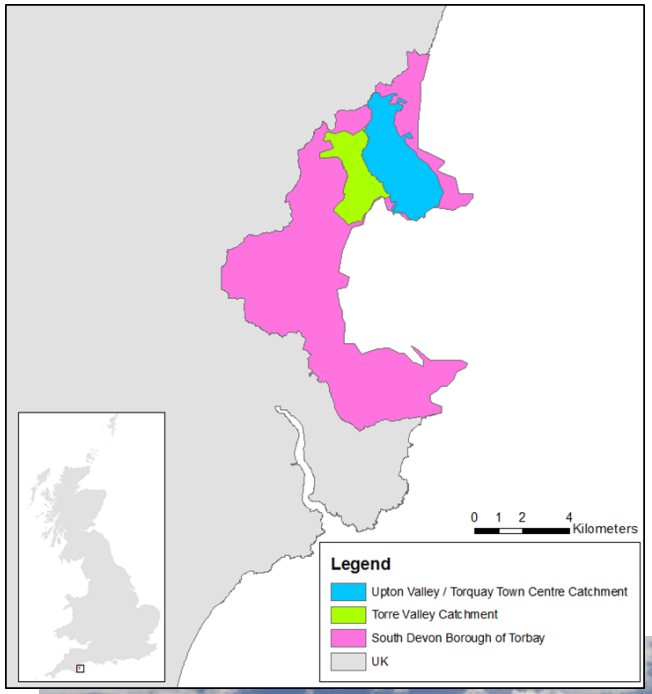
Torquay Town Centre, South Devon Borough of Torbay

1. Location and Environmental Setting

- Two critical subcatchments connected through a pumping station: Upton Valley and Torre Valley subcatchments
- **Area:** 936 ha + 530 ha = 1466 ha
- Highly urbanised, high density of receptors
- "British Riviera", tourist destination
- Severe pluvial flooding in the last few years: October 1999, May 1999, October 2004, August 2007
- Tides may exacerbate surface flooding



1. Location and Environmental Setting

2. Urban pluvial flood risk problems and management objectives

Flooding mechanisms:

- Pluvial flooding mainly driven by the local topography
- Steep slopes channel water to the natural depressions corresponding to the former paths of natural watercourses (e.g. River Fleet – Fleet Street)

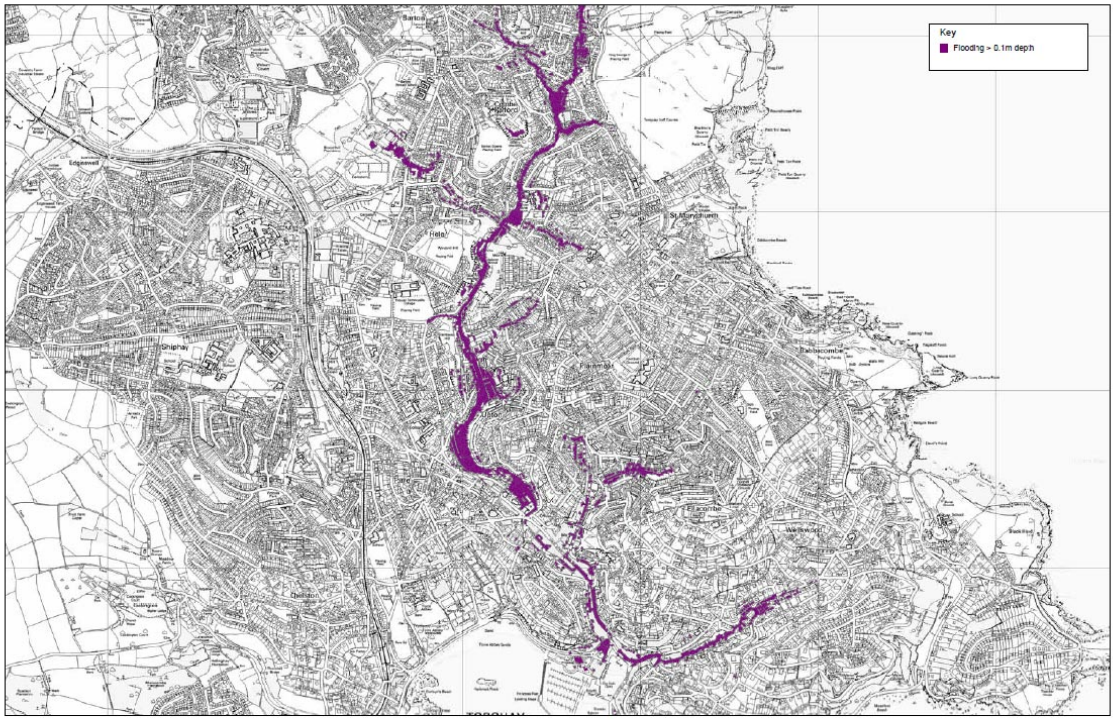


Figure 8 - Torquay Surface Water Flooding

- In other areas flood depth is not excessive, but flow velocity is high, therefore flood hazard is high
- When attenuation tanks are overwhelmed, flooding happens quickly
- High tides reduce hydraulic capacity of sewer system at some points

2. Urban pluvial flood risk problems and management objectives

Properties and people at risk of surface water flooding

- 50 properties at risk during an event of 1 in 30 years
- 97 properties at risk during an event of 1 in 100 years

Town	Number of people at risk of flooding	Subcatchment	Number of people at risk of flooding
Torquay	3,908	Torre Valley	1,137
		Upton Valley	1,952
		Edginswell	367
		Babbacombe	452

2. Urban pluvial flood risk problems and management objectives

Impacts of flooding in the Torquay Town Centre

- Damage to residential properties, business and open spaces

  = thousands £££ of damage + social impacts

- Of particular concern is that the main shopping area of Torquay, in addition to some hotels, have been flooded during the majority of the registered events; **this has large negative effects on the local economy, which is mainly based upon tourism**.

- Significant consequences to human health have been caused by previous flood events

- Flood water combined with sewage when surcharging occurs has led to environmental damage (including CSOs discharging into the ocean)

- Roads have been inundated, causing severe disruption to transport

2. Urban pluvial flood risk problems and management objectives

Historical flood events in the Torquay Town Centre

Date	Location	Main Source	Secondary Source	Flooded properties	Return Period	Total and peak rainfall during storm event
23/06/91	Torquay	Surface runoff	Combined sewers	74	1:5	Total rain: 37.1 mm / 9 h Peak rain: 18.6 mm / 1 h
22/09/92	Torquay and Paignton	Surface runoff	Ordinary watercourse	46	1:2	Total rain: 11 mm / 20-30 min
29/05/99	Torquay	Surface runoff	Ordinary watercourse	30	1:13	Total rain: 34 mm / 4 h Peak rain: * / 0.58 h
24/10/99	Torquay and Paignton	Surface runoff	Combined sewers	162	1:50	Total rain: 57.2 mm / 10 h Peak rain: > 40 mm / 2 h
19/08/00	Torquay	Surface runoff	Combined sewers	41	1:24	Total rain: 30.4 mm / 1.25 h Peak rain: 23 mm / 0.58 h
20/08/07	Torquay and Paignton	Surface runoff	Ordinary watercourse	64	>1:30	Total rain: 37.8 mm/5 h Peak rain: 15.6 mm/0.5 h

2. Urban pluvial flood risk problems and management objectives

Historical flood events in the Torquay Town Centre


Union Street, August 1938


Fleet Street, August 2007


Basement in Torquay town centre, early 1980's


Fleet Street, October 1999

2. Urban pluvial flood risk problems and management objectives

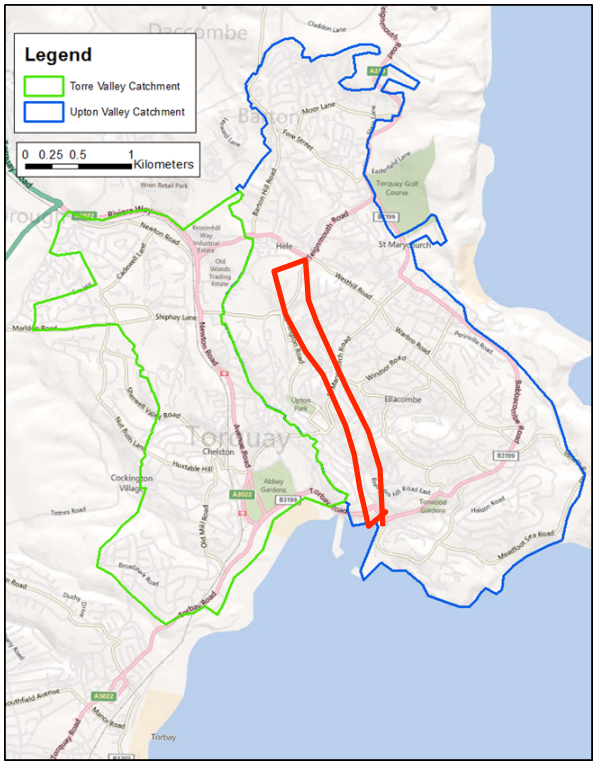
Potential SWFR mitigation alternatives

1. Construction of a new large diameter drainage pipe in Union Street and Fleet Street

2. Separation of surface water flows from the combined sewer

3. Implementation of property-level sustainable drainage systems that increase infiltration, thus reducing runoff

4. Raising community awareness + local property resistance and resilience measures



5. **Optimisation of the existing sewer system through real time control, using the multiple control elements within the system (i.e. storage tanks and pumps) – supported by forecasting**

3. Characteristics of drainage and monitoring system

Sewer system:

- Mostly combined
- Water from the Torre Valley Catchment is pumped to Upton Valley Catchment (this exacerbates flooding in Upton Catchment)
- At the downstream end water is pumped to treatment plant
- Several control elements, including 3 attenuation tanks and 4 pumping stations
- Some CSOs discharging into the ocean

3. Characteristics of drainage and monitoring system

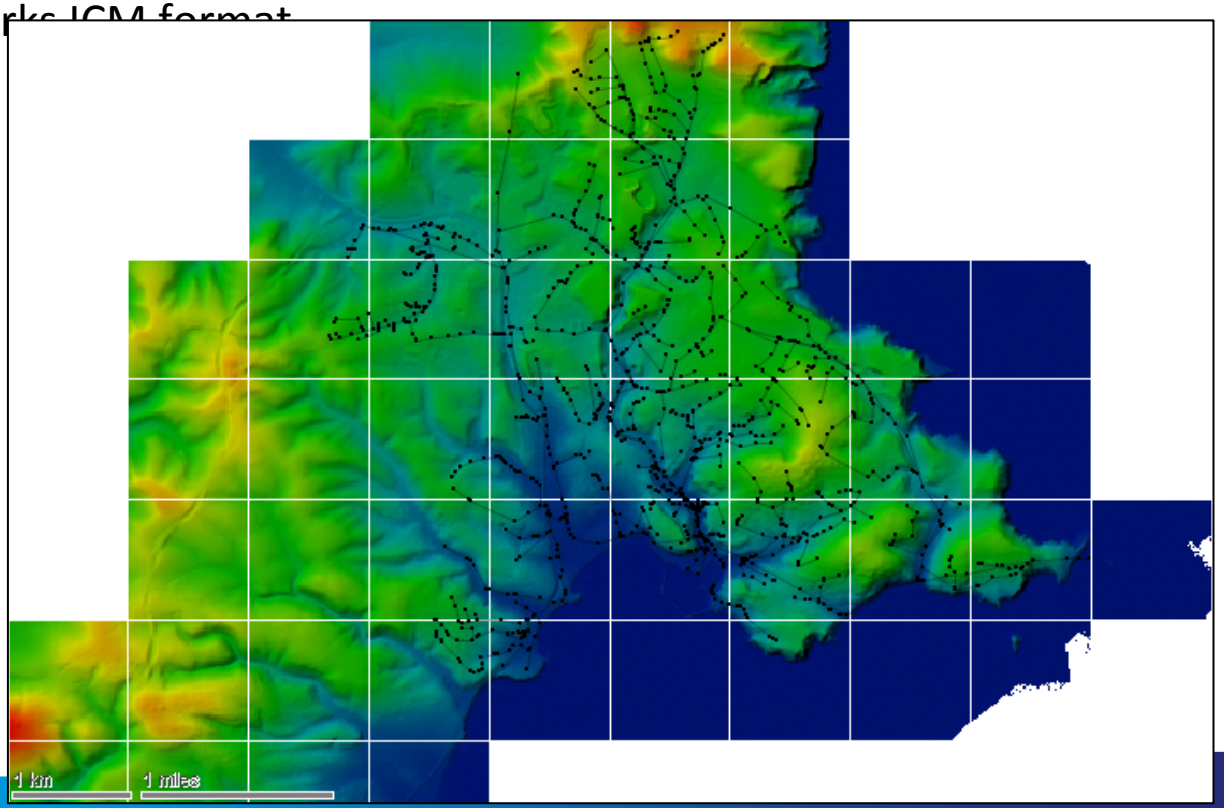
Model of the sewer system:

Total contributing area (ha)	550.7900
Number of nodes	1288
Number of pipes	1235
Total pipe length (km)	93.6839
Number of subcatchments	936
Max subcatchment size (ha)	19.9600
Min subcatchment size (ha)	0.0050
Mean subcatchment size (ha)	0.5885
Standard Deviation of subcatchment size (ha)	1.0489
Rainfall-runoff model	Wallingford
Length of longest path to critical point or final outfall (m)	100
Time of concentration (min)	550.7900

3. Characteristics of drainage and monitoring system

DTM:

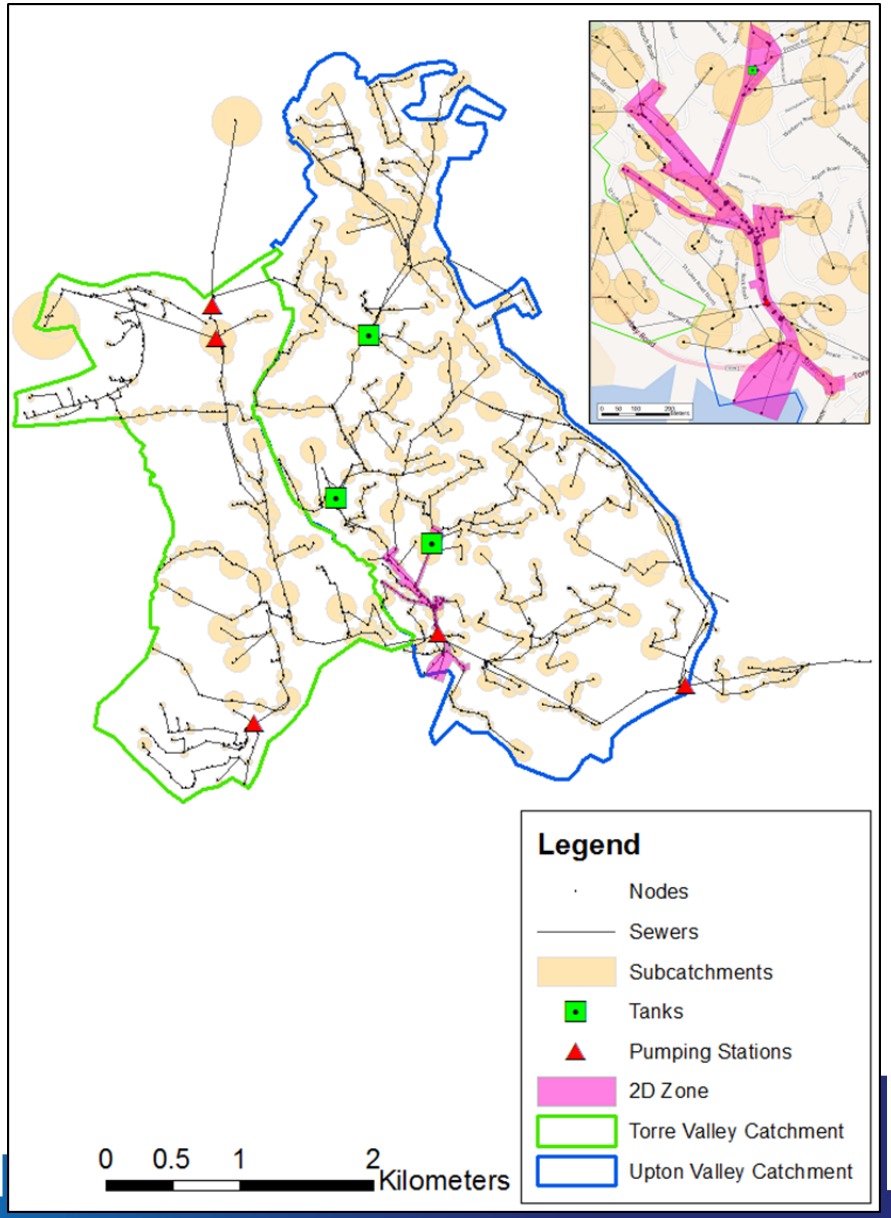
- 1 m horizontal resolution LiDAR-generated DTM (2010)
- Stated vertical accuracy of ±0.15 m and horizontal accuracy smaller than the pixel size
- In InfoWorks ICM format



3. Characteristics of drainage and monitoring system

Dual-drainage model

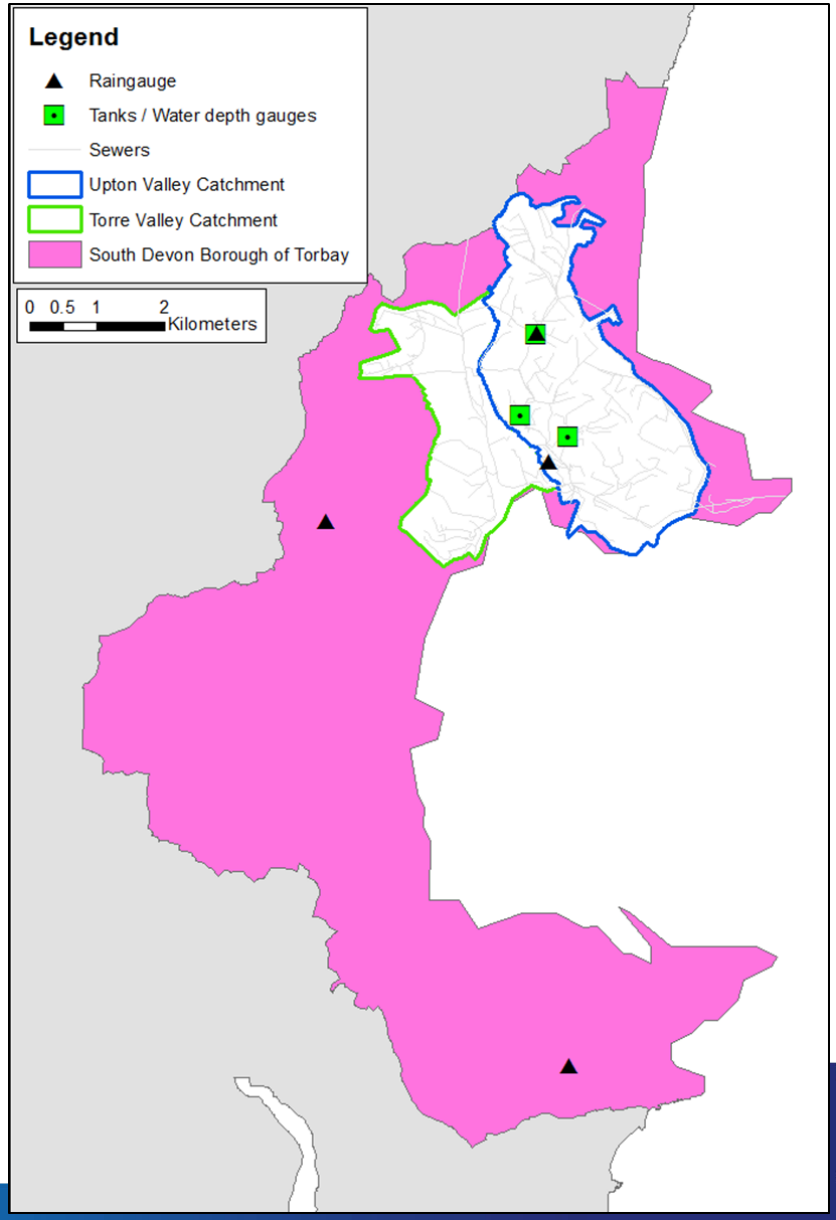
- 1D model of the sewer system covering the whole catchments
- 2D surface model only for critical area
- Calibrated according to UK Wapug standards



3. Characteristics of drainage and monitoring system

Local monitoring system

- 3 water level gauges in attenuation tanks
- 4 tipping bucket raingauges owned by Torbay Council

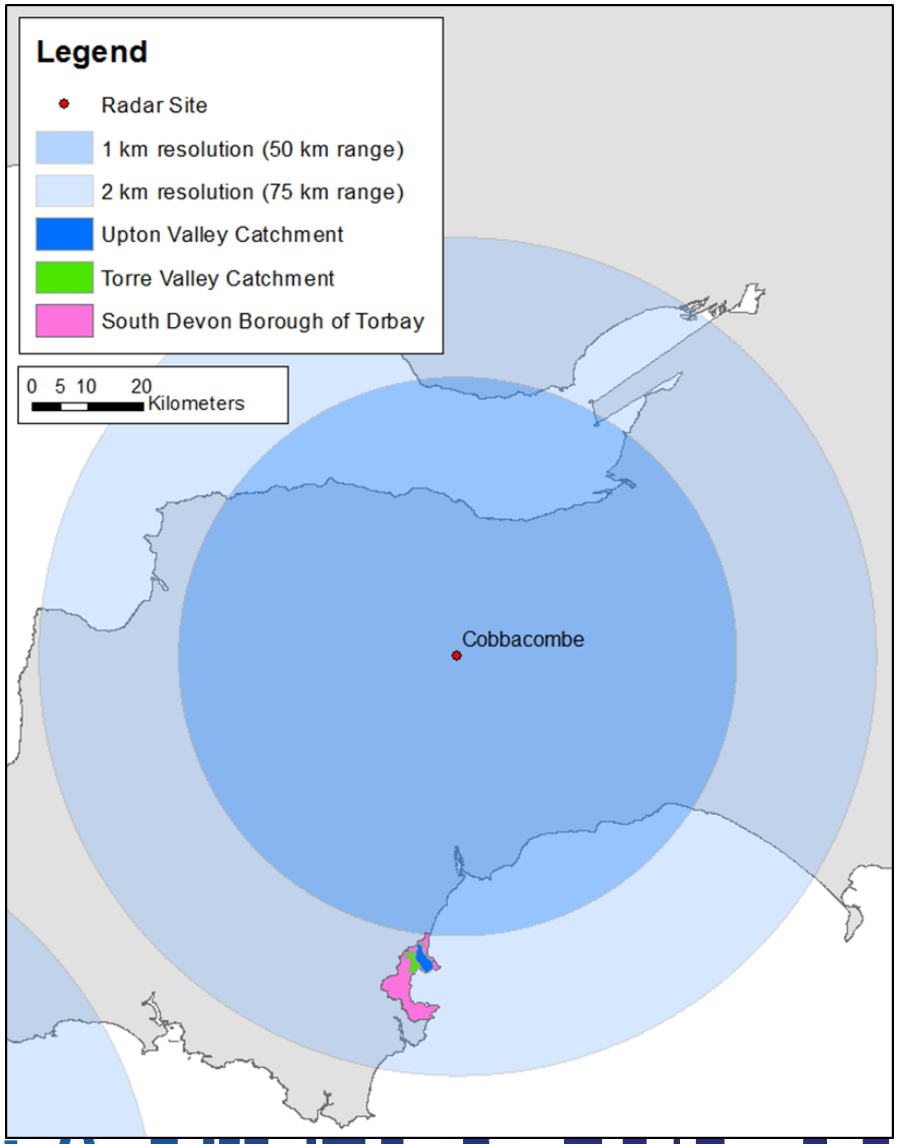


3. Characteristics of drainage and monitoring system

UKMO C-band Radars:

	Cobbacombe
Radar type	C-band
Polarisation	Single-polarisation*
Doppler (yes/no)	No*
Antenna	Parabolic 3.6 m diameter, 43 dB gain
Beamwidth	1°
Frequency range	5.4 – 5.8 GHz
Range resolution	1 km up to 50 km range / 2 km up to 75 km range
Temporal resolution	5 min scan repeat cycle**
Elevations (°)	0.0, 0.5, 1.0, 2.0, 4.0

*Will be soon upgraded to dual-pol and doppler
**Within the RainGain project the potential benefits of reducing the repetition cycle to 2-3 min will be tested.



Common Context – Common Actions in UK Pilot Locations

Surface Water Flooding related legislation has developed quickly

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012

PPS25

Integrated Urban Drainage Pilots

Future Water Strategy

Statement of Principles

ERAs

Flooding in England: National Assessment of Flood Risk

UK CLIMATE PROJECTIONS

FLOODFORECASTINGCENTRE

The Flood Risk Regulations 2009

Flood and Water Management Act 2010

PFRAs

exercise Watermark

Flood Guidance Statement
SWF warnings

Draft Water Bill

UK Climate Change Risk Assessment 2012

Making Space for Water

Summer 2007 Floods

Pitt Review

Update - PPS25

Government's Response to Pitt Review

'AREAS SUSCEPTIBLE TO WATER FLOODING MAPS'
1st Generation Maps

Cumbria Floods

'FLOOD MAPS FOR SURFACE WATER'
2nd Generation Maps

SWMP Technical Guidance

Drain London Forum

National Flood & Coastal Erosion RM Strategy

National Planning Policy Framework

General features of new legislation

- **Importance of surface water flooding has been understood:** recent events have brought into focus the risk imposed by surface water flooding, which is projected to increase significantly as a result of climate change and urbanisation

- **Clarification of roles:** In England, the division of responsibility for urban drainage was identified as an important barrier to better management of surface water flooding. To address this roles have been clarified and local authorities (i.e. county or unitary authorities) have been made responsible for managing all sources of local flood risk (including surface runoff, groundwater and ordinary watercourse flooding)

- **Integrated, sustainable and "soft" approach:** more integrated and sustainable approach to flood risk management, reducing the dependence on more and bigger flood defences (i.e. structural measures) and instead making space for water. The new strategies encourage communities, the public sector and other organisations to work together to find alternatives which balance the needs of communities, the economy and the environment. In this new approach planning, land management practices (including SuDS) and other non-structural measures (e.g. property level protection, public engagement, forecasting and warning) play a crucial role.

Common Actions
According to UK and EU Flood Regulations

- **Local Authorities must comply with Planning Policy Statement 25 (PPS25):** PPS25 aims at ensuring that flood risk is taken into account at all stages in the planning process:
  - To avoid inappropriate development in areas at risk of flooding
  - To direct development away from areas of highest risk
  - To prevent new developments from increasing current flood risk
- **Catchment Flood Management Plans (CFMP):** overview of flood risks across big catchment areas, considering all types of inland flooding, including surface water.
- **Strategic Flood Risk Assessments (in accordance with PPS25):** provide maps identifying areas at risk of flooding, where developments should be avoided.
- **Preliminary Flood Risk Assessments (PRFAs) for local flooding:** high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. Starting point for the Surface Water Management Plan (SWMP).
- **Surface Water Management Plans (SWMP):** form the locally agreed surface water information and strategies for the different boroughs