Flooding and Sustainable Urban Drainage Systems

Supplementary Planning Guidance Note

Falkirk Council
Development Services
Welcome to this supplementary planning guidance note on ‘Flooding and Sustainable Urban Drainage Systems’. It is one of a suite of such guides promoting development quality in the built environment and takes forward the Council’s commitment to sustainable development as set out in the Development Plan.

The nature of flooding in the Falkirk Council area is mainly caused by a combination of Coastal Flooding from the Firth of Forth, and flooding from the two catchments of the River Carron and the River Avon which flow into it. In an era of increased awareness of the challenges of adapting to climate change, it is appropriate that the Council publish guidance to clarify the roles and responsibilities of Falkirk Council and other key agencies and the requirements placed on developers to comply with flooding policy when proposing new development.

Sustainable Urban Drainage Systems are now a requirement in all but the very smallest of new developments and are a key method of ensuring that existing flooding problems within the area are not made worse.

The purpose of this guidance is to encourage an increased interest, understanding and knowledge in flooding and drainage issues of everyone involved in the development process and thus make the Falkirk Council area a safer, more pleasant place to live, work and visit.

October 2009
1. Introduction
   1.1 Aim of the Guidance

2. Flooding
   2.1 Types of Flooding
   2.2 Measures of Food Risk
   2.3 Impact of Climate Change
   2.4 Nature of Flooding in Falkirk
   2.5 Roles and Responsibilities
   2.6 Flooding and Planning
   2.7 Developer Requirements

3. Drainage Assessment

4. SUDS Design Guidance
   4.1 Introduction
   4.2 SUDS management Train
   4.3 Maintenance and Vesting of SUDS Facilities

5. Glossary

Appendix A  - Falkirk Council Planning Policy
Appendix B  - Flood Risk Assessment
Appendix C  - Drainage Impact Assessment
Appendix D  - Evaluation of Development Surface Water Runoff Flows
Appendix E  - Local Plan Sites at Risk of Flooding
1.0 Introduction

Flooding is a natural phenomenon that has occurred throughout history. However, current pressures for development are causing an increasing number of applications to develop land which is itself susceptible to flooding, or where development could exacerbate existing problems elsewhere within the same water catchment area, both in terms of surface water drainage and combined sewer storm overflow problems.

Additionally, global climate change is predicted to increase the likelihood of both coastal and inland flooding.
1.1 Aim of the Guidance

This guidance sets out:

1. The nature of the flooding problems generally and in the Falkirk Council area in particular, the roles and responsibilities of Falkirk Council and other key agencies and the requirements placed on developers to comply with flooding policy when proposing new development.

2. The requirement for drainage assessments to accompany planning applications for new development.

3. The Council’s requirements in relation to the provision of Sustainable Urban Drainage Systems in new development.

It is therefore intended as supplementary guidance in respect of those polices relevant to flooding and drainage in the Structure and Local Plans (see appendix A).

It is also intended to encourage an increased interest, awareness, understanding and knowledge in flooding and drainage issues of everyone involved in the development process and thus make the Falkirk Council area a safer, more pleasant place to live, work and visit.
2.1 Types of Flooding

The consequences of flooding, wherever it happens, can be devastating and can pose a risk to life. The natural causes of flooding fall into 4 main categories:

a) Fluvial Flooding: from rivers, burns and streams, including that resulting from the restricted capacity and blockage of culverts conveying watercourses;
b) Coastal Flooding: from high tides and/or storm surges;
c) Pluvial Flooding: sometimes known as ‘urban’ or surface water flooding resulting from the sensitivity and limiting capacity of the existing or proposed surface water drainage network and combined drainage systems, including the independent capacity of land drainage systems and the impact of overland surface water flow. (Pluvial flooding constitutes around 25% of flooding events.);
d) Groundwater Flooding.

Less likely, but more extreme, man-made situations can result in unexpected and catastrophic flooding. Indicative areas of concern include reservoirs and dams, flood defence failure, and the inadequate capacity of culverts, particularly below embankments. Flood risk can also exist in areas such as valleys and depressions, composed of low lying ground with no watercourses and served by drainage dependent on road gullies and surface water sewers, where flooding can occur rapidly to a substantial depth.

2.2 Measures of Flood Risk

Flood risk is measured by its "return period". The return period of a flood is a measure of its rarity, defined as the average interval in years between occurrences of floods that exceed it, for example a 1 in 200 year event. Current terminology tends to label the degree of risk in probability terms known as the Annual Exceedance Probability (AEP). This is the probability associated with a return period. Thus an event of return period 200 years has an AEP of 0.5%.

The calculation of return periods is based, in the first instance, on the assumption that historical records of floods represent a reasonably unbiased sample and that the conditions (e.g. climate and land use) have been basically constant during the period of the record.

There are now two weaknesses with this approach - climate change means that:

a) evidence of the level and extent of flooding in the past is not necessarily a good guide to what may happen in the future; and
b) any particular level of flood risk at the present time may not stay at that level for future years.
2.3 Impact of Climate Change

Fluvial, Coastal and Pluvial flooding are all likely to increase because of climatic change. The Government’s “climate change scenarios” anticipate:

a) A rise in annual average temperatures.
b) Higher summer temperatures will become more frequent and very cold winters increasingly rare.
c) Winters will become wetter and summers hotter.
d) An intensification in winter precipitation generally but also possibly increased in summer.
e) Relative sea level will continue to rise and extreme levels will be experienced more frequently.
f) More days of intense rainfall, saturated ground conditions, and back-to-back storms.

In general terms, this is likely to result in an increased probability of occurrence of extreme storm events. Based on current predictions, the indications are that the 1 in 200 year event (0.5% AEP) will become a 1 in 100 year event (1% AEP) by the year 2080 and that tidal surges are likely to be more frequent and more severe. Further information on climate change can be found in the References.

2.4 Nature of Flooding in Falkirk

The Falkirk Council area has one of the highest proportions of population which is at risk of flooding of any Council in Scotland. The Grangemouth Petrochemical Facility is also at high risk of flooding. The nature of flooding in the Falkirk Council area is mainly caused by a combination of Coastal Flooding from the Firth of Forth, and the fluvial flooding from the two catchments of the River Carron and the River Avon which flow into it. No catastrophic flooding events have occurred in recent years.

A flood defence scheme to protect the town of Bo’ness is currently under construction and studies into a flood defence scheme to protect Grangemouth are underway.

Falkirk Council produces a biennial flood report which details:

- The flooding events during the preceding 2 years in the Council area.
- The measures taken to prevent or mitigate flooding in the preceding 2 years in the Council area.
- The proposed measures to prevent or mitigate flooding in the Council area.

1 Flood Reports can be downloaded from: http://www.falkirk.gov.uk/services/development/roads_services/roads_and_development_unit/flood_prevention.aspx
2.5 Roles and Responsibilities

There are three areas in which Falkirk Council has a responsibility in reducing the risk from flooding or mitigating its effects. These are:

- a) preventing new developments being at risk of flooding or causing increased risk of flooding elsewhere (Avoidance);
- b) mitigating flood risk where possible in fluvial and coastal flooding for existing property and infrastructure (Alleviation); and
- c) responding to flooding incidents.

The Scottish Environment Protection Agency provides advice on request to planning authorities on the probability of flooding and flood risk based on the information it holds, including any provided by the developer. It also operates flood warning schemes and the Floodline advice service.

Scottish Water is responsible for drainage from within the curtilage of a property. Although road drains for adopted roads are primarily the responsibility of the Roads Authority, Scottish Water will in some circumstances accept roads drainage via a section 7 agreement. British Waterways is responsible for the canal system.
### 2.6 Flooding and Planning

From a planning perspective, flooding is a material consideration and therefore needs to be considered in both the production of development plans and when deciding applications.

**Scottish Planning Policy**

SPP1 "The Planning System" reinforces the message that: "the planning system should take the possible impacts of climate change, for example greater rainfall and increased risk of flooding, into account when taking decisions on the locations of new development and other changes in land use."

SPP7: Planning and Flooding (published in February 2004) establishes the concept of the ‘Functional Flood plain’. This is the area of land adjacent to any watercourse that has a greater than 0.5% annual probability of flooding in any year, i.e. it is the 1 in 200 year return period flood inundation envelope. Generally, built development should not take place within this demarcated flood plain. SPP7 also introduces the concept of the ‘risk framework’, within which the level of risk is related to the type of land use.

SPP7 effectively sets a return period of 1 in 200 years (0.5% AEP) as an acceptable minimum standard for many forms of development, including most types of housing. However, for essential civil infrastructure (such as hospitals, fire stations, emergency depots etc) a return period of 1 in 1,000 years (0.1% AEP) is given as the minimum – unless operational reasons dictate otherwise.

Within such areas that are currently protected by flood prevention measures, SPP7 differentiates between brownfield and greenfield sites. Generally development on the latter is unacceptable, whilst development of brownfield sites may be acceptable where the flood prevention measures are properly maintained and offer protection to a level acceptable in accordance with the SPP7 Risk Framework. Development that proposes to materially increase the number of properties or people at risk of flooding might not be appropriate where, for example, residential development might be proposed in an industrial area. Proposals for new development on brownfield sites which are not protected should not increase the net risk of flooding in their area.

**Development Plan Policy** (See also Appendix A)

Policy ENV.4 of the Falkirk Council Structure Plan 2007 together with Policy ST12 of the Falkirk Council Local Plan (Finalised Draft) presume against development which would be likely to be at risk of flooding or which would increase the level of risk for existing development or would be likely to require high levels of public expenditure on flood protection work. Policy ST12 also indicate that information demonstrating that any flood risks can be adequately managed both within and out with the site will be required where a planning application is likely to raise a flooding issue.

Policy ST11 of the Falkirk Council Local Plan (Finalised Draft) indicates that any drainage strategy submitted with a planning application must include flood attenuation measures.
2.7 Developer Requirements

Step 1 Establish if there are flooding issues
It is important when considering proposals for a new development of any type that they be located where they will not be prone to flooding. Also, developments should be located where they will not reduce flood storage, or where surface water run-off from the development site will not cause problems either upstream or downstream of a receiving watercourse or drainage network. The capacity of a new development’s surface water drainage system should be adequate to deal with the required storm events, without causing flooding.

In seeking to achieve this, the first consideration should be to avoid developing on land which is naturally liable to flood. Development in such areas not only puts the new development at risk, but also effectively removes areas of natural water attenuation / storage, as water displaced by development must go somewhere.

Flood Mapping
Following the publication of the National Flooding Framework in March 2000, the Scottish Executive commissioned SEPA to create flood mapping for Scotland. An Indicative River and Coastal Flood Map has been produced by SEPA in 2006. This provides a Scotland-wide picture of the areas estimated to be at risk of flooding from rivers and/ or the sea. It should be noted that the flood map does not explicitly take into account any flood defences in place now or in the future. Additionally the flood map does not show flooding from very small burns i.e. where the area draining to the river is less than 3km². A web version of the resulting dataset has been published². The approach is intended to raise public awareness of flood risk and, if appropriate, encourage people to take action with a view to reducing the risk to themselves, their property and possessions.

Step 2 Consult with Council
Should developers identify a potential flood risk under step 1 then they should consult with the Council as to the next appropriate step.

Step 3 Assess against SPP7 risk framework
The risk framework set out in SPP7 and summarised in section 2.6. dictates that certain types of development in areas of different flood risk probability are not appropriate. If the risk framework suggests that the proposed development is inappropriate then there is little merit in proceeding any further with plans.

Falkirk Council Roads & Development Unit: 01324 503480
SEPA: 01786 452595

² See:
www.sepa.org.uk/flooding/flood_map.aspx
Flooding

Developer Requirements

Step 4 Consider SUDS Mitigation
An acceptable approach, which can help mitigate flood risk, involves the use of Sustainable Urban Drainage Systems (SUDS). Such techniques can help to prevent flooding by attenuating surface water flows from new development and should, where practicable, improve the quality of water discharges in a way which is natural, sustainable and can add to amenity, environmental quality and biodiversity. Guidelines detailing good practice in SUDS design are set out in section 3. It should be noted that SEPA promotes SUDS for water quality improvement, however SEPA also supports the use of SUDS to gain the benefit of flood / flow control and / or reducing the load in the sewerage network, where discharges are made to the sewer. These benefits provide protection for the wider environment. Under the Controlled Activities Regulations, SUDS are now required for all new development except for surface water discharging into coastal waters, where discharge is to existing sewers and for single dwellings.

Step 5 Undertake Flood Risk Assessment
Local Plan sites affected by the 1:200 year Return Period (0.5% AEP) outline on the SEPA Indicative Flood Map and for whose development a flood risk assessment may be required are listed in Appendix D. Investigation may show that the risk of flooding for certain of these sites is less than 0.5% AEP. There may also be sites that do not fall within the 0.5% AEP outline which may still be at risk of flooding. The SEPA Indicative Flood Map does not provide complete coverage because it does not include small catchments (less than 3km²)³.

If any part of the proposed development site lies within a natural flood plain and/or is close to a burn, stream, river, estuary or open coast which has a history of over-topping and flooding, or even if there is a hint or a doubt about local incidences of flooding within the vicinity both downstream and immediately upstream of the proposed development, there should be justification if a properly formulated flood risk assessment is not to be prepared. A flood risk assessment should be submitted as part of the outline planning application for the proposed development. A further assessment may be required to accompany detailed proposals. A flood risk assessment should be undertaken in accordance with the recently revised “Technical Flood Risk guidance for Stakeholders” available on SEPA’s website at: http://www.sepa.org.uk/flooding/flood_risk.aspx

Consideration should also be given to the possibility of flood risk from sources such as ground water, reservoirs and dams, canals, cessation of mine-water pumping and the inadequate capacity of culverts, which convey watercourses - no possible source of flooding should be ignored.

In general a Flood Risk Assessment should assess the probability of flooding for a particular site or area and recommend mitigation measures including maintenance. Appendix B gives guidance on flood risk assessment for developments in the Falkirk Council area and sets out what is required to be submitted by developers for consideration of planning applications. It should be noted that the preparation terms of any flood risk assessment should also be acceptable to SEPA.

³ See: http://www.sepa.org.uk/flooding/mapping/about.htm for further information
3.0 Drainage Assessment

As the name implies, a drainage assessment is intended to clearly outline the impact that the proposed development has in both surface water and foul drainage terms. A satisfactory means of foul water and surface water disposal must be demonstrated in order to show that:

a) the site can be adequately developed;
b) any land-take required for proposed drainage facilities has been allowed for; and
c) due consideration has been given to the impact of the proposed development on the drainage catchment area.

A drainage assessment is site specific and should address foul and surface water drainage, and should consider flood risk where appropriate."

The only developments that might not require the submission of a drainage assessment are those which, due to their size, have little if any impact in drainage terms. This includes:

a) developments with no known existing drainage/flooding problems, along with no known connection capacity problems to natural watercourses, land drains or surface water drainage systems.
b) developments with a total proposed impermeable surface area of less than 1000 m² and developments, which are effectively a sub development of a larger development area for which a drainage impact assessment has already been submitted.

Surface Water run-off should not be discharged to a combined sewer as it reduces capacity in the drainage infrastructure. If surface water discharges to the combined sewer are unavoidable, storm flows would need to be attenuated. Under the Controlled Activities (Scotland) Regulations, surface water discharging into a combined sewer would still have to comply to General Binding Rule (GBR) 11’s “no pollution” requirement. To ensure the requirements of GBR11 are met there should be one treatment level of SUDS prior to a discharge to the combined sewer.

Drainage Assessment – A Guide for Scotland, May 2005 produced on behalf of the Sustainable Urban Drainage Scottish Working Party gives further guidance on drainage assessments and sets out what is required to be submitted by developers for consideration of planning applications.4

Appendix C of this SPG note gives further guidance on the evaluation of development surface water runoff flows for developments in Falkirk. It should be noted that the preparation terms of any drainage strategy should also be acceptable to SEPA.

* See:
4.1 Introduction

Traditional urban drainage
Built-up areas need to be drained to remove surface water. Traditionally this has been done using underground pipe systems designed for quantity, to prevent flooding locally by conveying the water away as quickly as possible. The alteration of natural flow patterns can lead to problems elsewhere in the catchment. Water quality issues have become increasingly important, due to pollutants from urban areas being washed into rivers or the groundwater. Once polluted, groundwater is extremely difficult to clean up. Conventional drainage systems cannot easily control poor runoff quality and may contribute to the problem. The amenity aspects, such as water resources, community facilities, landscaping potential and provision of varied wildlife habitats have largely been ignored. Conventional drainage systems are not designed with these wider considerations in mind. Continuing to drain built up areas with limited objectives and ignoring wider issues is not a sustainable long-term option as it causes an impact on the terrestrial and aquatic environments.

Sustainable drainage
Drainage systems can be developed in line with the ideals of sustainable development, by balancing the different issues that should be influencing the design. Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as Sustainable Urban Drainage Systems (SUDS). These systems are more sustainable than conventional drainage methods because they:

- Manage runoff flow rates, reducing the impact of urbanisation on flooding
- Protect or enhance water quality
- Are sympathetic to the environmental setting and the needs of the local community
- Provide a habitat for wildlife in urban watercourses
- Encourage natural groundwater recharge (where appropriate).

They do this by:
- Dealing with runoff close to where the rain falls
- Managing potential pollution at its source now and in the future
- Protecting water resources from point pollution (such as accidental spills) and diffuse sources.

They may also allow new development in areas where existing sewerage systems are close to full capacity, thereby enabling development within existing urban areas.

Urban drainage is moving away from the conventional thinking of designing for flooding to balancing the impact of urban drainage on flood control, quality management and amenity.
At a particular site, SUDS systems are designed both to manage the environmental risks resulting from urban runoff and contribute wherever possible to environmental enhancement. SUDS objectives are, therefore, to minimise the impacts from development on the quantity and quality of the runoff, and maximise amenity and biodiversity opportunities. The three-way concept set out in figure 1 below, shows the main objectives that the approach is attempting to achieve. The objectives should all have equal standing, and the ideal solution will achieve benefits in all three categories, although the extent to which this is possible will depend on site characteristics and constraints. The philosophy of SUDS is to replicate, as closely as possible, the natural drainage from a site before development.

SUDS design should aim to reduce runoff by integrating storm water controls throughout the site in small, discrete units. Through effective control of runoff at source, the need for large flow attenuation and flow control structures should be minimised.

For detailed guidance on design criteria for SUDS refer to Sewers for Scotland 2nd Edition and “SUDS Manual” published by CIRIA in 2007. This can be obtained via the CIRIA website: www.ciria.org or by writing to Classic House, 174-180 Old Street, London EC1V 9BP.

Falkirk Council’s Biodiversity and Development Supplementary Planning Guidance Note contains guidance on: how to design SUDS ponds to create wetland habitats of benefit to biodiversity; how to incorporate SUDS features into ecological stepping stones and wildlife corridors; and how to ensure the potential presence of protected species is taken account of.

See: http://www.falkirk.gov.uk/services/development/planning_and_environment/supplementary_planning_guidance/PDFs/biodiversity_and_development.pdf

**Figure 1 : SUDS Objectives**
4.2 SUDS Management Train

To mimic natural catchment processes as closely as possible, a “management train” is required. This concept is fundamental to designing a successful SUDS scheme - it uses drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

The hierarchy of techniques that should be considered in developing the management train are as follows:

1. Prevention - the use of good site design and site housekeeping measures to prevent runoff and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rainwater reuse/harvesting. Prevention policies should generally be included within the site management plan.

2. Source control - control of runoff at or very near its source (e.g. soakaways, other infiltration methods, green roofs, pervious pavements).

3. Site control - management of water in a large local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin).

4. Regional control - management of runoff from a site or several sites, typically in a balancing pond or wetland.

Wherever possible, storm water should be managed in small, cost effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas (end of pipe solutions). The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should be conveyed elsewhere only if it cannot be dealt with on site.

The number of stages of treatment required in a new development is roughly proportional to the size of that development. Smaller developments may need only to consider source control whereas large developments may need source control, site control and regional control. In all cases early discussion is encouraged between developers, the Council, Scottish Water and SEPA as site control and regional control can have real implications for site layout and may require parts of the site to be set aside for use as SUDS.

The passage of water between individual parts of the management train should be considered and make use of natural conveyance systems (e.g. swales and filter trenches) wherever possible, although pipe work and sub-surface proprietary products may be required, especially where space is limited. Pre-treatment the removal of gross silt or sediment loads) and maintenance is vital to ensure long term effectiveness of all SUDS techniques. Overland flow routes will also be required to convey and control floodwater safely during extreme events or as a consequence of system failures such as culvert blockage. In general, the greater the number of techniques used in series, the better the performance is likely to be, and the lower the risk of overall system failure.

A SUDS approach to drainage can be implemented for all development sites, although individual site constraints may limit the potential for a solution to achieve maximum benefit for all functions. The variety of design options available allows designers and planners to consider local land use, land take, future management scenarios and the need of local people when undertaking the drainage design. Active decisions have to be made that balance the wishes of different stakeholders and the risks associated with each design option.
Brief preliminary descriptions of a range of SUDS components are given in Table 1.1 below.

### Table 1.1

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Control Method</th>
<th>Ecological Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Strips</td>
<td>These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.</td>
<td>Source</td>
<td>Medium ecological potential</td>
</tr>
<tr>
<td>Swales</td>
<td>Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water in the ground (if ground conditions allow).</td>
<td>Source/Site</td>
<td>Medium ecological potential</td>
</tr>
<tr>
<td>Infiltration Basins</td>
<td>Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.</td>
<td>Site</td>
<td>Good ecological potential</td>
</tr>
<tr>
<td>Wet Ponds</td>
<td>Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.</td>
<td>Site/Regional</td>
<td>Good ecological potential</td>
</tr>
<tr>
<td>Extended Detention Basins</td>
<td>Extended detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.</td>
<td>Regional/Site</td>
<td>Medium ecological potential</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.</td>
<td>Regional/Site</td>
<td>Good ecological potential</td>
</tr>
<tr>
<td>Filter Drains and Perforated Pipes</td>
<td>Filter drains and trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water.</td>
<td>Source/Site</td>
<td>Low ecological potential</td>
</tr>
<tr>
<td>Infiltration Devices</td>
<td>Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.</td>
<td>Source/Site</td>
<td>Poor ecological potential</td>
</tr>
<tr>
<td>Pervious Surfaces</td>
<td>Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration into the ground, reuse, or release to surface water.</td>
<td>Source</td>
<td>Poor ecological potential</td>
</tr>
<tr>
<td>Green Roofs</td>
<td>Green roofs are systems which cover a building’s roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.</td>
<td>Source</td>
<td>Good ecological potential</td>
</tr>
</tbody>
</table>
4.3 Maintenance and vesting of SUDS Facilities

Introduction

Maintenance of Sustainable Drainage System is essential if they are to perform properly and not pose a risk of flooding themselves. The responsibility of maintenance of SUDS is not a simple topic and is described further in the following paragraphs:

SUDS within property boundaries

Responsibility for maintenance of SUDS within property boundaries is the responsibility of the property owner; therefore all kinds of source control detailed at table 1.1 are the responsibility of homeowners. Developers should make homeowners aware of the burden of responsibility and should investigate setting up factoring agreements to manage the maintenance of these types of SUDS.

SUDS outside property boundaries

Scottish Water

Sewers for Scotland 2nd Edition (SfS2) was published in late 2007 and now contains detailed guidance on the Sustainable Urban Drainage Systems (SUDS) that can now be vested because of changes to Scottish Legislation. As such SfS2 is breaking new ground in public surface water management requirements.

Scottish Water will now vest detention ponds, basins and underground storage structures of adoptable specification designed to attenuate surface water runoff before it enters watercourses or sewers. Scottish Water has no responsibility for SUDS within property boundaries and consequently the vested public SUDS will have to be located in public open space. SfS2 provides detailed design guidance on pond and basin configuration & dimensions, size, location, inlet and outlet structures, water quality, operation and maintenance, safety, amenity, and ecology, and design guidance for underground storage.

It is the first time a UK Sewerage undertaker has set out comprehensive requirements for the construction of public SUDS. SfS2 explains Scottish Water’s specific requirements and consequently it will be of interest to all SUDS practitioners.

Other SUDS components

There are a number of different types of SUDS which Scottish Water will not adopt i.e. filter trenches, downstream defenders, swales & porous paving. The use of these types of SUDS facilities should not however, be disregarded, as they offer a number of hydraulic, water quality, biodiversity and amenity benefits which the Council seeks to encourage. Early discussion between developers, the Council, Scottish Water and SEPA should be initiated when designing SUDS for a development. It may be that the Council or another public body can adopt those SUDS features which Scottish Water will not adopt. The Council may vest SUDS from major roads but has not decided whether it can adopt other SUDS features as a matter of policy, it is only under exceptional circumstances that the Council will consider adopting SUDS features. In such circumstances, an agreement to provide a commuted sum towards the cost of maintenance will be expected from developers before planning permission is granted.

6 Can be purchased at: http://www.wrcplc.uk/sfs
Glossary

**Brownfield land** - land which has previously been developed. The term may encompass vacant or derelict land; infill sites; land occupied by redundant or unused buildings; and developed land within the settlement boundary where further intensification of use is considered acceptable. (SPP3)

**Culvert** - a structure with integral sides, soffit and invert, including a pipe that contains a watercourse as it passes through or beneath a road, railway, building, embankment etc, or below ground.

**Detention pond** - a basin constructed to store water temporarily to attenuate flows.

**Drainage assessment** - a statement of the drainage issues relevant to a proposal and the suitable means of providing drainage. The length and detail should be proportionate to the issues. As appropriate it may include existing drainage systems and problems, infiltration, groundwater, surface water flow, foul and storm water disposal, SUDS and drainage related flooding issues (may also be called a Drainage Impact Assessment). See also PAN 61 paragraphs 23 - 24.7

**Flood Liaison and Advice Group (FLAG)** - a non statutory advisory group of public and private sector representatives, convened by Councils to share concerns and knowledge and to provide advice on a wide range of planning and other flooding issues in an informal setting. FLAGs were formerly called Flood Appraisal Groups under the 1995 NPPG. The new name better describes their roles.

**Flood plain** - the generally flat areas adjacent to a watercourse or the sea where water flows in time of flood or would flow but for the presence of flood prevention measures (also called the geographical flood plain). The limits of a flood plain are defined by the peak water level of an appropriate return period event. See also Functional Flood Plain.

**Flood prevention measures** - works including walls, new channels, embankments and flood water storage areas. Usually components of a flood prevention scheme (see below).

**Flood prevention scheme** - a scheme of flood management measures under the Flood Prevention (Scotland) Act 1961.

**Flood risk assessment** - an assessment carried out to predict and assess the probability of flooding for a particular site or area and recommend mitigation measures including maintenance.

**Flood warning system** - SEPA services giving general alerts (Flood Watch) for the whole of Scotland and Flood Warnings for specific areas only.

**Freeboard allowance** - a height added to the predicted level of a flood to take account of the height of any waves or turbulence and the uncertainty in estimating the probability of flooding.

**Functional flood plain** - the areas of land where water flows in times of flood which should be safeguarded from further development because of their function as flood water storage areas.

**Greenfield land** - land which has never previously been developed, or fully restored formerly derelict land which has been brought back into active or beneficial use for agriculture, forestry, environmental purposes or outdoor recreation. (SPP 3)


7 See: http://www.scotland.gov.uk/Publications/2001/07/pan61
GLOSSARY

Public drainage system - the drainage systems which are the statutory responsibility of the roads and water authorities.

Sustainable Drainage Systems - also called Sustainable Urban Drainage Systems, SUDS describes a range of techniques for managing the flow of water run-off from a site by treating it on site and so reducing the loading on conventional piped drainage systems.

Washland - an alternative term for the functional flood plain which carries the connotation that it floods very frequently.

Watercourse - all means of conveying water except a water main or sewer (see Flood Prevention (Scotland) Act 1961).

Water table - the level of ground water below which the ground is saturated.

Appendix A - Falkirk Council Planning Policy

STRUCTURE PLAN POLICY
Policy Env.4 "Coastal Planning and Flooding" presumes against new development in areas where there is significant risk of flooding, where it is likely to be at risk or would increase the risk of flooding for existing development. Supplementary information will be required where it is necessary to assist in the determination of a planning application.

Policy ENV.15 "Water Quality" supports the adoption of sustainable urban drainage systems in all major new developments subject to appropriate maintenance agreements.

LOCAL PLAN POLICY
Policy ST11 "Sustainable Urban Drainage" requires that surface water management for new development should comply with current best practice on sustainable urban drainage systems, including opportunities for promoting biodiversity through habitat creation. It further requires that a drainage strategy should be submitted with planning applications and must include flood attenuation measures, details for the long term maintenance of any necessary features and a risk assessment.

Policy ST12 "Flooding" indicates that there will be a presumption against development which would be likely to be at risk of flooding, would increase the level of risk of flooding for existing development or would be likely to require high levels of public expenditure on flood protection works. It further requires that information demonstrating that any flood risks can be adequately managed both within and outwith the site must be provided.
Appendix B - Flood Risk Assessment

Contents of Flood Risk Assessment
A flood risk assessment should be undertaken in accordance with the recently revised “Technical Flood Risk guidance for Stakeholders” available on SEPA’s website at: http://www.sepa.org.uk/flooding/flood_risk.aspx

A basic flood risk assessment should generally include and cover the following items:

For Fluvial (River/Burn) Cases:
A surface water catchment analysis to the 200 year return period storm event level (1000 year return period for critical infrastructure) using available, historic and recorded data when available and including where appropriate -
- The assessment of the burn, stream and river peak flow and water levels at/near the development site.
- The assessment of the pre development site flood water level and the extent of this flooding on site, appropriate to the 0.5% (1:200) annual probability of flooding.

Post development proposals to deal with the assessed site flooding, with an allowance for climate change (presently a 20% increase in peak flow). This should include establishing an appropriate and safe level of freeboard allowance above the maximum assessed flood level, and where appropriate the increased surface water runoff from the development site. (Indicative freeboard to garden level is 300mm minimum, and to property ground floor levels 600mm minimum.)

An assessment of the effects of the post development proposals on the burn, stream and river peak flow and water levels and therefore the potential for increased flooding on the site and elsewhere.

Where necessary proposals for compensatory or mitigation measures to combat and deal with any assessed potential post development increase in flooding on the site and/or elsewhere. This should include reference to the need to avoid measures which will require maintenance, and if maintenance is required then an indication of how it will be funded and undertaken should be provided.

The assessment should also consider the implications of the removal of upstream flow restrictions such as a road embankment or to system failures such as culvert blockage.

For Estuary/Tidal Cases:
An analysis of the predicted 200 year return period tidal surge event (1000 year return period for critical infrastructure) using available historic and recorded data when available and including due allowance for wave and wind action and an appropriate wave run up figure to determine the following:

- The adequacy or otherwise of the existing coastal defences, if any, in the vicinity of the site to deal with the required level of tidal surge.
- The assessment of the pre development site tidal flood water level and the extent of this tidal flooding on site, appropriate to the 0.5% (1:200) annual probability of flooding.

Post development proposals to deal with the assessed site tidal flooding, including establishing an appropriate and safe level of freeboard allowance above the maximum assessed tidal flood level, and where appropriate the increased surface water runoff from the development site. Indicative freeboard to garden level is 300mm minimum, and to property ground floor level is 600mm minimum.

An assessment of the effects of the post development proposals on any adjacent land or properties.
Numerical Modelling

It is likely that many flood risk assessments will require hydrological and/or hydraulic modelling. The following generic requirements represent good practice in undertaking numerical modelling. The sophistication, cost and safety implications of any development proposal should be reflected in the complexity, scope and precision of the models applied, the range of scenarios studied and the amount and range of input data collected. For flood risk modelling it is particularly important to justify the type of model used (e.g. dynamic or steady-state) and to describe and list the input data. On occasions data may have to be estimated by reference to neighbouring or to hydrologically similar catchments and the methods applied must be clearly stated and their limitations emphasised. The report of any modelling study should address all the following requirements at an appropriate level of detail.

1. **Statement of objective** - to explain clearly the situation being modelled and the objectives of the modelling study, including details of the output required from the model.

2. **Justification of the model** - to demonstrate that the model used is suitable for this study, this should include examples of previous applications in similar circumstances.

3. **Technical description of model** - history of the model, development history, published articles, details of the conversion of the model into a software package. Details of the experience and training of the model users.

4. **Data** - any model is only as good as the source data. The data required for the model must be clearly defined.

5. **Data collection** - all relevant data collection and measurement techniques should be quoted, including expected errors and relevant quality assurance. The raw data should be available to the client if required, as should details of the instrumentation and their calibrations.

6. **Model calibration** - it is important that the model is calibrated against a full data set which is representative of the range of conditions to be modelled. The model coefficients to be calibrated and the procedures used to optimise the calibration must be stated clearly. The choice of boundaries must be justified.

7. **Model validation** - data sets independent of those used for calibration must be employed for validation tests. Every effort should be made to validate the model across the range of conditions for which it will be run. Validation tests and analysis of model errors must be undertaken for the key variables required from the modelling study.

8. **Sensitivity analysis** - this analysis must be presented to demonstrate the effect on the key output parameters resulting from variation of input data and controlling assumptions.

9. **Quality assurance** - to demonstrate that the model has been subject to an evaluation procedure establishing its suitability for the relevant tasks. There might also be a requirement to consider the interaction between fluvial and tidal elements with regard to flood risk in estuarine areas.

10. **Auditability** - to ensure that there is a clear account of the modelling exercise for inspection by any appropriate auditors.

11. **Reporting** - clear description of the model including the underlying principles and implicit or explicit assumptions. Also a clear summary of the numerical output, the likely errors, bias, sensitivity and their implications for the objectives of the study and the conclusions. Developers who commission numeric modelling to support Flood Risk Assessments will be required to supply an electronic copy of the model used.
Appendix C: Drainage Assessment

DRAINAGE ASSESSMENT

When required?
As the name implies a drainage assessment is intended to clearly outline the impact that the proposed development has in both surface water and foul drainage terms. The development surface water drainage proposed should be designed utilizing SUDS principles and techniques. Almost all types and sizes of proposed developments will require a part or full drainage impact assessment to be prepared and submitted as part of the outline and full planning application for the development. The only developments which would possibly not require the submission of a drainage impact assessment are those, which due to their size have little if any impact in drainage terms, i.e. those developments with no known existing drainage/flooding problems and a total impermeable surface area of less than 1000 m² and a development, which is effectively a sub development of a larger development area, for which a drainage impact assessment has already been submitted.

Contents - A basic part or full drainage strategy should in surface water drainage terms generally include and cover the following items dependent on the form of planning application being applied for: Outline Planning/Permission in Principle.

- Drawings showing the development site in relation to the natural surface water runoff catchment or sub catchment areas, including contour plans and details of the existing receiving watercourses and surface water drainage.

- A statement identifying which, if any, of the receiving drains and watercourses are historically prone to flooding in any part of their length.

Sufficient information on the restriction of post development surface water forward flow, basic catchment areas, pervious and impervious areas ratio, proposed methods of attenuation and indicative SUDS details, in order that a Strategic Drainage Plan or a local drainage proposal can be agreed in principle.

Full Planning
Outline drawings showing the development site in relation to the natural surface water runoff catchment or sub catchment areas and the existing receiving watercourses and surface water drainage along with a statement identifying which, if any, of the receiving drains and watercourses are historically prone to flooding in any part of their length.

- Drawings showing the planned development layout including the proposed developed areas, roads, footpaths, parking areas and other planning features including landscaping.

- Drainage layout plans and details that clearly show the surface water drainage system/network proposed including any SUDS control and treatment devices and how it is intended to connect/link into the existing surface water drainage network and/or watercourses.

- Summary of the data relating to the proposed development and development site which should generally be included -

  - Total site surface area.
  - Land use proposed.
  - Soil and subsoil type and porosity, including porosity tests and any land or water contamination present.
Appendix C: Drainage Strategy

Percentage of impervious surfaces proposed.

Full surface water runoff calculations including where appropriate -

- The limiting pre development peak runoff flow rate as appropriate to the development site in question. (As outlined below)

- Basic drainage network calculations for an M2-60 storm event or 40mm/hr rainfall intensity.

- Modified drainage network calculation for 50mm/hr rainfall intensity where road drainage is included.

- The calculated post development peak runoff flow rates for the range of 100 year return period storm events.

- The attenuation required to limit the 100 year return period post development storm runoffs to the required limiting pre development runoff flow rates.

- Check drainage network calculation for range of 200 year return period storm events to assess the level and location of potential back up flooding within the drainage network and ensure that any back up flooding does not encroach within 600 mm of any adjacent property ground floor level.

- SUDS treatment volumes both individually and combined if necessary.

- Calculations for the outlet controls for attenuation structures and/or SUDS treatment facilities.

Water runoff quality treatment using SUDS with enhanced amenity and environmental benefits is a matter, which SEPA primarily deal with in the planning consultation process. A copy letter from SEPA outlining their approval of the surface water drainage proposals in quality treatment, amenity and environmental terms should be included if available.

Scottish Water are responsible for the public sewer network both surface water and foul and as such will in most cases comment, approve and ultimately adopt at least in part the proposed development drainage. A copy letter from Scottish Water outlining their approval of the drainage proposals including connections to the public sewers should be included if available.

SUDS facilities and attenuation structures which have significant areas of open relatively deep water for some periods of time should be designed with safety in mind and a health and safety risk assessment should be submitted for each of these devices.

Water quantity control and water quality treatment also require serious consideration during the construction phase of a proposed development and any submission should include proposals for how the polluted or contaminated water runoff from the construction works site are to be dealt with prior to outfall to the existing drainage or watercourses. The use of completed SUDS for this purpose will not be accepted.
Appendix D: Evaluation of Development Surface Water Runoff Flows

**General Case**
To allow for and limit potential flooding associated with urban development post development runoffs associated with a development should generally be limited to a pre-development greenfield runoff maximum value, equivalent to a 10% runoff rate for an M5-60 storm event (approximately 4.0 l/s/ha for the general Falkirk area.) The calculated post development peak runoff flow rate for the storm duration under consideration shall include an appropriate allowance for undeveloped or permeable areas of the site, in addition to the impermeable areas - ie the allowance shall match that used to derive the pre-development runoff flow rates, normally 10%.

**Case of a Steeply Sloping Site**
Consideration will be given to developments on steeply sloping sites (>8%) to adjust the limiting pre development greenfield runoff maximum value from the general 10% runoff rate to a 20% runoff rate for an M5-60 storm event (approximately 8.0 l/s/ha for the general Falkirk area.)

**Case of an Outfall to a Very Flood Sensitive Culvert or Drain**
In certain circumstances where the surface water runoff from a development outfalls to an existing culverted watercourse or piped drainage system which is particularly flood sensitive, having known regular backup floods, the limiting pre development greenfield runoff maximum value will be set at a 10% runoff rate for an M2-60 storm event. (Approximately 3.3 l/s/ha for the general Falkirk area.)

**Case Excluded by Size**
This is a criterion, which depends on specific site circumstances and should be considered on a case by case basis. This criterion will not apply to flood sensitive watercourses, existing surface water drainage systems, and land drains or flood risk areas. Due to potential practical problems of maintenance on very small constricted outflow controls a lower limit related to residential development size has been established, below which there will be no specific requirement to consider a limiting pre-development greenfield runoff value. This case relates to residential developments whose total gross impervious area is less than 2000m2, based on the impermeable area of the site being 40% of the gross site area. (This would generally be residential developments with less than 8 to 10 houses, but would not apply to phased development.)
APPENDIX E: List of Local Plan sites at risk of Flooding

H.B&B13 “Bankier Distillery”
ED.B&B1 “Bonnybridge Town Centre”
ED.B&B4 “Bonnybridge”

H.DEN4 “Stirling Street (East)”
H.DEN7 “Denny High School”
ED.DEN2 “Winchester Avenue 1”

H.GRA4 “Chisholm Place”
H.GRA5 “Oxgang Road”
ED.GRA2 “Grangemouth Docks Zone 2”
ED.GRA3 “Grangemouth Docks Zone 3”
ED.GRA4 “Grangemouth Docks Zone 4”
ED.GRA6 “Glenburgh Road”
ED.GRA7 “Earls Gate Park”

H.AVN1 “Main Street”
H.AVN2 “Slamannan Road”
H.AVN4 “Bridgehill”

H.SLA1 “Hillend Farm”
H.SLA4 “Blinkbonnie Terrace”
H.SLA6 “The Rumlie”
H.SLA7 “Southfield Farm”

H.WHT1 “Whitecross New Settlement”
RC.WHT1 “Whitecross New Settlement”
ED.WHT1 “Whitecross New Settlement”
If you would like a copy in community languages, braille, large print or audio tape call Development Services, Falkirk Council on 01324 504977.

Printed by Falkirk Printworks, Units 6 and 7 Castle Place, Bankside Industrial Estate, Falkirk FK2 7XB. 01324 501490
Printed on Evolve Business 100gsm (TCF - Totally Chlorine Free) stock.
Fibre source = 100% recycled fibre pre and post-consumer waste.
Supplied by Robert Horne Group.