
Highway Drainage

Highway Drainage - Design Guide March 2001

1. Design Criteria

The following criteria are generally to be used in the design of all Highway Drainage Systems. Any departures are to be approved of by the Group Engineer Bridges (Highway Management).

- Lloyd Davis Rational Method or the Modified Rational Method may be used for manual design calculations
- The Micro Drainage package can be used for computer-aided design. A disc containing the input data and the output must be submitted for checking to the Group Engineer Bridges (Highway Management).
- Rainfall figures used are to have a recommended average return period of 2 years (and a 4 minute time of entry) unless it is considered flooding of property might result in which case, a greater return period of at least 10 years should be considered.
- Rainfall intensities to be taken from the table of Bilham revised formula values attached to this Design Guide (Appendix A). The values given include a 12.5% local Oxfordshire adjustment.
- Design flow velocities in pipes should never be less than 0.75 m/s. In a situation where very steep gradients are unavoidable then detail design of the pipework must be in accordance with the recommendations of CIRA report number 14. On no account may design velocities exceed 7.5m/s. No gradient is to be flatter than 1:300 unless agreed with the Group Engineer Bridges (Highway Management).
- All highway drains or soakaways should be sited within the adopted highway boundaries. Where this is not possible the Group Engineer Bridges (Highway Management) must be consulted because an easement will be required.
- The use of Infiltration Basins and Swales to drain the Public Highway are permitted, but soakage tests must be undertaken on the site. Approval for each site must be obtained from the Group Engineer (Highway Management). A commuted sum for future maintenance will be required from Developer's wishing to use this type of system.
- Gully spacing shall be calculated using the methods described in HA 102/00 which replaces TRL Contractors Report No. 2, LR277 or LR602, whichever is appropriate. A minimum spacing of 5m and a maximum spacing of 50m shall normally apply. Width of flow for calculations shall be 0.75m, in urban areas and roundabouts (0.5m) and where a marginal strip is provided (1.00m).
- All gullies will be trapped unless otherwise agreed, and the appropriate grade of grating used.
- Grade D 400 gratings are to be used in all locations where braking and accelerating movements occur.

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- Twin wall plastic gully pots are approved for use.
- Gullies shall be placed at the low points on the channel line as well as at all cross over/roll over of carriageway crossfall. This includes the placing of gullies on larger island channels. Gullies should also be placed at the tangent points on road junctions.
- Double gullies shall be placed at the low points on roundabouts
- Wherever possible highway drains should be provided beside and not under the carriageway.
- If the drains are placed within the carriageway, all chambers are to be placed close to kerb lines and tangent points of junctions to allow safe access during maintenance.
- Minimum size of carrier drain will be 225mm diameter. Connection from a single gully shall be 150mm.
- Where two or more gullies are connected to a pipe run the minimum diameter of the pipe will be 225mm diameter.

2. Calculations using Lloyd Davies Rational Method

- The formula used will be $Q_p = C_i A$
Where Q_p is peak discharge in l/s.

C is dimensionless coefficient, 1.0 for Roads 0.25 for verges in rapidly draining soils, 0.5 for verges in heavy clay soils.

i is the average rainfall intensity in mm/hr.

A is the total contributing catchment area in hectares.

- **Rainfall intensity**

After calculation of the time of Concentration, the rainfall intensity will be extracted from the table of values for the Revised Bilham formula on Table 1 Appendix A.

The time of concentration t_c is defined by:

$$t_c = t_e + t_f$$

Where t_e is the time of entry

And t_f is the time of flow through the pipe system to the point under consideration.

Times of entry greater than 4 minutes are applicable to large, flat subcatchment (area greater than 400 m², slope less than 1 in 50). Note that these values of area and slope refer to the sub-catchment contributing to each pipe length.

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- **Discharge and Velocities**

Rates of flow and discharges will be those in Hydraulics Research Station Tables for the hydraulic designs of pipes Sixth Edition.

The allowable coefficient for all calculations will be the Normal K Values.

3. Soakaways

- The Group Engineer Bridges (Highway Management) is to be consulted if soakaways are to be used.
- Minimum diameter will be 1500mm.
- An approved oil interceptor (e.g. Appendix D or similar) is required to protect all soakaways.
- If more than one soakaway is planned, they are to be linked by a 225mm diameter pipe.
- Soakaways will be surrounded by Terram or similar, laid between the chamber and the filter material. The appropriate filter material to be used will vary according to ground conditions.
- Where possible, soakaways to have an overflow link (minimum diameter 225mm.) to an existing highway drain / outfall system.
- Soakaways are to be positioned not closer to the highway than shown in diagram Appendix E.
- Soakage test procedure is given in Appendix C.
(Test results to be submitted to the Group Engineer Bridges, Highway Management for approval).
- Soakaways must not be used in the vicinity of swallow holes.

4. Safety

- All covers of Manholes, Catchpits, Soakaways and Oil Interceptors shall be Ductile Iron to BSEN 124 1994 (Kitemarked or equivalent) Group 4 / Class D400.
- The only exceptions to the above is where the chambers are located so that heavy vehicles are unable to drive over them. (gardens, pedestrian areas or at the back of wide verges) where Group 2 / Class B125 would be acceptable.
- Inlet and outlet pipes at headwalls of 450mm and above require safety grids (standard details HSD / 5 / 524b & 543c refer)
- Step irons shall be provided for all chambers over 1.0m deep.
- For extra large or deep chambers access ladders are to be used instead of step irons.

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5. General

- All chambers are to be Catchpits unless the chamber is on the outfall run across fields/gardens where vehicular access for maintenance would be difficult.
- The maximum distance between chambers shall not be greater than 90 metres.
- All non-highway land shall drain away from the highway unless a licence to discharge is sought and commuted sums paid. (To be referred to the Group Engineer Bridges (Highway Management)).
- Where oil interceptors and soakaways are positioned within green areas a hard-standing area of grasscrete or similar is required to facilitate access to the chambers by maintenance vehicles.
- All on-site drainage storage facilities/flow restriction devices require the approval of the Group Engineer Bridges (Highway Management).
- All monies for Licences, Commuted sums and contributions for connections to existing highway drains are to be paid before the Developer connects to the existing system.
- For all connections to the existing highway drainage system, the Group Engineer Bridges (Highway Management) must be consulted at an early stage to ascertain whether any formal consent is required for the proposed discharge. If consent is required then the Developer will fund the investigation of the existing system and all legal costs incurred by the County Council.

Boreholes

- The Group Engineer Bridges (Highway Management) is to be consulted over the use of boreholes.
- Oil interceptors shall be constructed to protect all boreholes.
- If a borehole is the only way forward then early talks with the Environment Agency are to be undertaken and written consent obtained. (The Group Engineer Bridges (Highway Management) to be informed)
- Boreholes will not be approved within the vicinity of swallow holes.

Outfalls

- Any outfall to a main river watercourse shall be constructed to the requirement of the Environment Agency and the Highway Authority. The formal consent of the Environment Agency shall be obtained under the Land Drainage Act 1991, Section 23 and 24, and the Water Resources Act 1991, Sections 107, 109 and 165 shall apply.
- The Environment Agency and the Land Drainage Authority shall always be consulted over discharges to non-main rivers. Silt and oil interceptors will be required on these Outfalls

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- The Highway Authority has the right to outfall into a watercourse or public surface water sewer the highway water from the area which, when undeveloped, drained to that outfall. Compensation shall be payable to a person who suffers damage because of the drainage works. These issues will need to be agreed with the Highway Authority Officer (see Appendix 7 for contact details).
- To outfall into a watercourse run-off from an area which, before development, did not drain to that watercourse requires agreement of the Environment Agency, the Local Land Drainage Authority (usually the District Council) and adjacent Landowners.
- Discharges of water, other than roof water and clean surface water run-off, are not to be connected into highway drains unless permission is obtained from the Group Engineer Bridges (Highway Management) and the Environment Agency. Works may be required to the downstream system and a commuted sum will be required.
- Discharges of silty water must not be discharged to a watercourse via Highway Drains without going through settlement tanks etc. to remove the Silt.
- Run-off containing farm effluent or flows from garage forecourts and car washes must not be connected to the Highway Drainage system; they must be connected to the Public Foul Sewers.
- The Developer of a new street should negotiate the right to outfall water for the new highway into a watercourse or public surface water sewer with the Environment Agency or Thames Water Utilities. In the case of a watercourse the agreement of the adjacent landowner is also required. In the case of an outfall to a highway drain, the consent of the Highway Authority is required, and the formal consent of the Environment Agency may also be required (see general conditions above)

Ditches

- Care should be taken over the siting of ditches so that deep ditches are avoided adjacent to areas used by members of the public and to avoid the possibility of subsidence of adjacent embankments. Inclusion of ditches in any scheme is encouraged.
- Care should be taken to avoid scour or the deposit of silt in existing or proposed ditches. Gradients steeper than 1 in 100 should be avoided.
- All discharges into the sides of ditches require small headwalls with concrete bases to prevent scour and splashbacks to prevent erosion.
- Profiles for all ditches must be drawn to ensure that adequate falls are provided, and depths should not exceed 1 metre.
- Storage ditches should be designed as soakaways using the method given in Appendix C.

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Filter Drains for Road Formation Drainage

- Filter drains should be used wherever possible under the verge. Fin drains must not be placed over existing filter drains unless the filter drain is to be abandoned.

Land Drainage

- Care must be taken to ascertain details of existing Land Drainage by contacting landowners and the Land Drainage Authority. Proposed drainage must be of an adequate depth to intercept existing land drains.

Oil Interceptors

- A petrol / oil interceptor to the requirement of Oxfordshire County Council and the Environment Agency shall be included in any drainage system prior to any soakaway, borehole or outfall to watercourse. The location should be chosen to allow easy vehicular access for maintenance. See attached copy of the Environment Agency's Pollution Prevention Guidelines (Appendix F).

Combined Kerb and Drainage Systems

- These systems are approved for use on level roads and flat channels at junctions.

Silt Traps

- A silt trap shall be provided at the inlet from any ditch to a piped system and at the outfall to a watercourse.

Culverting Existing Watercourses

- The formal consent is required from the Environment Agency for the culverting of all watercourses. The Land Drainage Authority (The District Council) and the County Council must also be notified, even for minor ditches.

Camera Surveys

- All Highway drainage systems constructed for the Highway Authority are to be camera surveyed with a report and video submitted for approval. For all Section 38 and 278 works (Highways Act 1980) the camera surveys can be carried out by Oxfordshire County Council, but all costs will be met by the Developer. Contact Group Engineer Bridges (Highway Management) for further information.

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Consultations with Environment Agency

- For all consultations, use form FD1 copy attached. (Appendix G)

Consultation with Area Engineer

- Where there is a possibility that the drainage of existing highways may be affected, the Area Engineer must be consulted.

Consultation with the District Council

- The District Council may have details of land drainage schemes and should be consulted at an early stage so that the land drainage flows can be accommodated in the proposed drainage system.

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References

General

- OCC Drainage Design Guide
- Road Note 35 - Design of Storm Systems
- Vol. 2 Highway Engineering C A O'Flaherty
- Water Resources Engineering Ray K Linsley / Joseph B Franzini
- Methods for the Removal of Surface Water from Rural Trunk roads. TRRL Contractor Report 76
- Design and Analysis of Urban Storm Drainage The Wallingford Procedure Hydraulic Research
- Sewers for Adoption Water Authorities Association
- Tables for the Hydraulic Design of Pipes And Sewers Hydraulic Research
- Policy and Practice for the protection of Ground Water Environment Agency
- Land Drainage Responsibilities A Practical Code for Engineers Inst. Of Civil Engineers
- Conservation Guideline for Drainage Authorities MAFF
- HD 33/96 - Surface and Sub-surface Drainage Systems for Highways
- HA 39/89 - Edge of Pavement Details
- Sewer Jetting - Code of Practice 1st Edition June 97 - WRC
- Scope for Control of Urban Runoff - CIRIA Report 124 Vol 1-4
- Control of Pollution from Highway Drainage Discharges - CIRIA Report 142
- Infiltration drainage - Manual of Good Practice - CIRIA Report 156
- Methane and Associated Hazards to Construction - CIRIA Report 149 - 152
- Water and Drainage Law John H Bates
- Erosion of Sewers and Drains - CIRIA Report 14
- PPG25 - Development and Flood Risk
- Sustainable Urban Drainage Systems - CIRIA C522 Design Manual for England and Wales

Channels

- HA 37/97 Hydraulic design of Road-edge Surface Water Channels
- HA 78/96 Design of Outfalls for Surface Water channels

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Pipe Bedding

- HA 40/89 Determination of Pipe and Bedding Combinations for Drainage Works

Gully Spacing

- RRL report LR277 The Hydraulic Efficiency and Spacing of BS Road Gullies
- TRRL Lab Report 602 Drainage of Level or Nearly Level Roads
- TRRL Contractors Report No 2 The Drainage capacity of BS road gullies and a procedure for estimating their spacing
- HA 102/00 Advice Note for the spacing of road gullies

Appendices

- Appendix A – OCC Revised Rainfall intensity chart
- Appendix B – Calculation of Run-off from Catchment Areas
- Cont'd. – Chart of Nash and Shaw's Formula
- Appendix C – Determination of Soakaway Capacity
- Cont'd. – Formula transposed for h
- Cont'd. – Calculation sheet
- Appendix – OCC approved small Oil Interceptor HSD/5/425
- Appendix – Positioning of Soakaways and Soakage Trenches
- Appendix – Environmental Agency, Special Requirements
- Appendix G – Application for Consent for Works affecting Watercourses and/or Flood Defences (Form No. FD1)
- Appendix H – Environmental Agency. Policy Regarding Culverts