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Transport Infrastructure Ireland

TII Publications

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Edge of Pavement Details (including Amendment No. 1 dated June 2015)

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DN Design

Standards

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For all documents that existed within the NRA DMRB or the NRA MCDRW prior to the launch of TII Publications, the NRA document reference used previously is listed above under 'historical reference'. The TII Publication Number also shown above now supersedes this historical reference. All historical references within this document are deemed to be replaced by the TII Publication Number. For the equivalent TII Publication Number for all other historical references contained within this document, please refer to the TII Publications website.

An tÚdarás um Bóithre Náisiúnta
National Roads Authority

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Part 1
NRA HD 139/15

Edge of Pavement Details

(including Amendment No. 1)

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(including Amendment No. 1, dated June 2015

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Summary:

This Standard provides guidance on the use of the various types of edge of pavement drainage details which are depicted in Series 100 and 500 of the NRA Road Construction Details (NRA RCD): NRA Manual of Contract Documents for Road Works (NRA MCDRW 4)

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VOLUME 4 GEOTECHNICS AND DRAINAGE

SECTION 2 DRAINAGE

PART 1

NRA HD 139/15

EDGE OF PAVEMENT DETAILS (INCLUDING AMENDMENT NO. 1)

Contents

Chapter

1. INTRODUCTION

1.1 This Standard describes the various types of edge of pavement drainage details which are depicted in the NRA Road Construction Details Series 100 and 500 (NRA RCD) (MCDRW 4) and provides guidance on the use of the details. It also includes details of additional information required for contract documentation.

1.2 The NRA RCD are intended for use on all contracts for the National Roads Authority. Series 100 and 500 of NRA RCD (MCHW 4) depict standard details for drainage and service ducts; this includes pavement edge details dealing with drainage aspects of road verges and central reservations. Series 700 of NRA RCD depict the maximum drop from the edge of pavement to the adjacent road verge, central reservation and associated drainage details.

1.3 The Standard augments some of the advice given in the UK Highways Agency TA 57 Roadside Features (document for background reading only) but it does not cover Road Geometry, Pavement Design, Signing, Lighting and Road Layout Aspects. Safety aspects of the juxtaposition of surface water channels and safety fences are considered in NRA HD 137 Hydraulic Design of Road Edge Surface Water Channels. Design details of outlets to surface water channels are given in NRA HD 78 Design of Outlets for Surface Water Channels. UK Highways Agency HA 79 Edge of Pavement Details for Porous Asphalt Surface Courses extends the guidance given in this Standard to the particular requirements for porous asphalt. The principles of drainage design including design for the effects of climate change, are contained in NRA HD 33 Drainage Systems for National Roads.

1.4 The 2015 revision of the NRA's drainage standards was precipitated by post-doctoral research carried out under the NRA's Research Fellowship Programme and mentored by the NRA's Environment Unit. This research looked at the impacts of national road drainage systems on both surface and ground water. The research concluded that the NRA's drainage standards needed to be expanded to promote the use of sustainable drainage systems and to maximise environmental benefits. A report entitled *Drainage Design for National Road Schemes – Sustainable Drainage Options* (NRA, 2014) documents this research and provides useful background reading to the NRA's drainage standards. This document is available at: nrastandards.nra.ie/latest/other-nra-documents.

Scope

1.5 The principles outlined in this Standard shall apply to all National Roads projects.

Implementation

1.6 [1]This Standard shall be used forthwith on all schemes for the construction and/or improvement of national roads except where the scheme has received, prior to publication of this Standard, its statutory approvals to allow it to proceed. If this exception applies, the standard to be used may be either this current Standard or the Standard applicable preceding the March 2015 version of the Standard. Where the previous Standard is to be used, Designers Organisations shall confirm this by e-mail to the Standards Section of the National Roads Authority at infoDMRB@tii.ie.

[1] *Amended as per Amendment No.1, item 1*

2. DEFINITIONS

2.1 The following definitions are used and shall apply in this Standard.

2.2 **Channel:** A narrow longitudinal strip generally near the edge of the carriageway specially constructed to collect and convey surface water runoff. Series 100 and 500 of NRA RCD (MCDRW 4) show the following:

a) **Surface Water Channel:** A triangular or trapezoidal cross section channel as depicted in RCD/500/22.

b) **Grassed Surface Water Channel:** Consists of a shallow surface water channel that is lined with grass usually adjacent to the carriageway edge as depicted in RCD/100/4.

c) **Swale:** Wide linear vegetated drainage feature in which surface water can be stored or conveyed as depicted in RCD/500/25.

d) **Kerbed Edge Channel:** channel formed by the surface of the carriageway and a kerb as depicted in RCD/100/2, RCD/100/6 and RCD/100/7.

e) **Drainage Channel Block:** A precast concrete unit with cross sectional shapes as depicted in RCD/500/23, RCD/500/24, RCD/100/11, RCD/100/7, RCD/100/8.

f) **Linear Drainage Channel:** A longitudinal sub-surface closed profile hydraulic conduit with slots located in and above the conduit, as depicted in RCD/100/12.

2.3 **Filter Drain:** A drain constructed using permeable materials which allow the entry of water whilst retaining the surrounding material.

The Series 500 Drawings show three particular types:

a) **Combined Surface and Sub-surface Drains:** Depicted in RCD/500/20.

b) **Fin Drain:** A planar geocomposite structure designed to perform the same function as a filter drain. Three types are shown in RCD/500/40, RCD/500/41.

c) **Narrow Filter Drain:** A filter drain with a maximum trench width of 200 mm where either the filter material and pipe together or the pipe alone is enclosed within a layer of geotextile. Two types are shown in RCD/500/40, RCD/500/42.

2.4 **Combined Kerb and Drainage System:** A kerb combining a closed profile hydraulic conduit with slots as depicted in RCD/100/9.

3. GENERAL NOTES FOR GUIDANCE ON 100 AND 500 SERIES NRA RCD

3.1 The NRA RCD (MCDRW 4) supplement the NRA Specification for Road Works (NRA SRW) (MCDRW 1) as does the Notes for Guidance on the Specification for Road Works (NRA NGSRW) (MCDRW 2). The role of Guidance for Series 100 and 500 of NRA RCD is fulfilled by this Standard.

3.2 The general philosophy developed is that surface water should be kept on the surface but clear of the carriageway running surface for as much of its journey to its ultimate outfall as possible and fin or narrow filter drain should be used to drain pavement layers of the road. Combined surface and sub-surface drains provide both surface water collection and pavement layer drainage and are commonly used in Ireland. (see paragraph 3.4 and chapter 4).

3.3 Surface water channel systems have been designed for this purpose and are capable of carrying large volumes of water over long distances reducing the need for carrier pipes. The principles described here can quite well be served by the use of kerbed systems, informal (over the edge) drainage into open ditches, kerbs and outlet channels and informal drainage into channel block systems. In all cases the pavement layers must be drained to remove small quantities of ground water via an extended capping layer, fin or narrow filter drain or the filter drain element of the combined surface and sub-surface drain.

3.4 Filter drain systems which are required to drain pavement layers of roads on embankment should be selected from fin and narrow filter drains. These should always be introduced on the low sides of carriageways on embankment if it is not feasible to provide extended capping layer. The selection of a filter drain system to drain pavement layers of a road in cutting should be influenced by considerations of possible ground-water, drainage during construction and whether or not a longitudinal carrier drain facility is necessary to transport surface-water runoff from the carriageways. A carrier drain facility will be necessary as soon as a surface water channel reaches its design capacity or if it is necessary to introduce features such as laybys which require associated kerbing and gully provision.

3.5 A combined surface and sub-surface drain is likely to be the best solution in cuttings where predicted high groundwater flows require provision of filter drains rather than fin or narrow filter drains. The presence of a filter drain within a verge will effectively prevent additional inclusion of a longitudinal carrier drain other than by vertical separation within the same trench which is expensive and likely to give rise to constructional and maintenance difficulties.

3.6 Wherever it is necessary to provide a carrier-drain facility in cutting the Designer should give careful consideration to providing for its function in the form of a combined surface and sub-surface drain, rather than as a surface water drain which would still require provision of a fin or narrow filter drain at the pavement edge to provide for drainage of the pavement layers.

3.7 The heights shown in the NRA RCD for all types of sub-surface drain have been developed on the basis that they shall extend below sub-base or capping for the maximum thickness of pavement construction permitted. This allows all thicknesses of pavement construction to be used without the need to re-design the drainage system or to re-adjust levels and gradients. The function of sub-surface drainage is to remove water from the pavement layers and sub-base, and also from the capping layer if a permeable capping material is used. However, it is not a requirement of capping materials that they should be permeable: wherever possible, the choice of capping material should be left to the Contractor. The use of extended capping layer in accordance with RCD/100/5 is also permitted as a means of sub-surface drainage. In certain circumstances it may be possible to increase the strength of the subgrade by installing drains at a greater depth than shown in the Series 500 of NRA RCD. If large ground water flows are expected, supplementary drainage measures should be taken.

3.8 Responsibility for the design of the drainage system rests with the Designer. However, in order to obtain the most cost-effective solution, the design should allow the Contractor to choose, on a commercial basis, from as wide a range of drainage products as possible. For example, all the pipe types and materials given in the NRA SRW and all the drain types 5, 6, 7, 8 and 9 shown in RCD/500/40 should normally be allowed. Only where there are sound engineering reasons, should a particular type of drain or material be excluded.

3.9 The adoption of the drainage systems described above is consistent with the move towards hardening central reserves in particular. Hardening central reserves of appropriate widths have a number of potential benefits apart from the obvious drainage one. These include ease of maintenance and providing alternative methods of mounting safety fences, lighting columns and signs.

4. COMBINED SURFACE AND SUB-SURFACE DRAINS

4.1 Combined surface and sub-surface drains alongside the carriageway have been in use for many years and due to the very open texture of the filter material provide for the rapid removal of rainwater from the road and verge surface and also the removal of sediment washed from the carriageway surface. Because the pipe diameters are relatively large, there is, except in rare instances, exceptionally large groundwater capacity which extends as a cut-off to below the capping layer. The choice of the filter medium material affects the performance of the drain, advice on filter media and also surface stabilization techniques is contained in NRA HD 33.

4.2 They have however several disadvantages. These principally are the increasing cost of suitably graded stone in some regions, the need for regular maintenance to prevent a build-up of grass kerbs, replacement or recycling of the filter materials about every 10 years, and the problem of stone scatter. Poor construction and/or lack of maintenance may result in water leaving the carrier pipe and entering the pavement foundation to detrimental effect. This risk also applies to systems where, although positive provision is made at the surface, gully connections are made directly to the combined surface and sub-surface drain pipe. They are recognized as a Sustainable Drainage System, see NRA HD 33, and are detailed in Series 100 and 500 of NRA RCD (MCDRW 4). They can be used for reconstruction work and for situations where large ground water flows from cuttings are to be dealt with and where a combined system can show significant cost savings. They may also be necessary when the road has long lengths of zero longitudinal gradient. Combined surface and sub-surface drain costs increase more rapidly than for other systems with increasing pipe diameter because of the cost of the filter medium. Pipe diameters shall not exceed 450 mm. Guidance on the design of combined surface and sub-surface drains, including stone scatter mitigation, is contained in NRA HD 33.

4.3 Combined surface and sub-surface drains (Filter Drains) are detailed in RCD/500/20. Filter drain type selection shall be in accordance with NRA HD 140 Determination of Pipe and Bedding Combinations for Drainage Works. Geotextile is required where filter drains are used:

a) Within soil types where water bearing sands or silts are encountered

b) Within cut sections containing drains to control groundwater where water bearing sands or silts are encountered.

Lightweight aggregate should also be considered for drainage filter material as shown in RCD/500/20.

4.4 Where combined surface and sub-surface drains are used in limestone areas, the use of concrete pipe shall be avoided due to the risk of carbon dioxide build up or where lime or cement stabilization is proposed there is a risk that pipe perforations may be affected by calcium based deposits.

5. SURFACE WATER CHANNELS

5.1 Surface water channels are normally of concrete construction, usually slip-formed set at the edge of the hard strip or hard shoulder and flush with the road surface. They provide an economical alternative to edge channels for positive drainage and are normally intended for use in rural roads. They may not be appropriate for roads with long stretches of zero longitudinal gradient.

5.2 Two cross-section profiles are acceptable: Triangular and trapezoidal. Details of triangular profiles are given in RCD/500/22 and dimensions for the variables T, U, V, W, X, Y and Z should be specified in Appendix 5/3 of the NRA SRW. The hydraulic capacity of channels should be designed in accordance with NRA HD 137.

5.3 Cross sectional details for surface water channels and the location of such channels relative to the position of safety fences shall be determined with due consideration to safety aspects. Guidance on this is given in NRA HD 137. Channels with crossfalls steeper than 1:4 or deeper than 150 mm, and all rectangular channels, can only be used behind safety barriers because of safety requirements. Typical details are given in RCD/100/3. In some circumstances, there will be insufficient space within the road cross sections shown in NRA RCD to comply with the above. In these cases, alternative types of positive surface water drainage, as described in this Standard, should be used. Designs should allow for these alternatives at an early stage to prevent complications later on.

5.4 The dimension Z in RCD/500/22 should be a minimum of 200 mm in order to provide a robust section capable of withstanding occasional vehicle overrun. This may be reduced to the carriageway slab thickness in rigid construction where the channel and slab are slipformed together. Depending on the pavement alternative chosen, the contractor may elect to increase the value of Z to found it on a convenient pavement layer. Channels greater than about 300 mm thick are difficult to slipform with a vertical edge and a tolerance should be allowed. With rigid carriageway construction, a tie bar is required to limit differential movement between the channel and pavement. A drainage path is also required for any water retained by the separation membrane. This detail is shown in RCD/500/43.

5.5 The hydraulic capacity of the channel shall adhere to design requirements outlined in NRA HD 33.

5.6 In verges, design requirements for the extent of surcharging of the channel are stated in NRA HD 33. The checks should normally be made adjacent to outlets where the depths of flow in the channel will be greatest. However depending on variations in cross fall, maximum flooding could sometimes occur some distance upstream. On the basis that in general crests will occur in cutting and sags in embankments, critical sections for flooding will occur on the latter. Thus the level of the back of the channel (dimension ‘Y’ in RCD/500/22) may be set so that any further flooding is avoided by allowing the water to flow onto the verge and down the embankment slope. This optimum value of Y will vary with road geometry and discharge volumes for each outlet. Hence for uniformity of channel cross section over the scheme, dimension Y may be set at the level required for the most vulnerable flood section.

5.7 In central reserves, the permitted width of flooding will vary with the type of road and is stated in NRA HD 33. In central reserves the level of the back of channel is set below the carriageway allowing flooding to occur within the non-pavement width of the central reserve. To safeguard against flows from the surcharged channel overtopping the central reserve and flowing into the opposing carriageway, a margin of at least 25 mm between the level of the edge of the opposite carriageway and the surcharged channel level should be maintained. Where carriageway levels differ appreciably, the channel and central reserve profile will need to be modified from that shown in RCD/100/10 and RCD/100/11.

5.8 The most economic use of channels will be obtained when the road geometry and outlet locations permit them to be designed to carry water over entire lengths of cuttings and embankments directly to outfalls, thus minimising lengths of piped drainage. While such channels will have excess hydraulic capacity for most of their length, for practical and constructional reasons frequent changes in channel cross section are inconvenient and will incur a cost penalty. The design should therefore seek a balance between the saving in material costs (concrete) and the added cost of providing more outlets and/or cost of changing of the slip-former mould. With a view to eventual standardisation of sizes, channel sections generally should be specified in width increments of 100 mm. On embankments with flattish gradients the effects of settlement on channel hydraulics should be considered. If substantial settlements are expected, additional outlets to offset possible reduction or reversal of channel gradients may be necessary over the critical lengths.

5.9 In central reserves of standard width with lighting columns it may not be possible to keep the channel clear of safety fencing posts. Safety aspects of the juxtaposition of surface water channels and safety fences are considered in NRA HD 137. Posts in a channel can be allowed for in capacity calculations but to minimise their effect, posts should not be located in the invert. However if the posts are placed in sockets set into the channel it will have to be structurally designed to withstand the loading requirements of the posts. Driven posts inserted through openings formed in the channel invert are not acceptable. Where the central reserve is hardened it will be more economical to combine the drainage and structural function rather than separately construct a RCD/500/22 profile channel. The channel profile will then be dictated by carriageway level differences but the triangular shape should preferably be retained.

5.10 Where there are frequent at-grade junctions or accesses, the channel lengths will need to be terminated except in the case of little used private accesses. In these situations unless regular outfalls, such as to soakaways, are available near the junction the use of channels may be uneconomic.

5.11 Details of the design of outlets for surface water channels are given in NRA HD 78. The Standard gives guidance on suitable outlet layouts for different types of surface water channel and provides methods for designing each type according to the flow rate in the channel.

6. GRASSED SURFACE WATER CHANNELS

6.1 Grassed surface water channels consist of a shallow surface water channel that is lined with grass. The grass sward reduces the flow velocity in the channel providing flow attenuation and facilitating deposition of suspended sediments and polluting heavy metals. Although, when compared with concrete surface water channels, the grassed surface water channels will require more maintenance in the form of mowing, they are considered a preferred sustainable drainage system (SuDS) and offer environmental benefits: a potential habitat for local fauna coupled with a better aesthetic value. The system is particularly suited to in-situ construction techniques.

6.2 Details of grassed surface water channels are given in RCD/100/4. The hydraulic and structural design of grassed surface water channels shall be designed in accordance with NRA HD 119.

6.3 The hydraulic capacity of the channel and associated permitted flow width criteria shall adhere to design requirements outlined in NRA HD 33.

7. DRAINAGE CHANNEL BLOCKS

7.1 The NRA RCD show six shapes of channel block and they are detailed on RCD/500/23 and RCD/500/24.

7.2 Block types A & B, as shown in RCD/500/23, are intended as a relatively inexpensive solution in situations where positive drainage is desirable for dealing with smaller volumes of flow and which would not justify the use of the larger surface water channel. Their use in RCD/100/8 for verge and slope drainage in cuttings would normally be necessary only in very impermeable soils or where fairly high flows occur such as from rock faces. The blocks, having small capacity, will flow full in average rainfall conditions. The surcharged levels shall comply with the criteria given in NRA HD 33 Drainage Systems for National Roads. The falls shown in RCD/100/11 may be increased to provide the required capacity. The distance of the channel block from the edge of carriageway will depend on the road type but should not be less than 1 m.

7.3 Rectangular channel block types E and F (RCD/500/24) in combination with block type C (RCD/500/23) are intended as an alternative to gullies on embankments where kerbs are used. They have a distinct advantage on high embankments, avoiding the difficulty of construction of long gully connections down the embankment slope. RCD/500/24 gives typical dimensions for block types E and F but their capacity shall be checked and if necessary increased. Safety aspects of rectangular channels are considered in NRA HD 137.

7.4 Block type D is articulated and is particularly suited to use on steeply sloping ground such as down embankment slopes where some settlement may be expected. The units fit into each other and will need a suitable anchorage and bedding support at the top and bottom. They are suitable as outlets for surface water channels and for block types E and F.

8. KERBED EDGE CHANNELS

8.1 General advice concerning the provision and placement of kerbs is given in UK Highways Agency TA 57 (document for background reading only) and concerning materials and construction in Series 1100 of the NRA SRW. Reference should be made to these two documents. Kerbs are not recommended for general use on rural national roads without adjacent footways. The predominant consideration for providing kerbs should therefore be road layout requirements; kerbs should normally be chosen from drainage considerations only when other systems are unsuitable or uneconomic (see chapter 1).

8.2 RCD/100/2 and RCD/100/7 combine edge channels for positive drainage with a subsurface drain. The channel outlets use gullies in RCD/100/2 and drainage channel blocks in RCD/100/7. Where gullies are used, the connections to the carrier drain may need to pass through the sub-surface drain. This may preclude the use of drain type 5 in RCD/500/40. For the remaining types of sub-surface drain a short interruption in the downward drainage path through the filter will not affect performance provided the carrier pipe is unaffected. The kerbs shown in RCD/100/2 and RCD/100/7 are of the extruded type, bedded on to the carriageway surface, but it is not intended to exclude the range of kerb/bedding combinations permitted in the NRA SRW.

8.3 Where kerbs are used, flooding widths for rural roads without adjacent footways should be designed using the same basis as that given in chapter 7 for limiting the surcharging of surface water channels. The design of outlet spacings should be in accordance with the methods in NRA HD 102 Spacing of Road Gullies.

9. OVER THE EDGE DRAINAGE

9.1 RCD/100/5 details verge and hard shoulder drainage over embankment slopes. The detail can be used to drain carriageway surface water over the edge of embankments directly into open ditches where appropriate. The detail in RCD/100/5 shows a drop from the edge of carriageway. The maximum drop should be in accordance with RCD/700/1.

9.2 Over the edge drainage is recommended for all embankments above 1.5m in height. Embankments constructed in accordance with Series 600 of NRA SRW will not be subject to instability due to this drainage method. However careful consideration must be paid to avoid channelized flow down the embankment without sufficient protection. This could occur in locations where:

a) inconsistent rounding of the embankment crest does not allow uniform sheet flow runoff

b) concentrated flow bypassing terminal gully/outlet or kerb/barrier termination.

If concentrated flow over the embankment is unavoidable suitable measures to protect the embankment from scour shall be incorporated (see paragraph 7.4).

9.3 Over the edge drainage is not appropriate:

a) Where footways abut the carriageway;

b) On some structures;

c) Where noise mitigation barriers/bunds are required.

10. SUB-SURFACE DRAINAGE

10.1 Sub-surface drainage is shown as a general requirement in all the relevant RCD drawings. It may be deleted only when free draining subgrade material is assured. In order to obtain the most cost-effective solution, the design should allow as wide a range of sub-surface drain types as possible (see chapter 3).

10.2 Types of fin and narrow filter drain are shown in RCD/500/40 and extended capping layer is shown in RCD/100/5. Their purpose is to drain the pavement layers to ensure that the road does not fail prematurely through water-related deterioration.

10.3 Fin and narrow filter drains which form part of the permanent works may not be used for the disposal of surface water run-off during construction.

10.4 Extended capping layer provides a useful alternative to fin and narrow filter drains and has the advantage of being a pipeless system.

10.5 The under channel drainage layer shown in RCD/500/43 is specified for use with rigid carriageways but it may also be used in conjunction with flexible carriageways, in particular where a thin surface course with higher permeability is proposed. Its purpose is to drain any water which percolates through the road surface or edge of carriageway seal into the pavement layers and sub-base. Where it proves impractical to use this detail, other drainage methods (e.g. a layer of free-draining granular material) below the channel should be considered as it is essential to provide a pathway to the sub surface drain.

11. COMBINED KERB AND DRAINAGE SYSTEMS

11.1 Combined kerb and drainage systems comprise a wide kerb unit within which is a hydraulic conduit. The system is placed adjacent to the pavement which is to be drained. Preformed openings within the kerb face allow surface water to enter the conduit. Water is discharged along the conduit to suitable outlet points. The combined function offers cost savings in certain circumstances and guidance is given in NRA HD 33. Advice on the use of such systems with porous asphalt is given in UK Highways Agency HA 79. The advice given in chapter 8 for kerb edge channels should also apply for this type of kerb system.

11.2 The Contractor is required to design the system in accordance with Series 500 of the NRA SRW with the design requirements given in Appendix 5/5. The requirements should allow the widest choice of alternative systems as possible.

11.3 Typical edge details for combined systems are shown in RCD/100/9. This shows the system founded on the capping layer, however, this will not always be present and the bedding concrete may be located on fill, existing ground or the sub base. In these situations the Contract Documents should indicate the appropriate position for the fin or narrow filter drain to ensure effective pavement layer drainage.

11.4 When used on relatively flat gradients such systems may be prone to the build-up of silt and debris which may impede flow into and within the system. The Designer should take account of potential maintenance difficulties in determining the most appropriate form of drainage system.

12. LINEAR DRAINAGE CHANNEL SYSTEMS

12.1 These channels comprise a longitudinal subsurface hydraulic conduit into which surface water is drained via longitudinal or angled slots situated above the conduit. Water is discharged along the conduit to suitable outlet points. The channels can be either manufactured units or concrete in situ construction and are set flush with the pavement. Guidance on their application is given in NRA HD 33 and of their use with porous asphalt in UK Highways Agency HA 79.

12.2 The contractor is required to design the channels in accordance with Series 500 of the NRA SRW with the design requirements given in Appendix 5/6 of the NRA SRW. The requirements should allow the widest choice of alternatives.

12.3 Typical edge details for linear drainage channels are shown in RCD/100/12. This shows the system founded on the sub-base layer, however, this will not always be the case and the bedding concrete may be located on fill, existing ground or the capping layer. In these situations the Contract Documents should indicate the appropriate position for the fin or narrow filter drain to ensure effective pavement layer drainage.

12.4 The range of slot dimensions permissible in the NRA SRW is suitable for motorised vehicles but is unsuitable for cyclists and pedestrians on safety grounds. The grating should be integral with the linear channel to avoid inadvertent separation of the grating from the channel. Linear drainage channels can be used in slip road nosings and in central reserves only behind safety fencing or immediately in front of vertical concrete barriers. Linear drainage channels shall not be permitted in the verge and shall only be considered by way of a Departure from Standards application. Where linear drainage channels are considered economical for areas subject to pedestrian and cyclist use the maximum permitted grate/slot openings shall be in accordance with IS EN 1433.

12.5 There are potential maintenance difficulties with these channels and the comments given in paragraph 11.4 are relevant.

13. SPECIFICATION REQUIREMENTS

13.1 Both the NRA SRW (MCDRW 1) and NRA RCD (MCDRW 4) require Contract specific information to be provided by the Designer in the Contract Documents.

14. REFERENCES

14.1 **NRA Manual of Contract Documents for Road Works (NRA MCDRW)**

a) NRA Specification for Road Works (NRA SRW) (MCDRW 1)

b) Notes for Guidance on the Specification for Road Works (NRA NGSRW) (MCDRW 2)

c) Road Construction Details (NRA RCD) (MCDRW 4)

14.2 **NRA Design Manual for Roads and Bridges (NRA DMRB)**

a) NRA HD 33 Drainage Systems for National Roads

b) NRA HD 137 Hydraulic Design of Road Edge Surface Water Channels

c) NRA HD 45 Road Drainage and the Water Environment

d) NRA HD 78 Design of Outfalls for Surface Water Channels

e) NRA HD 102 Spacing of Road Gullies

f) NRA HD 119 Grassed Surface Water Channels for Road Runoff

g) NRA TD 16 Geometric Design of Roundabouts

h) NRA TD 19 Safety Barriers

i) NRA TD 69 The Location and Layout of Lay-bys and Location Markers

14.3 **Design Manual for Roads and Bridges (UK Highways Agency DMRB)**

a) HA 79 Edge of Pavement Details for Porous Asphalt Surface Courses

b) TA 57 Roadside Features

14.4 TRRL Contractor Report CR2. The Drainage Capacity of BS Road Gullies and a Procedure for Estimating their Spacing. Transport and Road Research Laboratory, Crowthorne, 1984.

14.5 TRRL Laboratory Report LR 277. The Hydraulic Efficiency and spacing of BS Road Gullies. Road Research Laboratory, Crowthorne 1969.

14.6 National Roads Authority. 2014. Drainage Design for National Road Schemes – Sustainable Drainage Options.

15. ENQUIRIES

15.1 All technical enquiries or comments on this document, or any of the documents listed as forming part of the NRA DMRB, should be sent by e-mail to infoDMRB@nra.ie, addressed to the following:

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National Roads Authority

Design Manual for Roads and Bridges
(NRA DMRB)

Amendment No. 1 (June 2015) to NRA Design Manual for Roads and Bridges Volume 4, Section 2, Part 1

NRA HD 139 - Edge of Pavement Details

Dated March 2015

The NRA Design Manual for Roads and Bridges (NRA DMRB) NRA HD 139, dated March 2015 is amended as follows:-

1. Page 1, Clause 1.6

   Implementation Clause 1.6 is amended

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