APPENDIX F

Rainfall & Runoff from Development

Interim National Procedure

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RAINFALL RUNOFF MANAGEMENT FOR DEVELOPMENTS
INTERIM NATIONAL PROCEDURE

1. **Procedure status.** This procedure is an interim method, which is expected to be revised as improved tools are developed. It utilises well recognised existing methods, but revision is anticipated to provide a more consistent approach as and when FEH procedures can be extended to catchments at development scale.

2. **Compliance to national guidance.** The objective of this procedure is to assist developers and their designers to conform to PPS25.

3. **Application of the procedure.** This procedure applies to both greenfield and brownfield sites. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site (although it is preferable for solutions to provide runoff characteristics which are similar to greenfield behaviour). Therefore where greenfield performance is referred to in this document, this should be considered as meaning the existing site conditions for brownfield redevelopment sites. Sites with polluted land will have particular consent requirements and affect the drainage techniques that can be used.

4. **Use of infiltration.** Part H of the Building Regulations requires that the first choice of surface water disposal should be to discharge to infiltration systems where practicable. Infiltration techniques should therefore be applied wherever they are appropriate.

5. **Sewers for Adoption.** Drainage calculations and criteria, where appropriate, should comply with the 6th edition of Sewers for Adoption.

6. **Need for this procedure.** It is recognised that the impact of urban development on greenfield areas increases both the rate of run-off and the volume of run-off in response to rainfall and that the water quality impact on the receiving watercourse is likely to be detrimental.

7. **Procedure philosophy.** The objectives of this procedure are to:
- stormwater runoff discharged from urban developments to replicate or achieve a reduction from the greenfield response of the site over an extended range of storm probabilities (return periods)
- manage runoff on site for extreme events.

This requires:
- the **peak rate** of stormwater run-off to be controlled
- the **volume** of run-off to be reduced
- the **pollution** load to receiving waters from stormwater runoff to be minimised
- the assessment of **overland flows and temporary flood storage** across the site.

8. **Discharge rate criteria.** The Environment Agency will normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event. Exceptions only apply where it is not practical to achieve this due to either constraints on the size of the hydraulic control unit (see point 17), or excessive storage volumes. The purpose of this is to retain a natural flow regime in the receiving watercourse and not increase peak rates of flow for events of an annual probability greater than 1%. Three annual probabilities merit specific consideration; 100%, 3.33% and 1%. (Note that in many places elsewhere in this Guide return periods are used instead of annual probabilities, as much historic nomenclature and many formulae use return periods).

8.1 *The 100% annual probability* (1 in 1 year event) is the highest probability event to be specifically considered to ensure that flows to the watercourse are tightly controlled for these more frequent events.

8.2 *The 3.33% annual probability* (1 in 30 years event) is of importance because of its linkage with the level of service requirement of Sewers for Adoption 6th edition (SfA6). SfA6 requires that surface water sewers should be capable of carrying the 3.33% annual probability event within the system without causing flooding to any part of the site.

8.3 *The 1% annual probability* (1 in 100 years event) has been selected since it represents the boundary between high and medium risks of fluvial flooding defined by PPS25 and also recognises it is not practicable to fully limit flows for the most extreme events. Also SfA6 recognises that, during extreme wet weather, the capacity of surface water sewers may be inadequate. SfA6 requires that the site layout should be such that internal property flooding does not result, by demonstrating safe above ground flow paths. The return period for this analysis is not specified, but it is recommended that 1% annual probability event (i.e. an event with a return period of 100 years) is used.

8.4 *Flood flows.* up to the 1% annual probability event should preferably be contained within the site at designated temporary storage locations unless it can be shown to have no material impact in terms of nuisance or damage, or increase river flows during periods of river flooding. Analysis for overland flood flows within the site will need to use short high intensity rainfall events of between 15 minutes and 1 hour duration.

9. **The calculation of greenfield runoff rate.** The calculation of peak rates of runoff from a greenfield site is related to its size. The values derived should be regarded as indicative due to the limitations of the existing tools. Table 9.1 summarises the techniques to be used.

Table 9.1 Tools to be used for calculation of greenfield run-off criteria

Development size	Method
0 – 50 ha	The Institute of Hydrology Report 124 Flood Estimation for Small Catchments (1994) is to be used to determine peak green field runoff rates. Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha. FSSR 2 and 14 regional growth curve factors are to be used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.
50 ha – 200 ha	IH Report 124 will be used to calculate greenfield peak flow rates. Regional growth factors to be applied.
Above 200 ha	IH Report 124 can be used for catchments that are much larger than 200 ha. However, for schemes of this size it is recommended that the Flood Estimation Handbook (FEH) should be applied. Both the statistical approach and the unit hydrograph approach should be used to calculate peak flow rates. The unit hydrograph method will also provide the volume of greenfield run-off. 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.

10. **Volumetric criteria.** The stormwater runoff volume from a site should be limited to the greenfield runoff volume wherever possible. The additional runoff volume caused by urbanisation should be controlled using two criteria.

10.1 *Interception***.** Where possible, infiltration or other techniques are to be used to ensure minimal discharge to receiving waters for rainfall depths up to 5mm.

10.2 *Additional runoff due to development***.** The difference in runoff volume pre and post-development for the 100 year 6 hour event, (the additional runoff generated) should be disposed of by way of infiltration, or if this is not feasible due to soil type, discharged from the site at flow rates below 2l/s/ha.

10.3 Where compliance to 100 year volumetric criterion, as defined in section 10.2, is not provided, the limiting discharge for the 30 and 100 year return periods will be constrained to the mean annual peak rate of runoff for the greenfield site (Referred to as QBAR in IH Report 124).

11. **Percentage runoff from greenfield sites.** The percentage runoff of the rainfall on a greenfield site can be assumed to be approximately equal to the SPR value of the soil type of the site. The SPR value can be used from either the Flood Studies Report (FSR) or the Flood Estimation Handbook (FEH).

12. **Percentage runoff from developments.** Calculation of the run-off volume from the developed site for preliminary assessment and design of drainage facilities will assume 100% run-off from paved areas and 0% run-off from pervious areas. Runoff from impermeable surfaces served by effective infiltration systems can be assumed to contribute no runoff for storage volumes assessment.

13. **Detailed design of stormwater runoff.** All network design for stormwater runoff and proof of compliance in meeting peak flow rate discharge criteria, using computer simulation, should use the standard Wallingford Procedure variable UK runoff model using appropriate parameters.

14. **SUDS for water quality.** SUDS units should be used to achieve water quality improvements and amenity benefits as well as achieving compliance to these hydraulic criteria. Best practice in achieving water quality protection should be used.

15. **Reliability of SUDS.** At present certain SUDS units are considered to have some degree of risk of medium term hydraulic failure, due to either maintenance or possible change of status. In these situations, to ensure compliance with pipe capacity criteria, they will be deemed not to be effective when calculating pipe sizes and storage requirements. For pipe sizing the current view of the Water Undertakers should apply (see the National SUDS Framework document). For storage sizing of all structures which are not to be adopted by Water Undertakers, the view of the Environment Agency should normally apply.

16 **Climate change factor.** Climate change will be taken into account in hydrological regions by increasing the rainfall depth by the recommended allowances in PPS25 for computing storage volumes. No allowance for climate change should be applied to calculated greenfield peak rates of runoff from the site for any hydrological region. It should be recognised that although climate change is acknowledged as taking place, certainty regarding the hydrological changes, particularly of extreme short duration events, is very low.

17. **Minimum limit of discharge rate.** A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. It is suggested that this is 5 litres per second, using an appropriate vortex flow control device or other technically acceptable flow control device. The minimum size of pipe discharging from a flow attenuation device should be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 6th Edition.

18. **Catchment Flood Management Plans.** CFMPs (Catchment Flood Management Plans), consider the impact of development on flood risk in the catchment based on existing land use plans contained in the local plan published by the Local Planning Authority and projections of development beyond the periods covered by the land use plans. Strategy Plans identified in the CFMPs each cover part of the catchment and may consider the local impact of these

developments in more detail. Where these exist for an area proposed for development, their findings must be taken into account in the development proposal.

Further information can be found in the books:

Preliminary rainfall runoff management for developments (R & D Technical Report W5-074/A Revision D (Environment Agency and Kellagher R, 2004 - Free download from the Environment Agency web site www.environment-agency.gov.uk).

CIRIA C697 The SUDS manual ***(Woods Ballard B; Kellagher R et al, 2007 – available from CIRIA bookshop www.ciria.org)***

Interim code of practice for sustainable drainage (National SUDS Working Group, 2004) - Free download from CIRIA web site www.ciria.org or Environment Agency web site www.environment-agency.gov.uk)