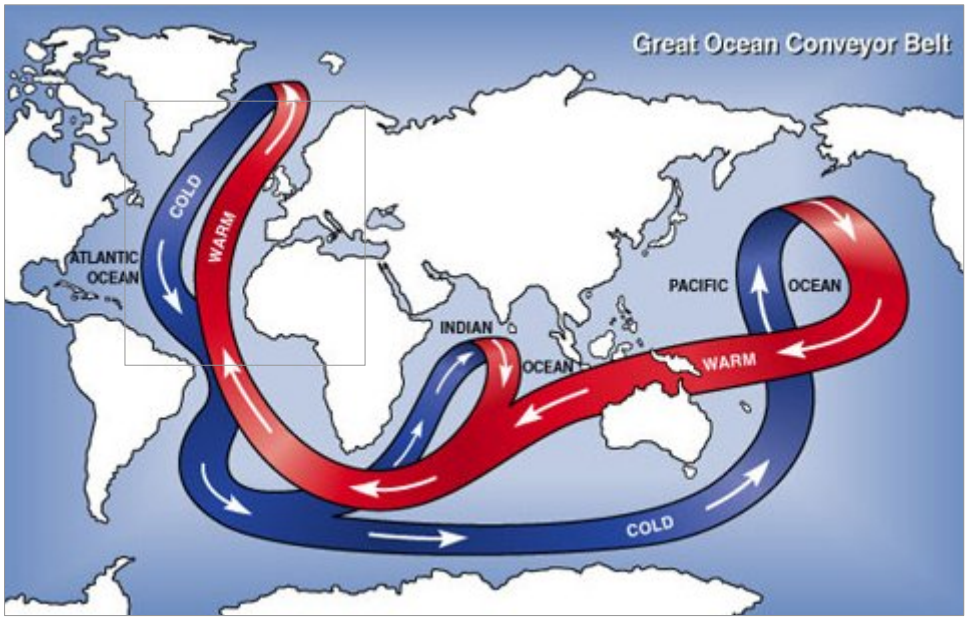

Figure 1 Thermohaline Circulation

The Thermohaline Circulation[5] (THC) is a current which brings warm tropical ocean water from the southern latitudes to the North Atlantic, and returns cool North Atlantic water back southwards. When this circulation slows or weakens, less heat is brought up from the equator and the northern latitudes (i.e. northern Europe) cool. When the THC strengthens, more warm water is brought north from the tropics, and the northern latitudes warm. Consequently, a strengthening of the THC may cause warming of the northern latitudes.

Solar forcing: Changes in solar activity may be contributing to some of the changes in the temperatures but it is not yet understood how much of our climate's change may be a result of solar activity.

4 National Oceanic and Atmospheric Administration Palaeoclimatology (2010) Astronomical Theory of Climate Change, Accessed 30/11 /10, http://www.ncdc.noaa.gov/paleo/milankovitch.html

5 National Oceanic and Atmospheric Administration Palaeoclimatology (2010) Thermohaline Circulation, Accessed 30/11/10, http://www.ncdc.noaa.gov/paleo/ctl/thc.html

Evidence of the role these factors have played in climate change (i.e. the Ice Ages and interglacials) suggests that they, at different scales, have the capacity to contribute to the complex causes of the present warming climate.

The significance of this is that the understanding behind climate change drivers is not focused entirely on the anthropogenic emissions; other factors which have been affecting the Earth's climate for millennia are influencing the warming we see today.

Looking at past trends and the fluctuations which have occurred naturally without human intervention it is clear that nature is powerful and can have enormous impacts on the Earth's climate. The evidence of greenhouse gas forcing due to the atmospheric emissions from human activity suggests that our current lifestyles are making a significant contribution to the warming climate.

Irrespective of the cause of climate change, the trend of a warming climate is irrefutable, and the need to adapt to minimise the impact of future weather events will become more significant.

The Intergovernmental Panel on Climate Change (IPCC)[6] have reported that the warming of the climate in the last 50 years cannot be attributed only to natural variations in the Earth's climate, but must include human-induced greenhouse gas emissions. Recent climate change has been scientifically proven, and is becoming a more serious threat to the future, needing urgent response from all levels of governance.

3.1 The Greenhouse effect

The greenhouse effect (Figure 2) describes the ability of the atmosphere to retain warmth, according to the concentration of greenhouse gases.

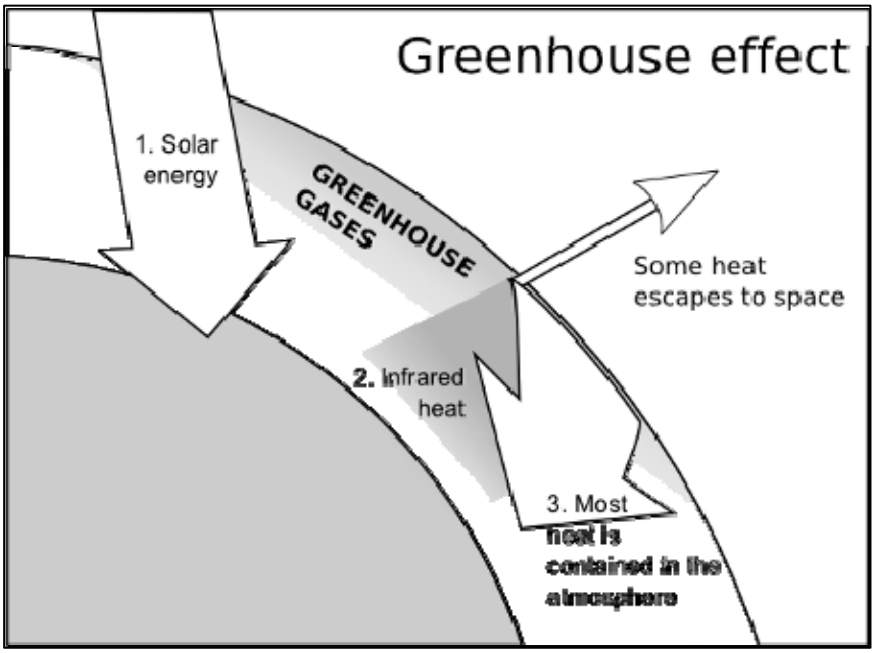

Figure 2 Greenhouse Effect

6 Intergovernmental Panel on Climate change (2010) Reports, Accessed 30/11/10, http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

Greenhouse gases (GHGs) such as carbon dioxide, methane, nitrous oxide and water vapour are found high in the atmosphere, and reflect, absorb and allow certain amounts of radiation to pass through them. The higher the concentration of GHGs, the more heat radiation is absorbed and retained within the atmosphere.

Solar radiation is partially reflected from the atmosphere back out to space, and partially enters the atmosphere and is absorbed by the Earth's surface.

Terrestrial radiation is emitted from the surface, the majority of which becomes absorbed and trapped by the GHGs in the upper atmosphere. A small proportion passes through the atmosphere out into space.

The balance of terrestrial radiation absorbed by the atmosphere and solar radiation which reaches the Earth's surface directly affects the Earth's temperature.

As GHG concentration increases, the amount of terrestrial radiation which escapes out of the atmosphere is reduced, and there is greater retention of warmth.

Tipping Points: A tipping point in climatology terms is a point where our climate changes from one stable state to another stable state[7]. The climate tipping point occurs when greenhouse gas levels reach a point that no additional input is required for large climatic change. Some scientists say levels are already above the tipping point. It may often be the case that the tipping point of a system is undetectable, and the effects only seen much later[7] .

3.2 Anthropogenic inputs

The balance of GHGs within the atmosphere is crucial to the temperature of the Earth, with increased GHG concentration causing temperatures to rise.

Anthropogenic (human) activity since the Industrial Revolution has significantly increased the amount of carbon dioxide which has entered our atmosphere.

Figure 3[8] shows the concentration of greenhouse gases within the atmosphere for the last 2000 years. Fluctuations are evident up to 1500AD, which reflects the natural variation in the Earth's atmosphere. Post-1500AD, there is a clear rise in all GHGs within the atmosphere, with almost double the concentration of methane, which is 25 times more potent as a greenhouse gas than CO2[9].

7 Wikipedia - Tipping Point (Climatology) http://en.wikipedia.org/wiki/Climate_tipping_point

8 IPCC AR4 Working Group I (2010) FAQ 2.1 How do Human Activities Contribute to Climate Change and How do They Compare with Natural Influences?, Accessed 24/11/10, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-2-1.html

9 National Oceanic and Atmospheric Administration (2010) Carbon Dioxide, Methane Rise Sharply in 2007, Accessed 30/11/10, http://www.noaanews.noaa.gov/stories2008/20080423_methane.html

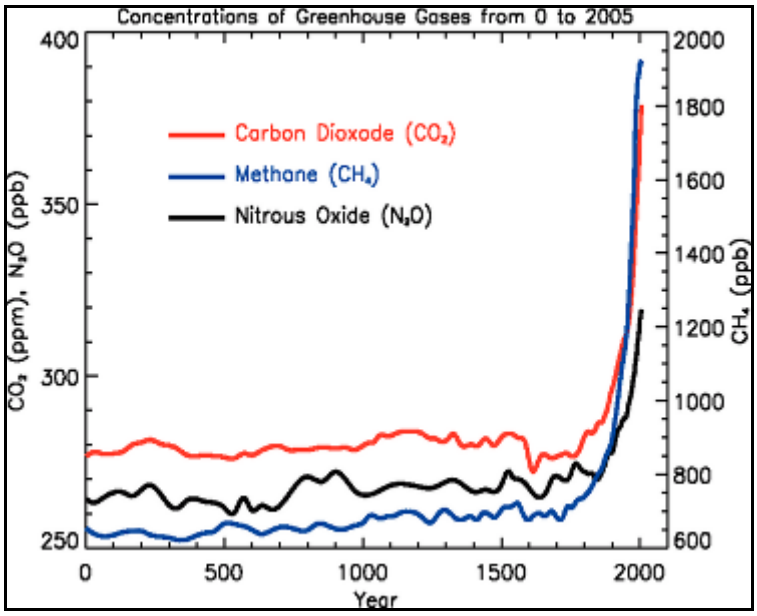

Figure 3 Change in atmospheric concentration of Carbon Dioxide, Methane and Nitrous Oxide

Applying our knowledge of the careful balance between absorption and reflection of terrestrial and solar radiation within the atmosphere in accordance with GHG concentration, there is clear evidence that the increase in GHGs within the atmosphere over the last 50-100 years has been a significant contributor to the warming climate. Figure 4 shows the change in global temperature and CO^2 levels since 1880.

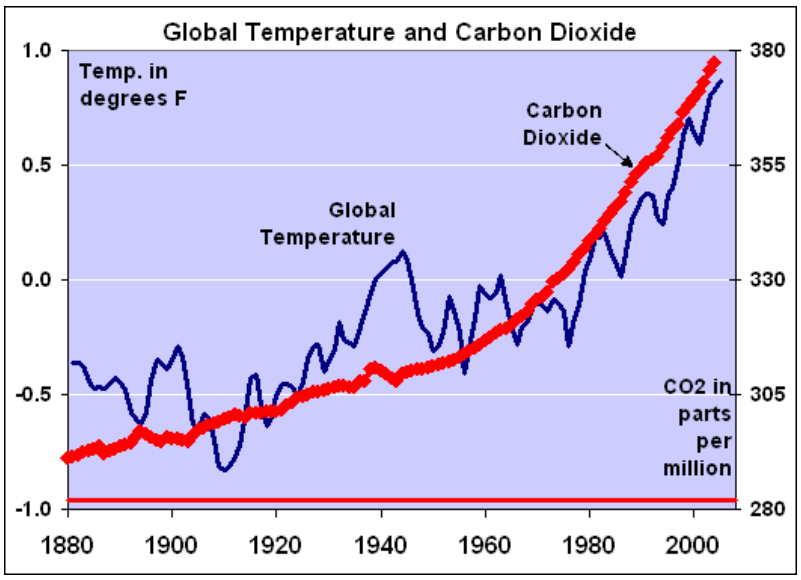

Figure 4 Change in Global Temperatures and CO2 levels

3.3 The Intergovernmental Panel on Climate Change (IPPC)

The Intergovernmental Panel on Climate Change (IPCC) is the “leading international body for the assessment of climate change. Established by the United Nations Environment Programme and the World Meteorological Organization to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts”. The IPCC review and assess the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It provides the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. The IPCC has concluded that “warming of the climate system is unequivocal" and "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".

4 Role of Government

4.1 National Considerations

Climate change is now perceived as the greatest environmental challenge which faces our world today, and it is becoming increasingly clear that the most effective, and potentially the only way for this to be tackled is through a coordinated approach.

Legislation passed by the Government commits it to long-term action on climate change but also sends a strong signal to local communities that this work is urgent and needs to start now.

The following Acts set the agenda for tackling climate change adaptation:

The Climate Change Act 2008[10]

- In 2008, the UK passed the first legally-binding Act which aimed at tackling the long-term dangers of climate change. This act aimed to set ambitious, legally-binding emissions targets, enhance the UK’s ability to adapt to climate change and strengthen the nation’s infrastructure.

The Planning Act 2008[11]

- This Act sets out to provide a new integrated planning system for the country’s major infrastructural projects in areas such as waste, water, energy, and transport, taking into account the risks of climate change.

10 Department of Energy and Climate Change (2010) The Climate Change Act 2008, accessed 24/11/10, http://www.decc.gov.uk/en/content/cms/legislation/cc_act_08/cc_act_08.aspx

11 The Planning Act 2008, accessed 24/11/10, http://www.legislation.gov.uk/ukpga/2008/29/contents

4.2 Local Government

The Island's Local Government is at the forefront of climate-related issues, tackling dangers from flooding, extreme weather events and the continual impact of coastal erosion.

The impacts of climate change on the Isle of Wight can be seen in weather events such as heatwaves, storms and flooding. Climate change encompasses the increased variability of the climate as well as the long-term trends.

The Isle of Wight Council can be seen to have two main roles when dealing with climate change:

- Leadership: communicating the benefits of adapting to climate change, leading by example and persuading the community to prepare for the impacts.
- Service provision: ensuring the continued supply of services during extreme weather conditions and improving the resilience of the services.

5 The Island's Changing Climate

The UK Climate Projections 2009 (UKCP09)[12] data and figures used in this section are taken under a medium emissions scenario for the period between 2049 and 2060.

The UKCP09 projections differ from previous versions in that they deliver probabilistic data rather than a single figure. This ensures that the uncertainty of the data is explicit and while requiring more work to interpret, does mean that more robust decisions are possible. The UKCP09 uses cumulative probabilities at the following probability levels:

- 10% (very unlikely to be less than)
- 50% (central estimate)
- 90% (very unlikely to be greater than)

The UKCP09 probabilistic climate projections are reported as a central estimate (50%) when referring to a projected change that has equal probability of being exceeded and not being exceeded.

12 UKCP09 (2009) UKCP09 data, Accessed 08/11/10 http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=163&Itemid=293

The graphs on the following pages originated from models using the middle of the three emission scenarios used in UKCP09, referring to SRES A1B emissions which is a mid-line for carbon dioxide output and economic growth.

The graphs show the 25KM grid squares outputted by UKCP09. The west of the Island falls in a maritime climate model as there is more sea than land on the grid.

5.1 Hotter summers

Climate models suggest that in the next 100 years the climate is likely to incrementally become warmer, with summer temperatures suggested to be the most affected. Figure 5 illustrates the change in summer temperatures for the Isle of Wight, showing that summer temperatures are estimated to increase on the Isle of Wight by 2.8°C , and by no more than 4.7°C.

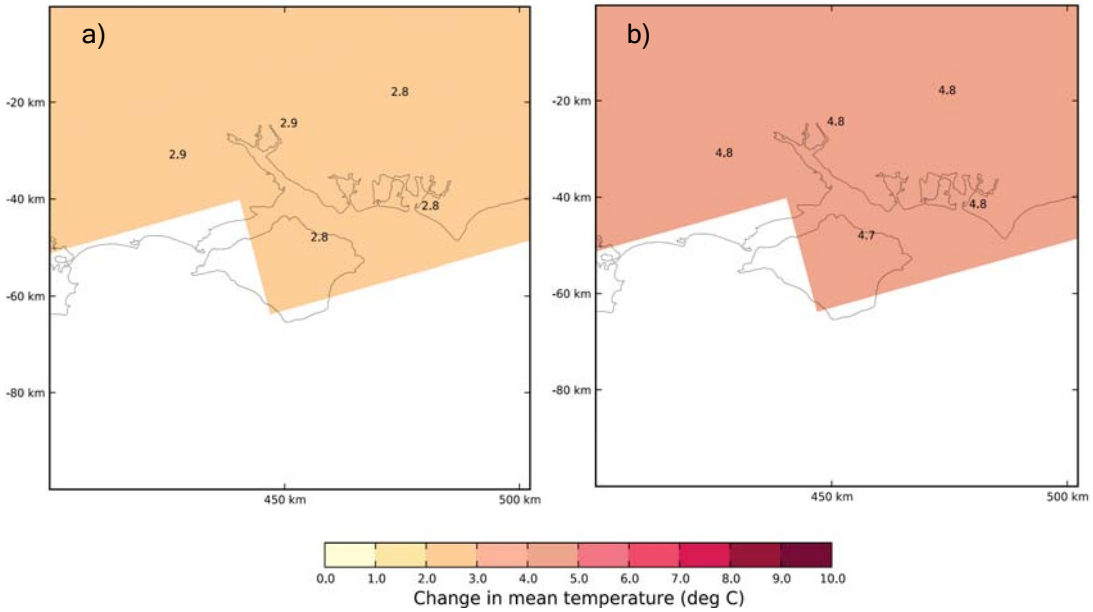

Figure 5 Change in mean summer temperature. a) 50% scenario, b) 90% scenario

In comparison to other areas of the UK, the models demonstrate that the Isle of Wight has a slightly lower increase in summer temperatures which is due to the maritime position. The ocean has a slower heat transfer with the surrounding air than landmasses, and therefore in hotter summer months it takes longer to heat up. Consequently there is a constant supply of cool maritime air which reduces the air temperature over land.

5.2 Drier summers

Alongside hotter summer temperatures, models predict drier summers. The UKCP09[12] data shown in Figure 6a demonstrates a 20% fall in precipitation compared with baseline values.

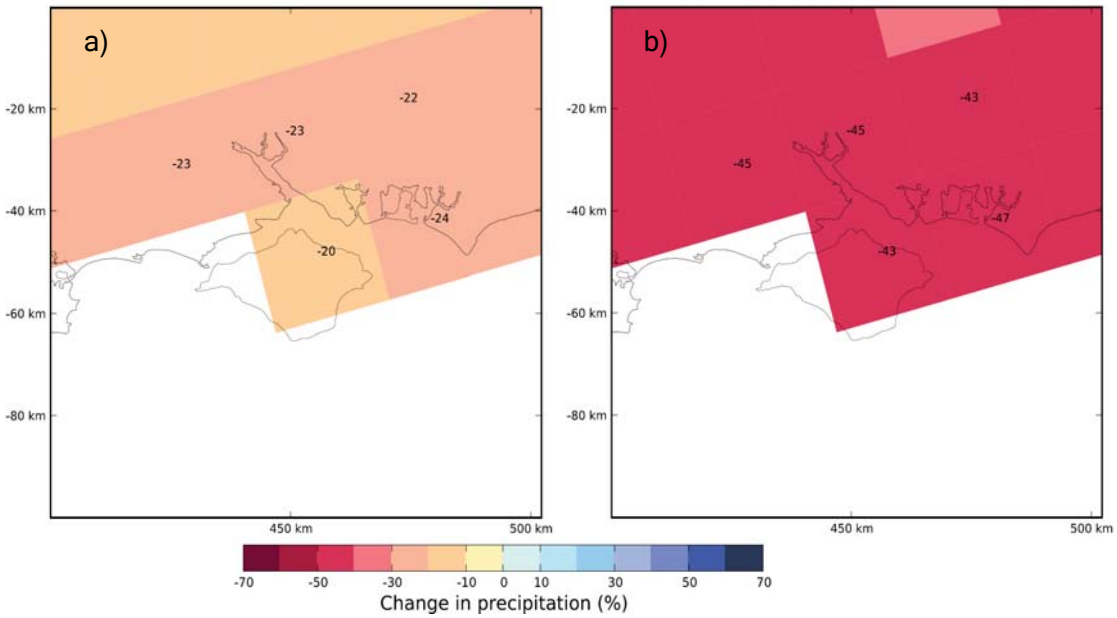

Figure 6: The change in mean summer precipitation (%). a) 50% scenario, b) 10% scenario

The extreme scenario (Figure 6b) suggests it is unlikely to be more than a 43% fall in summer precipitation. In comparison with values shown for southern England, the reduction in precipitation is not quite as severe. With increasing distance inland, the amount of summer precipitation decreases more dramatically due to the distance from a moisture source. Consequently, the Island is in a position of advantage being in such close proximity with the coast. However, a 20% fall in summer precipitation by 2060 is severe, and will need addressing.

For summer precipitation, the 10% scenario represents the most extreme or worst case scenario (very unlikely to decrease more than this).

5.3 Milder winters

Figure 7 demonstrates the change in winter temperatures between now and 2049-2060 for the Isle of Wight. It is evident that there is an increase in temperatures, with the most likely scenario showing an increase of 2.2 ^{o}C. The most extreme scenario, of which the temperature change is not likely to exceed, suggests 3.5 ^{o}C.

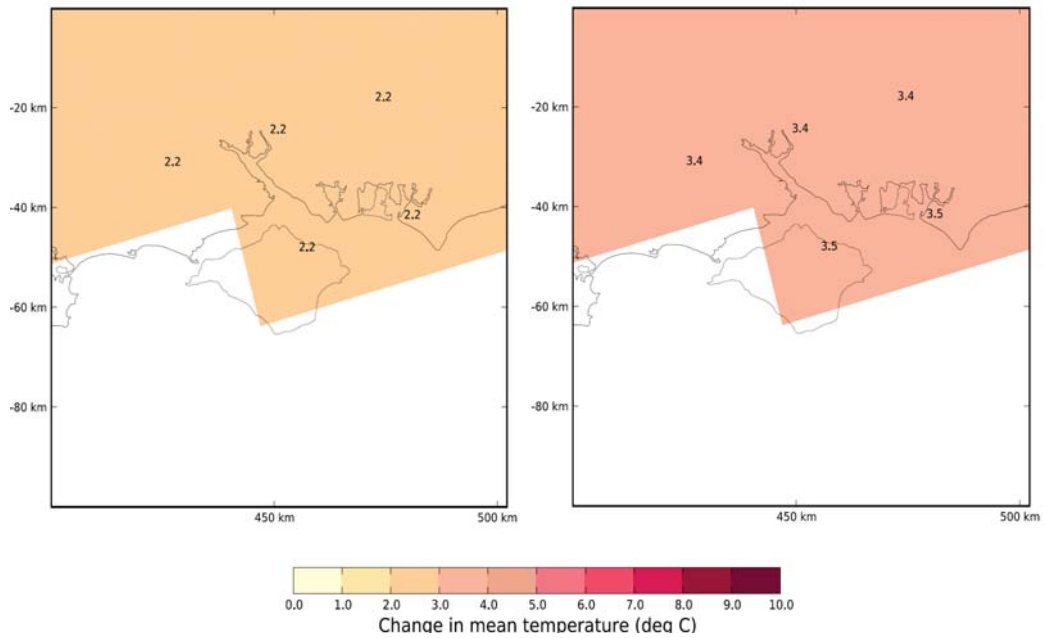

Figure 7 Change in mean winter temperature 50% scenario (left) 90% scenario (right)

The 90% scenario (on the right) represents the most extreme or worst case scenario (it is very unlikely to be warmer than this).

5.4 Wetter winters

Figure 8 illustrates the increased precipitation expected throughout the winter months between now and 2049-2060. The 'likely' scenario (Figure 8a) shows a 17% increase in precipitation whereas the 'extreme' scenario (Figure 8b) demonstrates as much as a 45% increase. This is significantly higher than other areas of southern England, due to the close proximity to the coast of all areas on the Isle of Wight.

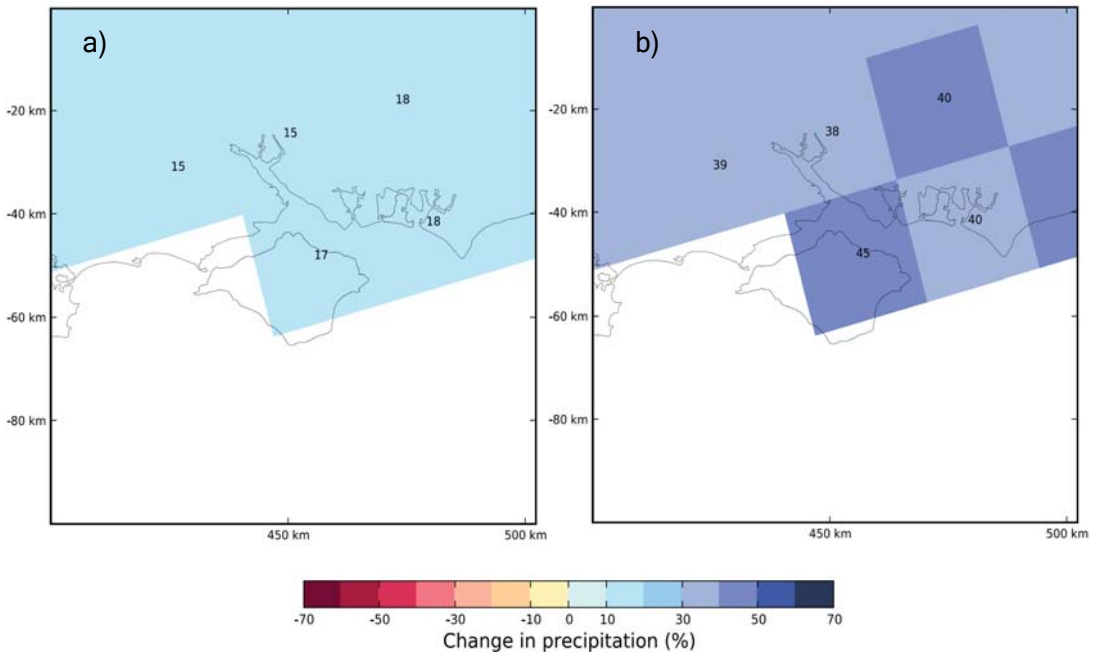

Figure 8 Change in mean winter precipitation a)50% scenario, b) 90% scenario

The 90% scenario (on the right) represents the most extreme or worst case scenario (it is very unlikely to be wetter than this).

5.5 Rising Sea Level

A warming climate will cause sea level to rise due to three principal reasons:

1) Thermal expansion of the sea water. As the sea surface temperature increases, the energised water molecules will move further apart and the ocean volume will increase.

2) Land movement. Since Scotland became deglaciated, the Scottish landmass has been rising, and consequently the Isle of Wight (on the other side of the tectonic plate) is lowering into the sea.

3) Melting of glaciers and ice sheets. With a warming climate, the ice sheets which cover Greenland, West Antarctic and the higher latitudes are melting, adding a large amount of water into the oceans.

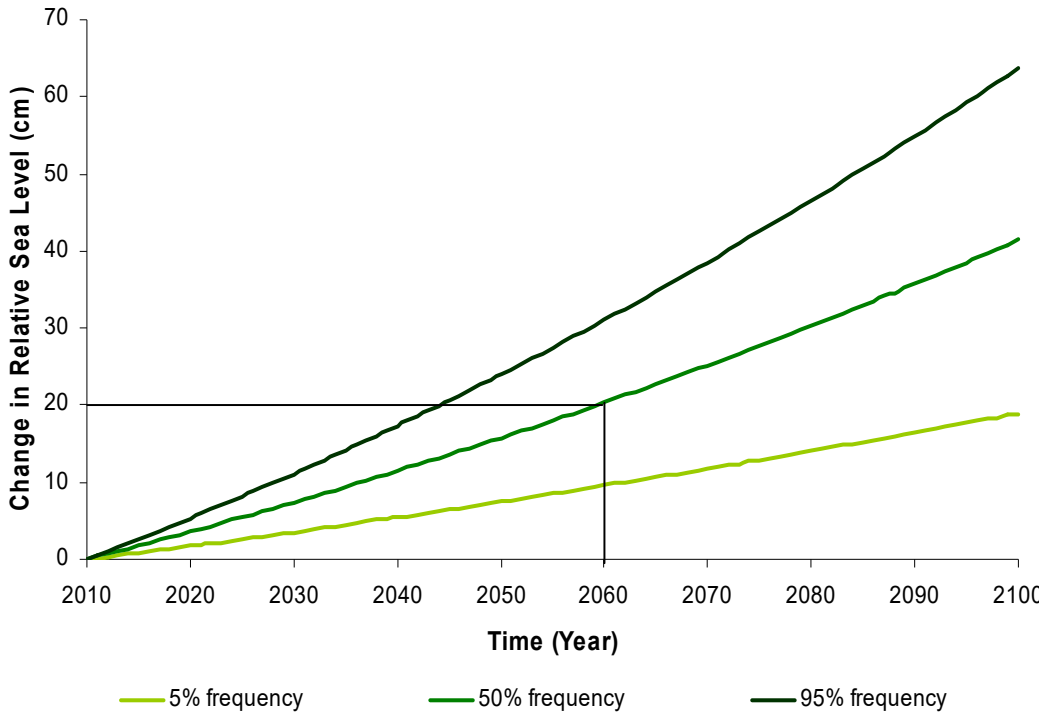

Figure 9 Relative sea level rise (cm)

The 5% frequency line on Figure 9 shows the minimum amount of sea level rise expected, whereas the 95% frequency line shows the maximum. Accordingly, the 50% line represents the central estimate of sea level rise.

Therefore, a 20cm rise by 2060 is likely, though a relative rise of 10-30cm is possible. At the least extreme scenario, a 10 cm rise in sea level will still have an impact on the low-lying areas of the Island's coastline.

5.6 Extreme Weather Events

As well as summers becoming hotter and drier, and winters becoming wetter and milder, it is likely there will be an increase in frequency, severity and duration of extreme weather events (droughts, storms and heavy rainfall, heatwaves, and possibly snowfall).

Droughts and heatwaves will become more common as a result of longer, hotter and drier summers whereas rainstorms will occur more frequently due to increased evaporation of sea water into the air masses. This will in turn cause increased flooding events on the Island which will be exacerbated by the wetter winters, as the water table will be high and the ground saturated.

The winters of 2009/10 and 2010/11 have forced consideration of the micro-scale effects of our changing global climate. These are relatively small-scale weather system effects caused by larger shifts in global climate. One such effect could potentially be responsible for the bitter temperatures and snow experienced in the UK during these winters.

The snow at the end of 2010 was due to a large area of high pressure in the Atlantic, blocking our usual mild westerly winds. Instead, bitter Arctic air was predominant, which has collected moisture from the North Sea that is then deposited on the UK as snow.

Our changing global climate may explain why the Arctic high pressure is so far south. As our climate changes, air masses are becoming more dynamic resulting in increasingly extreme weather. Our weather could frequently swing from big chills and flooding in the winter to drought and heatwaves in the summer months.

However, during the same period as the UK experienced unusually cold winters, average global temperatures continued to increase, as shown in Figure 10 below.

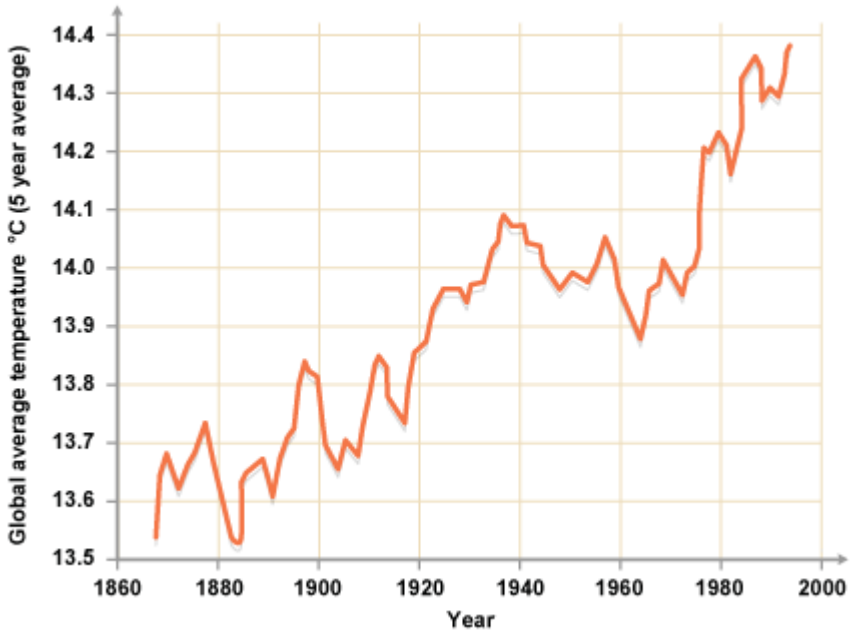

Figure 10 Change in Global Temperatures

6 Summary of how climate change will impact on the Isle of Wight.

For full details of the impacts of climate change on the Isle of Wight refer to the Isle of Wight Climate Impacts Report[3].

6.1 Summary of impacts of hotter and drier summers

Hotter and drier summers could have both positive and negative impacts on the Isle of Wight:

As British summers become warmer, there has been a rise in the number of UK citizens taking 'stay-cations', which sees British tourists staying within Great Britain for their summer holiday. As the Isle of Wight is a well-known, popular and easily-reached destination within the UK, there may be a greater number of tourists visiting in the future. As the summer season lengthens it is predicted there will be two impacts from increased visitors:

1. Greater tourism will boost the Island's economy as tourist attractions and hotels around the Island have greater business for a longer period of time. Additionally, hotter and drier summers may see a new age group of younger tourists visiting the island, spending money on the Island services.
2. Greater pressure from tourism may damage the natural environment and vulnerable archaeological features. A higher summer population on the Island may also see more pressure on public services.

Hotter and drier summers may impact on the health of Isle of Wight residents, as greater incidences of sunburn, heat stroke, heat exhaustion and the contraction of new diseases are associated with a warmer climate. But it should also encourage a healthier outdoor lifestyle.

The majority of buildings (residential and commercial) are not equipped to withstand warm temperatures and consequently, staff and home owners may experience discomfort as the indoor temperature rises. This may reduce productivity of staff and have health implications for homeowners.

As temperatures rise and the summers become drier, this may have significant impacts on our biodiversity as species migrate to a cooler climate to the north, habitats dry out and other species from the continent colonise our shores.

Long dry spells may result in decreased water quality and quantity. Reduced river flow means less dilution of contaminates therefore potentially requiring extra treatment. Southern Water is contracted to guarantee basic water supply but hose pipe bans and even stricter controls may become more common in the future.

The impact of long dry spells on the Island's clay soils is damaging and costly. The clay soil under roads and building responds to extended periods of dry weather by contracting, leading to unstable buildings and damage to roads.

6.2 Summary of impacts of milder and wetter winters

Milder and wetter winters will have significant impacts on the health of residents, and increase flood risk on the Isle of Wight.

As temperatures rise in winter months, and there is greater precipitation, the amount of damp within buildings may be expensive to repair. Additionally, this may have consequences for health as damp conditions may cause greater respiratory illness within the population.

Wetter winters in general will raise the water table within the ground, and therefore in the event of a storm, the ground will already be saturated and flooding is more likely to occur. This has implications for the built environment, including damage to infrastructure and buildings. Landslips may become more frequent with potentially serious impacts on the nearby community. Extreme flooding can also damage wildlife and their habitats.

Flooding in East Cowes

Long periods of wet weather may cause travel disruption as roads become damaged from continued overland flow (causing potholes) and flooding closes roads.

Warmer winters may impact on creatures which hibernate for the winter. With a shorter and less extreme cold period, hibernating animals will wake earlier in the spring or winter, altering their hibernation pattern and exposing them to conditions they may not be able to survive.

6.3 Summary of impacts of rising sea level

Coastal erosion on the south coast of the Isle of Wight

The Isle of Wight is one of the counties in England which will be most affected by rising sea level.

A large proportion of the Island's population live in coastal towns and villages which are likely to be affected by rising sea levels and coastal erosion. Yarmouth and Sandown seafronts are currently at or below sea level and could become flooded unless there is continued and strengthened protection. Towns on the cliff top will be affected as coastal erosion increases.

Higher sea levels will mean that natural protection of cliffs provided by beaches will decrease. Beaches are a natural defence to cliffs as they dissipate wave energy and create a barrier between the sea and backshore. Consequently, as sea level rises the waves will reach further back towards the backshore and cliffs, and the beach will dissipate less energy. This will lead to faster cliff retreat, threatening coastal communities and infrastructure.

Saline Intrusion and coastal flooding: Freshwater marshes and river estuaries may be flooded by seawater, threatening freshwater ecosystems. Coastal flooding will also affect coastal properties and infrastructure, causing structural damage. The Isle of Wight Strategic Flood Risk Assessment[27] shows which areas of the coastline and interior are likely to be affected by flooding. These areas include the lower Eastern Yar, Yaverland, Monkton Mead Brook, Wootton, Yarmouth and St Helens.

6.4 Summary of impacts of extreme cold and wet: snow and storms

Travel disruption: Icy and blocked roads from snowfall can affect staff travelling to work, and emergency services reaching people in need of help.

The vulnerable: Extreme cold is most significant in the vulnerable population as they may not be prepared to cope with long periods of cold weather, and their health is often at the greatest risk.

High winds: High winds from storms can cause a significant amount of damage to historical and contemporary buildings which are not designed to withstand such extreme events.

Flooding: The damage to infrastructure and buildings as a result of flooding will be significant, and with increased frequency there will be continued damage to low-lying and vulnerable areas.

Figure 11 demonstrates that the Isle of Wight is one of the regions in the UK which is most at risk from flooding. [13]

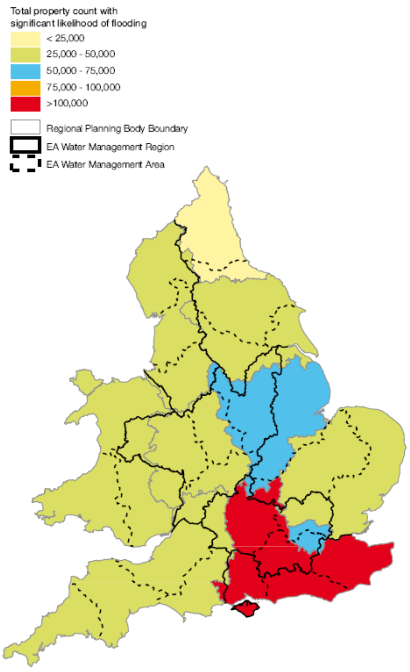

Figure 11 Copyright E.A. - Source:"ARUP - Retrofitting existing homes for changing climate impacts"
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office (c) Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.

Environment Agency, 100026380, 2006

13 Environment Agency Fact Sheet (March 2010) www.environment-agency.gov.uk/.../Isle_Of_Wight_Fact_Sheet_Apr_10.pdf

6.5 Summary of impacts of extreme hot and dry: heatwaves and drought

During the summer months there will be greater frequency, severity and duration of heatwaves and droughts.

The vulnerable: In the same way that storms affect vulnerable groups the most, so too will heatwaves. The majority of residential properties on the Isle of Wight are able to stay cool during the midday heat. The impact is most noticeable on the vulnerable who will suffer from heat exhaustion and heat stroke most easily.

Discomfort: Extremely high temperatures will create uncomfortable working and living conditions. There could be increased admissions to hospital with heat stroke, heat exhaustion, sun burn and dehydration.

Irrigation: Reduced water for irrigation will lower crop yield, and reduce the quality of green spaces on the Island. Additionally, the water supply which is available may become contaminated due to the increased concentration of fertilisers and pesticides coupled with low river flow.

Water supply: Reduced water supply for drinking water will also cause health issues within the population and with an increase in visitors will further stretch the Island's water supply.

Highways: our road surfaces are extremely vulnerable to the effects of drought and heavy rainfall on the clay soils underneath.

7 Isle of Wight Adaptation Measures

The Isle of Wight has made good progress in preparing for some of the major impacts of climate change, principally the flood risk posed by higher rainfall and sea level rise. Following is a summary of the main local documents which set out how the Island will deal with likely impacts. Most of the existing adaptation actions are currently in the planning stages. For example the Isle of Wight is at the forefront of research into the effects climate change will have on our coastline, leading on a cross-European project called RESPONSE (Responding to the Risks from Climate Change)

7.1 Isle of Wight Shoreline Management Plan Summary

The Shoreline Management Plan[14] is a large-scale assessment of the risks which are associated with coastal evolution, and delivers a policy framework to address these risks in a sustainable manner. The plan considers objectives, policy setting and management requirements for 3 epochs in the future:

Epoch 1 – 0 to 20 years;

Epoch 2 – 20 to 50 years;

Epoch 3 – 50 to 100 years

The aim of this plan is to consider the specific circumstances of each of the sections of Isle of Wight's coastline, and through this plan to deliver the greatest benefit to all coastal communities in the area.

Policies

No Active Intervention (NAI) – where the coast needs to be allowed to develop naturally or where it is unlikely there will be funding for defence measures, or the cost/benefit ratio is not acceptable.

Hold the Line (HTL) – maintain the defence protection which is important to assets or interests along the coast.

Managed Realignment (MR) – management of the coastline would be improved by either allowing for/or creating the conditions for the coast to realign. E.g. moving defences back.

Advance the Line (ATL) – advance the shoreline to create a more robust defence position and provide additional opportunity for increased intertidal width and/or land reclaim.

14 Isle of Wight Shoreline Management Plan. Available online: http://www.coastalwight.gov.uk/smp/index.htm

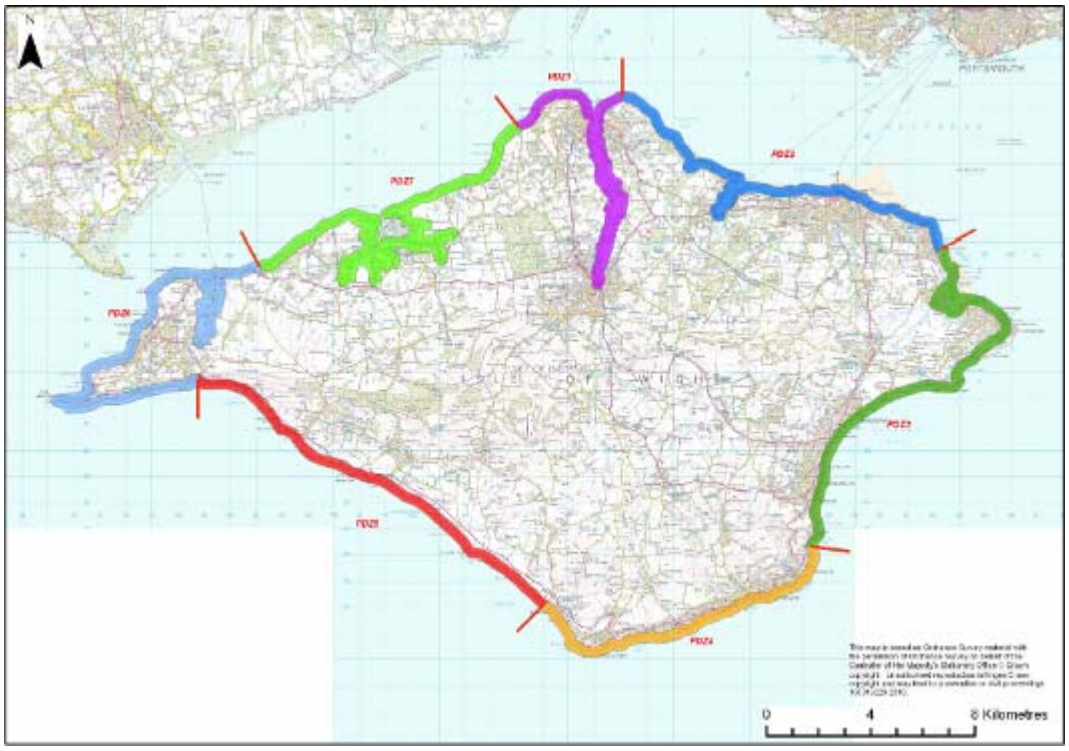

Figure 12 Policy Development Zones (colours differentiate zones)

There are a number of factors which are important in setting the context of the Shoreline Management Plan on the Isle of Wight. Many of the 138,000 residents live and work in towns at the coastline. These towns are critical for the Island's economic viability in terms of tourism and the marine industry. The ferry routes are the main links to the mainland. Additionally, at Ventnor and the Cowes-Gurnard sections, there are deep landslide complexes which will be influenced by sea level rise. The plan assesses each Policy Development Zone under the No Active Intervention scenario to determine how severe the effects of climate change and sea level rise would be on the Island without protection. Secondly, it assesses the projected impacts of continuing under the scenario set out by the first Shoreline Management Plan, the 'With Present Management' (WPM) scenario.

Main conclusions of the Isle of Wight Shoreline Management Plan 2:

- Significant issues with tidal inundation and flooding splitting the Island, affecting coastal towns
- Eroding cliffs characterise the Isle of Wight will retreat, risk to properties
- Risks of deep-seated landslide reactivation (Ventnor/Gurnard-Cowes)
- The designations around the Island make it an important heritage and natural environmental area.
- The main 'round the island' coastal road at risk from erosion or tidal inundation

- Key economic drivers of Isle of Wight are dependent on coastal locations which will require adaptation.
- Potential loss to beach width due to sea level rise.

7.2 Isle of Wight Strategic Flood Risk Assessment Summary

The Isle of Wight Strategic Flood Risk Assessment (SFRA) aims to inform both the Local Planning Authority (LPA) and potential developers. It assesses the Isle of Wight's flood risks, and in particular the risks associated with areas considered for future development as part of the Local Development Framework (LDF).

The report covers the flood risks, impact of climate change, impact of wave action and spray, sustainable management of surface water, and flood risk management through avoidance and design.

Flood Risks

- Fluvial – Post-rainfall event river flow exceeds the amount the channel can carry, leading to inundation of the floodplain.
- Tidal – At the centre of a deep low pressure system, a raised 'dome' of water forms. On making landfall, this 'dome' appears as a storm surge, leading to coastal flooding.
- Groundwater – Dependant on the soil permeability and superficial geology deposits. A less significant issue on the Island according to the Environment Agency.
- Runoff potential – Island-wide assessment so that each potential development site could be attributed a qualitative likely runoff profile.
- Surface water flooding – Surface water generated off-site (e.g. urbanised area), flows on-site (downstream).

Flood Risk Zones

Box 2 Introduction to the Environment Agency's Flood Zones

Flood Zone 1

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)

Flood Zone 2

This zone comprises land assessed as having a 1 in 100 and 1 in 1000 annual probability of river flooding (1% 0.1) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Flood Zone 3a

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Flood Zone 3b

This zone comprises land where water has to flow or be stored in times of flood. This Flood Zone is land which would flood with an annual probability of 1 in 20 (5%) or greater in any year.

Additional Information

- The Flood Zones are mapped using a 'no defences' scenario which has necessitated areas of floodplain know to be defended to be identified on the Flood Map as benefiting from defences.
- The Flood Zone extents, regardless of whether the area benefits from a defence, are used to determine when Flood Risk Assessments are required to support a planning application.

Figure 13 Extract from the Isle of Wight Strategic Flood Risk Assessment

Assessing the impacts of Climate Change

In the report this section assesses the sensitivity of the fluvial and coastal domain to climate change. The principal impacts of flooding as a result of climate change are sea level rise and greater intensity and frequency of storms, which has implications for sustainability and site allocation due to the extension of Flood Zones 2 and 3.

Sensitivity to Climate Change in the Fluvial domain

This assesses the vulnerability of the fluvial domain to increased river flows.

The SFRA has identified two areas on the Isle of Wight which have significant differences between Flood Zones 2 and 3 after modelling increased river flow, and are considered sensitive to climate change:

- The lower Eastern Yar – the area downstream of Alverstone is the widest expanse of fluvial floodplain on the Isle of Wight. The areas identified as at risk are those to the north and east of Sandown, near Yaverland, due to the large amount of potential development sites in the area. The report suggests that any subsequent Flood Risk Assessments should assess the implications.
- Monkton Mead Brook, Ryde – Flood Zone 2 is significantly larger than Flood Zone 3 here, however this is attributed to different modelling methods used to produce the two Flood Zone extents.

This assessment demonstrates in general there is little difference between Flood Zones 2 and 3 due to the Island having well-developed floodplains. Subsequently, the report concludes fluvial climate change modelling is not necessary at an Island-wide level to inform the assessment. Small areas of the Island see changes in the Flood Zones however, and developments which fall within these small areas should take climate change into account within their Flood Risk Assessments.

Sensitivity to Climate Change in the Tidal Domain

The perceived risk of sea level rise requires tidal climate change modelling along the coastline of the Regional Development Areas (RDAs).

Below are areas of the Isle of Wight which show significant differences in flood extent between the year 2010 and 2115:

- West Wight: The Western Yar confluence is likely to see an increase in severity in tidal flooding.
- Wootton: Increased depth of flooding.
- Brading: Number of sites which may become flood zone within next 100 years. Represents the area of greatest change between present day and future extreme flood extents. Any site which comes forward for development should ensure the proposed development has accounted for flooding.
- St Helens: Two sites affected, should be covered by Flood Risk Assessments.

- Ryde: An increase in flood extents, plots of land or parts of sites may become included in flood zone in next 100 years.
- Cowes and East Cowes: Significant change in flooding on both sides, especially by high speed terminal, and behind industrial units of Clarence Road.
- Newport: vulnerable areas at region adjacent to River Medina in Coppins Bridge and East Street, the lower reaches of Lukely Brook and both the banks of the River Medina between Seaclose Park and the crossing of the A3020 – all will see tidal flooding increases.

No areas exhibited large predicted increases in spatial extent, which indicates the Island is topographically well defined.

The outline of possible future flood zone extents should inform the Isle of Wight Council of where the long term sustainability of developments may be compromised. Datasets (Appendix E-V) may draw the Council's attention to where site specific Flood Risk Assessments should include mitigation measures to demonstrate how the risk of flooding will not increase as a result of the impacts of climate change.

Assessing the impacts of wave action and wave spray

This section of the Strategic Flood Risk Assessment focuses on the areas which are not within the Flood Zones identified by the Environment Agency, but are affected by wave energy and spray, particularly on exposed coastlines. This assessment relates resilience to the impact of wave action and spray.

Baseline assessment

The vulnerability of the coastline is determined by three factors:

- Exposure – depends on the predominant wind and wave direction. Differs according to coastal landform e.g. headland (high exposure) or estuary (low exposure).
- Tidal height and coastal topography – low lying areas, or high tidal levels are at greatest risk. Low-lying land covering a large distance inland is at great risk, and high exposure. Land with a steep back wall e.g. cliff represents lower risk and reduced exposure.
- Wave action and spray – 'sand blasting' of buildings caused when spray is heavily laden with gravel, sand and finer particles.

Isle of Wight coastline

The Island's coastline is varied and dynamic, where the dominance of marine erosion and diverse geology present has formed a coastline of varying morphology.

Figure 14 below (SFRA Figure 18, Appendix A) demonstrates the high, medium and low risk wave and wind exposure areas of the Island's coastline, determined through exposure to wave impact and height, and the level of defence (man-made e.g. groynes, and natural e.g. beaches).

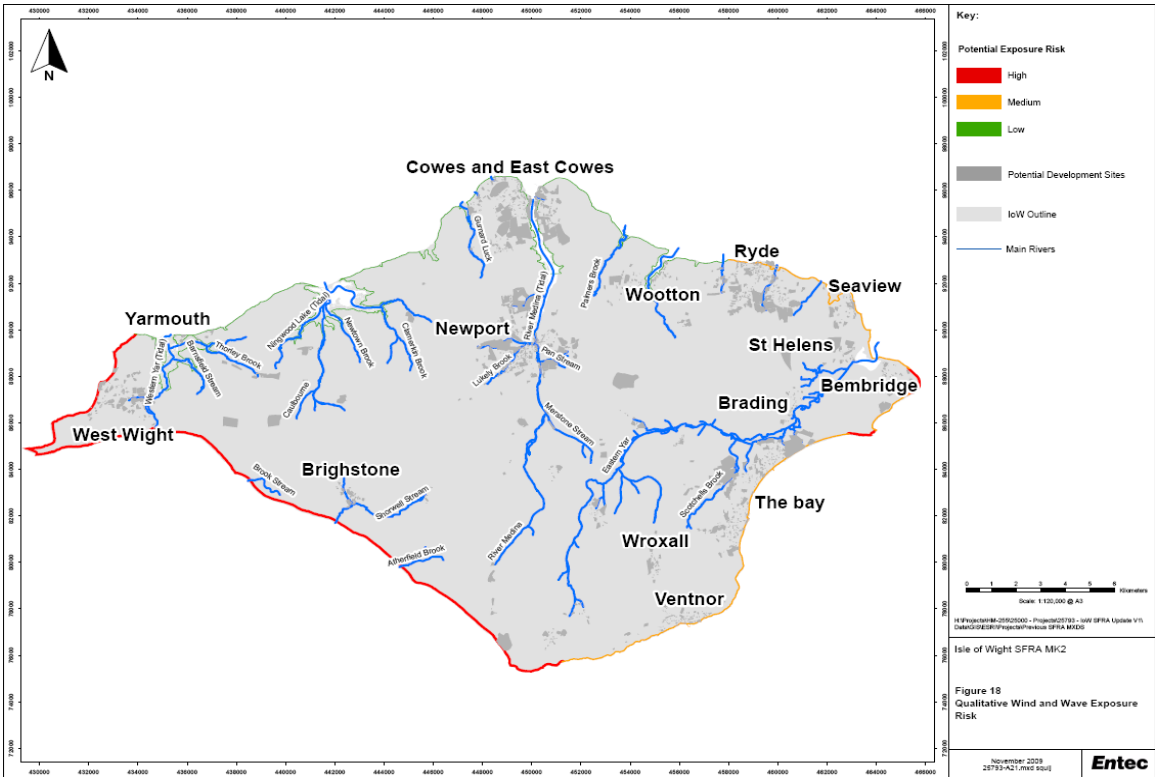

Figure 14 Isle of Wight coastline exposure risk. Source: Isle of Wight Strategic Flood Risk Assessment

This exposure map must next take into account tidal data for the Island so that low-lying areas with high tides are considered at greatest risk. The use of this data can be used to inform the width of the buffer zone.

The wave exposure risk buffer can be used for development management decisions. The buffer zone identifies where development proposals should demonstrate that within the planning application, the potential risks associated with wind and wave action have been considered in the building design.

Sustainable management of Surface water

To ensure that downstream flooding is not exacerbated by increased runoff post development, the Planning Policy Statement 25[15] requires all planning applications for sites >1ha in Flood Zone 1 to undertake a Flood Risk Assessment. Additionally, all sites in Flood Zone 1 >0.25 ha should be accompanied by a drainage strategy which details how the proposed development will not increase run-off. For existing developments, the strategy should detail how the site reduces run-off rates.

Sustainable Drainage Systems (SuDS)

Above ground drainage is often preferable to traditional below ground methods due to advantages to ecological and amenity value. Therefore, rather than conveying water away as fast as possible the report suggests: attenuating flows, limiting peak discharges and having source control of rainwater is favourable.

The assessment suggests that Sustainable Drainage Systems (SuDS) should be factored into the design of new development, considering surface flooding issues.

15 Planning Policy Statement 25
http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk

The use of SuDS reduces dependence on piped solutions, contributes to wider water quality sustainability issues and reduces peak flow rates.

Further information on SuDS options can be seen in the SuDS Manual (CIRIA 2007)[16], a supporting document to this SFRA which discusses the SuDS options available and their suitability.

The appropriateness of SuDS on the Isle of Wight

Infiltration SuDS are the preferred option of Planning Policy Statement 25[15], and it is the suitability of this technique which is the focus of this assessment.

Figures 9 and 10 in Appendix A of SFRA MkII (2010) demonstrate the infiltration potential and groundwater contamination potential across the Island, summarised below:

- Infiltration potential – High infiltration is found throughout the central band of the Isle of Wight as well as in specific southern areas. The south of the Isle of Wight generally has medium infiltration potential whereas the north has relatively low infiltration with the exception of river floodplains e.g. Newport, Western Yar and River Medina Estuary.
- Groundwater contamination potential – the east-west band through the centre of the Island has high contamination potential. The south has medium potential whereas the north has low contamination, with the exception of river floodplains

Regional control is the most significant objective to this SFRA as the Isle of Wight Council can use this to be proactive in planning on a regional level. Suitable SuDS for Regional control include: Ponds, Wetlands, Detention Basins, Infiltration basins and there are some opportunities for sand filters.

Integrated Drainage Strategy

This section of the Strategic Flood Risk Assessment describes the collaboration of all stakeholders to produce a scheme in which surface water drainage is addressed at a strategic level. The opportunity for Integrated Water or Drainage Management Strategy across development site boundaries is recommended. These are often more efficient and reliable surface water management systems due to a wider variety of potential flood mitigation options used.

Once a site allocation process has been executed on the Isle of Wight, consideration of drainage strategy should be given at an early stage to maximise benefits.

16 http://www.ciria.org/service/AM/ContentManagerNet/Default.aspx?template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=19&ContentID=10559&TPPID=4334&AspNetFlag=1&Section=content_by_themes

Flood Risk Management through Avoidance

The Sequential risk-based approach - this strategy of Flood Risk Management ensures that development occurs preferentially on sites which have the lowest flood risk.

Use of the Sequential Test enables determination of whether the proposed development increases the vulnerability of the site and whether the location of the settlement is in the lowest risk area possible.

Flood Risk Management through Design

'The exception test' is undertaken in the circumstance that a development cannot be located anywhere other than a high risk Flood Zone. In such a case, design of the building is important to mitigate against and minimise the risk of flood damage to the property.

Recommendations

Planning Policy Statement 25[15] Practice Guide states a minimum of 100 years worth of predicted climate change impacts should be considered for new development. Within Flood Zone 1, assessing Climate change within the Flood Risk Assessment is suggested.

According to tidal-related flooding, site layout should follow the principles of risk avoidance and should be located outside of predicted flood risk extents. If this is not possible, risk management should be undertaken in design.

It is recommended that there should be no basements or below ground habitable spaces within Flood Zones 2 and 3. If spaces are developed then these must have a safe internal escape.

Building design should include flood avoidance, flood resistance, flood resilience and be flood repairable.

The CLG Flood Resilient Construction Report[17] sets out to help the designer determine the best option or design strategy for flood management at the building site level based on known flood parameters. According to these parameters, a water exclusion or water entry strategy can be applied.

Flood warnings - provided by the Environment Agency, however they are developed for the existing properties and may not be appropriate for new developments. Additionally, they do not necessarily warn on all flood sources e.g. groundwater or culvert blockages.

Emergency planning – residents should sign up to the Environment Agency Flood Warning System, especially those in Flood Zone 3b (functional floodplain), where water rises the fastest and access routes may become cut off.

Assessment and Management of Flood Risk in Regional Development Areas

The individual assessments of flood risk for each Regional Development Area (RDA) are set out in Appendices E-V, with an overview of the Island in Appendix A.

17 http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

Flood Risk Assessments and Windfall Sites (Section 11)

Windfall sites – highly likely windfall development (sites which unexpectedly become available for development) will occur. These developments will need to be assessed and pass the Sequential and Exception tests. Additionally, the Sequential approach to flood risk management will be required within the development site and will need to be addressed in Flood Risk Assessment and development proposals.

Areas of Recommended Further Flood Risk Work (Section 12)

Yarmouth – the area is surrounded by flood zones and sea level rise may increase extent of risk zones within the town. Therefore further development would benefit from further flood risk analysis.

Newport, Cowes and East Cowes – a large number of potential development sites are along the Medina estuary. Climate change could potentially influence the flood risk zones and increase flood depth. Due to the number of sites proposed it may be worth undertaking further research into the role of current flood defences, and to understand the residual risks facing the sites.

Niton, Chale and Godshill – current flood zones do not extend into these settlements due to the small drainage areas of respective watercourses established by the Environment Agency. Therefore, they may be affected by fluvial flood risk which SFRA have not identified.

The settlements predicted to be at greatest risk are: Newport, Cowes, Ventnor and The Bay.

Future assessments should build an integrated surface water model of each town, incorporate information relating to drainage network discharge points, analyse all the historic surface water flood incident reports and modelling should use a ground model which is inclusive of buildings, which this Strategic Flood Risk Assessment did not.

7.3 Isle of Wight Green Infrastructure Mapping Study[18]

Definition of Green Infrastructure (GI):

Natural England[19] defines Green Infrastructure as:

"Green Infrastructure (GI) is a strategically planned and delivered network of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities. Green Infrastructure includes parks, open spaces, playing fields, woodlands, allotments and private gardens."

18 Isle of Wight Green Infrastructure Mapping Study: http://www.iwight.com/living_here/planning/images/IoWGIReport-FINAL250810.pdf

19 Natural England: http://www.naturalengland.org.uk/ourwork/planningtransportlocalgov/greeninfrastructure/default.aspx

Green Infrastructure provides a range of climate change services that can make both a substantial contribution towards adaptation and a more limited but important contribution to mitigation. Adaptation services include the attenuation of catchment flood events and urban cooling.

The planning and management of multi-functional green spaces helps to support biodiversity and contributes to a better quality of life[20]

Benefits from Green Infrastructure:

- Climate change adaptation and mitigation
- Catchment water resource and water quality management
- Recreation and healthy living
- Biodiversity enhancement
- Education

These benefits are enhanced and extended by the connectivity between and the multi-functionality of the individual assets (spaces).

The Isle of Wight Biodiversity Action Plan (BAP) summarises the principal issues which relate to the management and conservation of GI quality:

- Woodland –Nearly half of 'ancient' woodlands replanted with conifers or non-native broadleafs.
- Grassland and Heath – the survival of flower-rich grasslands depends on traditional management and grazing which are today harder to ensure.
- Farmland – Unstable grain prices, diseases and pests have caused greater expense, worry and damage to the natural environment, particularly lowland farms.
- Wetlands – water abstraction for agriculture and public supply has put pressure on rivers and wetland habitats.
- Coast – Salt marshes and salt meadows, vegetated shingle and dunes are all at risk from sea level rise and consequent coastal squeeze, and increased/continuous erosion inhibits vegetation becoming established.

43% of the Island has been proposed as a Biodiversity Opportunity Area,[21] (see map below) demonstrating the quality of the Island's environment and its biodiversity. This approach also helps nature conservationists to work at a landscape scale, expanding sites and linking habitats. Embracing landscape scale sympathetic land management is seen as the best way of enabling species to cope with the long-term effects of climate change.

20 South East Green Infrastructure Framework
http://www.gos.gov.uk/497648/docs/171301/SEGIFramework.finaljul09.pdf

21 Biodiversity Opportunity Areas, Wild on Wight http://www.wildonwight.co.uk/boa.php

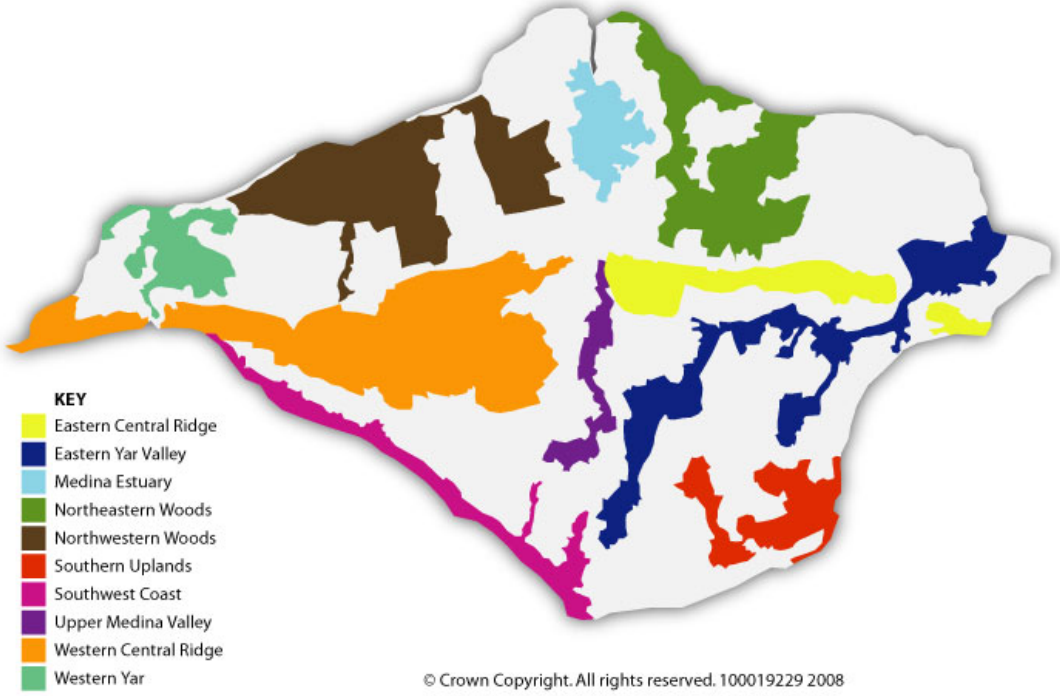

Figure 15 Biodiversity Opportunity Areas

Summary

Opportunities exist to mitigate pressures and threats on vulnerable habitats and species by managing the GI network to provide landscape scale mass and connectivity as well as by creating GI 'stepping stones' - areas which lie between other often larger green spaces and which allow for the movement of species, as well as people between them.

Efforts should be targeted where, in an area of unevenly distributed population, there is greatest pressure i.e. the greatest population, as they may have the most to gain. They should also be targeted where there is greatest deprivation as studies report green areas benefit those who are deprived more.

The Next Steps

The mapping report concludes that future work should conserve Green Infrastructure and develop a Green Infrastructure strategy which sets out how the Isle of Wight can function as effectively as possible to deliver a wide range of ecosystem services in the form of a robust network of interconnected and multi-functional green spaces.

The strategy should:

- Set up a framework for strategic networks for the Isle of Wight to provide a high quality of life for the people that live and work there.
- Maximise multifunctional use of open space
- Promote connectivity of all types of green space
- Provide a key mechanism of the Island's proposals for mitigation in relation to habitats regulations.

7.4 Climate Change Adaptation and Biodiversity Report

This report highlights the key findings and recommendations from an extensive literature review that has particular relevance to the landscape, ecosystems, habitats and species of the Isle of Wight.

The report does not provide a detailed assessment of all likely changes to all species, habitats and ecosystems or landscapes on the Isle of Wight; however it identifies key examples, and the sources of information and evidence underpinning them.

Specific Isle of Wight recommendations

- Undertake an Isle of Wight Character Area Study using established methodology from Natural England Character Area case studies
- Identify, map and promote opportunities for habitat migration, enhancement and creation
- Investigate possibility of combining current mapped information into one on-line data source
- Undertake specific site-based multidisciplinary assessment and monitoring of climate change impacts on conservation priority species and habitats
- Raise the profile of climate change impact and the need for adaptation amongst nature conservation organisations and the public.

7.5 Planning Policy Statement 25 (PPS 25): Development and Flood Risk

Sets out the roles and responsibilities of different parties associated with the planning process and demonstrates the appropriate process for flood risk management with consideration of the reports detailed above. The Isle of Wight Council has set out local policies compliant with the PPS[22].

7.6 Development Management Policy 16: Coastal Management

DM16 sets out the Council's approach to development in flood risk areas in line with PPS 25. Covering flood risk assessments, sustainable urban drainage, drainage strategies. It has been informed by evidence in the Strategic Flood Risk Assessment.

7.7 Development Management Policy 13: Landscape, Seascape, Biodiversity and Geodiversity

A policy which states the Isle of Wight Council will support proposals which enhance or protect the landscape, seascape, biodiversity or geological interest of the Island.

7.8 Emergency Planning Adaptation Report

Emergency Planning: Adapting to Climate Change

22 http://www.iwight.com/living_here/planning/images/2SAAppendixD-OptionsAppraisalOct200.pdf

The purpose of Local Resilience Forums is to plan a response to severe weather events; it has been suggested that they may need to consider the long term changes in climate which will affect their capacity to respond.

This report summarises the initial thoughts as to how emergency planning may need to respond to Climate Change including:

- Strengthen the understanding of the risks: climate change risk assessments for NI188.
- Build future resilience of emergency services: encourage LRF members to review the resilience of their own buildings and equipment to future climate changes.
- Understand and communicate the new climate projections for the Isle of Wight

7.9 Historic Environment Action Plan

Historic Environment Action Plan (HEAP) Report

This report gives an overview of how the direct and indirect impacts of Climate Change may affect the historic environment resource on the Isle of Wight.

At the end of the report, there are additional Climate Change Actions which guide organisations and individuals who are involved with the Island's historic environment to help to sustainably manage the fragile and finite resource for future generations.

Assessment of the Historic Environment

The Island has land-based historic assets such as wetlands, artefact scatter and palaeo-environmental remains as well as assets within the cliffs, intertidal and marine zones. The assets come from all periods of time: Palaeolithic, Mesolithic, Neolithic, Bronze Age, Iron Age, Roman, Anglo-Saxon, Medieval and post-Medieval. Representing a valuable resource requiring active regard for its conservation in the light of climate change scenarios.

7.10 Environment Agency Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) [23] give an overview of the flood risk across each river catchment. They recommend ways of managing those risks now and over the next 50-100 years.

CFMPs consider all types of inland flooding, from rivers, ground water, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding), which is covered in Shoreline Management Plans. They also take into account the likely impacts of climate change, the effects of how we use and manage the land, and how areas could be developed to meet our present day needs without compromising the ability of future generations to meet their own needs.

23 Isle of Wight Catchment Flood Management Plan(2009) http://publications.environment-agency.gov.uk/pdf/GESO1008BOWB-e-e.pdf

7.11 Isle of Wight Council Emergency Arrangements

The Civil Contingencies Act 2004 (CCA 2004) sets out a legislative framework for emergency planning arrangements at the local level. Local Resilience Forums (based on police force areas) provide responding agencies the opportunity to meet, share ideas, discuss risks and create and test emergency plans together. These emergency situations are predicted to increase as extreme weather events (storms, flooding, heatwaves etc) rise in frequency and severity.
The CCA 2004 defines an emergency as:

1. An event or situation which threatens serious damage to human welfare in a place in the UK, Only if it involves, causes, or may cause large scale:
    - Loss of human life
    - Human illness or injury
    - Homelessness
    - Damage to property
    - Disruption of a supply of money, food, water, fuel or energy
    - Disruption of a system of communication
    - Disruption of facilities for transport
    - Disruption of services relating to health

2. An event or situation which threatens serious damage to the environment of a place in the UK. Only if it involves, causes, or may cause large scale:
    - Contamination of land, water or air with biological, chemical or radioactive matter
    - Disruption or destruction of plant or animal life

3. War or terrorism, which threatens serious damage to the security of the UK

The Act separates local responders into two categories depending on the extent of involvement in civil protection work and sets a proportionate set of duties on each:

Category 1
- Police
- Fire and Rescue
- Ambulance
- Maritime Coastguard Agency
- Environment Agency
- NHS bodies
- Local Authorities

Category 2
- Health & Safety Executive
- Strategic Health Authorities
- Transport companies
- Utility companies

Category 1 Responder duties:
- Information Sharing: With local responders to enhance co-ordination.
- Assess Risk: Within the Local Resilience Forum (LRF) and for Island-specific risks.
- Maintain Plans: Develop and maintain generic and specific plans for emergencies.

- Maintain Plans: Develop and maintain Business Continuity plans.
- Co-operation: With other local responders to enhance co-ordination and efficiency.
- Communication with the Public: Develop and maintain arrangements making information available to the public about emergencies and inform and advise the public in the event of an emergency.
- Promote Business Continuity to the voluntary sector and local businesses (Local Authority only).

The Isle of Wight has specific risks and capabilities separate from that of the LRF. Resulting in a need for an Island Resilience Forum (IRF) with the following structure:

Standing Groups

- Executive
- Co-ordinating
- Risk Assessment

Task & Finish

- Emergency Planning
- Humanitarian Assistance
- Voluntary Sector
- Health
- Telecommunications
- Warning & Informing
- Environment
- Chemical Biological Radiation and Nuclear (CBRN)

7.12 Risk Assessment

National Risk Register[24]

Figure 16 summarises the types of risks covered by the National Risk Register. It attempts to illustrate the breadth of the high-consequence risks we face. It also gives an indication of the relative likelihood and impact of these types of risks in comparison to each other.

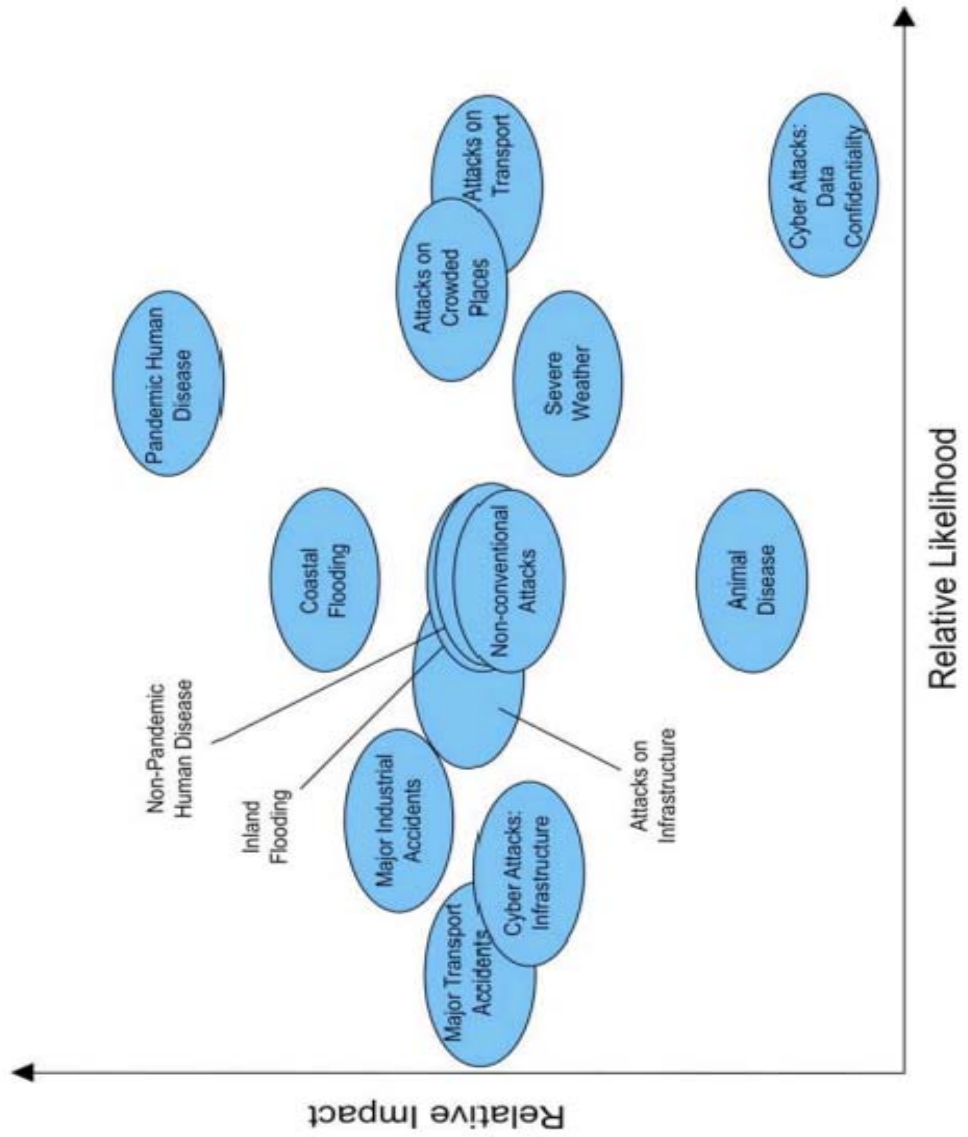

Figure 16 High consequence risks facing the UK[25]

The LRF assess risk at a local level and maintains a Community Risk Register which can be found on the Hampshire and Isle of Wight Local Resilience Forum website[26].

24 National Risk Register: http://www.cabinetoffice.gov.uk/resource-library/national-risk-register

25 National Risk Register. Available online: http://www.cabinetoffice.gov.uk/sites/default/files/resources/nationalriskregister-2010.pdf

7.13 Isle of Wight Multi-Agency Emergency Response Plan

The aim of this plan is to provide a framework for the Island's Category 1 Responders to respond to an emergency as defined by the Civil Contingencies Act (2004).

This plan is generic in content so that it can be activated in response to any emergency, regardless of scale, nature or impact.

The objectives of the plan are:

- Define the procedures for multi-agency Alert & Activation, Command & Control, Stand Down and Debrief
- Outline the tactical and strategic level management structures and procedures used by the Island Resilience Forum for implementing a co-ordinated, multi-agency emergency response process
- Enable multi-agency working and sharing of information to reduce, control or mitigate the effects of an emergency on people, property, environment and/or infrastructure
- Outline roles, responsibilities, actions and considerations of multi-agency participation
- Identify and facilitate the co-ordination and allocation of resources, support and services
- Enable co-operation, participation and co-ordinated management
- Enable the use of initiative and judgement to ensure a flexible approach

This plan refers to individual Category 1 Responders Emergency Response Plans, an example of which being the Isle of Wight Council's Emergency Response Plan. It is essential that these plans fully recognise the increasing impact climate change will have on the nature and frequency of emergency events.

7.14 IRF Adverse Weather Office Procedures

The Island Adverse Weather Office is a means for Category 1, and any relevant Category 2 responders, to liaise, share information, gain a common understanding and jointly assess an anticipated flooding situation.

Organisations can then discuss considerations regarding the risk and impact of an anticipated emergency situation, the next steps and necessary actions including the possible initiation of a co-ordinated multi-agency response.

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26 Hampshire and Isle of Wight Local Resilience Forum http://www.hiow-localresilienceforum.org.uk/index/communityriskregister.htm

7.15 Multi-agency Flood Plan reference

With rising sea levels and climate change, flooding will become a more common and more severe event across the UK. The aim of this plan is to provide a framework for the Island Resilience Forum (IRF) to respond to the risk or situation of a flood emergency, as defined by the Civil Contingencies Act (2004)

The objectives of the plan are:

- Define the different types/sources of flooding on the Isle of Wight and their risk status.
- Define the procedures for multi-agency Alert and Activation, Command and Control, Stand Down and Debrief.
- Outline the weather and flood alert and warning systems and also the services provided by the Environment Agency, Met Office and Flood Forecasting Centre.
- Outline the tactical and strategic level management structures and procedures used by the Island Resilience Forum for implementing a co-ordinated, multi-agency flood response process.
- Enable multi-agency working and sharing of information to reduce, control or mitigate the effects of a flood emergency on people, property, environment and/or infrastructure.
- Outline roles, responsibilities, actions and considerations of multi-agency participation.
- Identify and facilitate the co-ordination and allocation of resources, support and services.
- Provide site and risk specific technical information, including flood risk area maps and community flood risk summaries.
- Enable co-operation, participation and co-ordinated management.
- Enable the use of initiative and judgement to ensure a flexible approach.

This plan refers to individual Category 1 Responders Flood Response arrangements, an example of which being a Local Authority service area response.

7.16 Business Continuity

Business Continuity Management is a planned process aimed at managing the many and varied operation risks which are inherent in the day-to-day activities involved in delivering services. The main purpose is to ensure continuity of service delivery following unexpected serious disruption to normal working.

The Island's Category 1 Responders all have Business Continuity Arrangements in place.

The Local Authority has Corporate and Service Area Business Continuity Management Strategies. These strategies:

- Can be progressively activated depending on the level and impact of disruption
- Identify services which are vulnerable to serious disruption, enabling an informed decision to be made as to whether to mitigate, plan for, manage or accept certain risks.
- Define the roles of individual officers for when planning, responding and recovering from serious disruption.
- Determination of the resources required to maintain a certain level of service to the community.
- Enables the process to continually improve ensuring that plans remain fit for purpose.

8 Managing Climate Risk on the Isle of Wight

This chapter details the risks of climate change on the Isle of Wight and suggests possible adaptation action in the following areas:

- Built Environment
- Commerce and Industry
- Public Services
- Health and Care
- Biodiversity
- Water
- Agriculture and Forestry

For each sector the risks from climate change have been identified and adaptation responses suggested.

8.1 Managing the effects of climate change on the Built Environment

New buildings and development sites need to be resistant to future flooding; looking forward as far as reliable data exists. The frequency and extent of fluvial and coastal flooding will influence the future of land use on the Island. There is a greater need for well-planned use and management of green (vegetation) and blue (water) space within urban and rural areas which can alleviate flooding and also mitigate the effects of higher temperatures through shading and cooling.

Priority adaptive actions in this area include:

- Increase understanding of i) how climate change will impact on properties and ii) appropriate adaptation measures.
- Encourage developers to consider future climate impacts and related environmental limitations.
- Encourage building vulnerability assessments to help prioritise action.

8.1.1 Planning

8.1.1.1 New developments need to consider more frequent and severe flood events

Greater frequency and severity of flooding on the Island will have a significant impact on the planning process. The Isle of Wight Strategic Flood Risk Assessment has determined which areas of the Island are most likely to be affected by flooding, either tidally or fluvially. This is shown by an increase in the flood extent or extension of Flood zones 2 and 3.

In areas of development, or future development, this will impact on the decision of where to locate a new property.

Adaptation options:

- Conduct local inventories of public open space and appropriate management plans that consider both climate mitigation and adaptation functions.
- Review long-term public landscape maintenance contracts (school playing fields, public parks, roadside verges, footpath networks, beaches etc) to build in climate adaptation services where appropriate.
- Whilst planning, reference to the Isle of Wight SFRA[27] should be considered and where appropriate, a separate FRA should be conducted.
- In accordance with the SFRA or FRA, do not develop on high flood risk land. To ensure minimum risk, conduct the Sequential Test[27], and if necessary the Exception Test[28]
- Manage competing pressures on the land e.g. domestic, commercial, agricultural in preparation for potential impacts of climate change[29]
- Ensure new developments do not increase the flood risk of the land, or increase flood risk to other developments. In urban areas, integrate Sustainable Drainage Systems (SuDS) into the building design.

8.1.1.2 Increased ground heave and land subsidence needs to be considered during planning

Continuous drying and wetting of the ground expands and contracts the sub-soil, causing the ground to move and damage structures above. The Island has a significant amount of clay soils which are particularly likely to be affected.

Water abstraction additionally causes land subsidence and can have similar consequences, affecting the number of locations in which new developments could be built.

Adaptation options:

- Investigate the sub-soil structure of the Isle of Wight to inform where subsidence and ground heave may occur.
- Plan to develop in areas which have less likelihood of ground movement.
- If planning is granted in areas subject to ground movement ensure structural precautions are taken (flexible or deep foundations, underpinning or infilling)

27 Isle of Wight Council (2010) Isle of Wight Strategic Flood Risk Assessment Mk II, Entec UK Limited, Chapter 8, p. 56

28 Isle of Wight Council (2010) Isle of Wight Strategic Flood Risk Assessment Mk II, Entec UK Limited, Chapter 9, p. 60

29 Adaptation Sub-Committee of the Committee on Climate Change (2010) How Well Prepared is the UK for Climate Change?

8.1.1.3 Higher urban temperatures need to be considered during planning

Within urban environments, heat can become trapped and lead to uncomfortable working and living conditions. Increased development of an already developed area may exacerbate these conditions and reduce the productivity of staff, and increase cases of heat-related illnesses.

Adaptation options:

- Enhance and develop green spaces within urban environments to reduce heat trapping and create breeze pathways (See Section 8.4.2)
- Include water features within urban areas. Ideally run from renewable energy and with harvested water[29]
- 'Cool rooms' within buildings/city centres for shelter during midday heat and/or heatwaves.
- 'Cool pavements' – pavements which reflect solar radiation, enhance evaporation and are able to remain cooler than conventional pavements. They additionally allow storm water to penetrate into the subsoil rather than add to runoff during periods of frequent storms.[30]

8.1.1.4 Increasing pressure on limited resources needs to be considered during planning

The Isle of Wight is only 147 square miles with a limited ability to support residents' requirements for water, a limited capacity to dispose of waste and a limited amount of land available for development without threatening the natural landscape. Climate change is likely to exacerbate these factors. Therefore development that would see an increase in the Island's population needs to be carefully considered.

Adaptation options:

- Carefully consider the capacity to provide water for new communities and new developments.
- Increase communication with Southern Water regarding future supplies and projected development.
- Ensure the impacts of climate change are considered in the planning stages of all developments.

8.1.2 Building Design

8.1.2.1 Buildings need to cope with higher internal temperature extremes:

Increasing summer temperatures and a longer summer season will have an impact on living and working conditions. At present the majority of buildings are not built to provide comfortable conditions during extreme weather such as heat waves.

30 US Environmental Protection Agency (2010) Heat Island Effects - Cool Pavements, Accessed 8/11/10, http://www.epa.gov/heatisland/mitigation/pavements.htm

Reasons for rising indoor temperatures[34]:

1) External air temperature – when external temperatures are warmer than internal, open windows will heat the building up.

2) Internal heat gain –waste heat from equipment and lights which can be limited by using energy-saving light bulbs and turning equipment off when not in use.

3) Heat gain through windows – solar radiation passes through windows, warming up internal surfaces of the room.

4) Solar heat gain through warming external surfaces – roofs and walls absorb heat which passes through to the internal surfaces.

Adaptation options:

High internal temperatures- consider the following points in building design:

- Building aspect: consider which direction the windows face for minimised solar gain.
- Office layout – open plan mixes air from warmer south facing windows and cooler north facing windows.
- Roofs: Roof Insulation to reduce heat input, Cool roofs (i.e. high solar reflectance to reduce solar input[31]), Green roofs reduce penetration of thermal energy[32]
- Consider light-coloured external walls to reflect solar radiation
- External awnings on south and west facing windows
- External shading e.g. trees - reduce demand for air conditioning, intercept runoff and reduce pavement deterioration[33]
- Switch off unused appliances to reduce internal heat gain
- Open windows at night for cooling (security issues need to be considered)

8.1.2.2 Buildings need to be designed to cope with water shortages

Droughts are likely to become more frequent and severe and the supply of water to offices and homes may become restricted or more expensive.

Adaptation options:

- Promote water conservation schemes e.g. save-a-flush
- Promote greywater and rainwater harvesting

31 US Environmental Protection Agency (2010) Heat Island Effects - Cool Roofs, Accessed 8/11/10, http://www.epa.gov/heatisland/mitigation/coolroofs.htm

32 US Environmental Protection Agency (2010) Heat Island Effect - Green Roofs, Accessed 8/11/10, http://www.epa.gov/heatisland/mitigation/greenroofs.htm

33 US Environmental Protection Agency (2010) Heat Island Effect - Trees and Vegetation, Accessed 8/11/10, http://www.epa.gov/heatisland/mitigation/trees.htm

CASE STUDY: CAMBRIDGE HOUSING SOCIETY

A small scale, affordable housing development in Cambourne includes Sustainable Drainage Systems such as:

- permeable paving

- detention basins

- swales

- green roofs

- water butts

This reduces the flood risk of the development site, and is being monitored continuously for the next 2 years in comparison to a site with traditional drainage.

8.1.2.3 Buildings need to withstand more frequent and severe flood events

After the location of a new development has been determined, the development may still be prone to flooding. This is particularly true where the development has undertaken the exception test and is therefore not in a low risk flood zone.

Adaptation options:

Building design adaptation measures can be divided into two forms; Resistance and Resilience measures[34]*:*

- Resistance measures prevent or limit the water entering the home during a flood. This is effective as long as all entry points are blocked. Points of entry may include toilets, air bricks, sinks and external gaps such as pipes. Long duration events may cause water to enter the building through the wall, which can be prevented through the addition of waterproof membranes/renders.
- In extreme flooding, the practicality of excluding water may lead to wall damage and it may be necessary to allow the water to enter.
- Resilience measures include actions which reduce flood damage and the time and cost of recovering from an event. For example, storing valuables upstairs (e.g. IT equipment), turning off gas, electricity and water mains, using water-resistant paint on walls, rewiring electrical points above flood level, relocating meters and boilers above flood level and replacing carpets with tiles can all reduce the impact of a flooding event.
- To further reduce the impact of flooding on new development, the design should not increase or exacerbate the costs of such an event.

34 Three Regions Climate Change Group (2008) Your Home in a Changing Climate: Retrofitting Existing Homes for Climate Change Impacts, Greater London Authority.

- Conduct climate vulnerability mapping to identify buildings in at-risk areas.
- External measures can be adopted to reduce the amount of runoff and allow rainwater to drain into the ground. An example of such a measure is SuDS (Sustainable Drainage Systems) e.g. porous paving or green roofs.
- Building design in areas at risk from flooding should not include below ground levels e.g. basements. Where these are incorporated, there should be safe internal escape routes.

8.1.3 Building Maintenance

8.1.3.1 The cost of maintaining all existing buildings may increase

Most of the current buildings and infrastructure on the Isle of Wight are not equipped to withstand the impacts of increased severity and frequency of extreme weather. Coastal properties are at even greater risk from flooding, sea spray and wind-blown sand particles. More properties will be at risk of subsidence and loss as coastal erosion increases.

Adaptation options:

- Encourage building vulnerability assessments to help prioritise action.
- Retrofit buildings to ensure they can withstand extreme weather events for the duration of their expected lifespan.
- Flood resilience and resistance measures should be implemented on existing at-risk properties. See section 8.1.3
- Where possible, place SuDS within/around existing buildings to reduce the need for future maintenance by reducing runoff levels during extreme weather events.
- Investigate materials which are less susceptible to corrosion or temperature extremes for coastal properties.

8.1.3.2 The cost of maintaining coastal infrastructure will increase

A changing foreshore can impact on the Island's infrastructure such as harbours and seafront attractions.

Adaptation options:

- Conduct regular inspections and implement a preventative maintenance programme to increase the resilience of Ryde Harbour and other important coastal infrastructure.
- Prepare for the impacts on seafront infrastructure, have sandbags ready and an early warning system.
- Reduce the cost of maintenance, determine where it is practical to protect and continue sea defences according to the Isle of Wight Shoreline Management Plan 2 and determine a maintenance plan accordingly, creating priority areas i.e. where defences are to be held

there may be less need to maintain infrastructure behind and therefore periodic inspection may be sufficient, whereas more exposed coastlines where coastal defence may not be sustainable may need greater priority for maintenance.

- Where maintenance is costly, assess the option of leaving the building or relocating.

8.1.3.3 The cost of maintaining sea defences and managing breaches will increase

Coastal defences on the Isle of Wight are continually being maintained as storms increase in severity and frequency. As sea level rises and this pattern continues into the future, there is likely to be greater damage to defences and increasing costs associated with maintaining them. The Isle of Wight Shoreline Management Plan 2 undertook research determining the areas of the Island's coastline where maintaining defences and 'holding the line' is unsustainable.

Adaptation options:

- Refer to the Isle of Wight Shoreline Management Plan 2 for sustainable/unsustainable coastal defence maintenance.
- Where not sustainable follow plans set out by the Isle of Wight Shoreline Management Plan 2 i.e. continue maintenance in short term to allow residents to adapt or move for long term 'No Action'.
- Assess the materials used for sea defence construction and impact on maintenance.

8.1.4 Utilities and Infrastructure

8.1.4.1 Damage to power and water infrastructure is likely to increase

Continual wetting, drying, cooling and heating of water pipes can cause them to crack which can be unsustainable to repair and maintain across the Island as it is likely to occur at similar periods of time when the conditions are most extreme.

Additionally, flooding events may inundate the pipes and substations, impacting the supply of power to the Island. Gas pipes are hydraulically driven and so will not be affected.

Inundation of the drainage systems will cause ineffective removal of sewage as the pipes are filled with rainwater, leading to potential health problems through water contamination.

Adaptation options:

- Investigate alternative pipe materials / laying methods which are resistant to changes in temperature and environmental conditions.
- Investigate the possibility of increasing the capacity of the Island's drainage systems.
- Investigate the use of SuDS to reduce runoff and the amount of water entering the sewerage system.

- Investigate alternative electricity supplies which will be less affected by adverse weather conditions.

8.1.4.2 Increased frequency of power failure events

An increase in storms and adverse weather events will lead to greater frequencies of power failure events. This can disrupt working days, cause data loss and reduced productivity of staff.

Adaptation options:

- In-house back-up generators to take over during power cuts.
- Ensure protection of sub-stations from flooding through movement to higher ground or less flood-prone areas.
- Research possibility of other energy sources such as solar panels.

CASE STUDY: CORF CAMP SOLAR PANELS

Scouts from the Island and mainland fundraised to buy and install solar panels on the roof of the main camp hut.

The electricity generated from the panels is used to power the camp and any excess is sold back to the National Grid.

Consequently, if there is a power failure event the camp is self-powered and unaffected.

8.2 Managing the effects of climate change on the Island's Heritage

8.2.1.1 Archaeological Site Damage

Archaeological sites are highly sensitive to changes in the surrounding conditions in which they are buried. Higher temperatures and the associated increased tourism pressures may cause damage to ancient archaeological sites such as Brading Roman Villa.

Additionally, where remains are buried in peat and preserved, higher temperatures and greater water abstraction may cause the peat to dry out, exposing the remains to air and starting the decomposition process.

Flooding can damage buried remains as well as complex geological remains due to increased risk of landslides (e.g. Ventnor Undercliff). Coastal erosion may cause the loss of many artefacts and at the very least remains can shift out of place, which has important implications for dating unknown deposits.

Adaptation options:

- Identification of priority remains to protect
- Establish sites which should be moved for safety and follow up as necessary
- Monitor conditions at priority archaeological sites

- Management of tourist pressure to reduce stress on sites e.g. create 'view points' to reduce erosive damage to the sites.

8.2.1.2 Damage to Historical Buildings

Historical buildings are most vulnerable to storm events and the associated weathering and flooding which may occur. Degradation of historical buildings can be expensive and can result in a loss to the historic and economic value.

It has been noted in the Historic Environment Action Plan Climate Change Type Report (HEAP)[35] that some adaptation measures can also reduce the value of historical buildings.

Adaptation options:

- Retrofit the buildings, consider ensuring no damage to the value of the property, or experience of visitors.
- Modification of drainage on historic buildings and the discreet provision of irrigation and water storage facilities in parks and gardens[36]
- Where appropriate undertake flood resistance and resilience measures [See section 8.1]
- Conduct asset vulnerability assessment; ensure each asset is assessed for its individual needs dependent on its location, type, use and current condition.
- Temporary flood barriers – stopping water reaching the building[37].

8.3 Managing the effects of climate change on Commerce and Industry

More extreme weather conditions may cause significant disruption and costs to business. Although some risks may be covered by insurance, this won't include indirect risks such as the impacts on staff. It may be more cost effective and simpler to include climate risk in business strategies to reduce and manage risks before they become an issue.

The Stern Review[1] states that global economic output would reduce by 3% with a 2-3^{o}C temperature rise. Globally, extreme weather associated with climate change is predicted to reduce global gross domestic product (GDP) by up to 1%[1].

However, warmer temperatures will increase the amount of tourists who visit the Island during the summer months, and so there will be greater revenue coming from the tourism industry. The types of different industries on the Island may change.

Climate change presents two main challenges to businesses:

35 Isle of Wight Archaeology and Historic Environment Service (2010) Historic Environment Action Plan Climate Change Type Report, 2nd Draft,

36 Centre for Sustainable Heritage, University College London (2010) Case Study: Climate Change and the Historic Environment, Accessed 8/11/10, http://www.ucl.ac.uk/sustainableheritage/climate_change.htm

37 English Heritage (2010) Flooding and Historic Buildings

i) reducing greenhouse gas emissions to mitigate further climatic changes, and

ii) to assess and adapt to predicted changes to the climate.

Climate change is likely to affect all sectors although the extent of the effects will depend on where a business is located, the nature of their work and their supply chain. Most businesses will face new risks and challenges as a result of climate change, and all Island businesses will suffer when weather events mean that staff cannot get to work.

Tourism and agriculture could be hit hard by a changing climate. Tourism businesses will benefit from warmer summers, but need to be resilient to the more erratic and severe extreme weather events. Agriculture will need to combat the arrival of new pests and diseases, droughts and increased flooding. There will be opportunities for new crops and so for the creation of new 'local produce'. There are close links between tourism and farming and this combination could lead to new opportunities (for more on agriculture see section 8.8).

Priority adaptive actions in this area include:

- Increase awareness amongst business community of how the Island's climate will change and the impact on their business.
- Encourage businesses to develop adaptation plans in terms of their commercial property, their staff and the maintenance of viable business activity.
- Climate change needs to be treated as a key driver of risk assessment and adaptation planning to enable business continuity.

8.3.1 Tourism

8.3.1.1 Seaside facilities will be more vulnerable to flooding and the impacts of coastal erosion

A large proportion of the Island's tourist activities and resorts are located around the coast, including Cowes, Ryde and Sandown. Many of these towns are either partially below sea level (Sandown Esplanade) or in locations vulnerable to flooding and coastal change (Yarmouth, Cowes, Ryde). Other seaside facilities are threatened by increased erosion and rising sea level.

Adaptation options:

- Where sustainable and cost-effective, maintain sea defences to protect seaside towns e.g. Ventnor, Sandown and Ryde.
- Where not sustainable, change to the 'No Active Intervention' defence scenario which will mean adaptation or progressive retreat for such resorts.
- Retrofit buildings to withstand flooding events.
- Where possible, move attractions/businesses to higher, less vulnerable ground.

8.3.1.2 Visitors may be deterred and inconvenienced by extreme weather events

Extreme weather includes both storms and heatwaves, both of which are likely to increase in frequency and severity and each potentially discouraging tourists or making it harder to travel to the Island.

Adaptation options:

- Increase awareness amongst business community of how the Island's climate will change and the impact on their business.
- Alter opening times to allow tourists to use the facilities during cooler parts of the day.

8.3.1.3 Increased visitors to the Island puts a strain on services and resources

Hotter summers and a longer summer season will see an increase in the number of tourists choosing the Isle of Wight as a holiday destination. This will lead to greater use and pressure on local services and facilities such as the road network, health system and the natural environment.

The Isle of Wight Festival and Bestival weekends attract tens of thousands of tourists to the Island. With changing weather, such as higher temperatures, or increased storm likelihood, the damage to the fields in which the events are held may increase and the level of disruption caused to nearby roads and communities may increase and last for longer.

Adaptation options:

- Increase the Island's resources during the summer months to cater for increased numbers of tourists e.g. frequency of bus service.
- Promote car-share schemes e.g. reduced ferry fares if travelling with a full car, preferential parking spaces for car-share (e.g. Isle of Wight Festival car-share scheme).

CASE STUDY: Isle of Wight Festival Car-share

To reduce the pollution and number of cars on the road and resultant air quality implications as a result of the Festival, a PRIORITY PARKING scheme allows people who are arriving with a full car to park in preferential places.

FESTIVALBUDI.com additionally puts people in contact who are either taking a car and have empty spaces or need a lift.

8.3.2 Business

8.3.2.1 Warmer summers and heatwave events will reduce staff comfort and ability to work

Higher temperatures, longer summer seasons and the associated increase in pollen levels may lead to increased staff illness and discomfort, increasing pressure on the remaining staff.

Adaptation options:

- Increase awareness amongst business community of how the Island's climate will change and the impact on their business.
- Invest in resources to ensure staff can work from home.
- Introduce flexible working hours to reduce discomfort during midday heat.
- Alter building design to reduce office temperatures (see Section 8.1.2.1).

8.3.2.2 Buildings will be at higher risk from flooding

Similar to the impacts on coastal tourist resorts, businesses located within the coastal towns are vulnerable to damage from storm surges, flooding and high winds. This is most relevant on the southern coastline of the Island, due to the long fetch (distance of open water which waves can build up on) and strong southerly winds.

Adaptation options:

- See Section 8.1 for flood protection measures.
- Investigate financial incentives to adapt through savings on insurance policies.

CASE STUDY: CAMBRIDGESHIRE COUNTY COUNCIL BUSINESS ADVICE

The County Council published a booklet titled 'Is your business at risk from flooding?' This booklet highlights the issues associated with flooding, and how to make a business more resilient.

www.cambridgeshire.gov.uk

8.4 Managing the effects of climate change on Public Services

Extreme weather has an immediate impact on the Island's transport network, affecting business continuity and provision of emergency services. The Local Resilience Forum (Hampshire and Isle of Wight) has identified that severe coastal or inland flooding is a very high risk on the Community Risk Register.

The Island's roads are also at risk from the more chronic impact of high temperatures on our soils; repairing subsided roads has cost the Isle of Wight Council millions and will continue to be an issue. Heavy rainfall scours road surfaces

and can undermine roads, particularly an issue for coastal routes where geological instability adds to the issue. The Local Transport Plan[38] has identified the Military Road, Undercliff Drive and the road at Bouldnor, east of Yarmouth as roads most likely to be affected by climate change in the short to medium term.

The frequency and extent of fluvial and coastal flooding will greatly influence the future of land use on the Island. There is a greater need for well-planned use and management of green and blue space within urban and rural areas which can alleviate flooding and also mitigate the effects of higher temperatures through shading and cooling. The Island is set to experience more extreme weather events; effective emergency management will ensure business continuity and minimise disruption. Effective planning will ensure services continue despite increased need and reduced ability to deliver.

Priority actions in this area include:

- Conduct climate vulnerability mapping to identify at-risk areas (buildings, roads, land).
- Local inventories of public open space and assets with appropriate management plans that consider both climate mitigation and adaptation functions.
- Review long-term public landscape maintenance contracts (school playing fields, public parks, roadside verges, footpath networks, beaches etc) to build in climate adaptation services where appropriate.
- Ensure climate risks are fully covered in risk registers.

8.4.1 Emergency Preparedness

8.4.1.1 Increase in emergencies

There should be measures in place to effectively and efficiently manage emergency situations to reduce the impact on human lives and infrastructure.

The Isle of Wight Council's Emergency Management Team has produced the following multi-agency and Local Authority documents to ensure there is an appropriate and proportionate response to an emergency:

- Multi-agency Response Plan
- Local Authority Response Plan
- Island Resilience Forum Adverse Weather Office Procedures
- Multi-agency Flood Plan
- Isle of Wight Council's Corporate and Service Area Business Continuity Management Strategies

Adaptation options:

38 Local Transport Plan Available online: www.iwight.com/transport

- Increase the integration of climate change risks throughout the Island's Category 1 Responders Emergency Planning and Business Continuity Arrangements.

8.4.1.2 Increased likelihood of IT and communications failure during emergency events

During an extreme weather event (flooding/heatwave), computer systems may fail due to loss of power or flooding, threatening the IT and communications systems relied on by emergency responders.

Adaptation options:

- Investigate climate vulnerabilities within emergency plans.
- Organise secondary communication system for emergencies
- See section 8.1.4 for power failure measures

8.4.2 Public Open Spaces

8.4.2.1 Water shortages (Landscaping)

Some public planted areas require replanting every six weeks during the summer months due to the plant choices not being able to survive in increasing heat and a reduced water supply.

Adaptation options:

- Xeriscaping is a process which involves using species which require low levels of water to survive and so conserve water and stay alive longer reducing maintenance costs.

CASE STUDY: ONE MILLION BLOOMS

Million Blooms replaced drought-susceptible plants in public areas across the Island with long-life and drought-resistant species to conserve water.

8.4.2.2 Increased Need for Maintenance

Some types of green spaces within the urban environment will need greater maintenance as reduced water supply and warmer temperatures will lead to lower life length of plants. During periods of adverse weather conditions, more maintenance will be required e.g. the uprooting of plants, and high leaf fall.

Adaptation options:

- Regular inspection of public areas to determine where is most vulnerable
- Alteration of spaces to create more multi-functional and connected green spaces which require less maintenance[39].

39 Isle of Wight Council (2010) Isle of Wight Green Infrastructure Mapping Report

- Consider use of new species (grass/shrubs) which will thrive in hotter drier conditions in the summer but able to withstand heavy rain in the winter.

GREEN INFRASTRUCTURE MAPPING REPORT

Green Infrastructure is a term which encompasses all areas which are planned to support biodiversity and a better quality of life. This includes parks and gardens, green corridors, cemeteries and church yards, allotments, outdoor sports facilities.

MULTIFUNCTIONALITY

Green Infrastructure aims to create spaces which are multi-functional, so that they may be used for a variety of purposes by a variety of people.

CONNECTIVITY

The connectivity of Green Infrastructure helps to dissipate urban heat and can allow biodiversity to migrate and move. This does not necessarily mean continuous green space, as most species can hop between sites as long as they are not too dispersed.

8.4.2.3 Increased urban temperatures

In urban areas which have little green space, the 'urban heat island' effect can exacerbate hot weather. This is where the heat gets trapped within the urban environment and therefore the temperatures within towns and cities rise higher than that of a rural area.

Adaptation options:

- Investigate increasing the amount of Green Infrastructure within Newport and Ryde as well as other major towns on the Island.
- Refer to the Green Infrastructure report[39] to determine where there is little green space, or where the quality or accessibility of the green space is poor.

8.4.3 Coast

The Isle of Wight has 65 miles of coastline, 25 miles of which is a designated Heritage Coast. This is an important feature of the Isle of Wight and affects the lives and livelihoods of a high proportion of the population.

8.4.3.1 Increased flooding of coastal land

Rising sea level could result in the flooding of lowland coastal areas such as Sandown Esplanade, Yarmouth, and wetlands around the Island. The impacts could be extensive as wetlands and marshes experience coastal squeeze or become flooded, built environments become damaged (Section 8.1) and it has a direct impact on the tourism industry and economic development of the Island.

Adaptation options:

- The Isle of Wight Shoreline Management Plan determines coastal areas which are sustainable to continue defending i.e. coastlines which have significant development or designated environmental protection.
- To adapt to the loss of wetland and marshes land which could become marsh/wetland in the future (inland areas) can be identified and could allow these wetland areas to migrate.

8.4.3.2 Increased coastal erosion

The south coast of the Island has significant coastal erosion each year, as demonstrated by the continued retreat of Blackgang Chine and the cliff running parallel to Military Road. In addition, sea level rise can cause beaches to become starved as sediment cells become cut off and supply stops. Therefore the protection beaches can offer for cliffs and back shore features may be reduced and consequently lead to increased erosion and retreat of the coastline.

Coastal erosion consequently has significant impacts on coastal resorts and transport networks which may in the future be financially unsustainable.

Adaptation options:

- With reference to the Isle of Wight Shoreline Management Plan, cliff defence and protection may help to reduce the speed which the coast is eroding. However, it is important to note that there is little potential to stop coastal erosion entirely.
- To combat sediment supply issues for Island beaches, delivery of sand to tourist beaches may in the short-term reduce this impact, however in the long-term it is unsustainable and an alternative needs to be investigated.

8.4.4 Transport and Highways

8.4.4.1 Increased disruption to the transport network

Extreme weather conditions such as storms, floods and snow disrupt the road networks, preventing staff from reaching work and emergency services from operating efficiently. Trees which overhang roads may be vulnerable to high winds as they are more likely to break and obstruct a transport network.

Adaptation options:

- Emergency management plans must ensure the effective and fast removal of objects/conditions which disrupt transport networks.
- Pre-planning to remove trees which overhang roads can prevent disruption.
- Where staff cannot reach work, the ability to work from home should be investigated e.g. laptops, access to the server from home.

CASE STUDY: EAST MIDLANDS THREE COUNTIES ALLIANCE PARTNERSHIP (3CAP)

This study identified 7 priority areas (bridges, drainage, materials, grass cutting, resurfacing, tree and hedge maintenance and winter maintenance) in regards to adaptation to climate change.

Through creating an adaptation report identifying the services most at risk, the 3CAP has saved £700,000 in the first year of the partnership.

Lessons learnt:

It is important to ensure the ideas and proposals are initiated by local authority officers who are in charge of highways, with climate change and project information provided by a project team to ensure the project outcomes are practical and deliverable.

Adaptation action does NOT need to cost a lot of money, consider changing approach to highway maintenance to include adaptation to climate change rather than starting anew.

Source: UKCIP ukcip.org.uk

8.4.4.2 Increased damage to and loss of road networks

Roads on the Isle of Wight are very vulnerable to changes in thermal extremes such as freeze-thaw cycles and high temperatures. Many of the Island's roads are built on the underlying clay sub-soil which is particularly prone to damage from expansion and contraction. The resulting ground movement and heave can lead to the deformation of the carriageway, pavements, rights of way and cycle routes together with increased problems in terms of cracking and potholes.

Coastal roads may become threatened due to the increased erosion of the Island's coastline and exacerbating effects of climate change. Of particular note are the Military Road, Undercliff Drive and roads in Ventnor which are all located in the complex landslip and soft geology of the south and south-west of the Island; the A3054 at Bouldnor, east of Yarmouth, is at risk as a result of soft geology and coastal erosion and slippage. The cost of maintaining and ensuring the safety of cars on these roads will become increasingly expensive.

Adaptation options:

- Investigate the potential of new road materials which are resistant to temperature extremes.
- Identify which coastal roads are unsustainable and research alternative options such as upgrading an inland road to hold additional traffic once the coastal road closes.
- Investigate the sub-soil to determine which areas are prone to subsidence and will be most likely to experience road damage.
- Evaluate existing maintenance measures to assess their sustainability.

8.4.4.3 Damage/Disruption to Ferry Ports

The ferries which operate from the Island to the mainland transport the Island's produce, supplies and population off and on to the Island. Consequently, the loss of service, damage to the ports and inability of the ferry to dock on the Island due to storms and sea level rise is a significant issue which needs to be addressed. The ferry companies are able to offer a limited service in all but the most severe storms so disruption is normally minimal.

Adaptation options:

- The Isle of Wight Shoreline Management Plan 2 proposes to continue the 'Hold The Line' scenario for the ferry ports to ensure continued provision of the service.

8.4.4.4 Reduced mobility of Emergency Services (i.e. health, police)

The mobility of Emergency Services on the Island is most important during extreme weather. However, it is during extreme weather that the mobility of ambulances, the police and fire services become most restricted.

For the hospital and its patients the continued running of the ferry services to transport medicine and patients across the Solent is important to continue a high standard of care. In some cases, treatment must be carried out within a short time-frame and during transport disruption this can compromise the care that can be provided.

The Island hospital is unable to carry out all procedures so needs to transfer patients to mainland hospitals, often by ferry which if disrupted will cause a delay to treatment and require costly transportation options such as helicopter.

Adaptation options:

Health care and ambulances

- Continue to work with the Coastguard during an emergency e.g. access to 4x4s in heavy snowfall
- Link with weather station or forecasters to prepare for potential extreme weather i.e. awareness of impending snowstorm
- Flexibility of work – care staff working from medical centres they are able to travel to even if it is not their normal place of work.

Police

- Investment in vehicles for all terrain
- Develop a network for stranded police force who may be nearer an accident than the police station and able to reach it faster for first response.

8.4.5 Waste Management

Waste management is an important issue in regards to climate change as it affects hygiene, water pathways and with increasing temperatures and extreme weather events must be kept regulated and monitored.

8.4.5.1 Increased leachate and odour from Landfill

With greater precipitation levels and an increase in storm events, there is likely to be greater leachate from the landfill on the outskirts of Newport. Consequently there are greater levels of harmful substances entering the environment.

Adaptation options:

- Further research is needed into the location of the Isle of Wight's landfill, and the impacts on the surrounding area of leaching e.g. road networks, agricultural land, towns and watercourses.

8.4.5.2 Increased kerbside and windblown litter

High winds and storminess will lead to greater windblown litter from kerbside rubbish, increasing the amount of litter on the streets of the Island. This has secondary impacts as it can be unhealthy and reduce the visual image of the Island.

Adaptation options:

- Consider encouraging use of wheelie bins which are covered to reduce rubbish being lifted out.
- Consider use of localised secure waste sites which can be used to gather waste rather than being left at kerbside.

8.5 Managing the effects of climate change on Health and Care

People will suffer a variety of new health issues as a result of a changing climate. Heatwaves have already been responsible for a number of deaths (2,000 reported UK deaths in the 2003 heatwave), and their occurrence is set to increase. A warmer climate will also increase the number of new pests and diseases and allow current variants to survive milder winters. Wetter winters resulting in damp conditions will increase respiratory cases. Extreme weather could result in an increase in emergency admissions. Changing climate could result in an increase in vector-borne diseases and zoonoses.

Priority adaptive actions in this area include:

- Increase awareness amongst community of how a changing climate will affect their health and offer accessible guidance on prevention and precaution.
- Develop contingency plans and adaptations for public health service delivery (buildings, transport, staff)

8.5.1.1 Reduced supply of medicines and food

In storage at St Mary's hospital there is always two days worth of fresh food and five days worth of dried food. However, the amount of some medicines stored at the hospital covers only one day's reserve. Some medicine is brought in daily due to a short shelf-life. Medicine for in-patients relies on the continued running of ferries and transport to and from the Island and hospital.

Adaptation options:

- Further research is needed to provide a suitable solution to the short term supply of medicine available in case of an emergency
- Transport issues are discussed in section 8.4.4

8.5.1.2 Increased injuries from extreme weather events

Greater storm frequency and wind speeds may cause more accidents, increasing the numbers of patients and demand pressure on the hospital.

Adaptation options:

- Increase community awareness of how weather may change and what preparations to make.
- Increase community awareness of what to do in emergency situations, including improved self-dependency.

8.5.1.3 Reduced outdoor recreation

As a result of increased day temperatures, outside recreation may decrease due to the risks of high UV exposure and heat exhaustion in the summer and during extreme weather events.

Adaptation options:

- Strategic planting of trees for shade or creating other shaded areas will provide respite in hot weather (especially important for vulnerable people e.g. in play grounds and gardens/sun-rooms of nursing homes)
- Promote use of sun cream and drinking water to combat heat exhaustion and burning.
- Increase awareness of the importance of staying hydrated.
- Reorganisation of the working day.

8.5.1.4 Water shortage for community recreation areas

Drought during the summer months may have a significant impact on grass sports pitches of schools and clubs.

Adaptation options:

- Collection and storage of rainwater during the winter season to re-use for irrigation during periods of drought.
- Investigate drought-resistant grass species which can withstand periods of low water availability.

8.5.1.5 Increase in vector-borne, water-borne and exotic diseases

An increase in exotic and vector-borne diseases (such as malaria) may impact on the general health of the Isle of Wight's population. The lack of awareness of symptoms and causes of such diseases by both the public and trained healthcare professionals (due to current irregularity of cases) may initially reduce the efficiency of diagnosis and treatment.

The health issues which arise due to water shortage or reduced water quality are broad and can range from dehydration to chemical overdose due to ineffective treatment. Research has shown that the process of water treatment in the UK is not effective at addressing the issue of the 'Cryptosporidium' group which causes infections[40].

Adaptation options:

Vector-borne and exotic diseases

- Inclusion of treatment for bites, stings and heat exhaustion in first aid training.
- Increased public and health sector awareness of the symptoms and threat of exotic and vector-borne diseases.

Water-borne diseases

- Greater awareness of increased chemicals within the water supply amongst independent abstractors.
- Greater awareness of chemicals and pathogens likely to be found in the public water supply, assisting effective treatment

8.5.1.6 Increase in food poisoning cases

With increasing summer temperatures, cases of food poisoning are likely to increase. An increase of approximately 10,000 cases per year by 2050 is expected[40.]

Adaptation measures

- Increased awareness within the public of how to prevent the causes of food poisoning.

8.5.1.7 Increased respiratory diseases and allergies

Reduced air quality is a likely consequence of hotter temperatures, pollution and higher levels of ozone as a result of pollution.

An increase in allergies is an additional impact of climate change as the number of bites and stings will increase, pollen levels will rise, for example an increase in CO^2 is likely to cause an increase in the production of ragwort pollen which is one of the most allergenic.[41].

Adaptation measures

- Formation of specialist services to reduce the number of fatal or serious admissions to hospitals.
- Increase awareness of how to respond to people who experience anaphylactic shock.

8.5.1.8 Increase in UV and sun damage

Hotter summers will increase the amount of time spent outdoors, and as a consequence there will be greater exposure to UV rays.

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40 Hertfordshire (2009) 'Chapter 4: Health Impacts of Climate Change in Hertfordshire' in Impacts of Climate Change on Hertfordshire's Health and Adult Care Services

41 Wayne, P., Foster, S., Connolly, J., Bazzaz, F. and Epstein, P. (2002). Production of allergenic pollen by ragweed (Ambrosia artemisiifolia L.) is increased in CO2-enriched atmospheres, Annals of Allergy,Asthma and Immunology, 8, 279-282.

Adaptation options:

- Increase awareness of the impacts of sun damage.
- Promote sensible sun advice, for example use of high factor sun cream and avoiding midday sun.

8.5.1.9 Increased risk for vulnerable groups

Vulnerable groups in this context are those groups with a reduced ability to react to an emergency situation: young, elderly, mobility-impaired for example. These groups are often the most at-risk part of the community in regards to climate change, and the impacts of extreme weather.

Adaptation options:

- The formation of a group (e.g. professional carers, a voluntary organisation, charitable organisation) which is responsible for identifying vulnerable persons within the community and ensuring their safety during extreme weather events.
- Once there is understanding of who is at risk, their homes can be adapted to withstand extreme weather events such as heatwaves or storms.

CASE STUDY: GLOUCESTERSHIRE RURAL COMMUNITY COUNCIL

With a higher than average proportion of 50+ year olds who are dispersed in rural villages across the county, Gloucestershire Rural Community Council appointed 28 part-time agents who receive training and cover 203 Parishes.

These agents raise awareness in the community of the impacts and likelihood of flooding. During an event, they ensure the safety of each community.

In the 2007 floods they ensured the continued supply of bread, milk and water (as well as other essentials) to all parishes.

ukcip.org.uk

8.6 Managing the effects of climate change on Biodiversity

As an Island there is a limit to how much our natural environment can adapt to a changing climate. Our native flora will be affected by a lack of water in the summer and flooding in the winter. Changes in the seasons will suppress some species and promote others (including new pests and diseases). Some change in our habitat mix is inevitable (due to coastal loss, changing seasonal temperature and rainfall) but the Island's isolation means that it is less possible for some habitats and species to migrate and colonise. Similarly there is limited room for resident species and habitats to retreat when facing climatic change.

Priority adaptive actions in this area include:

- Monitor changes in biodiversity and habitat quality and extent.
- Reassess local conservation designations in order to provide protection for diminishing habitats to be conserved or emerging habitats to be extended.

8.6.1.1 Increase in saline intrusion

Around the coast of the Isle of Wight there are important freshwater habitats such as the Alverstone Mead Local Nature Reserve. These extensive riparian freshwater habitats are significant for both resident and migratory species, and are under threat from saline intrusion as sea level rises.

Saline intrusion can also impact on agricultural land, reducing the quality of the land for arable farming and therefore impacting on the crop yield.

At present, areas of significant importance e.g. Alverstone Marshes are protected by designations such as the Site of Special Scientific Interest (SSSI), which, if the site becomes endangered, will instigate measures to continue and enhance its protection.

The Isle of Wight Shoreline Management Plan demonstrates that such areas should be protected by the 'Hold the Line' defence strategy. The Embankment Road between St. Helens and Bembridge will have continued maintenance to ensure its ability to protect the Eastern Yar Marshes, and the Sandown end of the catchment will have similar plans.

Adaptation options:

- Monitor the situation and water salinity.
- Monitor the condition of sea defences and reassess the situation when breaches threaten the habitat.

8.6.1.2 Migration of Species

The two significant risks from species migration are the loss of native species e.g. northerly migration of the species' ideal habitat, and the arrival of new species together with the further proliferation of other, sometimes invasive species e.g. Japanese Knotweed[3]. Not all new species will be undesirable. Many new colonists will find suitable niches which will not necessarily compete with native species. There will also be many changes in the ecology of coastal waters with many new more southerly species arriving.

Additionally, migration patterns may change - overwintering birds may choose more northerly locations instead of the Isle of Wight. This will reduce the species diversity of the Island during the winter months.

Adaptation options:

- Monitor changes in biodiversity and habitat quality and extent.
- Reassess local conservation designations in order to provide some protection for diminishing habitats to be conserved or emerging habitats to be extended.
- Identity areas where habitats can successfully migrate to under the influence of climate change e.g. soft cliffs, coastal brackish wetlands and the freshwater systems inland of them.

8.6.1.3 Increased flooding or drought causing loss of habitat

With warmer summers and droughts, it is likely that some species may suffer and entire wetlands may be lost. Conversely prolonged periods of flooding can threaten many plant species. Marine flooding can harm salt-intolerant species, whilst freshwater flooding has a similar impact on the saline species of saltmarshes.

Adaptation options:

- Where possible and applicable provide new areas for habitat to develop.

8.6.1.4 Increased risk of fire to forests, heaths and grassland

The Isle of Wight has a variety of habitats which have been protected by national designations. Alongside these protected areas, there are multiple grasslands, woodlands and heaths across the Island which are important to the landscape.

At present, temperatures rarely reach a level which cause concerns about forest fire, however the impacts and risk associated with such events can be seen across the world, most recently in Australia and western USA. The main cause of forest fires is the heating of undergrowth and scrub to temperatures which cause it to spontaneously catch alight.

With predicted increases in temperatures on the Island, the risk of a forest fire will become more likely and should be considered.

Adaptation options:

- Within the appropriate bodies, increase awareness of the greater potential for forest fire.

- As the threat becomes more current, provide guidelines to the public who live near to or regularly make use of forests and woodlands as to what temperature thresholds and conditions are likely to start a fire and the potential risks to human health and property.
- To reduce the likelihood of a forest fire, controlled burning of the undergrowth can remove the main cause.

8.7 Managing the effects of climate change on Water Supplies

By 2025, rainfall is predicted to reduce by 8% during the summer months, and increase by 8% in winter[12]

Water supply and quality would be affected during droughts or through a failure of pipeline and treatment infrastructure during extreme weather events. Impacts will include public health problems related to dehydration and public health issues related to sewage capacity overrun. Businesses will also be affected through impacts on productivity and staff wellbeing. Manufacturing, agriculture, forestry and aggregates are examples of sectors likely to be hard hit because of their need for water supplies.

Priority adaptive actions in this area include:

- Increased communication with the water company to ensure security of supply and/or adequate warning of shortages.
- Promotion of practical water conservation measures: rainwater harvesting, grey water systems, increased winter storage capacity.
- Demand management – encouraging responsible behaviour to reduce wasteful consumption.
- Investigate capacity of waste water system.
- Investigate methods to reduce negative impact on Island river water quality – particularly impacts which will be exacerbated by predicted climatic changes

'If every household in the UK switched from mains water to rainwater to water their gardens and wash their cars, 30,000 million litres of water could be saved each summer' – RETROFITING report (waterwise)

8.7.1.1 Increased water shortages

Increased severity, duration and frequency of droughts on the Isle of Wight could lead to a reduced supply of water impacting on the natural environment (which it is abstracted from), communities and business. Results could include: loss of wetlands and drought-susceptible species, reduced irrigation for agricultural purposes, lower river water quality and there are implications for our quality of life. Water shortages could also be caused by flooding or damage of water supply infrastructure (see section 8.1.4 for more on this).

Adaptation options:

- Maintain good communication with the Island's water company.
- Continue to investigate options for the future of the Island's water supply.
- Consider water supply availability when planning is sought for new housing developments.
- Promote rainwater harvesting
- Greywater use – gardens and private open spaces
- Creation of water areas e.g. swales (SuDS)
- Promotion of water saving to reduce demand
- Island, community, business and household plans to manage the effects of water shortages.

8.7.1.2 Reduced water quality

Water contamination on the Isle of Wight may occur as a result of several different factors and is especially likely during periods of very low rainfall when river levels are low and moving slowly.

Farming of hill slopes and increased runoff from more severe or frequent storms will increase the degree of soil erosion and increase the sedimentation of our rivers during periods of flash flood and heavy downpour. With the threat of new pests and diseases, the amount of pesticides and fertilisers used may increase and consequently increase the amount of chemicals reaching rivers.

A significant cost associated with contaminated water is that as the water is abstracted there will be a need for greater processing to make it suitable for drinking. In areas where the public abstract their own water they may not be sufficiently aware of the increased level of contaminants and inadvertently drink or use unsafe water.

Contamination can impact on a river's biodiversity, for example high levels of fertiliser within the water can lead to algal blooms where the water is still, and may harm animals and plants.

CASE STUDY: CATCHMENT SENSITIVE FARMING

Catchment Sensitive Farming is land management that aims to control the levels of diffuse pollutants within the downstream catchment, whilst being consistent with the ecological sensitivity of the catchment.

This includes controlling agricultural pollutants (manure, fertilisers, and pesticides) as well as promoting good soil structure and rain infiltration to reduce overland flow. Additionally this includes avoidance of compaction through high stock levels and separating clean and dirty water on farms.

Adaptation options:

- Increased awareness of the potential of river contamination may help to inform private abstractors of the threat posed.
- Promote the value of soil integrity as both a climate adaptation and mitigation measure.
- Increase Catchment Sensitive Farming scheme[42].
- Investigate the use of non-polluting fertilisers and pesticides.
- Promote the benefits of farming practices to reduce run-off, for example making use of Slope Maps to highlight particularly steep areas of land.
- Encourage organic farming and crop rotation to reduce leaching of nutrients and reduce the need for added fertiliser.

8.7.1.3 Sewerage Capacity Overrun

During periods of flooding, a proportion of the runoff flows into the sewerage pipes, reducing the space for sewage. As a result, overspill can occur which has important health implications especially when coupled with flooding of roads and buildings.

Adaptation options:

- Further research to determine potential adaptation options related to sewer overspill
- Promote use of SuDS to reduce amount of runoff
- Look at the methods employed by countries which currently experience regular heavy rainfall events and utilise adaptation options.

CASE STUDY: CORNWALL SURFACE WATER MANAGEMENT PLAN

Regeneration of a former industrial area of Cornwall has prompted issues with surface water and sewer networks.

Unless the surface water is removed from the sewer system, it will not be able to cope with new developments, and overflow from the sewers will pollute watercourses.

To reduce surface water entering the sewer system, SuDS were created in the form of ponds and open channels.

This enabled the developments to continue and more sewer pipes could be added without the risk of overflow.

ukcip.org.uk

42 DEFRA (2010) Catchment Sensitive Farming, Accessed 1/11/10, http://www.defra.gov.uk/foodfarm/landmanage/water/csf/index.htm

8.8 Managing the effects of climate change on Agriculture and Forestry

Island farmers and foresters will have already noticed changes in the seasons and weather. To avoid economic loss this industry needs to prepare for the changes which will have a direct impact on productivity. The industry has an opportunity to take advantage of new conditions to grow a more varied range of crops and so create and manage new suites of lowland farm habitats.

Priority adaptive actions in this area include:

- Ensure the land-based industries are well-informed on how climate change may impact on their work.
- Promote agri-environment and other incentives to support sustainable landscape management and adaptation.

8.8.1.1 Reduced Crop Yield

With warmer climates and more severe droughts, crops currently sown may not produce as great a yield due to unfavourable conditions. Additionally, increased flooding and heavy rainfall may damage crops.

Shorter and milder winters may impact on the crop yield as many plants, including cereals and fruit trees, need a period of low temperature to initiate flowering, or to break dormancy prior to flowering.

Adaptation options:

- Further research is required to gauge what assistance businesses in this sector require to adapt to climate change.
- Investigate proper soil management and the use of fertilisers to enable greater summer water retention and availability during periods of drought.
- Consider water storage for use in summer months for irrigation.
- Consider ability to diversify into crops which are not currently grown.
- Take advantage of extended growing season.
- Encourage crop rotation to increase soil stability.

8.8.1.2 New Diseases and Pests

A changing climate will inevitably lead to an increase in pests and diseases which may affect crops and animals, for example rust diseases[43] which at present crops are not protected against.

Adaptation options:

43 Farmers Weekly Interactive(2010) Changing Climate Might Change Spray Programmes, Accessed 8/11/10, http://www.fwi.co.uk/Articles/2008/03/11/109755/Changing-climate-might-change-spray-programmes.htm

- Investigate changing the spray patterns on arable farmland to include new diseases and pests.
- Investigations into which diseases are likely to become more common.
- Crop rotation or growing of multiple crops to reduce chance of loss of entire yield for that season.

8.8.1.3 Increased Soil Erosion

Greater frequency, duration and severity of heavy rainfall events can impact on the amount of soil erosion which occurs across a catchment. Increased soil erosion on steep gradients into a river channel can increase turbidity and introduce chemicals.

Adaptation options:

- Increase crop rotation
- Improve hedgerow maintenance and creation: to reduce erosion and soil removal from each field as well as provide shade and shelter for livestock from the sun and wind.
- Increase field drainage to reduce poaching by livestock.
- Ensure correct soil management to maximise summer water retention.

8.8.1.4 Increased threat to livestock from extreme events including heat-stress and flooding

Livestock will be affected by extreme temperatures which could reduce productivity of dairy cows for example or cause illness due to dehydration. Flooding can ruin forage and prolonged damp conditions are not tolerated by some species, causing foot rot. Excessive damp can also allow the proliferation of bacterial and viral infections.

A changing climate can impact forage growth, currently on the Isle of Wight hay is in short supply and prices have increased on average from £2 per bale (2009/10) to over £6 per bale (2010/11). This situation was exacerbated in 2010 by bad weather in the summer when stock were kept inside to prevent poaching of land, and farmers had to start feeding limited hay supplies months before the winter even started.

- Ensure adequate shelter from rain, wind and sun.
- Ensure adequate water supply.
- Ensure stock do not suffer excessive heat-stress during transport.
- Investigate alternative forage which will grow in new climate.

9 Next Steps

People living together as a community need to be informed enough and persuaded sufficiently of the need to adapt homes and businesses, understand and have confidence in emergency procedures and know where vulnerable individuals in their neighbourhood are located. People need a better understanding of the threats to public health that will come from a changing climate - heat issues, flooding and damp, increased vector-born diseases and food poisoning. People will face economic problems both in the short and long term if they fail to prepare.

An issue common to the risks above is a lack of community communication and individual awareness. People need to become aware of the costs of inaction and be prepared to plan the adaptation of their homes and businesses, their travel and routine to better cope with the changing environmental constraints.

A number of Island communities are threatened by a significant combination of sea level rise and coastal erosion. These communities need to be made aware of the timescale and extent of the coastal change they are likely to face, the constraints on future development and the threats to individual property and land.

Priority adaptive action:

- Introduce appropriate climate change adaptation fully in all new and reviewed Isle of Wight Council strategic policies and programmes, and minimise future risk through effective implementation.
- Increase awareness amongst communities of how a changing climate will affect daily life and how they might adapt and prepare for sustained disturbance to routines and the acute impacts of extreme weather events.
- Develop a freely accessible Island-wide resource of comprehensive information and expertise on climate adaptation.
- Conduct climate vulnerability mapping to identify priority at-risk sites, settlements, developments and properties across the Island.
- Continue to monitor the state of the Island’s coastline, coastal infrastructure and community.