

12. Surface water run-off

12.1 Background information on the current situation in Leeds

12.2 Rain falling on buildings and hard surfaces cannot infiltrate into the ground so it needs to be drained artificially in order to prevent problems of localised flooding. The traditional method of dealing with surface water has been to pipe it away from developments and discharge it to the sewerage system or nearby watercourses. This has implications for water quality, the ecology and amenity of watercourses, including canals, and downstream flooding. It is predicted that climate change, as a result of human activity, will result in increased rainfall in the UK as well as an increase in the frequency of intense rainfall events. This is likely to exacerbate flooding problems. Sustainable drainage systems provide an alternative to the traditional approach. Sustainable drainage seeks to mimic more natural drainage processes by allowing rainfall to soak into the ground where possible or by delaying discharges. This reduces both the volume and rate of surface water run-off



Upton housing SUDS, Nottinghamshire

to sewers and watercourses. While the primary function of sustainable drainage systems is to drain away water, they also have the potential to serve as amenity and/or wildlife habitats, but this should not compromise their ability to maintain them effectively to ensure their primary drainage characteristics are preserved.

12.3 The background and principles of sustainable drainage in Leeds are covered by the existing Supplementary Planning Guidance No. 22 - Sustainable Drainage in Leeds (Leeds City Council 2004).

12.4 The impact on the water environment should be a consideration at the site identification and appraisal stage. This includes impacts on water quality, protecting the flood capacity of watercourses and protecting features such as ponds and wetlands. The site layout should seek to minimise impacts on the water environment by reducing the quantity and improving the quality of surface water run-off.



A soakaway to alleviate flooding, Leeds



"With climate change, we are experiencing more unusual, extreme seasonal weather patterns and we are only too aware of more frequent downpours causing flash flooding. Trees in front gardens and streets reduce and slow surface runoff from storms, limiting soil erosion, and reduce and delay peak volumes of storm water reaching drains, helping to reduce the potential for flash flooding."

Tony Kirkham,
Head of the Arboretum,
Royal Botanic Gardens, Kew



Drainage channel



Allerton Bywater's SUDS, Leeds

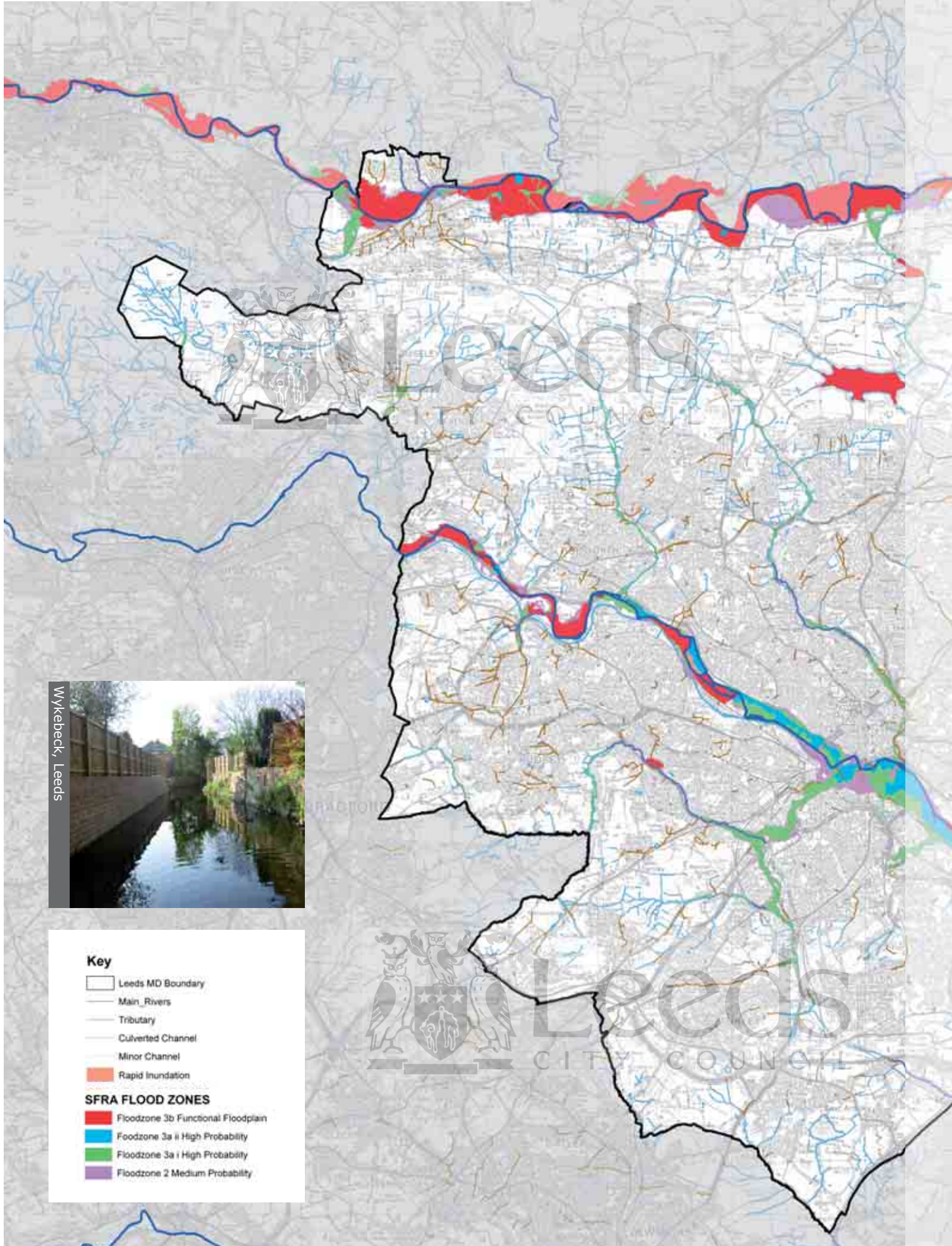
12.5 Flood plains are a vital part of our environment and their flooding is a natural event, which often occurs without risk to people. However, the effectiveness of a river and flood plain to convey and store flood water can be adversely affected by human activity. As well as their importance in providing natural storage for floodwater,

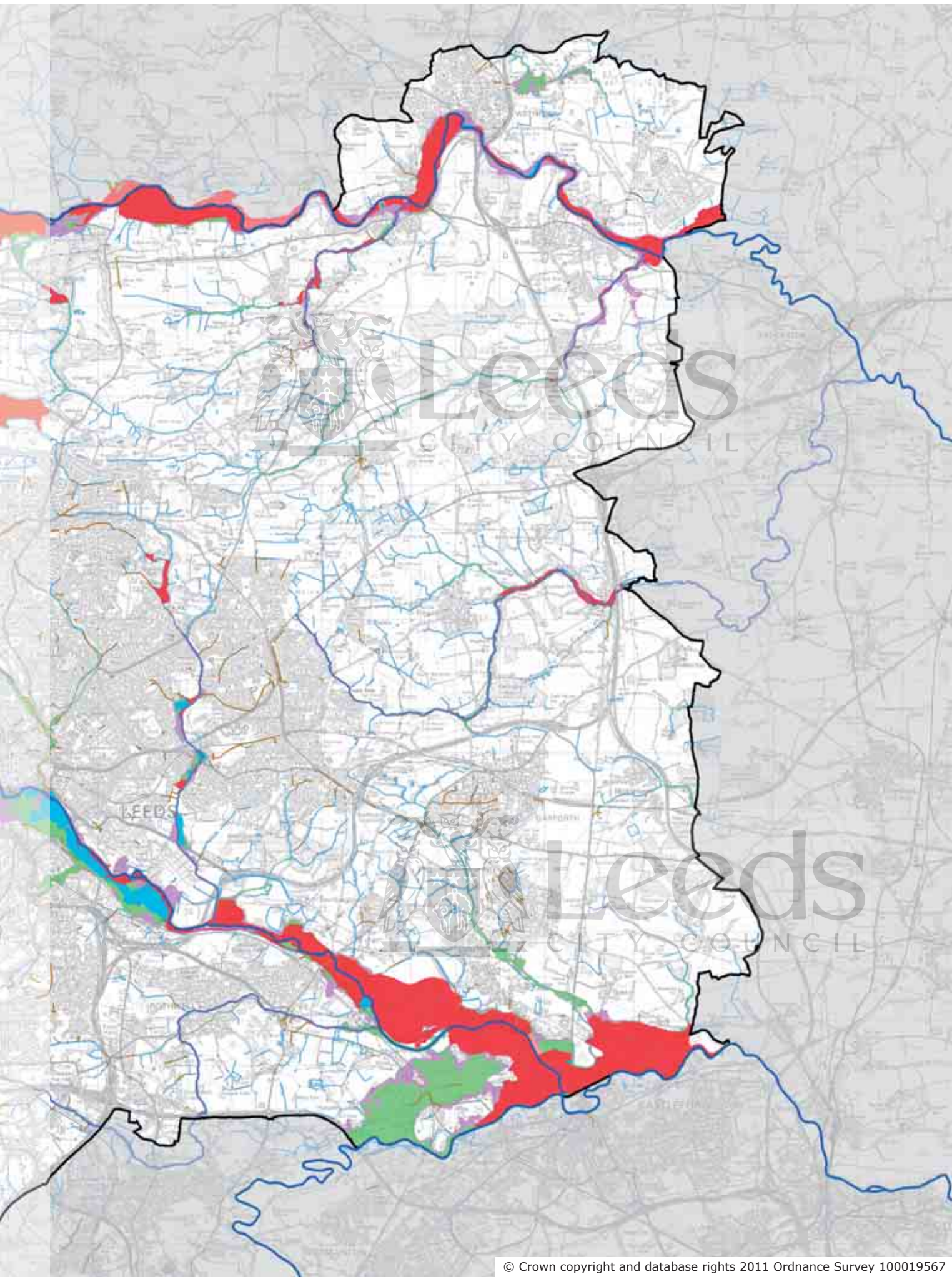
flood plains can also provide:

- Fertile agricultural land;
- Valuable habitat for wildlife and plants;
- A recreational resource;
- The periodic flooding of low-lying areas nourishes the soil, a benefit used by farmers for centuries.

12.6 Flooding can cause significant stress, disruption and economic cost for many people. Changes in our climate, such as more intense rainfall events and wetter winters, will increase the occurrence of flooding in Leeds and elsewhere.

Figure 12.1: Leeds Strategic Flood Risk Assessment Map





12.7 DEFRA (Department for Environment, Food and Rural Affairs), in conjunction with other stakeholders, is taking forward the developing strategy for flood and coastal erosion risk management via its 'Making Space for Water' programme (Department for Environment, Food and Rural Affairs 2005b). The programme is looking at:

- giving the Environment Agency a strategic overview of all forms of flooding and coastal erosion;
- identifying the most effective way to tackle the causes of urban flooding;
- ways to help people adapt to changing risk of flooding and coastal erosion;
- working with natural processes and developing approaches to flooding and erosion which achieve many objectives at once, such as improved nature conservation.

12.8 Leeds City Council is the Lead Local Flood Authority. It is responsible for identifying and mapping local flood risk and for drawing up flood risk management plans. Under the Flood and Water Management Act 2010, the council is the SUDS Approving Body (SAB) and needs to approve drainage plans for both permitted developments and those that require planning permission. This will ensure that SUDS are also included in construction that may cover large surface areas, but does not require planning permission.

12.9 As a local planning authority, the council is responsible for ensuring that flood risk is taken into account in relation to all new development. As a flood defence operating authority the council also has its own Flood



Flooding in Leeds City Centre, June 2007

Risk Management (FRM) Section (formerly Land Drainage) and has permissive powers to carry out flood alleviation work and to enforce good house-keeping by riparian owners in relation to ordinary watercourses.

12.10 The Environment Agency is the national flood defence operating authority with permissive powers to carry out flood alleviation work and to enforce good house-keeping by riparian owners in relation to main rivers. The agency has a strategic overview role in respect of flood risk management. It has responsibility for raising public awareness and providing flood forecasting/warning systems.

12.11 Through flood risk management the probability of flooding from watercourses can be reduced by land management, watercourse maintenance and flood defences. The level of damage caused by floods can also be reduced through effective land use planning, flood warning and emergency responses.

12.12 There are a number of other organisations who play an important role in the response to flooding. West Yorkshire Police coordinate the response of all public bodies, and are responsible for evacuating the public from properties and controlling traffic in flooded areas.

12.13 Leeds City Council's Peace and Emergency Planning Unit supports the work of the FRM Section, the Environment Agency and the police. In addition, the council holds a number of other responsibilities including setting up rest centres to accommodate and feed members of the public; addressing the needs of those most vulnerable in the event of a flood; organising vehicles to evacuate members of the public, ensuring road closures/diversions; cleaning debris from highways and blocked road gulleys; and arranging sandbags.

12.14 The analysis of the evidence in the Natural Resources and Waste DPD Resource Flow Analysis (Leeds City Council 2008d) draws the following conclusions:

- The most pressing water issues and the stand out point that the NRWDPD should look to address is the pressure placed upon the Leeds drainage system by under capacity, pressure caused by rapid run-off from impermeable surfaces and the more extreme weather events brought on by climate change
- There must be careful planning measures put in place to ensure that all development places drainage and flooding issues as a key consideration and the construction of further impermeable surfaces should be discouraged.

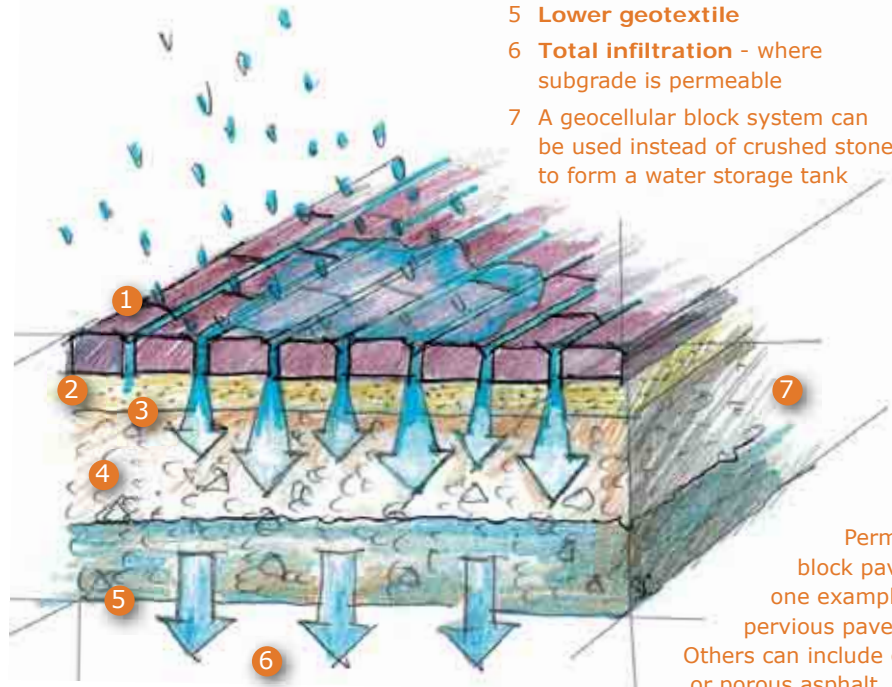
12.15 The CSH includes two issues in this category whose aims are:

Management of surface water run-off from developments	To design housing developments which avoid, reduce and delay the discharge of rainfall to public sewers and watercourses. This will protect watercourses and reduce the risk of localised flooding, pollution and other environmental damage
Flood risk	To encourage housing development in low flood risk areas, or to take measures to reduce the impact of flooding on houses built in areas with a medium or high risk of flooding

Figure 12.2:

permeable block paving

- 1 Blocks with open joints - no fines fill
- 2 Free draining bedding - no fines
- 3 Geotextile layer
- 4 Open permeable base course
- 5 Lower geotextile
- 6 Total infiltration - where subgrade is permeable
- 7 A geocellular block system can be used instead of crushed stone to form a water storage tank



Permeable block paving is one example of a pervious pavement. Others can include gravel or porous asphalt. These systems help breakdown pollutants and can assist with water attenuation.

12.16 Management of surface water run-off from developments

12.17 The preferred policy position in the council's NRWDPD is that all developments are required to ensure no increase in the rate of surface water run-off to the existing formal drainage system. Change of use developments and conversions will be expected to incorporate sustainable drainage techniques wherever possible:

- ☑ On previously developed sites peak flow rates must be reduced by at least 30%;
- ☑ On sites which have not previously been connected to the drainage infrastructure, or watercourse, surface water run-off rates will not exceed the 'greenfield' run-off rate (ie the rate at which water flows over land which has not previously been developed);
- ☑ Applications for development are expected to comply with the council's Minimum Development Control Standards for Flood Risk (Leeds City Council 2008c).

12.18 General guidance for the management of surface water run-off has been outlined in council's 'Minimum Development Control Standards for Flood Risk' (Leeds City Council 2008c). For all sites, we will require a **Flood Risk Assessment** (Drainage Impact

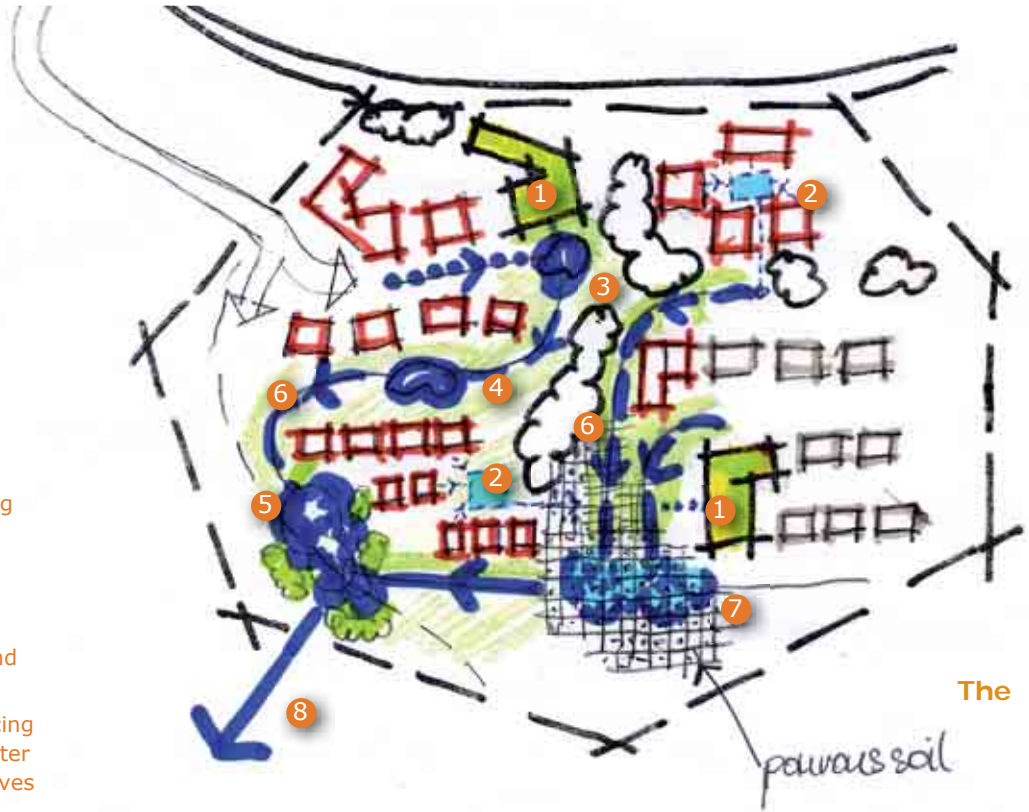


Assessment), which addresses the flood risk associated with the run-off generated by the proposed development.

Figure 12.3:

SUDS

- 1 **Green roof**
- can also act as a water storage area
- 2 **Rainwater harvesting**
- direct capture and use of water run-off (water used for domestic purposes) eg flushing toilets or irrigation
- 3 **Water detention basin**
- dry basin providing temporary storage of water run-off to reduce peak flow and allows settlement of solids
- 4 **Wet detention pond (balancing pond)** - permanent pool of water that reduces peak flow, improves water quality and supports shoreline vegetation
- 5 **Constructed wetland (enhanced balancing pond)** - shallow areas with wetland vegetation - pollutant removal and wildlife habitat enhancement
- 6 **Swailes and filter strips (natural conveyance systems)** - as well as filtering out silt these features can reduce peakflow. They can also infiltrate water into the ground in the right conditions
- 7 **Soakaways** - underground storage structures where the ground is porous and the water table is low. They provide storm attenuation, water treatment and ground water recharge
- 8 **Greenfield run-off rate**



12.19 Measures that can be taken to design developments which avoid, reduce and delay the discharge of rainfall to public sewers and watercourses include:

- ✓ Existing features such as wetlands, ponds and pools should be protected;
- ✓ The culverting and canalisation of watercourses should be avoided wherever possible, and opportunities to re-establish natural

watercourses, channels, margins and wetlands should be maximised;

- ✓ The amount of non-porous hard surfacing should be minimised. Porous surfacing materials should be used to enable surface water infiltration and manage run-off;
- ✓ Downstream watercourses should be protected from the adverse effects of excess surface water run-off, both in quantity and quality;





Table 12.1: The SUDS Hierarchy

Most Sustainable <-----> Least Sustainable	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape and Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviers	✓	✓	
Tanked systems - over-sized pipes/tanks - storms cells <i>NOTE: Will only be allowed in exceptional circumstances</i>	✓			

- ✓ Landscape areas should incorporate such features as swales and filter strips to reduce the volume of piped surface water run-off;
- ✓ Infiltration methods, such as soakaways, should be used wherever possible and where soil conditions permit;
- ✓ Where infiltration is not practical, other forms of sustainable drainage techniques should be used, such as attenuation tanks or balancing ponds. These should be designed to maximise their wildlife value;
- ✓ Install oil interceptors and silt traps to improve the quality of any surface water discharge to watercourses and/or soakaways;

- Provide facilities for rainwater collection for reuse such as water butts and green roofs;
- Where possible, site landscaping should utilise plant species which do not require a lot of water;
- The future maintenance requirements and responsibilities of any sustainable urban drainage measures should be made clear;
- The drainage plan for the site should be sufficient for the expected climate for the lifetime of the development.

12.20 Flood risk

- 12.21 For all sites a **Flood Risk Assessment** is required. This should be proportionate to the risk and appropriate to the scale, nature and location of the site – taking account of flooding from any source. The Leeds Strategic Flood Risk Assessment provides lots of detailed guidance on designing in flood risk areas, including minimum development control requirements and an indication of what should be included in the detailed flood risk assessment. The Environment Agency is currently working in partnership with Leeds City Council in developing a strategic approach to flood risk management.



CASE STUDY Fearn's Wharf, Leeds

The development consists of 3000m² (32,000sqft) of high quality office accommodation and achieved a BREEAM 'Excellent' energy efficiency rating. Sustainable features of the building include the overall design and construction as a heat sink with natural ventilation, while further sustainable elements have since been included with the introduction of geothermal heat pumps which provide an energy and capital efficient heating system.

Designed by Brewster Bye Architects for Bracken Developments (Yorkshire) Ltd

12.22 Leeds Flood Alleviation Scheme and Vision Document

12.23 The document aims to guide and influence the appearance, design and location of new flood defences and ensure past and future aspirations for the city are fully integrated. The 'Leeds Waterfront Strategy' (adopted by the council as Supplementary Planning Guidance) has helped define the key objectives. Recommendations will be made on general design principles, methods of reducing the visual and physical impact of defence structures and opportunities for environmental enhancements.

12.24 Flood Alleviation Scheme's Design Vision Objectives:

- Identify key sites directly affected by the flood defences;
- Establish design principles to reflect local issues and enhance local character;
- Recommend design alternatives which meet the objectives of flood defences;
- Promote improvements to connectivity and linkages to wider route networks;
- Safeguard and enhance the ecological value and nature conservation of riparian habitats and encourage sustainable methods;
- Identify key opportunities for environmental improvements;
- Pinpoint development sites and future growth areas within the river corridor.

*Other Case Studies to refer to:
– Moorgate Croft p57
– Epicentre p73*



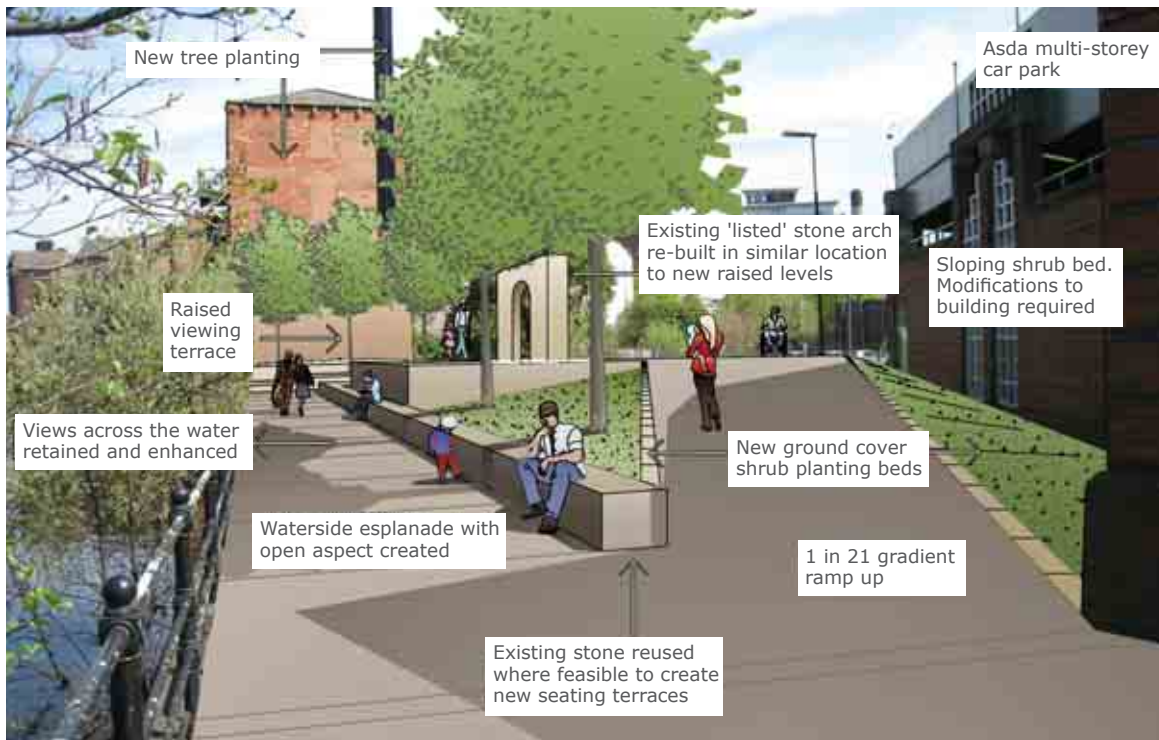
12.25

Measures that can be taken to enable development in low flood risk areas, or to take measures to reduce the impact of flooding on development built in areas with a medium or high risk of flooding include:

- A major recommendation of the Leeds Strategic Flood Risk Assessment is that in flood risk areas the whole of the site should not be regarded as the developable area and space should be made for storage and/or conveyance of flood water;
- Use flood prevention/mitigation techniques including building bunds, designing higher defensive road systems and landscape features such as wells and ponds;
- Use the ground floor space for flood-compatible uses (eg car parking) or raise the ground floor above the likely flood level.



Movable weir, Portugal



Previous proposal for Leeds Flood Alleviation Scheme: Water Lane



Leeds Flood Alleviation Scheme: Proposal for Movable Weir – concepts courtesy of Arup

12.26 Further information

- Floodzone data: www.environment-agency.gov.uk
- CIRIA (2000) Sustainable Urban Drainage Systems: Design Manual for England and Wales. Report C522: www.ciria.org
- CIRIA (2001) Sustainable Urban Drainage Systems: Best Practice Manual. Report 523: www.ciria.org
- National SUDS Working Group (2003) Framework for Sustainable Drainage Systems (SUDS) in England and Wales: www.ciria.org
- Scottish Environmental Protection Agency, Environment Agency & Environment and Heritage Service Sustainable Urban Drainage Systems: An Introduction: www.environment-agency.gov.uk
- Improving the flood performance of new buildings: Flood resilient construction, Communities and Local Government, Defra and the Environment Agency May 2007: www.communities.gov.uk/publications/planningandbuilding/improvingflood
- Leeds City Council (2007), Strategic Flood Risk Assessment: www.leeds.gov.uk
- Leeds City Council (2008), Minimum Development Control Standards For Flood Risk: www.leeds.gov.uk