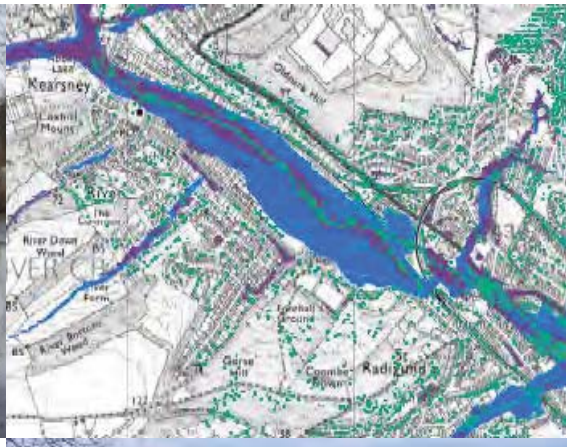
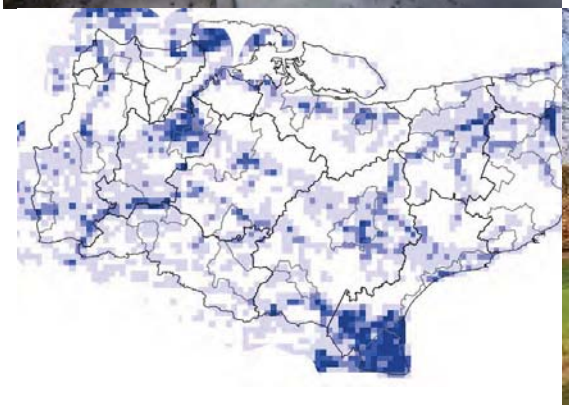
Kent County Council

# Preliminary Flood Risk Assessment

Final

September 2011



Kent County Council

# Executive Summary

This Preliminary Flood Risk Assessment (PFRA) has been prepared to meet our duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). The PFRA, comprising this document and the supporting spreadsheet are the first stage of the Regulations.

The PFRA is intended provide a high level overview of flood risk and identify areas of significant flood risk that need to be investigated in further stages of the Regulations.

Kent County Council is defined as a Lead Local Flood Authority (LLFA) under the Regulations. As a LLFA, Kent County Council must undertake a review of the risk from local flood sources, which include surface water, groundwater and ordinary watercourses. The Environment Agency will be responsible for delivering the assessment of fluvial and coastal flood risks.

The methodology for producing this PFRA has been based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas, both published in December 2010. The PFRA should report:

- Areas of significant flood risk – defined by the Minister as towns and cities where 30,000 people or more are estimated to be at risk of surface water flooding;
- Future flood risks – no advice is given on the scale of risk for reporting; and
- Past flood events with significant harmful consequences – which are advised to be 'an order of magnitude lower' than the significant flood risk criteria, i.e. approximately 3,000 people at risk of flooding.

The Environment Agency has undertaken a national exercise to map areas at risk of surface water flooding to help identify the future flood risk and significant flood risk areas across England and Wales.

Ten significant areas of surface water flood risk have been identified in England, of these ten areas, none are located within Kent County Council's administrative area. This has been reviewed as part of the PFRA and is not in dispute. As a consequence, Kent County Council will not be required to undertake the further stages of the Regulations.

However, that does not mean that Kent does not face significant risks from surface water flooding. In fact Kent is estimated to be the most at risk LLFA in England from surface water flooding. Approximately 70,000 properties are estimated to be at risk during a rainfall event with a 1 in 200 annual chance of occurring. The next highest LLFA is Hertfordshire with approximately 56,000 properties at risk.

A summary of the estimated risks to Kent from surface water flooding have been and presented in the PFRA for 48 'settlements' (based on groups of wards) that represent the whole of Kent. Appendix 1 contains a summary of

this risk information and a map showing the relative risk to each settlement determined by the number of dwellings flooded by surface water per square kilometre.

Kent also has significant flood risks from groundwater and ordinary watercourses, however the data available to assess these risks is less quantitative.

Information relating to approximately 2,500 flood events, caused by flooding from local sources, was collected from approximately 20 different local and national sources including the twelve district and borough councils, the Environment Agency, water companies, Internal Drainage Boards, emergency services and other risk management authorities.

Based on the evidence that was collected, no past flood events were considered to have had 'significant harmful consequences'. Therefore, no records of past flooding have been included in the PFRA, in accordance with the guidance.

The PFRA has been helpful to develop an overall understanding of the flood risk across Kent and highlight which areas are most vulnerable, which will be needed as we deliver other responsibilities required by the Flood and Water Management Act 2010, especially the Local Flood Risk Management Strategy.

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# Glossary

| Term | Description |
|---|---|
| AStSW | Areas Susceptible to Surface Water Flooding |
| Coastal Flooding | Flooding at the coast that is caused by a storm, high tide or other coastal process |
| CFMP | Catchment Flood Management Plan |
| Defra | Department for Environment, Food and Rural Affairs |
| DG5 | Register of sewer flooding incidents that must be kept by Water Companies |
| EA | Environment Agency |
| EC | European Commission |
| Fluvial Flooding | Flooding from rivers |
| FMfSW | Flood Map for Surface Water |
| FWMA | Flood & Water Management Act 2010 |
| IDB | Internal Drainage Board |
| Internal Drainage Board | Local boards established to manage areas of special drainage need |
| KCC | Kent County Council |
| LDF | Local Development Framework |
| LLFA | Lead Local Flood Authority |
| LRF | Local Resilience Forum |
| NRD | National Receptor Database |
| OA | Output Area |
| Ordinary Watercourse | Small watercourses managed by IDBs or District Councils |
| PFRA | Preliminary Flood Risk Assessment |
| PPS25 | Planning and Policy Statement 25: Development and Flood Risk |
| RFCC | Regional Flood and Coastal Committee |
| RFDC | Regional Flood Defence Committee |
| RMA | Risk Management Authority |
| SFRA | Strategic Flood Risk Assessment |
| SUDS | Sustainable Drainage Systems |
| SWMP | Surface Water Management Plan |
| WAG | Welsh Assembly Government |

# 1 Introduction

## *1.1 Scope*

As the Lead Local Flood Authority (LLFA) for Kent county, Kent County Council (KCC) has been tasked with preparing a Preliminary Flood Risk Assessment (PFRA). The PFRA is a high level review of flood risk within Kent that is caused by local flooding. Local flooding is flooding that is caused by the following sources:

- **Surface water**,
- **Groundwater**,
- **Ordinary Watercourses**[1].

The Environment Agency is responsible for identifying the risks from main rivers and coastal flooding, the risks from these sources is not included in this report.

Kent County Council includes 12 district and borough councils:

- Ashford Borough Council,
- Canterbury City Council,
- Dartford Borough Council,
- Dover District Council,
- Gravesham Borough Council,
- Maidstone Borough Council,
- Sevenoaks District Council,
- Shepway District Council,
- Swale Borough Council,
- Thanet District Council,
- Tonbridge and Malling District Council,
- Tunbridge Wells Borough Council.

The study area of this report is shown in Figure 1.

As a separate LLFA, Medway Council are responsible for preparing a PFRA for the Medway Council area.

[1] Ordinary watercourses are watercourses that are not main rivers. Main rivers are managed by the Environment Agency, ordinary watercourses are managed by district councils or Internal Drainage Boards.

## 1.2 Background

The Flood and Water Management Act 2010 (the Act) creates Lead Local Flood Authorities (LLFAs) at the County or Unity Council level. LLFAs have a responsibility for the strategic management of local flood risk. Local flood risk is defined in the Act as flooding from surface water, groundwater and ordinary watercourses.

The PFRA is a report required by the Flood Risk Regulations (the Regulations), which itself is a transposition of the EU Floods Directive (Directive 2007/60/EC) into UK Law. The purpose of the PFRA is to identify areas of significant flood risk. Once areas of significant risk have been identified the Regulations require two further stages to be undertaken to map the risk in these areas and to prepare a strategy for managing the risk. A timetable for the Regulations is given in Table 1.

**Table 1 Timetable for flood risk regulation deliverables**

| Deliverable | Due Date to EA | Due Date to EU |
|---|---|---|
| Preliminary flood risk assessment (PFRA) | June 2011 | December 2011 |
| Flood hazard and risk maps | June 2013 | December 2013 |
| Flood risk management plans | June 2015 | December 2015 |
| Periodic Review | Every 6 years | |

The subsequent stages of the Regulations are only required for areas identified as at significant risk in the PFRA. Therefore the PFRA is a report that covers the whole authority, however any further stages of the Regulations that may be undertaken are for specific risk areas.

## 1.3 Objectives

The PFRA is a high level screening exercise to locate areas in which the risk of surface water and groundwater flooding is significant and warrants further examination through the production of maps and management plans.

The aim of this PFRA is to provide an assessment of local flood risk across the study area, including information on past floods and the potential consequences of future floods.

The key objectives are:

- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures.
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events.

- Establish an evidence base of historic flood risk information, which will be built up on in the future and used to support and inform the preparation of Kent's Local Flood Risk Strategy.
- Assess the potential harmful consequences of future flood events within the study area.
- Review the provisional national assessment of indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas.
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information.

## *1.4 Flood risks*

### 1.4.1 Surface water

Surface water flooding occurs when heavy rainfall exceeds the capacity of the ground and local drainage networks to absorb it. This can lead to water flowing across the ground and ponding in low-lying areas. This sort of flooding is typically caused by short intense rainfall events.

### 1.4.2 Groundwater

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from ephemeral springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

### 1.4.3 Ordinary watercourses

Ordinary watercourses are small watercourses that are not designated as main river. Main rivers are the responsibility of the Environment Agency, the responsibility for ordinary watercourses lies either with district or borough councils or with Internal Drainage Boards (IDBs) where they operate.

The flooding mechanism for ordinary watercourses is similar to flooding from rivers, but the small nature of these watercourses means that the flooding is often on a local scale. However, IDBs often cover areas with a high concentration of ordinary watercourses where drainage is difficult and one rainfall event can cause flooding on several ordinary watercourses simultaneously. Ordinary watercourse flooding is also often effected by water levels in nearby main rivers that the ordinary watercourses would otherwise discharge into.

### 1.4.4 Sewer flooding

Sewer flooding is caused by a volume of surface water entering the drainage network that exceeds the capacity of the network. The nature of the sewer

network means that the flooding may occur away from the source of the surface water. This type of flooding is particularly severe when a combined sewer floods as it causes effluent to be discharged that can have health and environmental consequences.

# 2 Local flood risk responsibilities

## *2.1 Risk Management Authorities*

As well as defining county and unitary councils as the LLFA, the Act also defines Risk Management Authorities (RMAs) with responsibilities for delivering flood risk management functions. The RMAs are:

- District councils,
- Environment Agency,
- Water companies,
- Internal Drainage Boards (IDBs),
- Highways Authorities.

The Act requires all RMAs to cooperate and to work together to deliver strategic flood risk management.

## *2.2 Further responsibilities*

The Act gives KCC as a LLFA a wide range of responsibilities for the strategic management of local flood risks besides just the PFRA. These responsibilities include:

- **Investigating flood incidents** – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.
- **Asset Register** – LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- **SUDS Approving Body** – LLFAs are designated the SUDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SUDS) within their area.
- **Local Flood Risk Management Strategy** – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information

such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.

- **Works powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.
- **Designation powers** – LLFAs, as well as district councils and the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

## *2.3 Local governance*

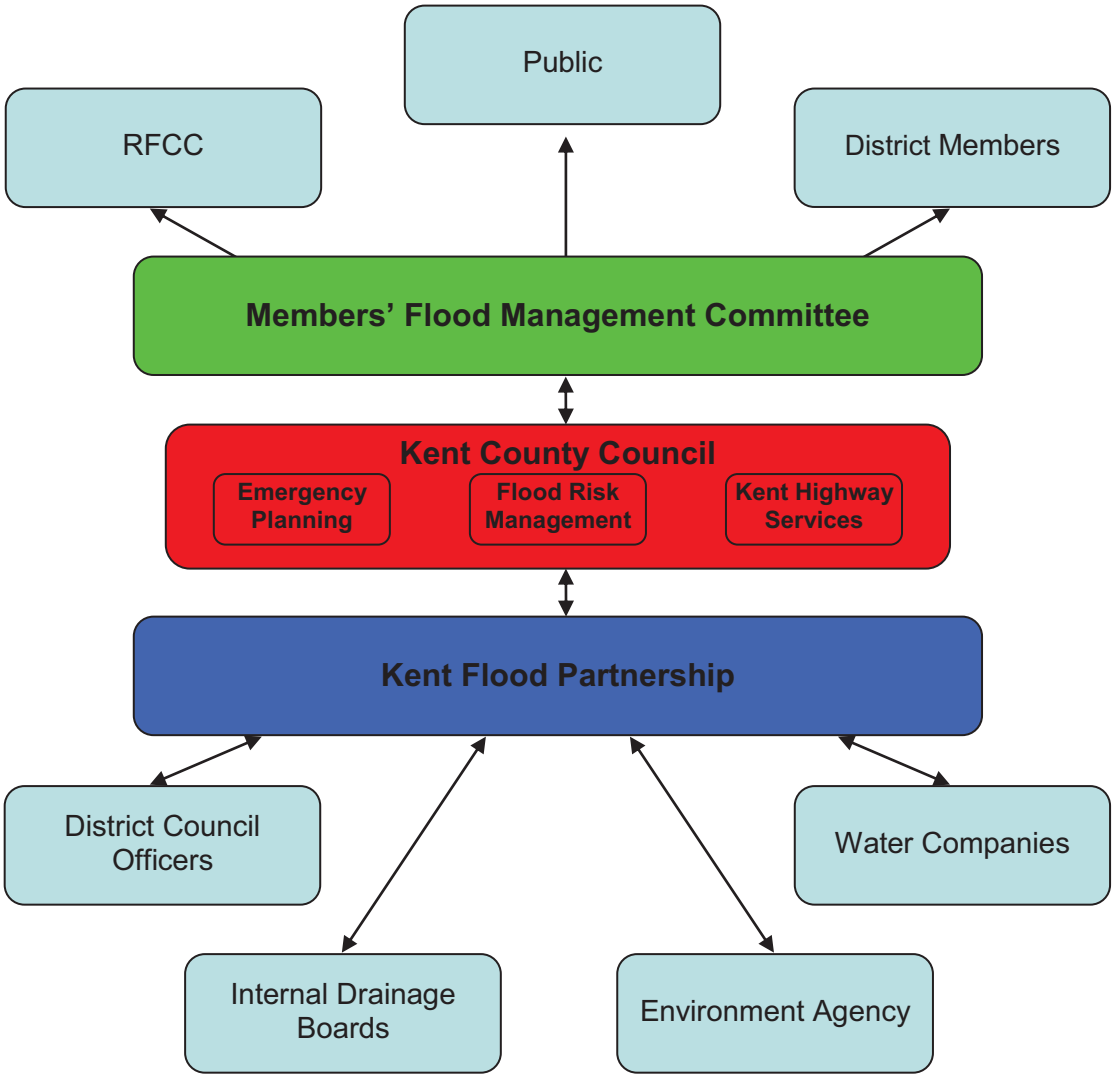
KCC is responsible for delivering the PFRA and for undertaking local consultation. To facilitate this and to help coordinate the delivery of other flood risk management responsibilities KCC has formed a members committee for flood risk management, the KCC Flood Risk Committee, and a pan-Kent group for officers from the Risk Management Authorities. Diagram 1 illustrates the role of these groups.

## *2.4 PFRA*

The management of local flooding has previously been on a largely ad hoc basis with various authorities having responsibility for certain aspects with little or no duty to cooperate. Given this new task to coordinate local flood risk management, the PFRA represents an opportunity for us as a LLFA to understand the scale and geographic extent of local flood risk.

This will be particularly important in helping us to deliver the Local Flood Risk Management Strategy (the Local Strategy). The Local Strategy is a document that will set out our policy for the management of local flood risk in Kent. All RMAs are obliged to act consistently with the Local Strategy.

**Diagram 1 Relationship of Risk Management Authorities in Kent**




# 3 Methodology and data review

## *3.1 Introduction*

The PFRA is a high-level screening exercise used to identify towns and cities where the risk of flooding is considered to be significant and warrants further examination and management through the production of flood risk and flood hazard maps and flood risk management plans in the subsequent phases of the Regulations.

The approach for producing this PFRA was based upon the Environment Agency's PFRA Final Guidance, which was released in December 2010. The PFRA is based on readily available or derivable data.

There are three key deliverables as part of this PFRA:

- To identify historic local flooding events that have had recorded significant harmful impacts;

- To identify areas of potential future flood risk; and
- To identify indicative areas of significant future flood risk.

The definition of significant for the latter case is defined by the minister as areas where 30,000 people are at risk of flooding, these areas will then be taken forward in the further stages of the Regulations. At this scale the areas that are identified are ones where, should this scale of local flooding occur, it would be nationally significant news.

For the former case the definition of significant is left for local determination, although the guidance suggests that it should be approximately an order of magnitude lower than the national level of significance, i.e. approximately 3,000 people at risk. The guidance also specifies that there must be specific records of the harmful impacts of the flood incidents, anecdotal evidence is not sufficient.

## *3.2 Flood risk identification methodology*

### 3.2.1 Data collection

The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA: 12 district and borough councils, Southern Water, Thames Water, Kent Highways Services, Upper and Lower Medway Internal Drainage Boards, Romney Marshes Area Internal Drainage Board, River Stour Internal Drainage Board and the Environment Agency.

The Kent Fire and Rescue and parish councils were not routinely contacted for information. This is because previous experience has indicated that the records kept by these organisations are usually either hard to filter for specific flood risk incidents and causes (i.e. an incident recorded as a flood event may be a broken washing machine or it may be a river flood event) or they are only anecdotal. It was decided that only where other sources indicated a significant flood event would these organisation be approached as the date and source of the flooding would help to find the appropriate data, which could then be used to improve the existing records.

With this approach some small events that only these organisations are aware of may be missed, but no significant events would be missed as they would not be recorded by these organisations alone.

Table 2 describes the data that was collected from each of the RMAs.

**Table 2 Datasets and data sources**

| Source RMA | Dataset | Description |
|---|---|---|
| Environment Agency | Areas Susceptible to Surface Water Flooding (AStSW) | The first generation national mapping, outlining areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more). |

| Source RMA | Dataset | Description |
|---|---|---|
| | Flood Map for Surface Water (FMfSW) | The updated (second generation) national surface water flood mapping which was released at the end of 2010. This dataset includes two flood events (with a 1 in 30 and a 1 in 200 chance of occurring) and two depth bandings (greater than 0.1 m and greater than 0.3 m). |
| | Flood Map (rivers and the sea) | Shows the extent of flooding from rivers with a catchment of more than 3 km² from the sea. |
| | Areas susceptible to groundwater flooding | Coarse scale national mapping showing areas which are susceptible to groundwater flooding. |
| | National Receptors Dataset | A national dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations. |
| | Indicative flood risk areas | Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG. |
| | Historic flood map | Attributed spatial flood extent data for flooding from all sources. |
| | Detailed river network | Map of watercourses with attributes describing watercourse type. |
| **District and borough councils** | Strategic Flood Risk Assessments (SFRA) | SFRAs may contain useful information on historic flooding, including local sources of flooding from surface water, groundwater and flooding from canals. |
| | Historical flooding records | Historical records of flooding from surface water, groundwater and ordinary watercourses. |
| **Kent County Council** | Highways Flooding Reports | Highways Flooding Reports for a number of locations within Kent, including details of the flood risk at each location. |
| | Demographic data | Maps of various demographic areas in Kent, for example Output Areas, wards, etc, including population estimates. |

| Source RMA | Dataset | Description |
|---|---|---|
| | Dover Surface Water Management Plan (SWMP) outputs | Maps from the SWMP undertaken for Dover. |
| Southern and Thames Water | DG5 Register for Southern Water areas | Historic Flood Records (hydraulic overload). |
| | DG5 Register for Thames Water Utilities areas | Historic Flood Records (hydraulic overload). |

### 3.2.2 Assessing historic flood risk

Existing datasets and reports from the stakeholders listed above were collated and reviewed to identify details of past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

Where necessary and where sufficient information was available data that had no geographic referencing was geo-referenced so that it could be put onto maps. Some data that was collected could not be geo-referenced due to a lack of sufficient geographical data to determine the specific location.

### 3.2.3 Assessing future flood risk

#### Surface water flooding

To identify future flood risks predicted flood event data needs to be used. To fill the gap in LLFA data regarding the modelled impact of surface water flood events the Environment Agency has undertaken a national surface water modelling exercise. This exercise has produced two data sets of areas affected by surface water flooding: the Areas Susceptible to Surface Water Flooding (AStSW) Map and the Flood Map from Surface Water (FMfSW). This data is available to all LLFAs.

The FMfSW is divided into two risks categories according to the predicted depth of flooding: greater than 0.1 m and greater than 0.3 m. The greater than 0.3 m category has been used from this dataset, as this depth approximates to an average threshold level for most properties, therefore properties in this area are likely to experience internal flooding. Flooding up to 0.1 m is unlikely to flood many properties internally.

Additionally, to assess the impact of these areas identified as at risk, the Environment Agency has also provided a dataset of receptors the National Receptor Database (NRD), which gives the geographical location of properties and the property type (for example residential dwelling, shop, factory etc). This has been used to calculate the number and type of

properties at risk in a given area using Geographical Information Systems (GIS) software, according to the methodology given in Property Count Method (Environment Agency, 2010).

Using the NRD and other receptor datasets the risk to the following receptors has been assessed:

- Dwellings.
- Critical services (schools, hospitals, electrical substations etc).
- Non-residential properties (all properties that are not dwellings, including critical services).
- Length of roads and rail.
- Agricultural land.

### Groundwater flooding

It is technically challenging to quantify the risk from groundwater flooding. At present there is no data available on the probability or depth of groundwater flood events. The Environment Agency has provided a relative risk map of areas susceptible to groundwater flooding. This map is based on areas that are topographically downstream of potential groundwater emergence areas. The estimate of risk in this map does not include any estimate of the likelihood or the volume of groundwater emerging.

Any flooding that occurs from groundwater will still affect the same areas as those indicated by the FMfSW, as this maps topographical flow routes and the groundwater will follow the same routes as surface water (as long as the property lies within or downstream of the emergence area). Therefore, areas identified as at risk of surface water that lie in the groundwater flooding susceptible areas *may* also be identified as at risk of groundwater flooding.

### Ordinary Watercourse flooding

As with groundwater the risk from ordinary watercourses is not well documented on a national scale. The Environment Agency Flood Map, of coastal and fluvial flood risk, does include some ordinary watercourses. However the complex interrelationship between ordinary watercourses and main rivers in the most sensitive areas and the larger scale of the main rivers in comparison to the ordinary watercourses means that areas indicated by this map are dominated by the effects of the main rivers. It is impossible to disaggregate the risk of ordinary watercourses from that from main rivers, therefore using the Flood Map leads to an over estimate of the potential risk.

As an alternative indication of the ordinary watercourse flood risk the settlements that have a high concentration of ordinary watercourses within them are assumed to have a higher risk of flooding from this source, as the presence of many watercourses generally indicates that the land does not drain well. Measuring the length of ordinary watercourses per settlement and normalising this with the area of the settlement provides an indication of the

risk from this source. This methodology is crude as it does not indicate if there is any direct risk to properties, further work is required to quantify this risk.

### 3.2.4 Identifying indicative flood risk areas

The definition of indicative flood risk areas has been made by the Minister. It is set at towns or cities where 30,000 people or more are at risk of surface water flooding. This is calculated by measuring the number of dwellings affected by the 1 in 200 year greater than 0.3m FMfSW event and multiplying by an occupancy rate of 2.34 people per dwelling.

An initial screening of these indicative areas has been undertaken nationally by the Environment Agency, which has identified 10 areas in England. As part of the PFRA LLFAs must review any indicative flood risk areas in their authority and decide if they agree or if any other areas in their authority should be added to this. There are strict criteria for adding or removing an indicative risk area given in the guidance.

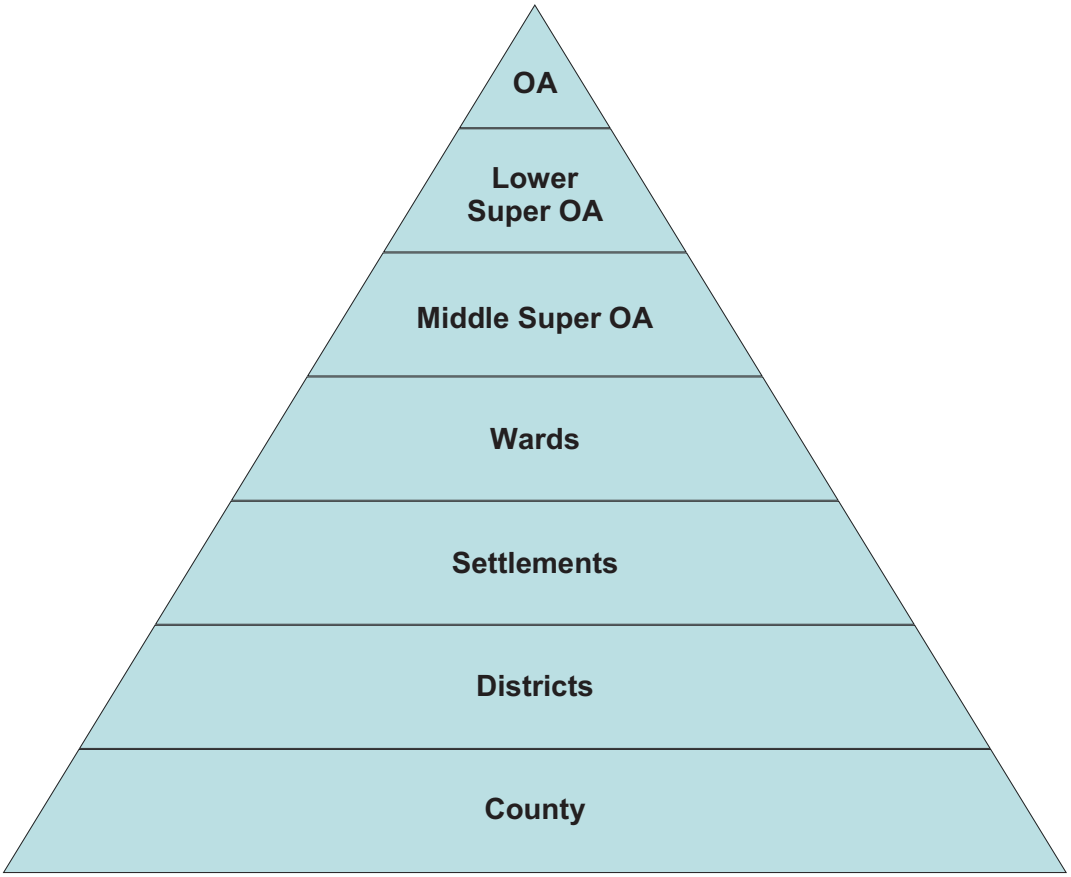
### 3.2.5 Data display

The county of Kent is large with many flood risks whilst the NRD and historic flood risk data is at a very small geographical level. In order to provide useful data at the county scale the numbers of properties at risk of flooding have been counted at various levels of reporting unit. The smallest level of unit that has been used is the Output Area (OA), once in these units the relevant OAs can be aggregated to give larger units. The hierarchy of reporting units is given in Diagram 2.

The advantage of using these areas to count and display the data is that population data is known for the units, which can be useful in assessing the impact of flooding, and that they broadly conform to areas of similar character, particularly at the lower levels where there are generally urban, suburban and rural units.

For the purposes of the PFRA the Settlement level has been chosen to count and display the risk. This is because at the county level this allows the areas to be distinguishable on one map and they are of recognised areas, as requested in the PFRA guidance. Figure 2 shows the settlements in Kent that have been used for the PFRA. KCC has the data that makes up these units and we area able to distinguish the flood risk for the constituent parts of these units, these have been chosen here for convenience.

**Diagram 2 Hierarchy of reporting units**




## *3.3 Data review*

### 3.3.1 Historic flood data

Records of historic flood risk in Kent are inconsistent. Some organisations have a statutory requirement to record data, for example the water companies, however this requirement is for specific issues only and those organisations that record this data do not record all events. Some organisations that record flood incidents only record certain types of event, for instance some district councils record only flooding from ordinary water courses and not surface water. Some organisations do not have official records of flood events, only anecdotal information.

Some historic data does not have data on the geographical location or extent of the event. Where possible this has been added, however flooding that is referenced for a road, for instance, may flood a long stretch or only a short depression and it is difficult to estimate the extent of the impact from the records, this has only been done where the records are explicit.

Historic flood data of this nature, no matter how accurately the geographical referencing is, rarely contains accurate records of the flood event itself, which can include the exact source of the flooding, the length of time of the flood or the depth of flooding. Additionally, some organisations have commercial sensitivity about the data and may be reluctant to release all the details. This can make the data ineffective as a verification tool for modelled outputs.

### 3.3.2 Future flood risk

The two surface water flood datasets, AStSW and FMfSW, are a significant improvement on no data, which is what would be available for the majority for Kent without these. However, the national mapping exercises that were undertaken to produce both these datasets had limitations that need to be understood and they should be used with caution.

The first dataset, AStSW, used a very simple model of estimated rainfall, a 1 in 200 year event, over a national terrain model and simulated the path of rainfall (after making adjustments for infiltration and surface roughness). This did not take any account of sewage infrastructure or of the presence of buildings.

The second dataset, FMfSW, was intended to improve upon the limitations of the AStSW, by including an estimate of the impact of sewers and the presence of buildings. However, the capacity of the sewers has been assumed nationally and this has been rendered in the model by reducing the rainfall by a set amount (to account for the assumed capacity of the sewers). In reality the capacity of sewers varies and the rainfall that runs into sewers is not lost (as this method would have it) but is still in the sewer network and can have an impact downstream as the cumulative effect of runoff in the sewers reduces the capacity, leading to increased flood risk in areas where there is a large upstream sewer catchment.

Figure 3 shows a comparison of the two Environment Agency surface water flooding datasets with modelling that has been undertaken in Dover for the Surface Water Management Plan (SWMP), which has included the sewers in the modelling. The FMfSW appears to be more accurate than the AStSW as it follows expected flow routes along roads etc. However, the FWfSW is clearly increasing the risk of flooding in uphill areas (the northwest of Dover) in comparison to the Dover SWMP modelling.

It should be noted that as there is no observational data for any surface water flooding on this scale in Dover, the assumed superior accuracy of the Dover SWMP modelling is only hypothetical, based on engineering judgement. The SWMP modelling includes more drainage infrastructure and more care has been taken over the representation of Dover, which is feasible on this local scale but difficult to replicate in a national mapping exercise. There is no recorded data to suggest that the Dover SWMP mapping is more accurate than the other two sources, or that the FMfSW is more accurate than AStSW, this has been assumed based on judgement.

The NRD used to count the properties at risk is also a source of inaccuracy. The NRD is a very useful dataset, however it is, to a degree, incomplete and inaccurate. Some areas do not have all the property types that are present, which is especially significant when looking at critical services for instance. Some properties are recorded in the wrong place or not at all or have the incorrect attributes. It has not been possible to quality assure or review this dataset for the whole county of Kent.

## *3.4 Data restrictions and recording*

### 3.4.1 Data restrictions and confidentiality

Some of the data provided for this report has restrictions on its use that Kent County Council must adhere to. These restrictions are summarised in Table 3.

**Table 3 Data restrictions**

| Data source | Data restriction |
|---|---|
| Environment Agency | The use of some data is restricted to Kent County Council for the preparation of its preliminary flood risk assessment, including topographic data and the national receptor database. The use of other data is unrestricted. |
| Southern Water | The use of provided data is restricted to Kent County Council for the preparation of its preliminary flood risk assessment. |
| Thames Water | Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement. |

### 3.4.2 Data recording

As mentioned above flood history data is recorded in an ad hoc and inconsistent manner. Kent County Council will work with the Risk Management Authorities to develop a consistent recording template for future flood events that will have broad access, be held centrally and be available to the public.

# 4 Past flood risk

Flood records across Kent were collected from the data sources discussed in Table 2. Records of approximately 2,500 historical flood events and flooding hotspots were collected across Kent County Council's administrative area. These records go back to 1986, with the majority being record since 2000. A

summary map highlighting the locations of these past flood events is shown in Figure 4.

These flood events came from a range of flood sources, and in many cases the source of flooding was unknown or not recorded, therefore some of these events may represent flooding from sources that we are not concerned with in the PFRA.

The distribution of data in Figure 4 does not necessarily represent the distribution of flood risk, it more accurately represents the quality of data recording by other RMAs in Kent. Each individual event recorded may represent the flooding of any number of properties, very few records specify the scale of the flood event, or may only indicate that a road was flooded or sandbags were requested.

There are no flood records that record the flooding of more than 1,000 properties or anything that approaches that number, which is approximately the order of event that we should be reporting in the PFRA, as outlined in Section 3.1. The largest flood event that records are available for is the flooding of the Pent Stream in Folkestone in September 1996, which flooded approximately 400 properties. However, the Pent Stream is a main river, which is not the subject of this report and mitigation measures have been put in place since this event.

Due to this lack of records no historic flood events have been considered to have had 'significant harmful consequences' and therefore none will be recorded in Annex 1 of the Preliminary Assessment Spreadsheet.

This record of flood events will be kept by Kent County Council as an evidence base. This will be built up in the future with further details of flood events and will then be used to support and inform future PFRA cycles as well as the Local Flood Risk Management Strategy.

# 5 Future flood risk

## *5.1 Overview of flood risks*

### 5.1.1 Surface water

Kent County has the highest surface water flood risk of any LLFA in England, according to the Environment Agency's national surface water mapping exercises. Table 4 shows the number of properties indicated to be at risk in the top five LLFAs in the 1 in 200 year greater than 0.3 m event.

The flood risk in Kent is not concentrated in one area. Surface water flood risk is generally worse in urban areas, due to the lower infiltration potential of the surface and the increased density of the population. The population distribution in Kent is fairly even with no settlements having more than 10% of the population of Kent. Therefore the distribution of surface water flood risks in Kent is fairly even, with each district having at least one settlement or conurbation identified as at risk. This leads to a total risk in Kent that is very high and the challenge as a LLFA to manage this risk is significant.

**Table 4 Properties at risk from surface water flooding**

| LLFA | Estimated number of properties at risk of surface water flooding *(flooding to a depth of 0.3 m from an event with a 1 in 200 annual chance of occurring)* |
|---|---|
| Kent County | 75,800 |
| Essex County | 54,400 |
| Hertfordshire County | 53,000 |
| Devon County | 50,000 |
| Hampshire County | 46,600 |

The whole of Kent has approximately 76,000 properties at risk of surface water flooding, of which approximately 60,000 are residential dwellings (this does not include dwellings that would be inaccessible in a surface water flood event as a result of blocked roads etc). This is estimated to be approximately 140,000 people at risk (using the national occupancy rate of 2.34 people per dwelling).

This highlights the significant issue in Kent: that the flood risk from local sources is relatively evenly spread and the management of local flooding will require investment in many different studies and initiatives over a long time period, rather than one project.

The flood risk from surface water for each Kent has been reported in Annex 2[2]. In line with guidance on completing Annex 2 only the total for Kent has been reported. However, to provide more detail on the areas in Kent that are at risk Table 5 and Figure 5 shows the relative risk to dwellings for all settlements.

As stated in Section 3.2.5, data is available for areas within each settlement and the risk to smaller areas can be determined, but the settlements have been used for the purposes of this report for their convenience. Future flood risk management decisions will be based upon the most relevant data at the most relevant scale, not necessarily on the statistics given for these areas alone.

[2] The count method used in this PFRA is slightly different to the method used by the Environment Agency, due to the availability of the property data we aren't able to count as many properties. Therefore the total number of properties at risk reported in Table 5 does not exactly match the Environment Agency's total given in Table 4.

**Table 5 Summary of settlement flood risks from 1 in 200 year greater than 0.3 m surface water event (ranked by dwellings at risk)**

| Settlement | Total Area, km² | Total Population | Dwellings at risk | Critical Services at risk | Non-residential properties at risk | Rail and Roads at risk, km | Agricultural Land at risk, ha | OW Length, km | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Maidstone | 84.59 | 106,980 | 4,988 | 62 | 488 | 23.046 | 147 | 48 | |
| Gravesend/ Northfleet | 23.18 | 78,555 | 3,790 | 23 | 359 | 14.436 | 18 | 12 | |
| Dartford | 53.96 | 83,585 | 3,530 | 62 | 617 | 23.230 | 68 | 38 | |
| Folkestone | 16.17 | 46,305 | 3,389 | 31 | 336 | 11.780 | 17 | 13 | |
| Canterbury | 36.59 | 49,040 | 3,109 | 55 | 437 | 14.866 | 74 | 44 | |
| Sittingbourne | 27.69 | 45,235 | 2,878 | 30 | 239 | 15.941 | 62 | 16 | |
| Tunbridge Wells/ Southborough | 55.96 | 65,640 | 2,792 | 26 | 345 | 6.587 | 129 | 100 | |
| Sevenoaks rural | 297.90 | 47,430 | 2,673 | 55 | 250 | 59.048 | 1,020 | 368 | |
| Dover | 48.07 | 39,335 | 2,613 | 98 | 626 | 21.369 | 95 | 7 | |
| Margate | 14.23 | 47,940 | 2,320 | 21 | 101 | 6.724 | 14 | 0 | |
| Ramsgate | 12.13 | 41,335 | 1,825 | 18 | 290 | 7.115 | 9 | 4 | |
| Tonbridge & Malling rural area | 167.29 | 45,930 | 1,710 | 26 | 233 | 23.018 | 509 | 216 | |
| Whitstable | 29.99 | 32,435 | 1,672 | 18 | 144 | 11.425 | 81 | 76 | Significant potential for Ordinary Watercourse flooding |
| Medway Gap | 37.36 | 33,145 | 1,517 | 27 | 179 | 16.091 | 109 | 22 | |
| Ashford | 54.06 | 70,865 | 1,459 | 35 | 179 | 9.139 | 160 | 93 | Significant potential for Ordinary Watercourse flooding |
| Tonbridge | 36.01 | 38,305 | 1,334 | 14 | 109 | 8.212 | 133 | 59 | |
| Herne Bay | 31.06 | 38,045 | 1,215 | 17 | 100 | 11.457 | 58 | 81 | Significant potential for Ordinary Watercourse flooding |
| Hythe | 12.27 | 14,060 | 1,169 | 11 | 120 | 5.017 | 11 | 20 | |

| Settlement | Total Area, km² | Total Population | Dwellings at risk | Critical Services at risk | Non-residential properties at risk | Rail and Roads at risk, km | Agricultural Land at risk, ha | OW Length, km | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Swanley | 9.13 | 20,710 | 1,158 | 15 | 39 | 8.404 | 37 | 0 | |
| Swale rural | 244.52 | 28,720 | 1,157 | 27 | 155 | 32.585 | 753 | 172 | Significant potential for Ordinary Watercourse flooding |
| Maidstone rural | 284.90 | 35,340 | 1,101 | 30 | 123 | 29.743 | 750 | 429 | Significant potential for Ordinary Watercourse flooding |
| Canterbury rural | 211.44 | 29,575 | 1,071 | 24 | 165 | 24.004 | 662 | 262 | Significant potential for Ordinary Watercourse flooding |
| Deal | 17.02 | 28,995 | 1,011 | 6 | 79 | 3.830 | 17 | 43 | Significant potential for Ordinary Watercourse flooding |
| Ashford rural | 506.09 | 36,365 | 977 | 46 | 145 | 26.338 | 1,674 | 893 | Significant potential for Ordinary Watercourse flooding |
| Dover rural | 199.22 | 26,250 | 968 | 36 | 107 | 22.449 | 653 | 179 | Significant potential for Ordinary Watercourse flooding |
| Sevenoaks | 21.51 | 24,305 | 944 | 19 | 163 | 6.976 | 27 | 10 | |
| Broadstairs | 11.36 | 24,870 | 943 | 13 | 80 | 4.238 | 7 | 0 | |
| Faversham | 11.37 | 18,575 | 942 | 13 | 40 | 4.043 | 19 | 13 | |
| Shepway rural | 266.31 | 20,710 | 815 | 26 | 109 | 16.942 | 478 | 416 | |
| Isle of Sheppey | 91.26 | 39,335 | 749 | 21 | 149 | 3.468 | 131 | 199 | Significant potential for Ordinary Watercourse flooding |
| Gravesham rural | 65.86 | 15,785 | 682 | 16 | 53 | 13.690 | 190 | 18 | |
| Birchington | 7.33 | 10,095 | 439 | 2 | 18 | 1.395 | 17 | 7 | |
| Tunbridge Wells rural | 197.10 | 20,310 | 432 | 20 | 75 | 6.900 | 602 | 409 | Significant potential for Ordinary Watercourse flooding |
| Dartford rural | 18.81 | 10,015 | 391 | 8 | 54 | 4.982 | 78 | 5 | |
| Paddock Wood | 9.83 | 8,145 | 390 | 8 | 18 | 2.555 | 36 | 29 | Significant potential for Ordinary Watercourse flooding |
| Thanet rural | 58.38 | 6,650 | 323 | 6 | 66 | 3.518 | 136 | 99 | |
| Meopham | 9.98 | 4,485 | 310 | 3 | 5 | 2.431 | 25 | 0 | |

| Settlement | Total Area, km² | Total Population | Dwellings at risk | Critical Services at risk | Non-residential properties at risk | Rail and Roads at risk, km | Agricultural Land at risk, ha | OW Length, km | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Edenbridge | 22.02 | 8,635 | 302 | 6 | 60 | 2.010 | 96 | 41 | |
| Hartley and New Ash Green | 19.78 | 12,100 | 268 | 5 | 28 | 1.665 | 54 | 0 | |
| Benenden and Cranbrook | 54.09 | 7,565 | 210 | 6 | 65 | 1.033 | 120 | 133 | |
| Tenterden | 20.47 | 6,850 | 155 | 4 | 23 | 0.633 | 54 | 45 | Significant potential for Ordinary Watercourse flooding |
| Sandwich | 35.61 | 6,830 | 141 | 4 | 25 | 1.464 | 67 | 79 | Significant potential for Ordinary Watercourse flooding |
| Pembury | 14.34 | 5,900 | 102 | 4 | 6 | 0.872 | 32 | 21 | |
| Aylesham | 15.52 | 4,725 | 66 | 0 | 5 | 1.005 | 53 | 0 | |
| Staplehurst | 23.85 | 5,875 | 63 | 0 | 15 | 1.148 | 62 | 48 | |
| Lydd | 48.24 | 6,170 | 18 | 2 | 7 | 0.065 | 5 | 107 | Significant potential for Ordinary Watercourse flooding |
| New Romney | 6.41 | 6,975 | 12 | 1 | 12 | 0.144 | 2 | 12 | Significant potential for Ordinary Watercourse flooding |
| Dymchurch and St. Mary's Bay | 7.29 | 6,140 | 0 | 0 | 1 | 0.079 | 1 | 20 | Significant potential for Ordinary Watercourse flooding |

### 5.1.2 Groundwater

The potential risk from groundwater in Kent is significant. The chalk hills of the North Downs and the sandstones and greensands of the Weald represent potential sources of groundwater flooding.

The Environment Agency's areas susceptible to groundwater flooding map is shown in Figure 6. The groundwater data is only indicative and groundwater flooding is indicated to affect most settlements in Kent to some degree. Due to the widespread indicative risk given by this dataset and its inherent inaccuracy, no additional areas of future flooding have been identified based on groundwater flood risk. Groundwater flooding is a countywide risk.

### 5.1.3 Ordinary watercourses

Ordinary watercourses also pose a significant risk in Kent. The presence of four large IDBs (the Upper and Lower Medway, the Romney Marshes Area and the River Stour IDBs) testifies to the drainage sensitivity in Kent. The areas the IDBs cover along some other ordinary watercourses in district authority control are potential areas of flood risk.

Figure 7 shows settlements with a high concentration of ordinary watercourses (given by length of ordinary watercourse per area of settlement). Figure 7 does not include any estimate of the risk to population or property. Some of the settlements have low populations and the risk posed may be low, although there may be risks to other receptors, for example farmland or transport infrastructure.

The areas at risk from surface water flooding within these settlements may also be at risk from ordinary watercourse flooding. No additional areas have been identified as at risk of ordinary watercourse flooding in addition to the surface water risk areas, as the risk cannot be quantified. Comments have been added to the existing risk areas in Annex 2 where relevant.

## *5.2 Locally agreed surface water information*

Other than the Environment Agency datasets, the only specific surface water information available in Kent is the Dover SWMP. This data has been used as the locally agreed surface water information to assess the risk in Dover. Elsewhere the FMfSW has been used as the locally agreed surface water information for the reasons given in Section 3.3. However that does not preclude using all available data to inform future decisions.

Work is progressing in other areas of Kent that may provide new locally agreed surface water information for other areas.

## *5.3 Climate change and long term developments*

### 5.3.1 The evidence

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts have changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

### 5.3.2 Climate change impacts

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 18% (very likely to be between 2% and 39%).
- Precipitation on the wettest day in winter up by around 16% (very unlikely to be more than 34%).
- Relative sea level is very likely to rise between 10 cm and 40 cm from 1990 levels (not including extra potential rises from polar ice sheet loss).
- Peak river flows in a typical catchment likely to increase between 11% and 24%.

### 5.3.3 Implications for flood risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding, especially in the rapidly responding catchments draining the South Downs and Weald.

More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

There is a risk of flooding from groundwater in the county. Recharge may increase in wetter winters, or decrease in drier summers.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

### 5.3.4 Adapting to change

Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, we have to make local decisions with uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

### 5.3.5 Long term developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to ‘ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall’.

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are ‘significant’ (in terms of the Government's criteria).

# 6 Review of indicative Flood Risk Areas

The Environment Agency has not identified any indicative Flood Risk Areas in Kent, which are defined by the Minister as areas with more than 30,000 people at risk of surface water flooding. Undertaking the PFRA and reviewing

the data available has not lead to a need to challenge this view. The highest risk in Kent is in Maidstone, with approximately 11,700 people estimated to be at risk.

Medway Council does have an Indicative Flood Risk Area, Chatham and Gillingham. The indicative Flood Risk Area covered a very small part of Kent County Council. Medway Council has amended the Indicative Flood Risk Area to their administrative boundary and it does not include any parts of Kent County Council.

There is also an overlap of the London Indicative Flood Risk Area into Kent County Council at Dartford and Swanley. These areas are not considered significantly at risk as shown in Table 5 and there is no hydraulic connectivity between either Dartford or Swanley and London. This is shown in Figures 8 and 9 for Dartford and Swanley respectively.

Dartford is separated from Bexley by a railway embankment, where that isn't the case the streets run in the direction of flow and no runoff from Dartford passes to Bexley.

Swanley is separated from Bromley by the A20 embankment, all surface water flows from Swanley flow into Kent. There is a small stream to the southwest that runs under the railway and into Bromley, further downstream this has no hydraulic connectivity beyond the A20. If this was considered to be significant it should be included by Bromley in their mapping. It would not be justifiable for us to undertake further mapping on the basis of the headwaters of a small ordinary water course that had no impact in Kent.

Therefore KCC has recommended that the London Indicative Flood Risk Area be amended to the edge of the London Boroughs neighbouring Kent and not include any part of Kent. The Environment Agency has accepted this and the London Indicative Flood Risk Area has been amended.

# 7 Next steps

## *7.1 Local Strategy*

This PFRA has given us a clearer picture of the areas in Kent that are at the greatest risk. The next step will be to take this work forward into the Local Strategy to develop a better picture of the local flood risks and explore opportunities to reduce those risks.

In particular the Local Strategy should address the shortcomings in the quality of the data used in this study, as highlighted in Section 3.3. The Local Strategy must ensure that areas identified as at risk are genuinely at risk and improve the understanding of the impact of ordinary watercourse flood risk.

## *7.2 Data collection*

KCC will work with other RMAs in Kent to develop a consistent system for recording flood events in the county to inform flood risk management decisions and provide evidence for the review of the PFRA in six years. This

system should be available to all relevant authorities, including district councils, Environment Agency, Internal Drainage Boards and Emergency Services.

# 8 References

Ashford Borough Council (2006) Strategic Flood Risk Assessment

Defra (2006) Flood and Coastal Defence Appraisal Guidance, FCDPAG3 Economic Appraisal, Supplementary Note to Operating Authorities – Climate Change Impacts. October 2006

Defra (2010) Surface Water Management Plan Technical Guidance

Defra / WAG (2010) Selecting and reviewing Flood Risk Areas for local sources of flooding – Guidance to Lead Local Flood Authorities

Dover District Council (2007) Strategic Flood Risk Assessment

Environment Agency (2010) Flood Map for Surface Water – Property Count Method

Environment Agency (2010) Preliminary Flood Risk Assessment – Annexes to the Final Guidance (Report – GEHO1210BTHF0E0E)

Environment Agency (2010) Preliminary Flood Risk Assessment - Final Guidance (Report – GEHO1210BTGH0E0E)

Environment Agency (2011) Flood Risk Regulations – PFRA FAQs

Kent Thameside Delivery Board (2009) Water Cycle Strategy (incl. Strategic Flood Risk Assessment)

Maidstone Borough Council (2008) Strategic Flood Risk Assessment

Parliament (2010) The Flood and Water Management Act

Sevenoaks District Council (2008) Strategic Flood Risk Assessment for Local Development Framework

Shepway District Council (2009) Strategic Flood Risk Assessment

Thanet District Council (2009) Strategic Flood Risk Assessment

The Pitt Review (2008) Learning lessons from the 2007 floods

Tonbridge and Malling Borough Council (2006) Strategic Flood Risk Assessment Stage 2 Report

Tunbridge Wells Borough Council (2009) Strategic Flood Risk Assessment Level 2