Surrey's
Local Resilience
Forum

# Surrey's Local Resilience Forum (SLRF) Strategic Climate Change Guidance

## Impacts, Mitigation and Adaptation for Surrey

June 2016

Version 1.2

## Version control

| Version | Change(s) recorded | Author |
|---|---|---|
| Version 1.1<br>December 2015 | Page 5, i4 – "affecting recharge of aquifers" removed for accuracy<br>Page 8, iii1 – "This risk also applies to fast responding watercourses where there is little or no flood warning lead time and surface water" added<br>Page 9, ii4 – "from surface water and river flooding" added after "Bagshot" for accuracy<br>Page 10, iv1 – capital letters removed<br>Page 10, iv5 – reference to "1 in 300 year event" removed<br>Page 23, 5.1 – Current likelihood for 'flash flooding' added | Brianne Vally |
| Version 1.2<br>June 2016 | General wording and formatting amendments | Christopher Bradshaw & Brianne Vally |

# Contents



# Linking documents

- UK Climate Change Risk Assessment
- Intergovernmental Panel on Climate Change 5th Assessment report
- Local Climate Impacts Profile (LCLIP) Local Impacts Assessment on Climate Change
- Surrey Community Risk Register
- Surrey's Local Resilience Forum Climate Change Risk Group Rationale document

# 1. Introduction

1.1. The purpose of this guidance document is to explore in more detail the projected risks identified in the Surrey's Local Resilience Forum (SLRF) Climate Change Risk Group Rationale document. This is in order to inform Surrey's Local Resilience Forum future planning arrangements especially with regards to the revision of the Surrey Community Risk Register. The Surrey Community Risk Register forms the baseline for resources, planning and exercising for a specific risk.

1.2. This guidance document, commissioned by SLRF and produced by the Climate Change Risk Group explores the likely impacts on Surrey for each risk and how it relates to the Surrey Community Risk Register. It will also seek to explore options for mitigation and adaptation.

1.3. Following on from this guidance document, interviews with multi-agency risk leads will take place based on the forecasted impacts associated with climate change identified by the SLRF Climate Change Risk Group and summarised in section two below.

1.4. The guidance document's findings and recommendations in addition to the interviewees' feedback will be used to produce a detailed report examining the perceived resilience of current arrangements and highlighting possible key gaps in planning.

# 2. Climate change projections

2.1. Climate change in Surrey, South East England has been projected through research based around the UK Climate Change Risk Assessment and the Intergovernmental Panel on climate change 5th Assessment report. The key projections[1] for Surrey, up to 2050 using the United Kingdom projected change of global warming at 2 - 4°C, are (Met Office n.d.):

- Higher average temperatures
- Variations in seasonal rainfall, including changes in distribution and intensity
- Increased winter temperatures and precipitation
- Decreased summer precipitation overall but more intensive rainfall events likely
- Increased summer temperatures
- Drier summers

# 3. Risks

3.1. The risks below for Surrey and the South East of England have been taken from the above projections.

- Drought (including water stress)
- Extreme heatwave
- Flash flooding
- Major river flooding incidents

[1] The information has been extracted from the Surrey's Local Resilience Forum Climate Change Risk Group Rationale.

- Land movement
- Severe environmental pollution
- Spread of infectious human and animal diseases
- Wildfires

3.2. The following chapter will explore how the above projections impact each risk mentioned above using information from various sources, showing historical data, their primary and secondary impacts, and their current planning in the Surrey Community Risk Register.

**i. Drought (including water stress)**

i.1. Droughts are normal events and vary in intensity and duration across the Country. Surrey Community Risk Register (2015) defines a drought as a prolonged period without rainfall (following three consecutive dry winters) leading to depletion of stored water reserves. This could lead to supply disruption, use of stand pipes and Emergency Drought Orders being implemented to authorise restrictions on usage of water.

i.2. The related projections are as follows:

- Increased summer temperatures
- Higher average temperatures
- Drier summers.

i.3. Surrey has been affected by periods of Drought over recent years, although these have not been severe enough to warrant Emergency Drought Orders, which are assumed under the Drought Risk Assessment. Recent years of drought are listed below;

- In 2011-12 Drought Order powers were granted to Sutton & East Surrey Water, Mid Kent Water and Southern Water allowing them to restrict water usage.
- In 2005-06 Drought Order powers were granted to Sutton & East Surrey Water, Mid Kent Water and Southern Water allowing them to restrict water usage. Restrictions were lifted on 18 January 2007 following four months of above-average rainfall.

i.4. According to the Surrey Community Risk Register, drought currently (as-of 2014) has a risk rating of medium with minor impacts and medium likelihood. The likelihood of this happening could be subject to change due to drier summers.

i.5. This could directly affect vulnerable people support services (Surrey County Council Adult and Children Social Care services, private care providers and National Health Service community providers). This could also directly affect utility companies and most of the Category 1 and 2 responders within the Civil Contingencies Act 2004[2].

i.6. More recently (July 2015), a burst water main operated by Affinity Water resulted in a water shortage across parts of Surrey and adjoining areas. This impacted a number of

[2] Further information can be found here: http://www.legislation.gov.uk/ukpga/2004/36/contents

districts and boroughs in Surrey including: Spelthorne, Runnymede and Surrey Heath. A drinking water supply was maintained to all residents during this event, albeit at low pressure. In the eventuality of a total loss of water supply within the impacted area, tankers were pro-actively deployed at key locations and bottled water made available to those that were most vulnerable. This event coincided with a one day Level 3[3] heatwave across Surrey which resulted in an increase in water demand (up to 30%) (Surrey County Council Emergency Management Team 2015). Following a multi-agency debrief, the following lessons were highlighted (non exhaustive list):

- Ensure that support to vulnerable people is co-ordinated as per the Surrey Local Resilience Forum Supporting Vulnerable People In-Situ Protocol.
- Greater consideration of the longer term risk and pressures being put on the Surrey Local Resilience Forum partners when declaring a Major Incident.

i.7. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Unusually low river flows and water levels, reduced oxygen content | Pressure on water demand potentially leading to higher costs or a lack of availability |
| Rise of water temperature in watercourses and increased presence of algal blooms | Changes to the ecology of sensitive areas; possible negative impacts on biodiversity |
| Reduced crop yields or even crop failure | Drying of wetlands |
| Increased risk of dehydration and infectious diseases for humans (vulnerable people especially at risk) and livestock | Subsidence of properties/building |
| Disruption to public water supply services including for industrial processes e.g. disruption to the supply of cooling water to power stations, farms, etc. | Low flows in rivers will also put pressure on the quality of water discharged under effluent consents |
| Restriction of boat movements on River Thames | Increase in risk of fires with a reduction in the availability of water as an extinguishing media |
| | Decline in tourism and negative impact to the local economy |

**ii. Extreme heatwave**

ii.1. Surrey Community Risk Register (2015) describes an extreme heatwave as: “daily maximum temperatures above 32°C and minimum temperatures above 15°C over most of the United Kingdom for at least five consecutive days and nights” (Surrey Local Resilience Forum 2015). Within Surrey, extreme heatwave has been assessed as a high risk, with a medium/high likelihood and moderate impact. Further information on the risk rating can be found in Appendix 1.

[3] Issued when the thresholds have been exceeded. Further information can be found here: http://www.metoffice.gov.uk/public/weather/heat-health/#?tab=heatHealth

ii.2. The related projections are as follows:

- Decreased summer precipitation overall but more intensive rainfall events likely
- Increased summer temperatures
- Higher average temperatures.

ii.3. In the United Kingdom there have been significant heatwaves over the past 25 years with the most notable being in 1990, 1995, 2003, 2006 and 2013. These are notable due to their protracted nature at certain temperatures as well as their secondary impacts. Those that had an impact on Surrey are listed below;

- In July 2015 a Level 3 Heatwave Warning was issued by Met Office[4]. The United Kingdom experienced a one-day heatwave as hot air moved north from Spain, setting a new July temperature record. The highest temperatures were recorded across South-East England, reaching the low to mid-30s, with 36.7$^{o}$C experienced at Heathrow Airport.
- In July 2013, a Level 3 Heatwave Warning was issued by Met Office.
- In 2006, a Level 3 Heatwave Warning was issued by Met Office.
- In August 2003, a heatwave across much of the Country led to temperatures 30$^{o}$C Celsius with a record max of 38°C on the 10th August in Kent. The Met Office estimated that the heat caused an extra 2,000 deaths over a 10-day heatwave period. This heatwave led to significant impacts across the United Kingdom and much of Europe, which are outlined in Appendix 2.

ii.4. In the United Kingdom, the Met Office forecasts day-time and night-time maximum temperatures to inform the Heat Health Watch. This system is designed to help healthcare professionals manage through periods of extreme temperature and operates from 1st June to the 30th September every year. The service acts as an early warning system forewarning of periods of high temperatures, which may affect the health of the public in the United Kingdom.

ii.5. Given the current predictions of climate change, it is anticipated that the likelihood of heatwave conditions will increase (Civil Contingencies Secretariat 2014). The temperatures that were reached in 2003 are likely to be typical summer temperature by 2040 (Maiden 2015). This could directly affect the health services specifically National Health Service England South (South East), social care services, local National Health Service community providers, Acute Trusts and Care Home providers. Furthermore, increased time spent outdoors due to warmer summers may result in increased population exposure to ultraviolet radiation (Vardoulakis *et al.* 2012). While moderate exposure to the sun can be beneficial, prolonged exposition could result in an increase in skin cancers (Vardoulakis *et al.* 2012).

ii.6. The following primary and secondary detailed impacts have been drawn out of various sources.

[4] Level 3: Heatwave action; this level is triggered when the Met Office confirms threshold temperatures for one of more regions have been reached for one day and the following night, and the forecast for the next day has a greater than 90% confidence level that the day threshold temperature will be met. This stage requires social and healthcare services to target specific actions at high-risk groups.

| Primary | Secondary |
|---|---|
| An increased number of admissions to hospital and consultations with National Health Service General Practitioners, minor injury units and walk in centres due to sunburn, heat exhaustion, respiratory problems and other illnesses such as food poisoning. This excess demand on the health service may cause the cancellation of elective surgery and routine procedures | Increased potential for drought (including water stress), heath-land fires, thunderstorms and flash flooding |
| Increase in heatwave-related mortality mainly among the elderly. Livestock is also impacted | Increased pressure on mortuary capacity |
| Decline in productivity through overheating of work places and disruption or quality issues where processes or products are temperature-sensitive | Higher mean water temperatures affect biological treatment processes and drinking water quality in distribution networks |
| Disruption to power supply e.g. excessive strain on National Grid due to higher demand in electricity in the summer created by the use of air conditioning, reduction in electricity transmission efficiency, etc. | Changes to water customer demand |
| Disruption to transport infrastructure e.g. speed restrictions imposed for trains to help avoid trains derailing, melted road surfaces | Increase in the rate of rubbish decomposition leading to alteration in processes |
| Increased evaporation will lead to reduced water supply from reservoirs, lakes and rivers | Increased level of tourism |
| | Crops failure leading to an increase in food prices |

**iii. Flash flooding**

iii.1. Surrey Community Risk Register (2015) describes flash flooding as heavy localised rainfall in steep valley catchments. Within Surrey, flash flooding has been assessed as a high risk, with a medium likelihood and moderate impact. Further information on the risk rating can be found in Appendix 1. This risk also applies to fast-responding watercourses where there is surface water and little or no flood warning lead-time.

iii.2. The related projections are as follows:

- Variations in seasonal rainfall, including changes in distribution and intensity
- Increased winter temperatures and precipitation
- Decreased summer precipitation overall but more intensive rainfall events likely.

iii.3. Given the projections on climate change listed in Section Two, the impact and likelihood of a flash flooding event are likely to increase from their current ratings. This would

directly affect small built-up areas, the emergency services, drainage planning, insurance companies, and vulnerable people.

iii.4. Surrey has suffered some localised flash flooding incidents and these are detailed below;

- In December 2013, over 400 properties flooded along the River Wey and the River Mole catchments in Surrey when over 50 millimetres fell in 24 hours. The Wey in Guildford responded rapidly, the river went from bankfull conditions to flooding property in one hour.
- In 2007, the Thames region experienced greater than average rainfall for most of May and June, but the majority of the rain fell on 19th and 20th July. Extremely high rainfall and already saturated ground meant that drains were overwhelmed, which led to a large amount of surface water flooding e.g. 141 mm of rain fell in Byfleet in July which is more than double the monthly average (Surrey County Council 2012). Approximately 150 properties flooded in Windlesham, Lightwater, Chobham, West End, Woking and Bagshot from surface water and river flooding.
- In 2006, localised storm conditions (two months of rainfall fell in the space of six hours over North West Surrey) caused flash flooding in Aldershot, Ash, Ash Vale, Windlesham, Lightwater, Chobam, West End and Addlestone, which resulted in over 115 properties being flooded in these areas (Surrey County Council 2012).
- In 1975, approximately 440 properties flooded on the River Hogsmill.

iii.5. Although not in Surrey, it is worth noting a devastating incident which occurred in 2004 in Boscastle, United Kingdom. Approximately 185mm of rain fell in just five hours (Geography Teaching Today 2011) causing two rivers to burst their banks (Met Office 2015). This resulted in two billion litres of water to rush down the valley into Boscastle (Met Office 2015). This is seen as a rare event due to the variables around it, but with the more intensive rainfalls predicted to occur, it is expected that localised flash flooding will become more common.

iii.6. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Drowning of people, pets and livestock | Disruption of economic life and major costs of rebuilding infrastructure |
| Pollution/health risks from sewage systems, chemical stores, fuel storage tanks, etc. | Insurance implications, including help for those who are uninsured |
| Evacuation and temporary /long-term accommodation needs for large numbers of people especially those that are vulnerable | Safety assessments and demolition of damaged buildings and structures |
| Major damage to property and surrounding land | Long term psychological effects |
| Disruption to transport infrastructure | Rising number of landslides |
| Disruption to utility services including communication links e.g. mobile phones | |

| | |
|---|---|
| Ground collapses e.g. sinkholes | |
| Shortage/overstretch of key resources (equipment and personnel) and agencies | |

**iv. Major river/fluvial flooding**

iv.1. Surrey Community Risk Register (2015) describes major river/fluvial flooding as a flooding event affecting more than 50,000 properties for up to 10 days and resulting in widespread disruption to infrastructure. Within Surrey, major river/fluvial flooding has been assessed as a very high risk, with a medium likelihood and significant impact. Further information on the risk rating can be found in Appendix 1.

iv.2. The related projections are as follows:

- Variations in seasonal rainfall, including changes in distribution and intensity
- Increased winter temperatures and precipitation
- Decreased summer precipitation overall but more intensive rainfall events likely
- Frequency of major flood events increased.

iv.3. Given the projections on Climate Change, the likelihood of a major river/fluvial flooding could be subject to increase. This would directly affect the majority of Category one and two responding organisations as defined under the Civil Contingency Act 2004, the public, voluntary sector and businesses.

iv.4. In the United Kingdom, there have been large flood events over the past 15 years, with the most prominent being in the 2000, 2003, 2007, 2012, 2013/14. These fluvial flooding events all caused considerable damage following intensive and extensive rainfall beforehand. Surrey County Council Deputy Chief Finance Officer has estimated that the winter storms of 2013/14 cost Surrey County Council over £4 million (Kilburn 2015).

iv.5. Surrey has been particularly affected by river/fluvial flooding incidents;

- Over the Christmas 2013 period and through to the end of February 2014, two Major Incidents were declared and 14 Severe Flood Warnings issued within two months.
    - In February 2014, approximately 1072 properties were confirmed as flooded internally from the main river along the River Thames catchment after the wettest Winter on record.
    - In December 2013, approximately 502 properties were confirmed as flooded internally from the main river along the River Wey and the River Mole catchments when approximately 50 millimetres fell in 24 hours.

- In 2003, over 330 properties flooded, mostly in Runnymede and Spelthorne along the River Thames and River Bourne (Surrey County Council 2012). The River Wey also burst its banks causing some properties to flood.
- In Autumn 2000, over 500 properties flooded, mostly along the River Wey and River Mole. This storm event resulted in over 260 residents being evacuated (Surrey County Council 2012).

- In 1975, over 440 properties flooded along the River Hogsmill.
- In 1968, over 3,300 properties flooded across Surrey.

iv.6. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Drowning of people, pets and livestock | Disruption of economic life and major costs of rebuilding infrastructure e.g. local businesses forced to close – temporary or full time |
| Pollution/health risks from sewage systems, chemical stores, fuel storage tanks, etc. | Insurance implications, including help for those who are uninsured |
| Evacuation and temporary /long-term accommodation needs for large numbers of people especially those that are vulnerable | Long term mental health effects (psychological distress, anxiety, depression and post-traumatic stress disorder) |
| Major damage to property and surrounding land e.g. loss of grazing and forage crops, loss of valuable and necessary nutrients impacting the productivity of arable crops, etc. | Safety assessments and demolition of damaged buildings and structures |
| Loss of access to business premises and disruption to staff travel, supply chains incl. fuel supply or other critical infrastructure | Decrease in tourism |
| Disruption to utility services including communication links e.g. mobile phones | |
| Shortage/overstretch of key resources (equipment and personnel) and agencies | |

**v. Land movement**

v.1. According to the British Geological Survey Landslides Team, increased rainfall has resulted in an increase in the number of landslides and slope failures, particularly during the months of July and December (Civil Contingencies Secretariat 2014). Landslides usually result in roads and transport infrastructure being impassable for a time, loss of essential services, potential for collapse of buildings and bridges, etc (Surrey Local Resilience Forum 2014). Within Surrey, land movement has been assessed as a low risk, with a low likelihood and minor impact. Further information on the risk rating can be found in Appendix 1.

v.2. The related projections are as follows:

- Variations in seasonal rainfall, including changes in distribution and intensity
- Increased winter temperatures and precipitation
- Decreased summer precipitation overall but more intensive rainfall events likely.

v.3. With precipitation set to change in distribution and intensity, along with increased precipitation in the winter, the likelihood and impact of a landslide event happening in Surrey are likely to increase.

v.4. Geologically, Surrey is a historically stable County and most of the land movement threat is from man-made structures, for example railway embankments, which could be more likely to respond to increased rainfall occurrence and increased rainfall intensity. In 2012, trains between West Sussex, Surrey and London were disrupted after a landslip blocked one of the lines. The landslide was caused by the wet weather leaving the ballast unstable (BBC 2012). The repairs were expected to last up to three weeks (BBC 2012).

v.5. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Trapped or missing people, fatalities, skeletal injuries | Long term health needs and monitoring of affected areas |
| Evacuation and temporary or long-term accommodation needs especially for those that are vulnerable | Public / Media need for information and advice |
| Transport infrastructure and local business affected e.g. roads and access routes impassable | Potential long-term environmental impact from hazardous materials |
| Shortage and/or overstretch of key resources (equipment and personnel) and agencies | Economic impact of clean-up costs |

**vi. Severe Environmental Pollution**

vi.1. Severe environmental pollution can be identified as air and water pollution, both of which could increase as a direct impact of the above projections. Secondary environmental impacts could also increase from the following risks;

- Wildfires: potential long-term environmental impact from hazardous materials
- River/fluvial flooding: pollution/health risks from sewage systems, chemical stores, fuel storage tanks.
- Flash Flooding: pollution/health risks from sewage systems, chemical stores, fuel storage tanks.
- Land movement: potential long-term environmental impact from hazardous materials.

vi.2. A pollution incident impacting upon controlled waters could lead to persistent and/or extensive effect on water quality. This could be caused by chemical spillage or release of large quantity of untreated sewage for example. The following effects could also be observed: major damage to aquatic ecosystems, closure of potable abstraction point(s), major impact on amenity (i.e. tourism) value and serious impact on human health.

vi.3. The related projections are as follows:

- Increased summer temperatures
- Higher average temperatures

- Drier summers.

A. Water Pollution

a. Low water levels and reduced river flows from drier summers and higher temperatures may lead to increased concentrations of pollutants from agriculture, sewage and air pollution, damaging freshwater habitats and other ecosystems. In Surrey, this has already been seen to a certain extent during the dry spell in 2011/12. Although pollution events during this time were not caused by low river flows they were exacerbated by them. The severity of organic pollution incidents is likely to be worse when there is less dilution. In Surrey between January 2011 and April 2012 there were eight water pollution incidents that were exacerbated by low river flows experienced at the time (Davies 2015).

b. Findings indicate that changing seasonal flow patterns and flow velocities, intense rainfall, drought events and temperature changes could all affect diffuse pollution (Davies 2015). Impacts can vary widely with location; for example responses in the upper reaches of a river may be different to those in the lower reaches. This may be attributed to factors such as land use and local geology, as well as climate.

c. The extent of pollution and its impact on the receiving waters has the potential to vary with climate in other ways too. An increase in winter rainfall and the frequency of intense rainfall events could lead to a rise in pollution from both point and diffuse sources. From point sources, there might be an increase in pollution from storm sewage due to more frequent occurrences of combined sewer overflow spills, particularly during the summer months when receiving waters have inadequate capacity for dilution (Davies 2015). From diffuse sources, pollutants could come from leaching of agricultural contaminants into rivers, lakes and groundwater, as well as from urban and non-agricultural sources including roads. Erosion and flooding, which could increase suspended solids and contaminants within waters, may also be affected by changes in rainfall intensities.

B. Air Pollution

a. Air pollution levels are largely controlled by man-made atmospheric emissions of chemicals, along with weather and climate and are hence difficult to project. An increase in temperature as the climate changes will lead to changes in the atmospheric chemistry associated with ozone formation, which at ground level will act as pollutants. This can lead to the formation of photochemical smog which is a combination of chemicals produced by the interaction of emissions from fossil fuel combustion and sunlight. This photochemical smog causes respiratory and eye problems, damages rubber and plastic and retards plant growth. Ozone-related mortality is currently estimated to be up around 11,900 premature deaths per year. It has been estimated that this could increase up to 15,000 for the 2030s depending on future ozone precursor emissions.

b. Hot summers in the United Kingdom, like in 2003 when there was a substantial photochemical smog episode in Europe including South East England, are likely to become ‘typical’ by the 2040s, leading to a higher frequency of summer pollution

episodes (Department for Environment Food and Rural Affairs 2013). There is evidence that emissions of volatile organic compounds from vegetation played a role in the 2003 episode; increases in temperature lead to increases in emissions of biogenic compounds such as isoprene (Department for Environment Food and Rural Affairs 2013).

c. Although not specifically linked within the Surrey Community Risk Register, it will become a more weighted risk in future. This risk, specifically air pollution, would directly impact upon the NHS due to the potentially negative effects on members of the public with respiratory issues.

vi.4. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Water quality degradation | Closure of potable abstraction point(s) |
| Damage to aquatic ecosystems | changes in plant and fungal distributions to cause indirect health impact on the United Kingdom population |
| Impact on amenity (i.e. tourism) value | |
| Endangerment to public health and welfare e.g. allergic and respiratory diseases | |
| Increase in the risk of eutrophication and loss of biodiversity | |

**vii. Spread of infectious human and animal diseases**

vii.1. In the Surrey Community Risk Register, 'emerging infectious diseases' has been assessed as a high risk, with a medium likelihood and moderate impact. Further information on the risk rating can be found in Appendix 1. The likelihood could be subject to change if vector borne diseases are given the right conditions for spread. Such an outbreak is likely to originate outside of the United Kingdom with a few cases amongst returning travellers and their families and close contacts. This could potentially then spread to health care workers within hospital settings. This would directly impact upon vulnerable people and in turn the health care system, and would also impact upon the business continuity of organisations and agencies within Surrey and the United Kingdom as a whole.

vii.2. Within Surrey, zoonotic and non-zoonotic notifiable animal diseases have been assessed has an overall low risk, with a medium likelihood and limited impact. Further information on the risk rating can be found in Appendix 1. Research has shown that the changing climate could lead to an increase in avian influenza transmission in wild birds (Erickson 2012). Changes in migration pattern might cause infected birds to come into contact with poultry. Transmission to humans in close contact with poultry or other captive birds is rare.

vii.3. The related projections are as follows:

- Higher average temperatures
- Variations in seasonal rainfall, including changes in distribution and intensity
- Increased winter temperatures and precipitation
- Decreased summer precipitation overall but more intensive rainfall events likely
- Increased summer temperatures.

vii.4. The increased frequency and more intensive rainfall can influence the transport and dissemination of infectious agents, while temperature affects their growth and survival. Vector borne diseases (infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, triatomine bugs, sandflies, and blackflies) are believed to be the most affected by climate change in scientific research due to the sensitivity of replication and dissemination of pathogen, vector and animal host populations to changing temperature and rainfall.

vii.5. Precise impact will depend upon effectiveness of antibiotics and antivirals in fighting infection. Severe Acute Respiratory Syndrome originated in China in 2002 and spread to other countries including the United Kingdom where four cases were recorded (NHS 2014).

vii.6. In America, Eastern Coast of the United States of America, researchers found a relationship between winter temperatures and the rate of infections. The fewer winter days with temperatures dipping below 28 degrees Fahrenheit (-2.2 degrees Celsius) the higher the number of cases of West Nile virus over the next summer. With United Kingdom temperatures set to rise by 2° - 4°, the United Kingdom will have temperatures that would be equivalent to current temperatures found in the United States of America on the Eastern Coast (Met Office n.d.).

vii.7. Moreover, in September 2007, Department for Environment Food and Rural Affairs confirmed Bluetongue disease, spread by biting insects, was circulating between the local animal and midge population in East Anglia. Since then further cases of Bluetongue have been confirmed elsewhere in England and Wales. By the end of 2008, Protection Zones covered the whole of England and Wales.

vii.8. In the United Kingdom, there has been different species of mosquito found (the Anopheles mosquito) which are carriers of malaria, if they carry infected blood, though these are in very small numbers. Despite the risk from malaria being considered low, some climate models predicted the possibility of localised infections in the United Kingdom as early as 2030 (NHS n.d.).

vii.9. During the foot and mouth disease outbreak in 2001, 2.3 million animals were culled to alleviate the suffering of animals which were not directly affected but could not be sent to market because of movement restrictions. (Farm Animal Welfare Committee 2012) AWC Opinion contingency planning). However, there is no clear evidence that climate change will contribute to an increase in foot and mouth disease outbreaks in the United Kingdom (Guida 2015). It is possible that climate change will affect movement of populations, food resources and imports of meat. These factors could contribute to the appearance of foot and mouth diseases in the United Kingdom.

vii.10. The climate seems to be important for both the emergence and spread of bluetongue disease, but climate is only one factor; there are lots of other things to consider such as land-change, human behaviour and farming techniques (Jones 2011).

vii.11. There is an increasing risk of new pests and diseases in the United Kingdom, such as the Oak Processionary Moth, whose caterpillars can also cause respiratory problems in humans. Climate change might be a factor - the reduced incidence of cold, wet weather during the spring-time larval emergence period in recent years might have enabled the moth to become established further north than would have been possible in the past (Forestry Commission n.d.).

vii.12. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Up to half the population could be affected in a reasonable worst case scenario (Surrey Local Resilience Forum 2015). The Office for National Statistics estimated that the total population for the United Kingdom by mid-2014 was 64.6 million | Increased demand for immunisation/vaccination |
| Localised increase in the number of casualties with some fatalities likely to result in an increase in demand on healthcare provision i.e. increase in G.P. consultations and hospital admissions. Possible disruption of several weeks to elective procedures | Local economy may suffer loss of business or tourism e.g. if unable to export produce, exclusion zone for some animal health disease, etc. |
| Health surveillance of people affected and their close contacts | Public concern about travel, within and beyond United Kingdom and possible international travel restriction advice |
| Vaccinations of close contacts | Disruption to the environment |
| Animal welfare detrimentally impacted | |
| Damage to native plants and ecosystems, or agricultural / horticultural crops | |

**viii. Wildfires**

viii.1. Surrey Community Risk Register (2015) describes the outcome of a severe wildfire as 'spreading over an area of 1500 hectares at an urban-rural interface lasting for seven-10 days'. Within Surrey, severe wildfire has been assessed as a medium risk, with a medium likelihood and minor impact. Further information on the risk rating can be found in Appendix 1. The likelihood could be subject to change in the coming years to reflect the possible increase in wildfires for the projections identified. This could directly affect the responding agencies, specifically Surrey Fire and Rescue Service, land managers, Surrey County Council Highways, Countryside Management teams at both County and Borough level, Highways England and residents in areas at risk.

viii.2. The related projections are as follows:

- Decreased summer precipitation overall but more intensive rainfall events likely
- Increased summer temperatures
- Higher average temperatures.

viii.3. The South East faces a particular threat from wildfires because of the proximity of high-risk areas to areas of dense residential and commercial development and critical infrastructure that can be damaged or disrupted by wildfire incidents. It has been demonstrated that climate and weather impacts are significant factors in the number and scale of wildfires, noting an increase during periods of unseasonably dry weather and hotter temperatures, as in 1995 and 2003 (Climate UK 2012).

viii.4. Surrey is the most wooded county in England with 22% coverage of the land area. As well as woodland, there is also extensive coverage of heathland with over 3,500 hectares (Surrey Wildlife Trust 2014). The amount of at-risk vegetation and the desirable conditions (above projections) for wildfire have allowed for this impact to be recognised.

viii.5. Surrey has been affected by wildfires over recent years, these are listed below;

- In 2015, Pirbright Heathland experienced a fire which is believed to have been as a result of arson. According to a conservation expert, it could take almost 10 years for wildlife to return to Pirbright Heathland where approximately 30 hectares of lands were destroyed (Get Surrey 2015).
- In 2006, Thursley Common experienced a 20-pump fire and lasted for a week. Resources from outside the County were brought in.
- In 2004, West End Common experienced a 26-pump fire.

viii.6. Other incidents in 1990, 1999 and 2003 have shown that Surrey Fire and Rescue Service's response to wildfires consume considerable man-power and equipment resources, on occasions this includes supporting the response to incidents outside Surrey.

viii.7. Note that in 2011 Surrey Fire and Rescue Service provided mutual aid to Royal Berkshire Fire and Rescue Service to tackle the Swinley Forest blaze. This fire affected an area covering 300 hectares (unknown 2011). Surrey Fire and Rescue Service deployed 40 pumps and high volume pumps (water pumped from two kilometres). The fire was the largest ever dealt with by Royal Berkshire FRS and involved support from another 11 fire and rescue services, the Forestry Commission, the local authority and police, and the use of a significant number of fire service national resilience assets (Forest Commission 2014). The fire, which lasted a week, had a considerable impact on the local area including the closure of major roads and schools. Further information can be found in Appendix 3.

viii.8. If temperatures were to increase in the United Kingdom between 2 – 4°C as suggested and there was decreased summer rainfall, the conditions required for wildfires will be seen across large parts of the United Kingdom, including Surrey, more frequently.

viii.9. The following primary and secondary detailed impacts have been drawn out of various sources.

| Primary | Secondary |
|---|---|
| Loss of life – fatality numbers low (under 10) and casualty figures of between 50 – 100, primarily as a result of respiratory complaints and burns (Surrey Local Resilience Forum, 2015) | Potential long-term environmental impact from hazardous materials |
| Loss of property - Evacuation and temporary or long term accommodation needs | Economic impact of clean-up costs |
| Transport infrastructure severely affected, local businesses affected | Economic impact of disruption to transport infrastructure |
| Pollution from plume, contaminated fire-fighting water run-off | Loss of wildlife |
| Significant natural environment impacts (special protection areas, special areas of conservation, sites of special scientific interest) | |
| Loss of agricultural production/income from the land | |
| Shortage and/or overstretch of key resources (equipment and personnel) and agencies, especially fire and rescue service | |

# 4. Adaptation and Mitigation

4.1. The following section aims to explore options for mitigation and adaptation, in relation to the projections and their potential impacts focusing on environment, housing, building and infrastructure and health and communities.

4.2. Adaptation refers to the ability to anticipate the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise (European Commission n.d.). This definition is inconsistent with that commonly used in risk management (where it is common to talk about mitigating risks). In fact, risk mitigation is defined as reducing the likelihood of a risk, rather than having plans and measures in place to deal with a risk once it has happened (Cabinet Office 2012). Throughout this document these two words will be used interchangeably.

## i. Environment/biodiversity including land management and wildlife

i.1. Agriculture in the United Kingdom is the biggest land use type, with 71% used for farming (Department for Environment, Food and Rural Affairs 2014). The ratio is similar for the South East of England. Within the next few decades, the climate change projections highlighted in Section 2 are likely to have severe effects on United Kingdom agriculture. Barclay (2012) argues that the “effects [of climate change] may be partially mitigated by planting different crops and developing new varieties [of crops]”. Though considerations have to be made regarding import and export demand

and European Union legislation around farming, which could impact businesses and encourage farming practices to change.

i.2. One of the impacts from the projections is the increase and intensity of wildfires. There are ways in which adaptation and mitigation can reduce the affect seen from these for example introducing whole site and landscape prevention measures, rather than fire breaks. Rather than one type of vegetation, sources can be mixed so there are increased natural fire breaks. Although this would reduce the spread of a fire, there has to be considerations around costs to land owners and land management planning permissions, and improved resources and space for responders. The Forestry Commission has guidance available[5] to land managers and South East England Wildfire group are training land managers in prevention planning and response to wildfire.

i.3. The risk of flooding remains one of the highest risks in the United Kingdom, as identified in both the National Risk Register[6] and the Surrey Community Risk Register[7], and is likely to increase with the projections identified. Many of the areas within South East England are identified as Flood Plains, which are areas of low lying land bordering rivers and streams that are subject to flooding from these water sources periodically.

i.4. Moreover, the restoration of at least 15% of degraded ecosystems as a contribution to climate change mitigation and adaptation has been identified as one of the outcomes of the Biodiversity 2020 Strategy set by Department for Environment, Food and Rural Affairs (2012a).

i.5. In England, there are 2.4 million properties at risk from flooding from rivers and the sea and a further three million properties are at some risk from surface water flooding in England (Maiden 2015). The report (2012), prepared by the Adaptation Sub-Committee of the Committee on Climate Change recommends “more transparent and careful planning of new development in flood risk areas by local authorities, taking account of long-term costs of flooding”. Encouraging greater use of property protection measures and sustainable drainage systems to cope with flash-flooding is also recommended by the Adaptation Sub-Committee (2012). Moreover, the Association of British Insurers (2014) recommends to those who are finding it more difficult to access affordable insurance either because their homes have been flooded in the past or they live in flood-prone “to consider installing flood defence measures, such as flood doors, airbrick covers and raised electrical sockets, in parallel with a property-level flood risk survey”.

i.6. Some insurers might be willing to reduce premiums once some resistance (i.e. that keeps water out of properties) and resilience (i.e. that reduces damage caused when water enters a property) measures have been put in place. Tax business rates could also be reduced for those businesses that put preventative measures in place.

[5] http://www.forestry.gov.uk/fr/INFD-7WKJDJ
[6] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419549/20150331_2015-NRR-WA_Final.pdf
[7] http://www.surreycc.gov.uk/__data/assets/pdf_file/0008/24479/Surrey-Community-Risk-Register-2014-v1.0.pdf

i.7. A general adaptation measure to protect properties close to flood plains could be the prevention of new major development on natural flood plains to protect future homeowners from the risk, and maintain the local ecosystem. However, it is acknowledged that there is a difficult balance to be achieved in doing this whilst meeting the significant need for affordable housing.

**ii. Housing, building and infrastructure**

ii.1. In light of the projections mentioned above, a number of initiatives have already started to take place.

ii.2. Flooding in the United Kingdom is one of the most important risks on the National Risk Register. This is also the case in Surrey which led to many changes in planning policy and ideas around adaptation for buildings. Currently (2015) a flood risk assessment has to be carried out by a planning applicant for the proposed development site; this may lead to the ground floor acting as a car park rather than a residential building and increased drainage. Building adaptation for flood risk involves schemes that businesses and home owners have purchased to protect their homes. These schemes could be mandatory for developers to include when building on areas with a specific flood risk.

ii.3. Drainage is an important part of the design in infrastructure, especially pre-existing drainage pipes. If drainage capacity was to be increased and pre-existing pipelines upgraded, flooding on roads rail and high built up areas could be reduced. As there are many different owners responsible for the maintenance of these pipelines, especially the drainage links from new developments, this can cause issues for continuity across the drainage network. Sustainable drainage systems are a natural approach to drainage that aims to balance the desire to control water quantity, improve water quality and provide amenity (and biodiversity) benefits. This approach to drainage is currently referenced in the Flood and Water Management Act 2010 and they were intended to be mandatory; instead the planning system (National Planning Policy Framework - NPPF) now forms the basis for their implementation. The National Planning Policy Framework (2012) states that sustainable drainage systems are to be provided in new developments wherever this is appropriate. If these were to be made mandatory and included, the implementation of sustainable drainage systems with new and existing infrastructure and resilience to flood events, especially surface water flooding, can be potentially increased.

ii.4. For example, the promotion of Sustainable Drainage Systems in Cambridge is projected to result in significant savings for Council services, homeowners and industry. At one specific site, based on average annual damages, a net value of £3.7 million could be achieved by avoiding damages worth £5.8 million via an engineering fix costing £2 million (London Assembly 2014).

ii.5. In the London Bridge area, green roof space, rain gardens and green walls are solutions being looked at to help boost flood alleviation for businesses. Pending funding and implementation, this is an example of how businesses can work with each other and public agencies to address potential impacts of climate change (London

Assembly 2014). A similar approach is being looked at in Victoria, London where a number of places have critical drainage problems. An audit revealed the potential of retrofitting 25 ha of green roofs across the at-risk zones, which would be capable of absorbing 80,000$m^3$ of rain water each year (Natural England 2013). Sustainable drainage systems are also being looked at.

ii.6. It is argued that London's gardens should be seen as a crucial environmental resources, wildlife habitat, amenity resource and flood protection system. In fact, more than a third of London's green space, and one-fifth of London's total land area, is made up of private gardens (London Assembly 2005). London's gardens, if not paved, would help alleviate the pressure on already overwhelmed Victorian sewerage and drainage system.

ii.7. The IPCC (2012) have also recognised the need to ensure infrastructure resilience to natural disasters, and acknowledge the challenge of interdependencies and network scale.

ii.8. With regards to increased temperatures, it is argued that by making changes to existing buildings as well adding these facilities to new property builds, the temperatures indoors could be dramatically reduced. However it should be noted that it is more difficult and expensive to adapt existing building stock (Vardoulakis *et al.* 2012). Furthermore, some measures will not be applicable in mental health facilities due to added risk such as ligature points in awnings. This could benefit vulnerable people for care homes, hospitals, day centres and public places. For example, the 'Supporting vulnerable people before and during a heatwave – Advice for health and social care professionals' (2015) guidance document states that the following measures should be looked at to reduce the effects of an heatwave:

- using outside shutters, overhead external shade and using reflective paint
- planting trees or leafy plants to provide shade and cool the air around the building – and indoor plants also help keep the environment cool.

ii.9. Considerations are being made for the selection of building materials and these are mentioned in the National Planning Policy framework[8], but it does not sit as a specific regulation. A suggestion would be for building regulations to include references to using heat-resistant materials with incentives given for the use of certain materials in development. Considerations would have to be given to costs as well as time for new regulations and standards to be fully implemented in order to mitigate the risks and change.

ii.10. Wiltshire Unitary Council undertook an exercise to look at the implications of climate change on the long term resilience of one of their buildings. Three factors that were studies for climate risks were: design for comfort, construction and managing water. Some improvements were immediately adopted and these include: a water awareness campaign for staff in the building and rainwater recycling (Climate UK 2012).

### iii. Health and communities

[8] https://www.gov.uk/government/publications/national-planning-policy-framework--2

iii.1. Climate change mitigation and adaptation policies in the built environment can have many advantages including the reduction of greenhouse gas emissions but some could have negative effects on human health. This should not be overlooked as the population of the United Kingdom typically spends 90% of their time indoors (Vardoulakis *et al.* 2012).

iii.2. The detrimental impacts of flooding and other events on mental health in the United Kingdom have been recognised and these include but are not restricted to post-traumatic stress disorder (PTSD), anxiety and depression. Despite an increase in understanding on the mental health effects of flooding on vulnerable people groups, gaps remain (Vardoulakis *et al.* 2012).

iii.3. Surrey County Council, in conjunction with partners, have invested officer time in developing joined-up partnership working around community resilience including flooding. It is hoped that this will significantly reduce the level of response needed from external agencies in times of emergency, saving significant sums of money for responding agencies, for example. The main focus is currently on identifying priority areas for community resilience development across the County, developing a non-prescriptive guidance framework for development using good practices examples, exploring funding bids and opportunities both for communities[9] and agencies to allow the sustainability of the ongoing work. It has been recognised that health and mental well-being are key to resilient communities, so work is underway to link and embed cross-messaging about health services and resilience through both these work streams in a complementary way, including promoting community social peer support as essential to preparation and prevention, as well as during response and recovery. This work includes:

- Web resources
- Training for volunteers
- Newsletter
- Social media, including Twitter: @Surrey Prepared
- Events and exercises
- Embedding resilience in the community for sustainability.

iii.4. The Surrey Community Resilience Partnership comprises Surrey County Council, all 11 Boroughs and Districts, the Environment Agency, some utility infrastructure providers - Southern Electric Power Distribution, UK Power Distribution Networks, Thames Water, Affinity Water, and Voluntary organisations such as the British Red Cross. This partnership is working to support existing resilience groups in the community and use this good practice to encourage more to form as community assets. A case study can be found in Appendix 4.

iii.5. Sometimes perception and beliefs relating to climate change can be altered by current events, for example a recent (2014/2015) study led by Cardiff University shed new light on public perception of climate change. Researchers interviewed 1,002 people across the country about their views on climate change and the floods (Capstick *et al.* 2015). The result show almost nine in 10 respondents said the world's climate is

[9] Refer to the Glossary for further information about the meaning of “communities”.

changing (88%), and more than eight in 10 said human activity was at least partly the cause (84%) (Capstick *et al.* 2015). Although there is a change in acceptance that the climate is changing, education on the understanding of natural climatic variability is needed to promote positive behaviour and adaptation changes.

iii.6. In 2007, Essex County Council identified a series of opportunities to deliver curriculum-based teaching materials which incorporated emergency planning ("What If" n.d.). The project also had a secondary educational effect on the wider community thanks to, but not limited to, the inclusion of older people and delivery of presentations from the children to their parents. Communication through education, for example including more topics around climate change in the school curriculum specific to the local area as well as nationally and globally, could increase knowledge around the impacts and their risk.

iii.7. At present, information regarding adaptation of residential buildings and gardens is available from an insurance company once a risk has been identified. It would be of benefit having the information widely available regardless of a risk being identified. Being better informed could increase the resilience of residential homes and businesses and enable property owners to be more successful when selling. There would be a cost involved in communicating with owners though and these processes may panic or discourage buyers in high risk areas within Surrey. By having more risks on the environmental impact assessment home insurance may increase for the buyer. There are a number of tools that are available for businesses. This includes the Business Areas Climate Impacts Assessment Tool produced by the UK Climate Impacts Programme which helps businesses assess their climate change-related vulnerabilities in the areas of financing, market demand, logistics, production processes and service delivery, workforce and customers, building premises and management implications.

iii.8. Although flooding is included on an Environmental Impact Assessment (EIA) when purchasing a property, other risks are not highlighted; for example inclusion in the risk assessment (if there is likely to be an impact) of wildfire risk to potential homeowners near large wooded and heathland areas.

# 5. Findings

5.1. The projections mentioned above would impact upon the LRF planning assumptions for the risk assessments for Surrey, with some seeing a more significant affect on the impact and likelihood of an event. It is possible that climate change could raise the likelihood of flash flooding in the future, unless sufficient adaptation and mitigation measures are put in place to support flood resilience at a property and community level supported by efforts to raise public awareness of the potential impacts. For example, it is feasible that the current likelihood for flash flooding could go from Medium-high to High as defined in Appendix 1.

5.2. One risk identified, land movement, appears to be least likely to change within its Community Risk Register remit, as Surrey has rare historical records of any slope failures/landslides. However, if there are significant infrastructure changes, for

example maintenance of embankments around infrastructure (roads, rail, tunnels), then the likelihood of land movement could increase.

5.3. If these projections are allowed to manifest without sufficient mitigation or adaption, it can be assumed there will need to be greater investment in resources relating to response capability to combat the increasing risk. For example, Surrey Fire and Rescue Service (SFRS) would have to increase their staff numbers, develop training and procure new specialist equipment, especially as wildfire likelihood and impact is forecast to increase. This has already been shown through flood risk, as the SFRS has evolved their response to incorporate flood rescue. Even though there is not a statutory duty to do this, public perception is that it is a requirement. If these potential gaps are identified now, with planning put in place, these resources can be considered now, with the cost implications weighed against the costs of adaptation measures. With public sector funding being reduced, including staff resources, reliance would rest upon the mitigation and adaptation measures to reduce the impact of risk from the projections identified. It has been estimated that the overall costs of climate change – if mitigation and adaptation measures are not implemented – could be equivalent to losing at least five per cent of global annual Gross Domestic Product, and could perhaps be as high as 20 per cent (HM Treasury 2006).

5.4. As many mitigation measures rely upon funding support from Central Government it is difficult to make plans to address risks that have not yet been realised. This affects Surrey as many of the planning arrangements around risk assessments involves allocation of resources and then associated procurement. Furthermore, it is recommended that mitigation policies be subject to health and safety impact assessments to ensure that the risk is not being transferred across e.g. sealing buildings to increase energy efficiency may lead to increased exposure to indoor air pollution, unless adequate ventilation is maintained (Vardoulakis *et al.* 2012).

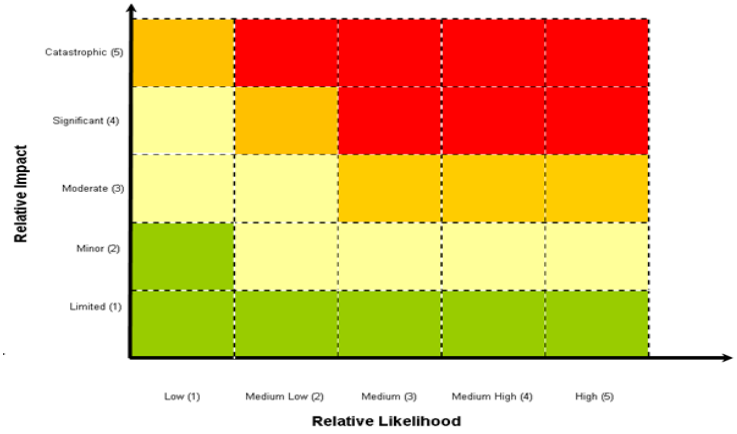
5.5. To complement this guidance document, the SLRF Climate Change Risk Group have conducted a series of interviews with identified multi-agency risk leads based on the forecasted impacts associated with Climate Change. These interviews took place between October 2015 and January 2016. Following these interviews with subject matter experts, a detailed report will be produced and it is hoped that this will help inform the future SLRF planning assumptions and identify potential gaps in existing arrangements and areas requiring further work and investment.

# Appendices

## Appendix 1 – Surrey Community Risk Register, Risk Matrix

The Surrey Community Risk Register has been created to provide public information about the hazards that exist within the County and the control measures that are in place to mitigate their impact.

The generic hazards have been assessed for the likelihood of the event happening and the potential impact that may have within the County, which is then used to create a risk rating for the hazard. The likelihood and impact values were agreed through the multi-agency Risk Assessment Working Group on behalf of the Surrey Local Resilience Forum. The relative impact can be rated as follows: limited (1), minor (2), moderate (3), significant (4) or catastrophic (5). While the relative likelihood can be rated as follows: low (1), moderate-low (2), medium (3), medium-high (4) or high (5).




*Likelihood scoring scale*

| Level | Descriptor | Stated chance in five years |
|---|---|---|
| 1 | Low | Between 1 in 20,000 and 1 in 2,000 |
| 2 | Medium Low | Between 1 in 2,000 and 1 in 200 (Between 0.05% and 0.5% stated chance in five years) |
| 3 | Medium | Between 1 in 200 and 1 in 20 (Between 0.05% and 5% stated chance in five years) |
| 4 | Medium High | Between 1 in 20 and 1 in 2 (Between 5% and 50% stated chance in five years) |
| 5 | High | 1 in 2 or more (50% or more stated chance in five years) |

*Definition of risk ratings*

Very high — These are classed as primary or critical risks requiring immediate attention. They may have a high or low likelihood of occurrence, but their potential consequences are such that they must be treated as a high priority. This may mean that strategies should be developed to reduce or eliminate the risks, but also that mitigation in the form of (multi-agency) planning, exercising and training for these hazards should be put in place and the risk monitored on a regular frequency. Consideration should be given to planning being specific to the risk rather than generic.

High — These risks are classed as significant. They may have a high or low likelihood of occurrence, but their potential consequences are sufficiently

| | |
|---|---|
| | serious to warrant appropriate consideration after those risks classed as 'very high'. Consideration should be given to the development of strategies to reduce or eliminate the risks, but also mitigation in the form of at least (multi agency) generic planning, exercising and training should be put in place and the risk monitored on a regular frequency. |
| Medium | These risks are less significant, but may cause upset and inconvenience in the short term. These risks should be monitored to ensure that they are being appropriately managed and consideration given to their being managed under generic emergency planning arrangements. |
| Low | These risks are both unlikely to occur and not significant in their impact. They should be managed using normal or generic planning arrangements and require minimal monitoring and control unless subsequent risk assessments show a substantial change, prompting a move to another risk category. |

## Appendix 2 - Case Study: 2003 Heatwave

*The information contained in the case study below has been extracted from the Met Office website.*

A high pressure area located over Western Europe in August 2003 led to a hot, dry, continental airflow across the United Kingdom for much of the month. This led to record temperatures across much of the United Kingdom. The United Kingdom record maximum temperature was reported on the 10th August at Faversham, Kent with 38.5°C.

For Surrey, the summer's mean temperature was 1.66°C above the long term average. For August this figure was 2.5°C above with maximum temperatures at 3.3°C above average. The maximum temperature recorded in Surrey was 37.8°C at Wisley.

There were significant impacts seen across Europe from the heatwave.

- An estimated 30,000 excess deaths across Europe (including 2,000 in the United Kingdom)
- Rivers and reservoirs fell to record low levels threatening water supplies with hosepipe bans introduced in the United Kingdom.
- Forest fires occurred across Europe with an estimated 647,000 hectares being destroyed.
- Livestock died across Europe due to the high temperatures and crops failed due to the dry weather. It is estimated to have cost European farmers as much as 13.1 billion Euros.
- Railway tracks buckled and road surfaces melted in the heat with Network Rail imposing speed limits across its network.
- A few European power stations had to be shut down as there was not enough water to cool them.
- Poor air quality which was estimated to have led to a third of the excess deaths in the United Kingdom.

- Deaths from drowning as people try to cool off in rivers and lakes.

## Appendix 3 - Case Study: 2011 Swinley Forest Fire

*The information contained in the case study below has been extracted from the Met Office website.*

In Spring 2011 there were some remarkably dry and warm conditions across England and Wales. It was the warmest spring across the United Kingdom for 100 years and the second driest spring across England and Wales. April was exceptionally dry and warm.
One of the impacts from these conditions were forest and moorland fires across many parts of the country including the Torridon Forest in the Scottish Highlands, the Mourne mountains in Northern Ireland, the Brecon Beacons in Wales, and Swinley Forest in Berkshire.
Swinley Forest, which lies across the Surrey-Berkshire border, was affected by a fire at the beginning of May 2011. Spring 2011 saw just 42% of the long term average rainfall for Surrey leading to ideal conditions for fires to take hold. The fire, started maliciously, quickly took hold and spread across 300 hectares of the forest and, at its peak, was being tackled by around 200 firefighters. The fire led to some significant impacts for the local area:

- Roads, including the A3095 and B3430, were closed.
- Schools in Bracknell and Crowthorne were closed.
- Residents were evacuated from nearby homes.
- Environmental damage to a Special Protection Area for three rare birds.
- An economic impact in excess of £1 million.

## Appendix 4 – Brockham Emergency Response Team

*The information contained in the case study below has been drafted by Elizabeth Fowler, Community Resilience Officer, Surrey County Council*

An example of one of the community resilience groups already in existence in Surrey are the Brockham Emergency Response Team (BERT). They supported their local community during the 2013/14 floods, not only pumping water but using go-carts and trailers to distribute sandbags and helping vulnerable people in the community. Robert explains how the group tackles both emergencies and prevention.

“Brockham is a great community but its resilience comes from the fact that people of all ages and from all walks of life live within the parish – during the spell of atrocious weather in November and December 2013 we had a team with a wide range of skills where the youngest member was 13 and the oldest was 70.

“The role of the group is to respond to calls for help of all types from the community, mostly following, or during, bad weather or a power cut.

“Prevention is a major part of what we do, such as clearing drainage ditches in the village. That’s also led to farmers and householders cleaning out and maintaining their own drainage ditches. There’s a strong ‘can do’ and ‘will do’ attitude.”

# Glossary

*The definition below has been extracted from the European Commission's website and can be found here: http://ec.europa.eu/clima/policies/adaptation/index_en.htm*

- Adaptation

Adaptation refers to the ability to anticipate the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise.

*The definition below has been extracted from the 'Chapter 4 Local responder risk assessment duty' guidance document. This document can be found here: site and can be found here:*
*https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61027/Chapter-4-Local_20Responder-Risk-assessment-duty-revised-March.pdf*

- Risk mitigation

This definition is inconsistent with that commonly used in risk management when it is common to talk about mitigating risks. In fact, risk mitigation is defined as reducing the likelihood of a risk, rather than having plans and measures in place to deal with a risk once it has happened (Cabinet Office 2012).

*The definition below has been extracted from the 'Strategic National Framework on Community Resilience', March 2011. This document can be found here:*
*https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/60922/Strategic-National-Framework-on-Community-Resilience_0.pdf*

- Community

In general terms, communities are groups of people linked by a common bond. In Strategic National Framework on Community Resilience, the Cabinet Office identifies and refers to four conceptual 'communities' who are relevant to the emergency management arena. These are: geographical communities, communities of 'Interest', communities of 'circumstance' and finally communities of 'supporters'.

*The definitions below have been extracted from the 'Lexicon of UK Civil Protection Terminology', verison 2.1.1, February 2013. This document can be found here:*
*https://www.gov.uk/government/publications/emergency-responder-interoperability-lexicon*

- Category 1 Responder

A person or body listed in Part 1 of Schedule 1 to the Civil Contingencies Act. These bodies are likely to be at the core of the response to most emergencies. As such, they are subject to the full range of civil protection duties in the Act.

- Category 2 Responder

A person or body listed in Part 3 of Schedule 1 to the Civil Contingencies Act. These are co-operating responders who are less likely to be involved in the heart of multi-agency planning work, but will be heavily involved in preparing for incidents affecting their sectors. The Act requires them to co-operate and share information with other Category 1 and 2 responders.

- Civil Contingencies Act (2004)

Act of 2004 which established a single framework for Civil Protection in the United Kingdom. Part 1 of the Act establishes a clear set of roles and responsibilities for Local Responders; Part 2 of the Act establishes emergency powers

- Community resilience

Communities and individuals harnessing local resources and expertise to help themselves in an emergency, in a way that complements the response of the emergency services.

- Community Risk Register

A register communicating the assessment of risks within a Local Resilience Area which is developed and published as a basis for informing local communities and directing civil protection work-streams.

- Local Resilience Forum

Process for bringing together all the Category 1 and 2 Responders within a Police Force area for the purpose of facilitating co-operation in fulfilment of their duties under the Civil Contingencies Act 2004.

- Vulnerable person

A person who is less able to help themself in the circumstances of an emergency.

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