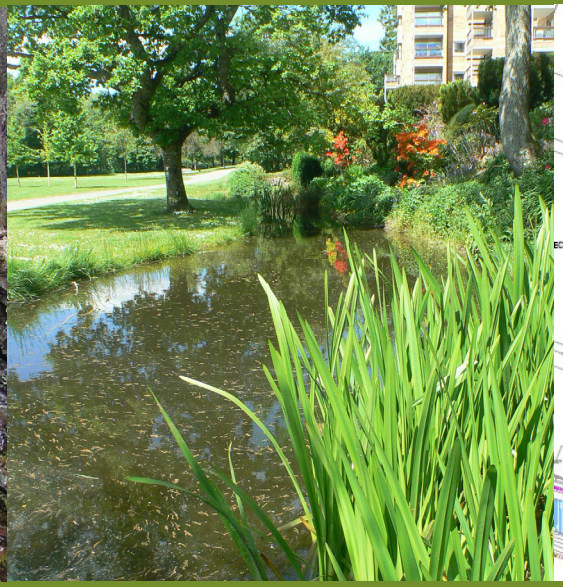
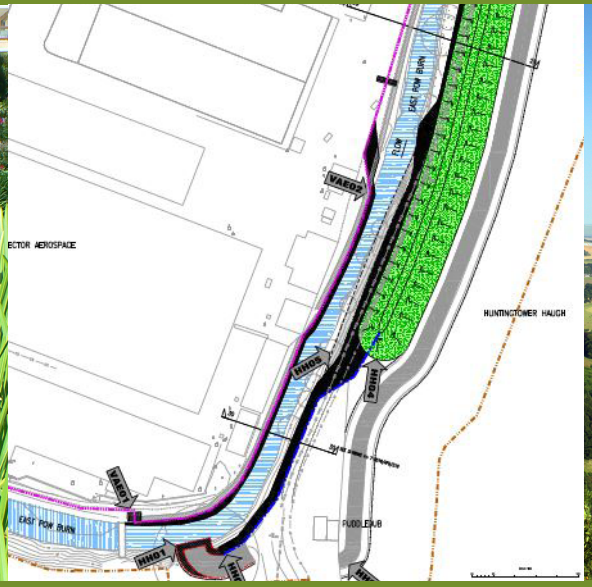
PERTH & KINROSS COUNCIL

Flood Risk and Flood Risk Assessments

Adopted March 2021

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Introduction 1

Flooding is a natural phenomenon and many parts of Scotland have a legacy of development at risk of flooding from watercourses, the sea, groundwater and inadequate drainage. Research indicates that climate change will significantly increase the risk of flooding due to changes in precipitation and rising sea levels. Already, since the mid 1980s, Scotland has seen an increase in the number of floods and high flow levels on many rivers.

As a result of the increased risk of flooding, the **Scottish Government** has developed a policy based on the principles of avoidance, awareness, assistance and alleviation. In June 2009, the Scottish Parliament enacted the **Flood Risk Management (Scotland) Act** to implement the **European Directive 2007/60/EC (the Flood Directive)** and modernise flood risk management in Scotland. The Act provides the framework for a sustainable and risk-based approach to flood risk management considering flooding from all sources. In June 2014, the Scottish Government published an update to **Scottish Planning Policy (SPP)**. This provides a national framework on which Perth & Kinross Council planning policy is based.

Planning can play an important part in reducing the vulnerability of existing and future development to flooding. This supplementary guidance document on flooding and drainage has therefore been prepared by **Perth & Kinross Council's** (PKC) Flooding Team to inform developers, their consultants and all stakeholders involved in the planning process about the Council's requirements. It is based on other existing legislation, planning policy and technical guidance. Compliance with the guidance will serve to meet the requirements of SPP, the Council's **Local Development Plan** (Policy 52: New Development and Flooding) and assists in the efficient processing of a developers' application.

Aim

This guidance document is intended as supplementary guidance for the area of Perth and Kinross in respect of existing national legislation and guidance regarding flooding and drainage (see list in **Section 4**). It also aims to encourage an increased awareness, understanding and knowledge of flooding and drainage issues for everyone involved in the development process, thereby making Perth and Kinross a safer place to live, work and visit.

This guidance document is not intended to replace the consultation that developers will require to initiate with Planning, the PKC Flooding Team and other consultees such as SEPA, SNH etc. Therefore, before submitting a planning application, developers are strongly advised to follow the chart in Section 6.14, read relevant documents detailed in Sections 4 before contecting the Council's Flooding TEam, SEPA, SNH and other relevant consultees. The Council holds information on historic flooding, flood studies, flood schemes, clearance and repair works, historic biennial flood prevention reports, Flood Risk Management Strategies, Local Flood Risk Management Plans etc. relevant to Perth and Kinross.

Background to Flooding 3

3.1 Responsibilities

3.1.1 Flooding is a natural phenomenon which can never be entirely prevented, although it can be managed to reduce its impact. Certain public bodies are expected to take a proactive role in managing and, where achievable, lowering overall flood risk, however the main responsibility for avoiding or managing flood risk still lies with land and property owners. It is long established that a property owner should take responsibility for the safety and security of their property, which includes a right to take steps to reduce the risk of flooding.

3.1.2 Under Common Law landowners:

- *must accept water from upstream;*
- *have the right to protect their own property;*
- *should not make the situation (flooding) worse for others;*
- *must undertake maintenance of watercourses on their property.*

3.2 Legislation

3.2.1 Flooding and drainage is covered by the legislation and policies outlined in the general summary below.

3.2.1.1 Flood Risk Management (Scotland) Act 2009

The Scottish Parliament enacted the **Flood Risk Management (Scotland) Act 2009** *to implement the* **European Directive 2007/60/EC** *(the Flood Directive) to modernise flood risk management in Scotland. The Act provides the framework for an integrated catchment-wide, sustainable and risk-based approach to flood risk management considering flooding from all sources. The Act identifies the roles and functions of the responsible parties with a view to reducing overall flood risk.*

The main roles and responsibilities for PKC under the Act are:

- *Map relevant bodies of water and Sustainable Urban Drainage Systems: PKC is continuing with the process of adding Sustainable Urban Drainage Systems into a GIS database and adding them to the map of water bodies.*
- *Assess bodies of water from time to time for the purpose of ascertaining whether the*

condition of any such body of water gives rise to a risk of flooding of land within or out with its area (this does not remove the landowners common law responsibility).

- *Where a body of water gives rise to such a risk, the authority shall prepare a* **schedule of clearance and repair works** *and carry out those works out (The authority will try to contact the landowner in the first instance to remove the defect/blockage).*
- *Assist SEPA in preparing the* **national flood risk assessment, flood hazard and risk maps** *and* **flood risk management strategies** *(published in December 2015 and every 6 years thereafter).*
- *Prepare* **local flood risk management plans** *(published in June 2016 and every 6 years thereafter).*

3.2.1.2 Scottish Planning Policy (SPP)

Scottish Planning Policy (SPP) *sets out national planning policies which reflect the Scottish Ministers' priorities for operation of the planning system and for the development and use of land. In particular, SPP states planning authorities must consider flooding from all sources and the risks involved when preparing development plans and determining planning applications. A grant of planning permission does not imply that there is an absence of flood risk. Developers must take flood risk into account and the ability of future occupiers to insure development before committing themselves to a site or project, as applicants and occupiers have ultimate responsibility for safeguarding their property.*

3.2.1.3 Water Environment Water Services (Scotland) Act 2003 (WEWS Act)

The **WEWS Act** *gave Scottish Ministers powers to introduce regulatory controls over water activities, in order to protect, improve and promote the sustainable use of Scotland's water environment. This includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater.*

3.2.1.4 Water Environment Controlled Activities (Scotland) Regulations 2011 (as amended)

These regulations are more commonly known as the **Controlled Activity Regulations (CAR)**.
If you intend to carry out any activity which may affect Scotland's water environment, you must be authorised by **SEPA** *to do so.*

3.3 Role of Local Authority Regarding Flooding and Drainage

3.3.1 Roads Authority

The Roads (Scotland) Act 1984 gives local authorities powers and duties with regards to public roads. Of particular relevance are:

- *Manage and maintain all roads in their area which includes draining roads and keeping drains clear.*
- *Contribute towards the costs of drainage works which appear to them desirable for protection or enjoyment of a public road.*
- *There is a duty on owners and occupiers of land adjacent to a road to prevent water or dirt from flowing onto or across the public road.*

3.3.2 Responsible Authority Under the Flood Risk Management (Scotland) Act

PKC have duties and powers to manage and, where achievable, reduce flood risk in their area. The Flood Risk Management (Scotland) Act 2009, briefly summarised in **Section 3.2.1.1**, outlines the duties of the Local Authority.

However, flooding is a natural phenomenon and as such the main responsibility for reducing flood risk still lies with the owner of the affected property.

3.3.3 Planning Authority

The planning system is used to make decisions about future development, and the use of land in our towns, cities and countryside. It decides where development should happen, where it should not and how development affects its surroundings. PKC, as Planning Authority, has a role in checking the adequacy or otherwise of a development in terms of flooding from all sources (ie surface water, river flooding, coastal flooding, groundwater), the application of climate change and to inform the Developer when a flood risk assessment and/or drainage impact assessment are required. SPP provides the framework in which to carry out these duties - refer to **Section 3.2.1.2**.

3.4 Types of Flooding[1]

3.4.1 Developers must consider all sources of flooding when assessing flood risk at a site. The various types of flooding are generally defined as follows.

3.4.2 **Fluvial -** flooding originating from a watercourse (either natural or culverted). This is normally caused when the river channel capacity (or culvert capacity) is exceeded and water flows out-of-bank onto the floodplain, which could either be natural floodplain or developed. A floodplain is the area(s) of land adjacent to a watercourse where floodwaters naturally flow and/or are stored during times of flood. In some instances fluvial flooding can occur from a combination of several local watercourses.

[1] **SEPA - Technical Flood Risk Guidance for Stakeholders**

3.4.3 **Coastal -** flooding originating from the sea (open coast or estuary) where water levels exceed the normal tidal range and flood onto the low-lying areas that define the coast line. This coastal plain could be either natural or developed. Coastal flooding can occur due to four physical elements (as outlined below) either acting on their own or in combination with each other:

- ***Predicted astronomical tide:*** *expected sea level due to the gravitational effects of the sun and the moon.*
- ***Storm surge residual:*** *elevated sea level caused by the combined effect of low pressure and persistent, strong wind (for every millibar drop in pressure, a 10mm rise in the sea surface elevation occurs).*
- ***Wave effects:*** *a function of both wind strength and open water 'fetch' length. As a result of high winds, waves can also be associated with low pressure systems which cause storm surge effects as described above.*
- ***Local bathymetric effects:*** *topographic funnelling due to the forcing of a large volume of open sea water into a restricted coastal embayment, eg estuary (Firth of Tay), tidal basin (Montrose Basin) or sea loch (Loch Fyne), which will elevate water levels locally.*

3.4.4 **Pluvial -** urban or rural flooding which results from rainfall-generated overland flow before the run-off enters any watercourse, drainage system or sewer.

3.4.5 **Groundwater -** flooding due to a significant rise in the water table, normally as a result of prolonged and heavy rainfall over a sustained period of time (can affect cellars and drainage systems). Normally associated with catchments where porous substrate and/or aquifers exist. This type of flooding can last for a considerable period of time, ie weeks, months.

3.4.6 **Drainage -** flooding as a result of surcharging of man-made drainage systems including combined sewers where the capacity of the system to convey run-off has been exceeded.

3.4.7 **Infrastructure Failure -** flooding due to collapse/failure of man-made infrastructure including hydro-dams, water supply reservoirs (private or public), canals, flood defence structures, underground conduits (eg sewers) and water treatment tanks.

3.4.8 Note that flooding may occur due to a combination of more than one type of flood process (eg fluvial and coastal flooding). In these circumstances please contact the PKC Flooding Team to discuss the implications and any additional work required.

3.5 Flood Probability

3.5.1 The annual probability (AP) of flooding is the statistical chance (or risk) that a location will flood in any given year and relates to a particular size or magnitude of flood, eg the 0.5% AP (200-year) flood event is smaller in size than the 0.1% AP (1,000-year) flood event (although a 0.5% AP flood event will occur more frequently than a 0.1% AP flood event).

3.5.2 For any given location, the 0.5% AP (200-year) flood event should (in theory) affect a smaller spatial area, or, will inundate the same area to a lesser depth (if the floodplain is constricted by topography), than the larger 0.1% AP (1,000-year) flood event. The chance of experiencing the larger 0.1% AP flood event, however, is smaller as explained below.

3.5.3 For the same location, the 0.5% AP flood event can be expressed as *'the flood which has a 0.5% chance of occurring in any given year'* (ie there is a 1 in 200 chance of experiencing a flood of that size, at that location); also referred to as the 200-year flood or the flood with a return period of 200-years.

3.5.4 However, it does not follow that if a location suffers the 0.5% AP flood event this year, it will not be flooded again to this extent for 199 years. Statistically, the chance or probability of experiencing the 0.5% AP flood event remains the same in any given year. Furthermore, it also does not follow that over any 200-year period, the 0.5% AP (200-year) flood event will definitely be experienced. Statistically, the chance of experiencing the 200-year flood event within a 200-year period is 63% (see Table 1 opposite).

Table 1: ***Probability of Experiencing a Range of Flood Events Over Different Time Periods (Design Life)***

Design Life (Years)	Return Period (Annual Probability)			
	50 (2.0% AP)	100 (1.0% AP)	200 (0.5% AP)	1,000 (0.1% AP)
1	2	1	0.5	0.1
10	18	10	5	1
20	33	18	10	2
50	64	39	22	5
70	76	50	30	7
100	87	63	39	10
200	98	87	63	18

3.5.5 Flooding is likely to increase due to climate change. In general terms this is likely to result in an increase in the probability of occurrence and severity of storm events. Estimates of flood probability are generally based on the current situation and therefore do not take into account the potential impact of future climate change. Hence there is a need to add an additional allowance for the potential impact of climate change as detailed overleaf.

3.6 Climate Change

3.6.1 Climate change is happening and there is mounting evidence of fundamental alterations to the key elements of our climate system as a result of human activities. Left unchecked these changes will accelerate, with significant consequences for our environment, economy and society.

3.6.2 The pace and signs of climate change vary across the globe, but eventually everyone will either be directly or indirectly affected. Flooding and drought are obvious direct threats and can have indirect impacts, such as higher food prices as a result of crop damage.

3.6.3 In Scotland, climate change is evident from observed changes in temperature, rainfall and snow cover. These changes are causing significant shifts in the growing, breeding and migration seasons, as well as species abundance and diversity. Higher river flows are leading to an increased risk of flooding and sea level rise is causing coastal erosion.

3.6.4 Left unchecked, climate change will accelerate. Therefore, the Council is committed to tackling climate change through our duties under the **Flood Risk Management (Scotland) Act 2009** and expects developers to reduce and account for the effects of climate change through more sustainable approaches to flood management (such as sustainable drainage techniques and natural flood management) in order to minimise the burden for future generations.

Design Guidance 4

4.1 Introduction

This section lists the main legislation, policy and technical guidance that PKC expects developers and their consultants to follow when preparing a Drainage Impact Assessment (DIA), Flood Risk Assessment (FRA), the design of Sustainable Drainage Systems (SuDS) and other drainage infrastructure. The list below is not exhaustive, and developers must ensure that all guidance and other relevant documentation are clearly referenced in their submissions.

Many of these documents are subject to frequent revision, and developers must ensure that they are using the current versions.

4.2 Scottish Government

Flood Risk Management (Scotland) Act 2009

Scottish Planning Policy, 2014

Online Planning Advice on Flood Risk

Planning Advice Note 51: Planning, Environmental Protection and Regulation

Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems [2]

Planning Advice Note 79: Water and Drainage[2]

The Water Environment and Water Services (Scotland) Act 2003

The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)

Roads (Scotland) Act 1984

Planning etc (Scotland) Act 2006

Green Infrastructure: Design and Placemaking

Delivering Sustainable Flood Risk Management (Second Edition - Feb 2019)

Surface Water Management Planning Guidance (Second Edition September 2018)

Surface Water Management Planning - A quick Start Guide (September 2018)

4.3 Scottish Environment Protection Agency (SEPA)

SEPA Policy No 41: Development at Risk of Flooding: Advice and Consultations

SEPA Technical Flood Risk Guidance for Stakeholders

SEPA Flood Risk Assessment Checklist

SEPA Strategic Flood Risk Assessment: SEPA Technical Guidance to Support Development Planning

SEPA Indicative Flood Maps

Reservoir Inundation Map

SEPA Water Level Data

SEPA advice on Sustainable Drainage Systems (SuDS)

[2] *Note: Planning Advice Note 61 and 79 are in the process of being consolidated into one document.*

Climate Change Allowance for Flood Risk Assessment in Land Use Planning

Guidance for Pollution Prevention (formerly PPGs)

Construction Site Licence

Development Plan Guidance

Standing Advice for Planning Authorities and Developers on Development Management Consultations

Planning Background Paper: Flood Risk

Natural Flood Managment Handbook

Other Guidance

4.4 SuDS Working Party

Water Assessment and Drainage Assessment Guide

4.5 Susdrain

Range of Resources Regarding SuDS

4.6 Construction Industry Research and Information Association (CIRIA)

CIRIA C532: Control of Water Pollution From Construction Sites - Guidance for Consultants and Contractors

CIRIA C582: Source Control Using Constructed Pervious Surfaces. Hydraulic, Structural and Water Quality Performance Issues

CIRIA C609: Sustainable Drainage Systems. Hydraulic, Structural and Water Quality Advice

CIRIA C624: Development and Flood Risk - Guidance for the Construction Industry

CIRIA C625: Model Agreements for Sustainable Water Management Systems

CIRIA C635: Designing for Exceedance in Urban Drainage - Good Practice

CIRIA C680: Structural Designs of Modular Geocellular Drainage Tanks

CIRIA C687: Planning for SuDS - Making it Happen

CIRIA C688: Flood Resilience and Resistance for Critical Infrastructure

CIRIA C689: Culvert Design and Operation Guide

CIRIA C698: Site Handbook for the Construction of SuDS

CIRIA C713: Retrofitting to Manage Surface Water

CIRIA C720: Culvert Design and Operation Guide: Supplementary Technical Note on Understanding Blockage Risks

CIRIA C753: The SuDS Manual

CIRIA C762: Environmental Good Practice on Site - Pocket Book

CIRIA R156: Infiltration Drainage - Manual of Good Practice

4.7 Scottish Water

Sewers for Scotland 4th Edition

4.8 Other

BRE Digest 365 Soakaway Design (2016)

BRE Digest 523 Flood-Resilient Building: Parts 1 and 2

DEFRA - Flood Risk Assessment Guidance for New Development

UKCP18

DEFRA FCDPAG3 October 2006 Supplementary Note on Climate Change Impacts

TAYplan

Perth and Kinross Local Development Plan (2019)

Perth and Kinross Local Development Plan (2019) Supplementary Guidance

BS EN 1610: 2015 Construction and Testing of Drains and Sewers

Institute of Hydrology Report 124

Flood Estimation Handbook

SuDS for Roads

SUDS for Roads Whole Life Costs Tool

Design Manual for Roads and Bridges

Dynamic Coast

Manual of Contract Document for Highway Works

Drainage Impact Assessment

5.1 Introduction

5.1.1 This section provides guidance on the requirements for the preparation and submission of a drainage impact assessment (DIA) for new developments.

5.1.2 The planning system aims to prevent development which would have a significant probability of being affected by flooding or would increase the probability of flooding elsewhere.

5.1.3 Drainage is a material consideration at the planning stage of a development and due consideration must be given to the impact of the proposed development on the catchment area. This includes an assessment of potential for both flood risk and pollution.

5.1.4 Submission of a DIA with all the information required will accelerate consideration of the planning application. Failure to demonstrate that satisfactory means of waste water and/or surface water drainage can be provided may lead to refusal of planning permission.

5.1.5 A DIA is site specific and should deal with waste water and surface water drainage. The latter should be drained according to the principles of SuDS, refer to **Section 7**.

5.1.6 Where the development is to be phased, constructed at different stages or by different developers, a strategic drainage plan covering the whole area of the development should be submitted at outline planning stage.

5.1.7 Where the development will lead to the production of waste water, a DIA must include a section on waste water.

5.2 Does the Development Require a DIA?

5.2.1 Most developments will require a DIA to be submitted as part of the planning process. The extent of a DIA will be dependent on the size and complexity of the Development. For large developments where there is an intention to separate the development into zones which will potentially be constructed at different stages or by different developers, a drainage masterplan covering the whole of the development will be required.

5.2.2 The following categories of development will not require a DIA, but the best available option for waste water and surface water drainage is still expected to be demonstrated:

1. *Developments with a total proposed impermeable surface area of less than 1,000m^2 unless the development may affect sensitive areas*.*
2. *Extension of building or hardstanding area under 100 square metres.*
3. *Changes of use not involving new buildings or hard*

surfacing.

4 *Where the submission forms part of a larger development for which a DIA has already been accepted. However, for completeness the original DIA should accompany the DIA for that specific phase.*

*Sensitive areas include:

a *areas where there is no available public sewer;*

b *areas affected by flooding;*

c *areas with high water table problems;*

d *flood sensitive receiving watercourse with no capacity for additional flow (eg Perth Town Lade);*

e *areas surrounding Fisheries, ie local fish farms;*

f *areas within or upstream (within 1km) of a conservation site designated under national or international legislation, for example a Site of Special Scientific Interest (SSSI); and*

g *contaminated Land.*

5.2.3 In the event that you are unsure as to whether a DIA is required or whether your development affects any of the sensitive areas please contact the Flooding Team for clarification, refer to **Section 10** for contact details.

5.3 What Should a DIA Include?

5.3.1 Planning Permission in Principle

Planning Permission in Principle will require a brief overview of the proposed development site drainage arrangements, associated issues and include the following:

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

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

iii *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.*

iv *Completed **Appendix B**.*

5.3.2 Full Planning Applications

A full DIA should include all information relating to the design, construction, operation and maintenance of the proposed drainage infrastructure. In particular:

5.3.2.1 Background Data

1 *Background to the existing drainage infrastructure, including a drawing (1:1250) detailing the size, percentage of impermeable area, type, level and rough gradient of each drainage infrastructure (field drains should be incorporated where possible). Photographs are recommended to record details of key site features/water-related structures (bridges, culverts, riverbanks, ditches, ponds, existing flood protection measures, existing SuDS, etc) and provide an assessment of their condition.*

2 *A brief summary of how the drainage design provides SuDS techniques in accordance with current design guidance.*

5.3.2.2 Supporting Text

1 *The size of the Development and percentage of impervious surfaces (including an additional 10% for future expansion).*

2 *The soil classification for the site including test results and, specifically, details of any site contamination.*

3 *Subsoil porosity test for proposed infiltration devices should be undertaken in line with the requirements of BRE Digest 365 or similar recognised methodology (to be confirmed by the Developer). Note: subsoil porosity tests must be undertaken as close as possible to the proposed location of each proposed infiltration device/component to ensure that the results are representative. If a porosity test is deemed by PKC to be too remote from the proposed location, the test will require to be re-done.*

4 *Summary of SuDS to be incorporated and how the system will perform and operate including suitability (or not) for future development connections. The summary of SuDS should include comment on the interaction with any contaminated soil present on the site during the construction and operation of the SuDS.*

5 *Assessment of flood risk including consideration of the overland flow route back to the receiving watercourse for up to the 0.5% AP (200-year) plus climate change flood event showing no detriment to land or property as a result of overland flow. The 0.5% AP (200-year) plus climate change flood event must be a minimum of 300mm from the lowest garden ground level [3] and 600mm from property finished floor levels (FFL).*

[3] *It is acknowledged that in certain circumstances 300mm freeboard for garden ground may not be achievable and early consultation and agreement with the Flooding Team is recommended.*

6 *A method statement detailing how water arising during construction will be dealt with (refer CIRIA publication C532 Control of water pollution form construction sites. Guidance for consultants and contractors), with particular reference to erosion prevention, sediment and run-off control and pollution prevention in order to ensure the integrity and satisfactory performance of SuDS. The use of completed SuDS for this purpose will not be accepted.*

7 *Copies of plans from Scottish Water confirming the location of the nearest public sewers and signed correspondence confirming their availability for servicing the development. This shall clearly state agreed flow rates for waste water and surface water as applicable.*

8 *Where applicable (on large developments) a copy of a letter from SEPA to obtain a CAR license for the discharge of surface water to the water environment.*

5.3.2.3 Calculations [4]

1 *Drainage network calculations for various durations (minimum of 15, 30, 60, 120, 240, 360, 480, 960, 1,440min) at the following return periods 1-year, 30-year, 100-year and 200-year.*

2 *Calculations demonstrating the attenuation required so that the post-development run-off volume does not exceed that for pre-development for the critical rainfall events (refer to* ***Section 7.6****).*

3 *Calculations demonstrating the pre-development peak run-off flow rate for the critical rainfall event for 3.33% AP (30-year), 1% AP (100-year) and 0.5% AP (200-year) and for post-development peak run-off flow rate for the critical rainfall event for 3.33% AP (30-year), 1% AP (100-year) and 0.5% AP (200-year), including 30% [5] for climate change (eg post-development for 0.5% AP (200-year) with Climate Change to be attenuated to pre development for 0.5% AP (200-year) with Climate Change). If using software, a USBD containing all input and results files with a Word document summarising the contents of each file should be included.*

4 *Calculation of the treatment volume (V_t) and required multiples thereof and demonstration that the level of treatment and available treatment volume in the SuDS is adequate. Swales as conveyance systems contribute to the total V_t.*

5 *Calculations for the outlet control for attenuation structures and/or SuDS treatment facilities, along with manufacturers' data for proprietary controls.*

6 *To aid review and understanding, all calculations should be suitably annotated to provide descriptive text of the logic, reasoning and methodology utilised. The origin of all formulae*

[4] *It is acknowledged that the requirement for fully detailed drainage calculations (Section 5.3.5) at full planning application stage is not always appropriate. Therefore, the developer should approach the Flooding Team to discuss the level of detail required to properly assess the application. Outline design calculations will be required as a minimum.*

[5] *As required under Scottish Water's 'Sewers for Scotland 4th edition'.*

should be identified. All assumptions should be clearly stated with reference to their origin. All units should be clearly stated.

5.3.2.4 Drawings

1 *Detailed scale drawing/s showing the development proposals at a scale of 1:1250.*

2 *Detailed scale drawing/s showing the development waste water and surface water drainage proposals at a scale of 1:1250 or 1:500 where complex.*

5.3.2.5 Maintenance

1 *Details of in-principle maintenance responsibilities including copies of relevant correspondence (ie with Perth & Kinross Council, Scottish Water or a proposed factor). Where a factor is proposed to take on the maintenance responsibility, the developer should provide contact details of the proposed factor. The Council and Scottish Water have adopted the principles set out in a national Memorandum of Understanding for the joint maintenance of surface water drainage systems and SUDS in new housing developments under Section 7 of the Sewerage (Scotland) Act 1968. Therefore, an individual Section 7 agreement will be required for the future adoption and maintenance of SuDS on such sites. Refer to Section 7.3.8.*

2 *Responsibility for maintenance of SuDS within property boundaries rests with the property owner. Developers shall provide confirmation on how they intend to make homeowners aware of the burden of responsibility (title deeds/design drawings/maintenance schedule) and whether there will be an allowance for setting up factoring arrangements to manage maintenance.*

3 *A maintenance schedule for all proposed SuDS, to include a detailed list of activities and timescales.*

5.3.2.6 Health & Safety

1 *Risk assessments for SuDS facilities and attenuation structures which have permanent or temporary opening and a water of a depth that could pose a risk to health and safety.*

5.3.2.7 General

1 *All documents, drawings and calculations should clearly state a reference title, number and version to ensure that appropriate version control is applied and to provide ease of reference through any subsequent necessary revisions.*

2 *All documents, drawings and calculations should show evidence of appropriate check, review and approval prior to issue. All levels should be related to Ordnance Datum Newlyn.*

3 *Completed **Appendix B**.*

Please note, this list is not exhaustive and additional information may be requested as required.

5.3.2.8 IMPORTANT INFORMATION

Important Information

In the event that the Development is approved, the Flooding Team require a copy of the Health & Safety File on completion of the Maintenance Period. The Health & Safety File should incorporate as a minimum:

1. ***Risk Assessments***
2. ***Maintenance Schedules***
3. ***Up-to-date Full CCTV Survey of System***
4. ***As-Built Drawings***
5. ***Maintenance Procedures***

The above information is required in order that PKC can comply with the Flood Risk Management (Scotland) Act 2009.

Failure to provide the above information may delay or prevent the adoption of your development.

Flood Risk Assessment 6

6.1 When is a Flood Risk Assessment (FRA) Required?

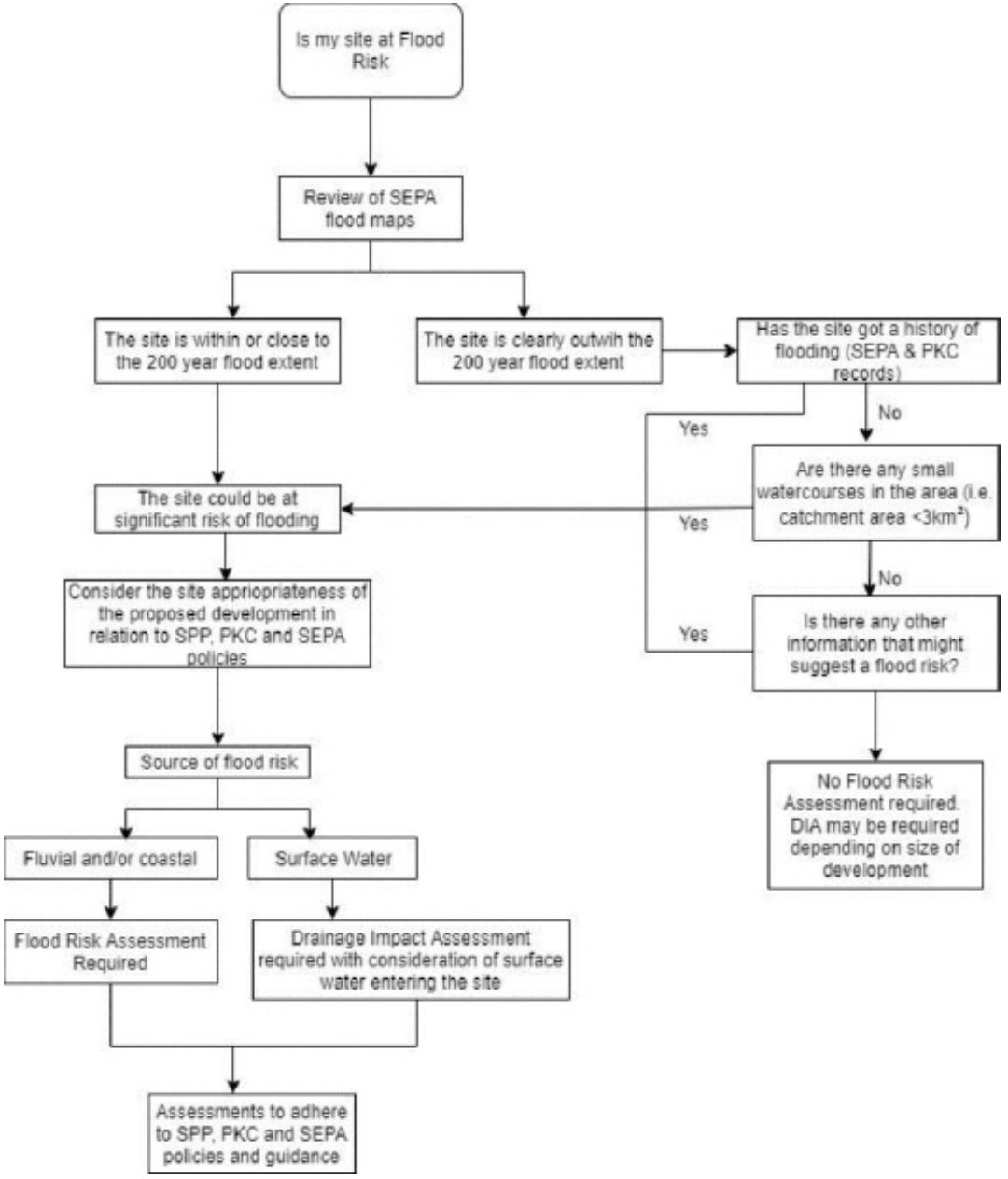
6.1.1 The planning system aims to prevent development which would have a significant probability of being affected by flooding or would increase the probability of flooding elsewhere. Piecemeal reduction of the functional floodplain shall also be avoided given the cumulative effects of reducing storage capacity.

6.1.2 Flooding is a material consideration at the planning stage of a development and is required from the outset (ie at planning permission in-principle stage). The Flood Risk and Planning Flow Chart, see Figure 1 opposite, illustrates when a FRA is required. Should a developer be unclear as to whether a FRA is required, then contact should be made with the Flooding Team for clarification, refer to **Section 10**.

6.1.3 In addition, a FRA is also required in the following circumstances:

1. *Construction of a new watercourse.*
2. *Construction of a structure over or adjacent to a watercourse.*
3. *Development in or adjacent to a flood bank or any flood control structure or constraint.*
4. *Construction adjacent to Coastal waters and/or below the 6m AOD contour.*

6.1.4 **Figure 1:** ***Flood Risk Assessment Flow Chart © PKC***



6.2 What Should a FRA Include?

6.2.1 PKC endorses technical guidance provided by SEPA and will require developers to strictly adhere to this. The detail and technical complexity of a Flood Risk Assessment will be proportionate to the scale and potential significance of the development but, in all cases, it should comply with the requirements of **SEPA's Technical Flood Risk Guidance for Stakeholders**.

Additional PKC requirements for a FRA are outlined below.

6.2.2 Climate Change

Under the Climate Change (Scotland) Act 2009, local authorities have a duty in relation to climate change. In accordance with current SEPA guidance[6], PKC require a climate change (CC) allowance (a 35% increase in the estimated peak river flow or rainfall intensity) to be applied to the 0.5% AP (200-year) calculations. This figure is subject to change as future SEPA guidance may be updated to reflect the latest scientific data.

In tidal waters a sea level uplift of 0.85m shall apply (plus 0.15 for every decade beyond 2100 where applicable)

6.2.3 Freeboard

Freeboard is an allowance in height above 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. PKC apply the following requirements for Freeboard:

- *Property Finished Floor Levels (FFL) must be a minimum of 600mm above the 0.5% AP (200-year) design flood level (the design flood level must include the appropriate climate change allowance).*
- *Lowest garden ground level must be a minimum of 300mm above the 0.5% AP (200-year) design flood level (the design flood level must include the appropriate climate change allowance).* [7]
- *Bridge soffit levels should be a minimum of 600mm above the 0.5% AP (200 year) design flood level must include the appropriate climate change allowance).* [8]

6.2.4 Most Vulnerable Uses Infrastructure

Most developments will be required to model up to the 0.5% AP (200-year) return period. However, where developments are regarded as essential infrastructure and Most Vulnerable Uses, under SPP, they will be required to model up to, and be outwith, the 0.1%AP (1,000-year) flood plain. [9]

6.2.5 Sensitivity Analysis

The Flooding Team expect an appropriate sensitivity analysis to be carried out to determine the sensitivity of the design water levels to key model parameters. A sensitivity analysis will include the following parameters and the appropriate figures to be used will be dependent on the site characteristics and the quality of data used:

[6] *Climate Change allowances for Flood Risk Assessment in Land Use Planning, SEPA.*

[7] *It is acknowledged that in certain circumstances 300mm freeboard for garden ground may not be achievable and early consultation and agreement with the Flooding Team is recommended.*

[8] *It may be difficult to achieve the above design standard for small bridges over a small watercourse. In these instances, the Flooding Team may agree to a reduced design level provided the bridge does not cause a risk of flooding elsewhere.*

[9] *Further details of these types of development can be found in SEPA's Land Use Vulnerability Guidance.*

- *Peak Flow*
- *Manning's Roughness*
- *Blockage to all obstructions (where applicable)*
- *Upstream/Downstream Boundary Conditions (where applicable)*

6.2.6 Safe Access/Egress

Any new development must incorporate safe access/egress for pedestrians and vehicular traffic within the development site. This should take account of flooding from all sources, the predicted 0.5% AP (200-year) including climate change flood envelope and overland flood routes from within and external to the site.

6.2.7 Coastal Areas

The FRA requirements for coastal developments differ from inland developments and should be discussed with the Flooding Team at the earliest opportunity.

6.2.8 Provision of Calculations and Modelling Data

When submitting a FRA an electronic copy of the modelling results and supporting information shall be submitted using email or USB pen drive. The FRA should contain the following information:

- *All data and modelling results files for each of the modelled scenarios: 50% AP (2-year), 2% AP (50-year), 1% AP (100-year), 0.5% AP (200-year), 0.5% AP (200-year) including climate change, pre- and post-development. If most vulnerable uses infrastructure, the 0.1% AP (1,000-year) scenario should also be included. This information should be in both raw data form and expressed in map form.*
- *Detailed modelled tabular outputs for scenarios (as a minimum it must include Froude numbers, velocities and flows);*
- *Proposals and calculations for compensatory storage or flood mitigation measures to deal with the assessed post development increase in flooding on the site and elsewhere (where required).*
- *Rainfall data (where required).*
- *Gauging station data (where required).*
- *Catchment descriptors.*
- *Other supporting information.*
- *A Word document containing a summary of the methodology behind the model; and*
- *Brief summary of each electronic file, where required (ie modelling files).*

6.2.9 Background Data

Good use of photographs is recommended to record details of key site features. Information should be provided to

identify the ownership of any water-related structures and an assessment of their condition.

6.2.10 Submission of a FRA

A FRA shall be submitted in electronic format as detailed below:

- **Email or USB device containing:**
  - *FRA**
  - *All associated correspondence**
  - *Completed **Appendix A****
  - *Completed **Appendix B****
  - *Complete Hec-ras, Infoworks, Mike 11, Flood Modeller, Microdrainage etc modelling results* ***and word document summarising methodology and file documentation*****.**

**Acceptable formats are .pdf, .xls, .doc.*

Failure to enclose any of the above documentation will prolong the assessment process.

6.2.11 Development of Land Defended by Flood Protection Schemes

Formal flood protection schemes (FPS) are justified on the basis of protecting existing development and not future development. Ideally these schemes would be constructed to reduce the risk of flooding to the 1 in 200 year standard and include a suitable allowance for freeboard and future climate change. However, this is often not feasible and many existing FPS in Scotland were also built to older standards and so an assessment is required in support of any proposed development in these areas. In theory this could mean that any new or brownfield development sites behind Flood Schemes could in theory never be developed. However, the Council has adopted a pragmatic approach to development behind flood schemes. The Council's approach permits the climate change allowance to be accommodated in the development design (e.g. by raising finished property floor levels) rather than insisting that the FPS itself includes a 20% allowance for climate change. The Council will therefore permit development in areas defended by a FPS with a minimum 1 in 200 year standard of protection subject to property finished floor levels being set at, or above, the 1 in 200 year flood level, including a minimum allowance of 20% for climate change and 600mm freeboard.

Within Perth and Kinross, the only existing flood protection schemes that are considered to have a high enough standard of protection to potentially allow development behind the flood defences are in Perth (1 in 250 year plus freeboard and high tide), Almondbank (1 in 200 year plus freeboard) and the proposed flood protection scheme in Comrie (1 in 200 year plus freeboard).

6.3 Can PKC Provide any Data for a FRA?

6.3.1 Yes, depending on the location of your development, PKC can, subject to availability, provide the following information:

- ***Historical Flood Records -*** *PKC hold historical biennial reports which record the measures required, and the measures taken, to mitigate flooding of land in their area and all occurrences of flooding. The latest biennial report can be requested by contacting the Flooding Team.*
- ***Completed Flood Protection Studies*** [10, 11] ***-*** *PKC are currently undertaking or have completed a number of flood studies in known flood risk areas such as Aberfeldy, Almondbank, Alyth, Bankfoot, Birnam, Blackford, Burrelton, Comrie/Dalginross, Coupar Angus, Craigie Burn (Perth), Dalguise, Dunkeld, Greenloaning, Inchyra (appraisal), Invergowrie, Kinross (south), Logierait, Longforgan, Meikleour, Milnathort, Perth, Pitlochry and Scone.*
- ***Flood Protection Schemes -*** *PKC hold records of existing flood protection schemes constructed in Almondbank, Bridge of Earn, Comrie, Milnathort, Perth and Weem (by Aberfeldy).*
- ***Telemetry - PKC hold telemetry data for some areas of Perth and Kinross including Perth, Almondbank, Comrie, Blackford and Weem.***
- **Flood Risk Management Strategies**
- **Local Flood Risk Management Plans**

6.3.2 It should be noted that SEPA also hold historic flood risk information and monitor river levels and flows throughout Perth and Kinross which can help in the assessment of flood risk.

[10] *Please contact a member of the Flooding Team for an updated list of ongoing/ completed flood studies/schemes.*

[11] *Please note that a number of these studies were completed over 5 years ago and the developer should (in consultation with the Flooding Team) review the information to determine if further assessment is required.*

Surface Water Drainage Design

7.1 Introduction

7.1.1 Under the **Water Environment (Controlled Activities) (Scotland) Regulations 2011** surface water drainage must be discharged by means of a SuDS (there are exceptions for single house dwellings or discharges to coastal waters). The SuDS shall avoid pollution of the environment and attenuate flows to Greenfield run-off levels (refer to **Section 7.6**).

7.1.2 SuDS are a soft-engineering solution that manages rainwater and potential flooding within the landscaping and greenspaces of a development, contrary to traditional hard engineering approaches. It aims to create multi-functional landscapes that deliver multiple benefits for water management, amenity and biodiversity – see Figure 2. The Council is committed to this approach and to maximising the multiple benefits of SuDS.

SuDS should:

- Be considered from the outset of the design/master-planning stage
- Be conceived as an integral part and an attractive contribution of a development's greenspaces and blue-green infrastructure
- Be designed to be multi-functional by a multi-disciplinary team composed of appropriate professionals (landscape architect or similar)
- Achieve Multiple benefits including amenity and biodiversity.

Figure 2 – Example of integrated SUDS (PKC Open Space Provision for New Developments supplementary Guidance 2021)

7.2 Hydraulic Design

7.2.1 The hydraulic design of surface water drainage systems (and SuDS), to be adopted by PKC, should meet the following criteria:

- *The surface water system should be designed so that the system does not surcharge during a 3.33% (30-year) flood event.*
- *The surface water system should be designed such that the system may surcharge but not flood properties or garden ground during a 1% AP (100-year) flood event.*
- *The surface water system should be designed so that should flooding occur during a 0.5% AP (200-year) flood event + 35% increase in peak rainfall intensity (to allow for future climate change), it should not encroach within 300mm of the lowest garden ground level [12] or 600mm of property FFL. The overland flow route shall be defined until a suitable conclusion to a receiving watercourse or suitable drainage system. In addition, access and egress must be maintained at all times during the event.*
- *The discharge rate from the development shall be restricted to the pre-development Greenfield run-off for the equivalent return period (or as agreed with the Flooding Team). Refer to* ***Section 7.6****.*

[12] *It is acknowledged that in certain circumstances 300mm freeboard for garden ground may not be achievable and early consultation and agreement with the Flooding Team is recommended.*

Note: PKC would prefer the SUDS system to attenuate up to the 0.5% AP (200-year) flood event + 35% increase in rainfall intensity (to allow for future climate change) in order that adjacent development zones are not blighted by overland flow routes.

7.3 SuDS Design

7.3.1 SuDS design should be in accordance with the most up-to-date CIRIA guidance and the Council's Supplementary Guidance on Open Space Provision for New Development.

Maintenance of SuDS is essential if they are to perform properly and not themselves pose a risk of flooding. ***It is essential that proposals for ownership/adoption and arrangements and responsibilities for future maintenance of all parts of the system are documented in the design submission.***

Early discussion between the Developer, PKC, Scottish Water and SEPA should be initiated when designing SuDS for a development. Where SuDS are being designed on the basis that they are to be vested by Scottish Water, the Developer shall ensure that the design is in accordance with Sewers for Scotland, 4th Edition. Where the Developer intends to request that PKC adopt/vest a SuDS feature, early discussion with PKC should be held to explore the potential for such an agreement. In these circumstances, an agreement to provide a commuted sum towards the cost of future maintenance may be expected from the Developer before Planning Permission is granted. Once the Section 7

process is in place all SuDS within residential schemes will be adopted by the Council and for a non residential scheme any SUDs not proposed for adoption by PKC or Scottish Water must have a demonstrable factoring agreement in place before any properties in the development are sold.

The Council and Scottish Water have adopted the principles set out in a national Memorandum of Understanding for the joint maintenance of surface water drainage systems and SUDS in new housing developments under Section 7 of the Sewerage (Scotland) Act 1968. Therefore, an individual Section 7 agreement will be required for the future adoption and maintenance of SuDS on such sites. Refer to Section 7.3.8.

Responsibility for maintenance of SuDS within property boundaries rests with the property owner. Developers must ensure the burden of responsibility on the homeowner is recorded in the title deeds and provide the homeowner with the required design drawings, detailed maintenance manual and any other relevant documents.

Submission of your surface water drainage design should always include a signed version of **Appendix B**.

Other relevant guidance specific to SuDS is outlined in the following sections.

7.3.2 Embankment Gradients

SuDS Embankment gradients should preferably be 1:6 (a maximum 1:4) in order to allow safe egress/aggress, ensure the amenity of the SuDS and enable the creation of biodiversity friendly habitats. Fencing of a SuDS pond should only be considered as a last resort or where required by Scottish Water in order to agree vesting of the asset.

7.3.3 Flood Flow Routes

Where the design of a SuDS shows the system will overtop during a 0.5% AP (200-year) flood event including climate change allowance, the flood flow routes shall be determined. Where they approach property and/or garden thresholds, the routes should be manipulated to divert the flood water to locations that cause minimal interference. A plan detailing the flood routes should be included with the planning application where required. The plan shall clearly identify where overland flow originating from within the development site has the potential to impact upon adjacent land or properties out with the development boundary until it reaches a suitable conclusion at a receiving watercourse or appropriate drainage system.

7.3.4 Pond Layout & Location

Areas for flood storage should be designed as accessible multi-functional green spaces. Well-designed multifunctional green spaces should consider how water moves around the site in the case of the various flood events. Embankments should be shallow and planted with preferably native species, but specified by an appropriate professional and suitable within its context. Ponds should be located to form an integral part of the amenity space and a site's green infrastructure, where they can make a positive contribution to

these.

Biodiversity-rich native planting around the SuDS and where appropriate within the surrounding greenspaces and the location of the SuDS should both aim for ecological connectivity with surrounding habitats.

The Council will not accept any SuDS located within the 0.5% AP (200-year) functional flood plain as during flood events the performance of the pond will be compromised by flood water and could potentially lead to more extreme flooding and pollution of the site.

A pond should create habitat mosaics with sub basins of permanent, temporary and semi-permanent ponds: vary these in size and depth – see figure 3. Some ponds or parts of basins should not be exposed to the main pollutant burden allowing many more sensitive animals and plants to exploit some parts of the site.

SuDS ponds should be designed to be open and accessible to residents and the general public.

All SuDS inlet headwalls, pipes and trash screens shall be designed and located with consideration so that they can form an acceptable and inconspicuous part of the amenity spaces.

Further information on the creation of a SuDS pond can be found in SEPA's 2000 publication "Ponds, Pools and Lochans - guidance on good practice in the management and creation of small waterbodies in Scotland".

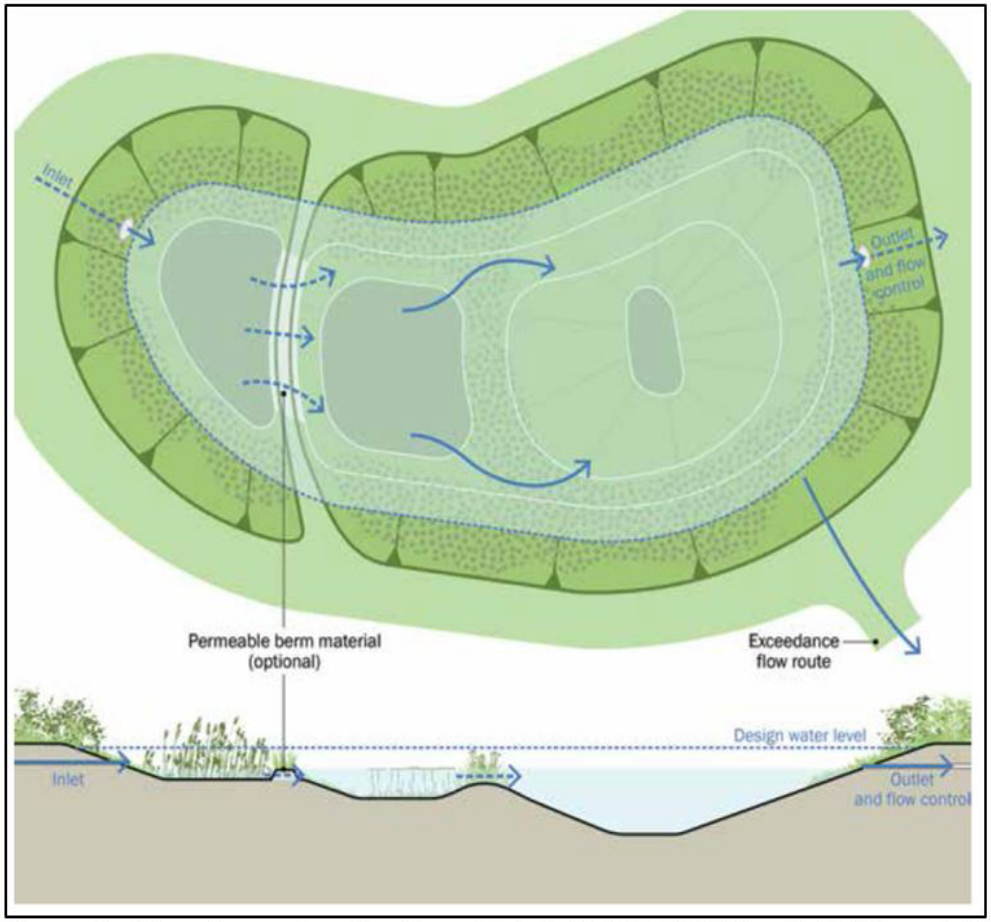


Figure 3 – Plan view and profile of pond details (CIRIA C753 The SuDS Manual, 2015)

7.3.5 Surface Water Systems to be Adopted by Scottish Water

Where surface water drainage systems are to be adopted by Scottish Water they must be designed to Sewers for Scotland, 4th Edition. However, in certain circumstances Scottish Water can make exemptions to certain standards by agreement. This potential exemption should be considered where it would help enable a higher quality, more integrated and more ambitious SuDS design or better place making. Currently, the design criteria is 3.33% (30-year) event. As a result, the developer must detail the flood flow routes for a 0.5% (200-year) flood event including climate change, and how this will be managed on-site in order that access and egress is maintained at all times and the designed flood water level is a minimum of 600mm from FLL and 300mm from the lowest garden ground level [13]. The overland flow route shall be defined until a suitable conclusion to a receiving watercourse or suitable drainage system.

[13] *It is acknowledged that in certain circumstances 300mm freeboard for garden ground may not be achievable and early consultation and agreement with the Flooding Team is recommended.*

7.3.6 Treatment Volume

$$V_t(m^3/ha) = 9.D.[SOIL/2+(1 - SOIL/2).I]$$

Where:

V_t	=	*Water Quality Treatment Volume (as a function of the total development area)*
SOIL	=	*Soil classification (from Flood Studies or Wallingford Procedure WRAP map)*
I	=	*Fraction of the area which is impervious (eg 30 per cent impermeable area = 0.3)*
D	=	*M5 - 60 minute rainfall depth (ie 5-year return period, 60 minute duration storm depth determined from the Wallingford Procedure)*

Equation 1 should be submitted as part of the planning application. Refer to Section 4.5 of CIRIA C753 *'The SuDS Manual'*.

7.3.7 Trash Screens

All SuDS inlet headwalls shall feature a trash screen (with access hatch) which includes an open tread surface to facilitate easy access but also allow an alternative route for water to flow should the face of the screen become blocked.

Any pipe outlets shall not be covered with a trash screen.

7.3.8 Future SUDS Maintenance Arrangements

Section 7 of The Sewerage (Scotland) Act 1968 allows roads authorities and Scottish Water to enter into agreements for the shared use of their sewers or drains for the conveyance of surface water from roads or premises. Representatives from the Society of Chief Officers of Transportation in Scotland (SCOTS) and Scottish Water have drafted a Memorandum of Understanding proposing the joint use and maintenance of SUDS. This approach is supported by the Scottish Government.

These new factoring arrangements would set up a framework to enable the Council and Scottish Water to agree maintenance responsibilities for shared drainage systems constructed as part of new private housing developments. It should be noted that this does not cover every development and some degree of factoring may still be required. The new arrangements would result in Scottish Water maintaining the below ground elements of shared drainage systems while the Council would maintain the above ground elements. This arrangement will also require developers to transfer land ownership to Scottish Water as part of their vesting process and the payment of commuted sums towards the cost of future maintenance.

The Council and Scottish Water have adopted the principles set out in the Memorandum of Understanding for the joint maintenance of surface water drainage systems and SUDS in new housing developments under Section 7 of the Sewerage (Scotland) Act 1968. Therefore, an individual Section 7 agreement will be required for the future adoption and maintenance of SuDS in such sites. Information is available on Scottish Water's website and further information will be available in due course concerning these individual agreements. Please contact the Flooding Team for the latest requirements.

7.4 Soakaway Design

7.4.1 Soakaways should only be used for surface water disposal where it can be demonstrated that the hydrological and hydrogeological conditions are suitable and the time for emptying will not be excessive.

7.4.2 The design of surface water soakaways should be to the requirements of BRE Digest 365 or CIRIA C753. However, the soakaway should be designed to accommodate the 200-year flood event + 35% increase in peak rainfall intensity (to allow for future climate change).

7.4.3 Soakaways should not be located within 5m of building foundations, nor in any position where the ground below foundations is likely to be affected. In addition, soakaways must take account of seasonal variations in the groundwater table.

7.4.4 Attention should be paid to the source of the run-off water to be collected and provision of appropriate pre-treatment facilities (ie grit traps, oil interceptors, etc) with suitable access for maintenance.

7.4.5 All soakaways shall be designed with facilities for inspection and maintenance.

7.4.6 Percolation testing shall be carried out to BRE Digest 365 and forwarded to the Flooding Team for approval. Depending on the sensitivity of the site to seasonal variations in groundwater level further percolation testing may be required (ie during the winter period). The developer should liaise with the Flooding Team regarding this issue. Note: subsoil porosity tests must be undertaken as close as possible to the proposed location of each proposed infiltration device/component to ensure that the results are representative. If a porosity test is deemed by PKC to be too remote from the proposed location, the test may require to be re-done.

7.5 PKC Adoption Requirements for SuDS/ Surface Water Drainage System

7.5.1 On completion of the maintenance period the following information and testing will be required before PKC will formally adopt any surface water drainage system or SuDS.

7.5.2 CCTV Survey and Drawings

A full CCTV survey and as-built drawings of the entire surface water system (including SuDS) shall be completed and handed over to the Flooding Team. This is required in order for PKC to comply with Section 17 of the **Flood Risk Management (Scotland) Act 2009**. ***Note: The system will not be adopted until such information is received.***

7.5.3 Health and Safety File

A completed Health and Safety File containing risk assessments, maintenance procedures, calculations and as-built drawings of all SuDS shall be handed over to the Flooding Team.

7.5.4 System Testing

A full test of all surface water drainage and SuDS shall be carried out and records passed to the Flooding Team. A full test shall consist of the following:

- *Drainage pipes shall be air or water tested to BS EN 1610 and where velocities are less than 1m/s a Mandrel Test may be required.*
- *Soakaways shall be 'on-site' tested to confirm rate of permeability.*
- *Ponds and basins will require suitable testing before they will be formally adopted. It is anticipated that suitable manual recording systems, video and photographic evidence during heavy rainfall events over the maintenance period will prove the following scenarios:*
  - *overflow facility operates correctly;*
  - *discharge rates are as per agreed Greenfield run-off rates;*
  - *no leakage through embankments; and*
  - *designed storage capacity has been provided (as-built drawings would provide this evidence).*

Failure to provide sufficient evidence will result in significant delays to the formal adoption of any drainage system by PKC. Any SUDS system not mentioned above will still be subject to testing and early discussions with the Flooding Team will be required in order to agree a suitable method of testing.

NB: A member of the Flooding Team should be informed of the test arrangements so they may attend if necessary, refer to **Section 10** for contact details. A minimum of 7 days notice is required prior to the test day.

7.6 Greenfield Run-off and Permissible Development Discharge Rates

7.6.1 Greenfield run-off rates are calculated to inform the selection of an acceptable rate of discharge from the site to the receiving watercourse, local Authority or Scottish Water owned surface water drainage system. The calculation of peak rates of run-off from Greenfield areas is related to catchment size. The method of calculating Greenfield run-off is outlined overleaf.

Table 2 summarises the approaches that may be used to calculate Greenfield run-off rate.

Table 2: *Greenfield Run-off Rate Estimation Methods (National SuDS Working Group, 2004)*

Development Size	Method
0-5ha	The Institute of Hydrology Report 124 *Flood estimation for small catchments* (Marshall & Bayliss, 1994) is to be used to determine peak greenfield run-off rates for QBAR. Where developments are smaller than 50ha, the analysis for determining greenfield discharge rate should use 50ha in the formula but linearly interpolate the flow rate value based on the ratio of the size of the development to 50ha. FSSR 14(IH, 1993) regional growth curve factors should be used to calculate greenfield peak flow rates for 1-, 30- and 100-year return periods.
50-200ha	IH Report 124 should be used to calculate greenfield peak flow rates. Regional growth factors to be applied.
Above 200ha	IH Report 124 can be used for catchments that are much larger than 200ha. However, for schemes of this size it is recommended that the Flood Estimation Handbook (FEH) (IH, 1999) should be applied. Both the statistical approach and the unit hydrograph approach should be used to calculate peak flow rates. However, where FEH is not considered appropriate for the calculation of greenfield run-off for the development site, for whatever reasons, IH 124 should be used.

In general, the majority of developments will come under 50 hectares and the flood estimation for small catchments is outlined in **Section 7.6.2**. PKC will accept discharge rates calculated using this method.

As a rule of thumb PKC expect the discharge rate for a 1% AP (100-year) flood event to be around 5l/s/ha and 5.5l/s/ha for a 0.5% AP (200-year) flood event. These discharge rates shall be adopted where no calculations have been carried out. However, **Section 7.6.4** outlines instances where more stringent discharge rates may or may not apply.

7.6.2 Flood Estimation of Small Catchments (QBAR)

QBAR can be calculated as follows:

Equation 2: *IH124 Mean Annual Flood Flow Rate Equation*

$$QBAR_{rural} = 0.00108AREA^{0.89}.SAAR^{1.17}.SOIL.^{2.17}$$

Where:

$QBAR_{rural}$ = *Catchment mean annual pack flow (approximately 43% annual probability or 2.3 year return period) (m^3/s)*

AREA = *Catchment area (km^2)*

SAAR = *Standard average annual rainfall for the period 1941 to 1970 (mm)*

SOIL = *Soil index (from Flood Studies or Wallingford Procedure WRAP maps). It is a weighted sum of individual soil class fractions, where:*

$$SOIL = 0.1\ SOIL_1 + 0.3\ SOIL_2 + 0.37\ SOIL_3 + 0.47\ SOIL_4 + 0.53\ SOIL_5$$

Values of SAAR and SOIL for a specific catchment can be obtained from the *Flood Studies Report (IH, 1975), The Wallingford Procedure (HR and IH, 1981),* the *Wallingford Procedure for Europe (Kellagher, 2000)* or you can contact the Flooding Team.

Greenfield peak flow rates for other probabilities can be estimated using the Q/QBAR factor from the appropriate growth curve, which for Perth and Kinross is region 1 (refer to the Institute of Hydrology - Flood Studies Supplementary Report 14) and is summarised below.

Table 3: *Scotland Growth Curve Factors*

PKC Growth Curve Factors							
Return Period							
2	5	10	25	50	100	200	500
0.9	1.2	1.45	1.81	2.12	2.48	2.84	3.25

7.6.3 Example Greenfield Run-off Calculation

Below is an example calculation method for finding the peak flow run-off from a Greenfield site.

Catchment Characteristics	
Location	*Perth*
Site AREA	*1 hectare*
SAAR	*786mm*
SOIL	*0.3*
Hydrological Region	*1*

Therefore, using the formula from the Institute of Hydrology Report 124 as detailed in Equation 2:

$$QBAR_{rural} = 0.00108AREA^{0.89}SAAR^{1.17}SOIL^{2.17}$$

Where developments are smaller than 50 hectares, the analysis for determining Greenfield discharge rate should use 50 hectares in the formula but linearly interpolate the flow rate value based on the ratio of the size of the development to 50 hectares. Therefore:

$$QBAR_{rural} = 0.00108 \times 0.5^{0.89} \times 786^{1.17} \times 0.3^{2.17}$$

$$QBAR_{rural} = 0.00108 \times 0.54 \times 2441 \times 0.073$$

$$QBAR_{rural} = 0.104 m^3/s \text{ or } 104 \text{ l/s for 50 Hectares}$$

Hence, $QBAR_{rural}$ for actual site = $QBAR_{rural}$ /50 x site area = 104/50 x 1 = 2.1 l/s/ha

Therefore, by multiplying the $QBAR_{rural}$ by the necessary return period factors as illustrated below, you achieve the following Greenfield limiting discharge rates:

1/1 factor - 2.1 x 0.85 = 1.8 l/s

1/30 factor - 2.1 x 1.9 = 4.0 l/s

1/100 factor - 2.1 x 2.48 = 5.2 l/s

1/200 factor - 2.1 x 2.82 = 5.9 l/s

7.6.4 Discharge Rate Exceptions

Known Flood Risk Locations

Where a development is located within a known flood risk location the Flooding Team may impose stricter discharge rates which are significantly below pre-development Greenfield run-off rates.

Excessive Levels of Greenfield Run-off

SPP states that any drainage measures should have a neutral or better effect on the risk of flooding both on and off site. Therefore, if in the opinion of the Flooding Team the calculated Greenfield run-off is deemed excessive they may impose reduced discharge rates.

Steeply Sloping Sites

Run-off rates for steeply sloping sites are likely to have increased discharge rates and therefore higher growth curve factors compared to flat sites. The developer should contact the Flooding Team for further information and clarification if this applies to the development site.

Small Developments

The Flooding Team accepts that it may not be possible for single house dwellings or small developments as defined under Section 5.2.2.1 to achieve the allowable Greenfield run-off discharge rates as the orifice size required to control such discharge may be susceptible to blockages. In these instances, the developer should contact the Flooding Team in order that a suitable discharge rate can be agreed. The agreed figure will be dependent on factors such as the size of the watercourse to which you will be discharging to and

the susceptibility of the area to flooding.

Discharges to Scottish Water Assets

Where surface water run-off from the development is to be discharged to Scottish Water Infrastructure, a copy of signed correspondence is required to confirm the rate of discharge that has been agreed with the water authority. Where the agreed rate of discharge is in excess of the equivalent Greenfield run-off rate, PKC reserve the right to enforce a more onerous discharge rate.

Frequently Asked Questions 8

8.1 What return periods and allowance for climate change should I design SuDS and other drainage systems too?

All SuDS and drainage systems (to be adopted by PKC) shall be designed to meet the following criteria:

- *3.33% (30-year) flood event - The surface water drainage system should be designed such that the system does not surcharge.*
- *1% AP (100-year) flood event - The system may surcharge but must not overtop the system (ie flood outwith the drainage network).*
- *0.5% AP (200-year) flood event + 35% increase in peak rainfall intensity (to allow for future climate change) - Surcharging and flooding may occur but it should not encroach within 300mm of the lowest garden ground level[14] or 600mm of property FFL. The overland flow route shall be defined until a suitable conclusion to a receiving watercourse or suitable drainage system. In addition, access and egress must be maintained at all times during the event.*

Note: PKC would prefer the SUDS system to attenuate up to the 0.5% AP (200-year) flood event + 35% increase in peak rainfall intensity (to allow for climate change) in order that adjacent development zones are not blighted by overland flow routes. In addition, an allowance of 10% should be added to impermeable areas to allow for future expansion.

8.2 What allowance for climate change should I add to the flood risk assessment river model?

At present a 35% increase in peak river flow or peak rainfall intensity must be applied to all river modelling.

8.3 What are your freeboard levels?

A minimum of 300mm freeboard to the lowest garden ground level [14] and 600mm freeboard to property finished floor level will be required in addition to the climate change allowance.

8.4 What are your Greenfield run-off rates?

This can be calculated using Equation 2 or as a rule of thumb we expect the discharge rate for a 1% AP (100-year) flood event to be 5l/s/ha and 5.5l/s/ha for a 0.5% AP (200-year) flood event. Refer to **Section 7.6** for further details.

8.5 Is there a minimum level to which I should design my bridge soffit?

Bridge soffit levels should be designed to the 0.5% AP (200-

[14] *It is acknowledged that in certain circumstances 300mm freeboard for garden ground may not be achievable and early consultation and agreement with the Flooding Team is recommended.*

year) flood event with a 35% increase in peak river flow or peak rainfall intensity and an addition of 600mm freeboard. Note that this climate change allowance may change in the future.

It may be difficult to achieve the above design standard for small bridges over a small watercourse. In these instances, the Flooding Team may agree to a reduced design level provided the bridge does not cause a risk of flooding elsewhere.

8.6 Is there a minimum and maximum gradient I can lay pipes to?

There is no minimum or maximum gradient as long as a minimum velocity of 1m/s is maintained. Testing of the system will be required prior to adoption, refer to **Section 7.5.4**.

8.7 Do you require electronic copies of my drainage/river modelling design?

Yes, any computer modelling should be forwarded via email or USB drive with your submission in addition to a paper copy, refer to **Section 6.2.8** and **6.2.10**. Details of the computer modelling software utilised should also be provided.

8.8 Is there a maximum gradient for SUDS embankments?

Yes, all SuDS embankments should have a maximum gradient of at least 1:4, but preferably a 1:6 slope. Due to safety and maintenance reasons, we cannot accept any gradients steeper than 1:4, therefore your design will not be accepted.

8.9 I am building next to a watercourse: is a maintenance strip required?

Yes, a minimum of 5 metres between the watercourse and any obstacles (such as a building or fence line) must remain in order to allow for maintenance access.

8.10 Can I develop land adjacent to an existing Flood Protection Scheme?

Yes, brownfield sites within or land adjacent to an existing formal Flood Protection Scheme can be developed, provided the scheme has a minimum standard of protection of 1 in 200 years. Property finished floor levels must be set at, or above, the 1 in 200 year flood level including a minimum allowance of 20% for climate change and 600mm freeboard. If you are proposing to develop on land within close proximity of an existing flood protection scheme then you should contact a member of the Flooding Team as soon as possible.

8.11 How long does it take to process a FRA or DIA?

The Flooding Team generally receive a request for comment on a FRA or DIA from Planning and endeavour to reply within 21 days of receiving all required documentation.

The process of concluding whether the FRA or DIA will be approved or declined is dependent on the timeous submission of the document by the developer and the complexity of the application. This process can take up to several months.

The **Flooding Team** is happy to liaise with developers and consultants at any stage in the process to help reduce the timescale for completion.

Certification and Insurance 9

9.1 Self-Certification and Insurance

The submission of your FRA/DIA/Surface Water Drainage Design or other documentation will mean that all reasonable skill, care and the attention of a qualified and competent professional in this field has been applied in accordance with this supplementary guidance.

To provide confirmation to this effect, **Appendix B** contains an assessment compliance certificate that should be completed and submitted in support of an application. Please note that a copy of your professional indemnity insurance policy will also be required. The minimum level of professional indemnity insurance to be maintained is five million pounds (£5,000,000).

Appendix A contains SEPA's FRA check sheet that should be completed and submitted in support of an application.

9.2 Third Party Certification

In certain circumstances (such as unique designs) the Flooding Team may require a third party Engineer check. In this instance, the Developer will be required (at their own cost) to identify a third party Consultant that is acceptable to the Flooding Team (ie a Chartered Engineer with suitable experience in Flooding and Drainage Issues) and have them conduct a review of your design as per this guidance. The complete third party report should be forwarded to the Flooding Team along with evidence to support any necessary updates and changes that have been carried out as recommended by the third party Engineer.

Contact Details

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10.1 PKC Flooding Team

Technicians:

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James Escott
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Address for Flooding Team:

Flooding Team
Environmental & Consumer Services
Housing & Environment
Perth & Kinross Council
Pullar House
35 Kinnoull Street
PERTH
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10.2 Road Construction Consent Queries

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Technician
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Housing & Environment
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PERTH
PH1 5GD

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10.3 Planning Queries (General)

Development Management
Planning & Development
Housing & Environment
Perth & Kinross Council
Pullar House
35 Kinnoull Street
PERTH
PH1 5GD

Tel 01738 475000
Email DevelopmentManagment@pkc.gov.uk)

Glossary/Abbreviations

AREA	*Catchment Area (km^2)*
Attenuation	*Reduction of peak flow by spreading it over a longer period of time*
BRE	*Building Research Establishment*
Bridge Soffit	*The under-surface of a bridge*
CCTV	*Closed Circuit Television*
CIRIA	*Construction Industry Research and Information Association*
DIA	*Drainage Impact Assessment*
FFL	*Finished Floor Level*
FEH13	*Update to the depth duration frequency figures for rainfall. These figures should be used in calculation of design flows using REFH2 and the design of SUDS*
FEH Rainfall runoff	*A method for estimating design flood flows and flood hydrographs for rural and urbansied ungauged catchments across the UK. Note that depth duration frequency FEH99 data should be used with this method and not FEH14 data.*
Freeboard	*A 'safety margin' to account for residual uncertainties in water level prediction and/ or structural performance. It is the difference between the height of a flood defence or floor level and the design flood level.*
Floodplain	*Land adjacent to a watercourse that would be subject to repeated flooding under natural consitions up to the 0.5% AP (200-year) return period*
Flood Estimation Handbook	*The FEH offers guidance on rainfall and river flood frequency estimation in the UK and also provides methods for assessing the rarity of notable rainfalls or floods.*
Flood Risk Management (Scotland) Act 2009	*A more sustainable and modern approach to flood risk management, Supersedes Flood Prevention (Scotland) Act 1961 and Flood Prevention and Land Drainage (Scotland) Act 1997*
FRA	*Flood Risk Assessment*
Groundwater	*Water that has percolated into the ground; it includes water in both the unsaturated zone and the water table*
Greenfield Run-off	*This is the surface water run-off regime from a site before development, or the existing site conditions for a brownfield redeveloped site through the attenuation of run-off by way of SuDS*
Ha	*Hectares*
Health & Safety File	*The Health & Safety File(s) is a statutory document held by the client. They are the means by which health and safety information is recorded and kept for future use at the end of a construction project*

HEC-RAS	*A software tool which can perform one-dimensional steady flow, unsteady flow, sediment transport/mobile bed computations, and water temperature modelling. Similar to Flood modeller.*
IH	*Institute of Hydrology (now Centre for Ecology and Hydrology).*
Flood Modeller	*A software tool which can perform river modelling. Similar to HEC-RAS.*
M2-60	*60-minute rainfall of 2-year return period (mm)*
Pond	*Permanently wet basin designed to retain and attenuate surface water run-off and permit settlement of suspended solids and biological removal of pollutants*
$QBAR_{Rural}$	*Mean Annual Maximum Flood (m3/s)*
QMED	*Median Annual Maxima Flood (m3/s). Hence has an annual exceedance probability of 0.5, and a return period of two years.*
ReFH2	The revitalised Flood Hydrograph model. A method for estimating design flood flows and flood hydrogrpahs for rurla and urbansied unguaged cathcments across the UK.
Return Period	*The theoretical return period is the inverse of the probability that the event will be exceeded in any one year. For example, a 10-year flood has a 1/10 = 0.1 or 10% chance of being exceeded in any one year and a 50-year flood has a 0.02 or 2% chance of being exceeded in any one year.*
Risk Assessment	*A Risk Assessment is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognised threat (also called hazard)*
SAAR	*Standard Average Annual Rainfall (1961-90) (mm)*
SEPA	*Scottish Environment Protection Agency*
SEPA's Indicative Flood Map	*Details areas of land in Scotland estimated to be at high, medium or low risk of flooding from either rivers, coastal or surface water*
Soakaway	*A subsurface structure into which surface water is conveyed to allow infiltration into the ground*
SOIL	*Soil index, being a weighted sum of SOIL1, …, SOIL5*
Source Control	*The control of run-off at or near its source*

SPP	*Scottish Planning Policy*
SuDS	*Sustainable Drainage Systems or Sustainable urban Drainage Systems. A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.*
Trash Screen	*A screen used at inlets to prevent the passage of material liable to block the pipe*
Treatment Volume	*The proportion of total run-off from impermeable areas captured and treated to remove pollutants*
V_t	*Treatment Volume*
Watercourse	*All means of conveying water except a water main or sewer*
Water Environment (Controlled Activities) (Scotland) Reg	*A set of regulations that control activities which may affect Scotland's water environment*
Water Environment Water Services (Scotland) Act	*Gave powers to introduce regulatory controls over water activities, in order to protect, improve and promote sustainable use of Scotland's water environment*
MICRODRAINAGE	*A software tool to design and analyse drainage systems*

If you or someone you know would like a copy of this document in another language or format, (on occasion, only a summary of the document will be provided in translation), this can be arranged by contacting the Customer Service Centre on 01738 475000.

You can also send us a text message on 07824 498145.

All Council Services can offer a telephone translation facility.

www.pkc.gov.uk (PKC Design Team - 2018619)

Appendix A - FRA Check Sheet

SEPA FRA Check Sheet

Appendix B - Assessment Compliance Certification and Insurance

Assessment Compliance Certification

I certify that all reasonable skill, care and attention has been exercised in undertaking the attached Flood Risk Assessment/ Drainage Impact Assessment/Surface Water Drainage Design* *(delete as appropriate)*. The documentation has been prepared for the below noted development in accordance with the PKC Developers' Guidance Note on Flooding and Drainage.

Name of Development

Address of Development

Name of Developer

Planning Application Number

Name and Address of Organisation Preparing this Assessment

Signed

Name

Position Held

Engineering Qualification[1]

[1] *Chartered Engineer or equivalent from an appropriate Engineering Institution.*

Date

Insurance

Please attach a copy of your professional indemnity insurance policy to this document.