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NORTH HYKEHAM RELIEF ROAD
DRAINAGE STRATEGY REPORT

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Ramboll UK Limited
Registered in England & Wales
Company No: 03659970
Registered office:
240 Blackfriars Road
London
SE1 8NW

CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

APPENDICES

1. INTRODUCTION

1.1 Report Scope

This report includes details of the surface water drainage strategy for the North Hykeham Relief Road following consideration to the National Planning Policy Framework (NPPF), Planning Practice Guidance, British Standard 8533:2011 Assessing and Managing Flood Risk in Development, British Standard 8582:2013 Code of Practice for Surface Water Management for Development Sites and local guidance documents. This proposed drainage strategy for the scheme includes design considerations and constraints that have been applied in order for key consultee's, such as the Environment Agency (EA), Internal Drainage Board (IDB) and Lincolnshire County Council (LCC), acting as Lead Local Flood Authority, to comment/approve in principle prior to planning submission.

2. EXISTING SITE

2.1 Site Location

The NHRR comprises a Dual All-Purpose 2 lane Carriageway with a combined foot and cycleway running to the north of the east-bound carriageway. It links the A46 to the Lincoln Eastern Bypass (LEB).

Feature requirements:

- River Witham Crossing
- Station Road Crossing
- A46 NMU Crossing
- Wath Lane NMU Crossing
- Wath Lane Bat Bridge
- Viking Way NMU Crossing
- Additional arm to A46 Roundabout
- New (A607) Grantham Road Roundabout
- New Brant Road Roundabout
- South Hykeham Road Roundabout
- Additional arm to LEB Roundabout
- Green Lane Drain Crossing
- South Hykeham Drain Crossing
- Waddington Dyke Drain Crossing
- Somerton Gate Lane Bat Culvert

Further features will be required as determined by the development of detailed design and client requirements.

Figure 2-1: Site Location Plan

2.2 Site Description

The existing location for the construction of the North Hykeham Relief Road is majority flat mixed farmland, with a single large hill in the East of the scheme. At the centre of the scheme is the River Witham, with shallow sloping banks on the floodplain down to the river which has steep soil banks. Grantham Road roundabout on the east is at the highest point being approximately 73.00 AOD. The lowest point is at the River Witham, at approximately 4.5 AOD. Most of the land within the scheme extent is agricultural with the exception of a few residential properties.

2.3 Existing Waterbodies

There are numerous existing surface water drainage ditches or riparian ditches in the current agricultural land, which convey surface water runoff towards the river Witham. To the west of river Witham, the main tributary, named The Beck, has a network of ditches connecting to it.

River Witham has a flood defence system which includes high bunds on either side of the bank to protect the adjacent lands from flooding. South Hykeham catchwater discharges into the Beck, which then discharges directly into the river Witham over the levee, at greenfield runoff rate. A network of other watercourses, both riparian and upper Witham IDB's ditches, discharge to the levy adjacent to the Witham which has a raised embankment in Witham washlands where a pump discharges water at a controlled rate of 1.4l/s/ha into the river Witham.

Appendix 1 shows the proposed Watercourse Strategy Drawings NHRR-RAM-HDG-HYKE-DR-CD-05038, NHRR-RAM-HDG-HYKE-DR-CD-05039, NHRR-RAM-HDG-HYKE-DR-CD-05040. The tributaries are maintained by the IDB, however, there are several private ditches for agricultural land which are connected to, or form part of these tributaries, as illustrated in these drawings.

2.4 Existing Sewers

2.4.1 Public Sewer Records from Anglian Water

The records indicate the following sewers within the vicinity of the site:

- Wath Lane, Rising main runs east of Wath Lane, perpendicular to the proposed carriageway. Discussions are underway with Anglian Water to accommodate this service.

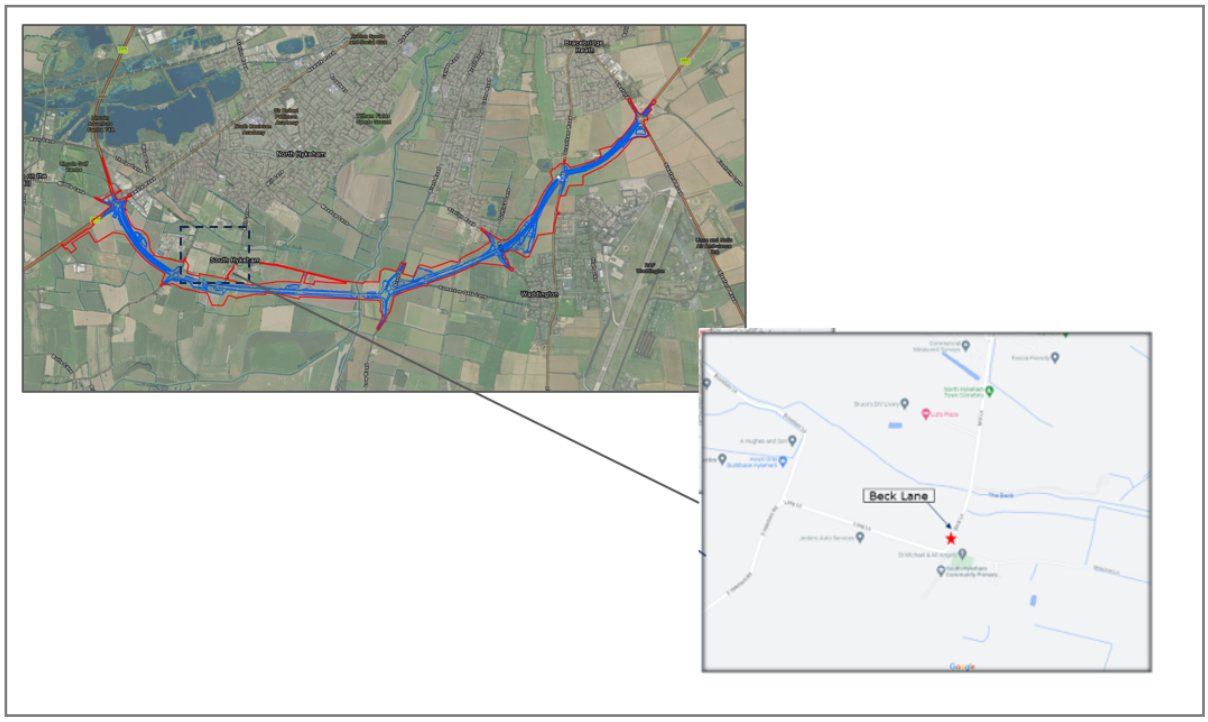

Figure 2-2: Beck Lane Location

- At Station Road, two gravity sewers traverse Station Road from south to north, and there is an existing rising main originating from the MOD site running from south to north along the existing road. The proposed carriageway is in a deep cutting, both sewers and the rising main will require a diversion. Discussions are underway with Anglian Water to determine the diversion of these services across the new bridge.

The underlying solid geology comprises a sequence of Jurassic strata as summarised in the table below:

Geological Unit	Age (Parent Formation)	Description	Location of Outcrop / Subcrop
Upper Lincolnshire Limestone Member (ULLM) of the Lincolnshire Limestone Formation (LLF)	Mid-Jurassic (Inferior Oolite Group)	Oolitic limestone with clays.	Between the two outcrops of lower Lincolnshire limestone.
Lower Lincolnshire Limestone Member (LLLM) of the LLF		Very thinly bedded, closely jointed strong limestone with some thin bands of clay. In the partially weathered state, comprises limestone boulders in a matrix of silty sand with limestone fragments and dark brown sandy clay. Reddish brown silty clayey sand when completely weathered.	Located to the east of the Grantham Formation and in the north-east corner of the study area up to the A15 roundabout.
Grantham Formation and Northampton Sand Formation (GFNSF)		Sandstone and Ironstone. Ferruginous sandstones and limestones.	A very thin band to the east of the Whitby Mudstone.
Whitby Mudstone Formation (WMF)	Early Jurassic (Lias Group)	Grey fossiliferous mudstone and siltstone.	A thin band to the east of the CMF.
Charmouth Mudstone Formation (CMF)		Dark grey laminated shales, and grey mudstones – locally tabular limestones and finely sandy beds in some areas.	From the A46 roundabout to Station Road / Waddington.
Scunthorpe Mudstone Formation (SMF)	Late Triassic / Early Jurassic (Lias Group)	Interbedded mudstone and Limestone.	Located at the south-west end of the alignment near to the existing A46 roundabout.

Table 3. 1: Shows the underlying solid geology with the route shown indicatively with the red dashed line.

The figure 2-3 below shows the underlying solid geology with the route shown indicatively with a red dashed line.

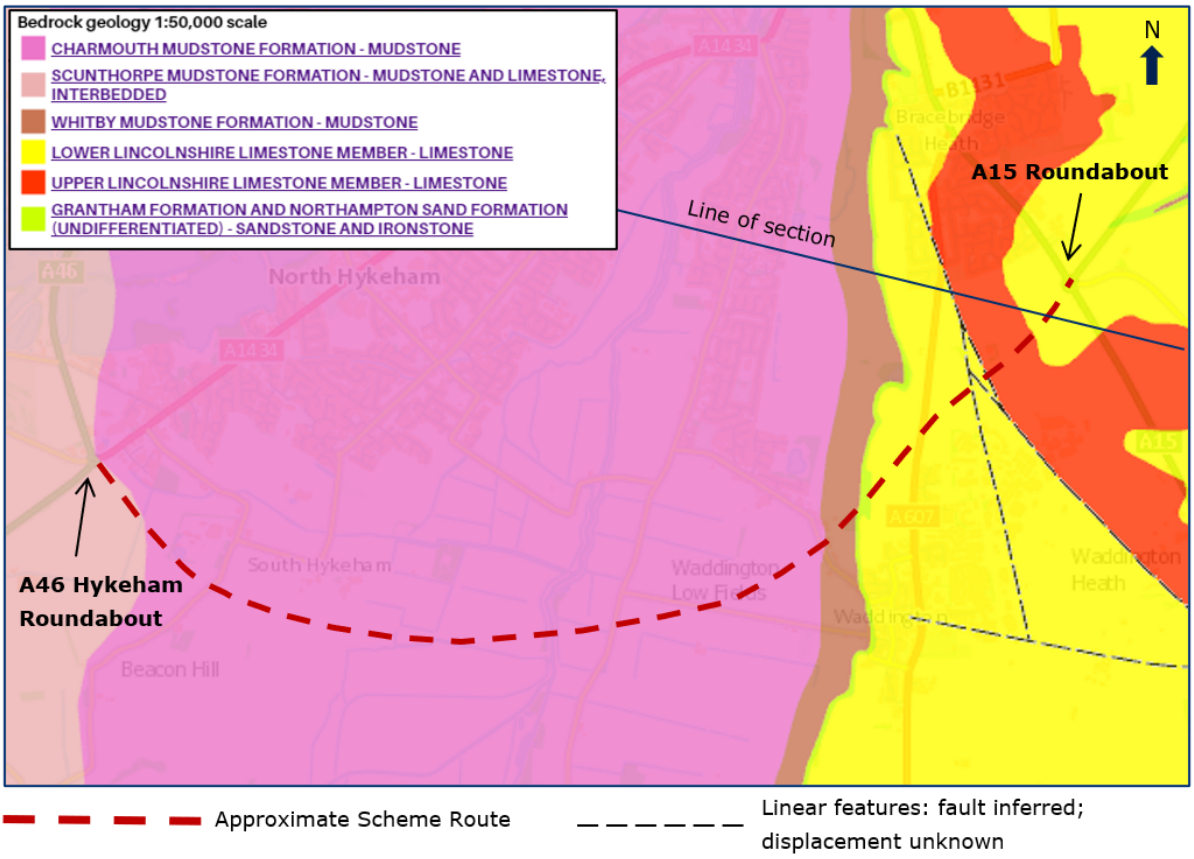

Figure 2-3: Bedrock Geology 1:50,000 Maps, BGS GeoIndex Viewer.

The site does not lie within any Environmental Agency (EA) Groundwater Source Protection zone (SPZ) from A46 Roundabout to Station Road. From Station Road to Grantham Road the site is within SPZ3 and from Grantham Road to Sleaford Road the site is within SPZ2.

3. SURFACE WATER MANAGEMENT – POLICY CONTEXT

3.1 National Planning Policy Framework (NPPF) – December 2023

The revised NPPF was adopted in December 2023 superseding national planning policy statements and guidance. One of the overarching objectives of the NPPF is the encouragement of growth and acknowledgement that decision-makers should adopt a presumption in favour of sustainable development. Paragraph 11 of the document states:

"Plans and decisions should apply a presumption in favour of sustainable development.

- **For decision-taking this means:**
- approving development proposals that accord with an up-to-date development plan without delay; and
- where there are no relevant development plan polices, or the policies which are most important for determining the application are out-of-date, granting permission unless:
  - the application of policies in this Framework that protect areas or assets of particular importance provides a clear reason for refusing the development proposed; or

- any adverse impacts of doing so would significantly outweigh the benefits, when assessed against the policies in this Framework taken as a whole."

Paragraph 163 of the NPPF states that:

"When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- within the site, the most valuable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- the development is appropriately flood resistant and resilient;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

3.2 Sustainable Drainage Systems

Written Statement HCWS161 (December 2014)

The Secretary of State for Communities and Local Government laid a Written Ministerial Statement in the House of Commons on 18 December 2014 setting out changes to planning that will apply for major development from 6 April 2015. This confirms that in considering planning applications, local planning authorities should consult the relevant Lead Local Flood Authority (LLFA) on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

Therefore, from January 2023 local planning policies and decisions on planning applications relating to major development are required to ensure that Sustainable Urban Drainage Systems (SuDS) are used for the management of surface water.

Major development is development involving any one or more of the following:

- The winning and working of minerals or the use of land for mineral-working deposits;
- Waste development;
- The provision of 10 dwellings or more;
- The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or
- Development carried out on a site having an area of 1 hectare or more.

3.3 DEFRA Sustainable Drainage Systems

Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015)

This document sets out non-statutory technical standards for sustainable drainage systems. It should be used in conjunction with the National Planning Policy Framework and Planning Practice Guidance.

For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer, or surface water body in accordance with the above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year rainfall event.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station) within the development.

The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property.

DEFRA completed as review January 2023 to identify the benefits and impacts of making sustainable drainage systems (SuDS) mandatory for new development to ensure that its implementation will help address the pressures of climate change, increasing population and urbanisation whilst achieving multiple benefits, such as reducing surface and sewer flood risk, improving water quality, and harvesting rainwater to meet current and future needs. Schedule 3 provides a framework for the approval and adoption of drainage systems, an approving body (SAB), and national standards on the design, construction, operation, and maintenance of SuDS.

This review recommends that the government must act and implement Schedule 3 to the Flood and Water Management Act 2010 as written, with the unitary authority or, if there is not one for the area, then the county council as approving bodies. The successful implementation of Schedule 3 will require professionals with the skills and knowledge to design, construct, assess and maintain SuDS. It also recommends that actions are developed to ensure there is sufficient access to the right skills and capabilities to deliver and maintain SuDS.

It is expected that the suggested change will be implement in 2024. DEFRA's review does not impact the design approach or requirements, and follows best practice outlines in SuDS Manual (C753)

3.4 Climate Change

The Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in autumn 2000, and between December 2013 and

February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

New EA guidance "Flood risk assessments: climate change allowances" issued on 19 February 2016 and forming part of the NPPF technical guidance provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

For this proposed site, based on the new guidance, the North Hykeham Relief Road may be considered essential transport infrastructure (considered "Essential Infrastructure" in flood risk terms) and should be reviewed against the following new climate change allowances:

Table 3-1: Summary of Climate Change Factors

Flood Criteria	Climate Change Factor
3.3% annual exceedance rainfall event	35%
1% annual exceedance rainfall event	40%

Surface water drainage systems shall be designed using the rainfall events described in the 'Drainage Design Input Plan' NHRR-RAM-HDG-HYKE-RP-CD-05000.

4. DESIGN OVERVIEW

The route of the Project crosses several watercourses and an overland flow path. These are either culverted or crossed by a clear spanning structure that includes a 120 m long viaduct across the river Witham.

The highway surface water drainage across the proposed project has been split into ten sub-catchments to allow the design of a highway drainage system to convey runoff from the highway and proposed cuttings. The surface water runoff system proposed for these catchments is predominantly via lined grass surface water channels to a carrier ditch network.

The proposed pipework and chambers shall be located off the carriageway such that chamber access points provide for minimal intrusion into the carriageway and the design adheres to the Design Manual for Roads and Bridges (DMRB), with no iron works within the carriageway. The viaduct across the River Witham (River Witham Bridge) will be drained via kerb drain units on the bridge deck into a carrier drain located at either end of the structure. Bridge deck drainage details are shown on the River Witham Bridge detailed design drawings.

Surface water runoff is managed through attenuation ponds before being discharged into the adjacent watercourses or the IDB ditch system, with discharge rates as agreed upon with the Upper Witham Internal Drainage Board (IDB) and Lincolnshire County Council (LCC) in their capacity as the Lead Local Flood Authority (LLFA). The agreed discharge rates are detailed in Table 7.1. An exception to this is the proposed network 10, where an infiltration basin is proposed and suitably sized to ensure appropriate attenuation is provided.

The proposed carriageway alignment will intercept a number of watercourses and natural flow paths. Culverts will be installed where watercourses are crossed. In certain cases, watercourses will be combined before culverted to optimise the design. Where natural flow paths are intercepted by the proposed scheme, drainage cut off ditches are proposed to capture the natural runoff. These ditches will be connected to the existing ditches/watercourses. The natural runoff is kept separate from the highway's runoff. Side roads intersected by the project is either drained by the proposed network or by the existing highway network.

The footway/cycleway proposed to run the length of the scheme will, where appropriate, drain to the adjacent grassed surface water channel, ditch system or to the proposed carriageway where it will be collected and attenuated as part of the surface water drainage system. The risk of pollution from access vehicles and members of the public is considered too low to warrant any further pollution control.

The infiltration basin proposed for network 10 at the A15 Sleaford Road Roundabout will be provided with a forebay to incorporate pollution prevention measures in order to protect the Source Protection Zone 2 (SPZ2) which is located between the A607 Grantham Road Roundabout and the A15 Sleaford Road Roundabout. For further detail on pollution mitigation measures proposed, refer to the Water Quality Assessment report, document NHRR-RAM-HDG-HYKE-RP-CD-05004 included within Appendix 2.

The NHRR team liaised with Anglian water Strategic Pipeline Alliance (SPA) pipeline with a view to ensure that the SPA pipeline will be installed at a suitable depth with suitable protection such that it will not be affected by the construction of the NHRR, and such that it will not be necessary for SPA pipeline to impose any construction restrictions on the construction of the North Hykeham Relief Road. Refer to the drainage strategy drawing in Appendix A

At the eastern end of the project, the surface water drainage ties into the existing highway drainage on the Lincoln Eastern Bypass Road (LEB). The levels for this existing system are taken from topographical survey information, as-built records and a CCTV drainage survey. Below is the list of survey information received:

Document Number	Information Received	Location
31773 A46 Roundabout 3D.DWG 31773 A46 Roundabout .DWG 31773 A46 Roundabout .pdf 31773 A607 Grantham Road 3D.DWG 31773 A607 Grantham Road.DWG 31773 A607 Grantham Road.pdf 31773 Brant Road_Somerton Gate Lane 3D.DWG 31773 Brant Road_Somerton Gate Lane.DWG 31773 Brant Road_Somerton Gate Lane.pdf	Topographic Survey	pw:\\ramboll-uk-pw.bentley.com:ramboll-uk-pw-03\Documents\Projects\1620013942 - North Hykeham Relief Road\Incoming Information\Managed\MK Surveys\Topographic Survey

Document Number	Information Received	Location
31773 Sleaford Road Roundabout3D.DWG 31773 Sleaford Road Roundabout.dwg 31773 Sleaford Road Roundabout.pdf 31773 South Hykeham Road 3D.DWG 31773 South Hykeham Road.dwg 31773 South Hykeham Road.pdf 31773 Station Road 3D.DWG 31773 Station Road.dwg 31773 Station Road.pdf 31773_Ditches_3D.DWG 31773_Ditches.dwg 31773_Ditches.pdf		
31773 CCTV Report.pdf	CCTV Survey Information	pw:\\ramboll-uk-pw.bentley.com:ramboll-uk-pw-03\Documents\Projects\1620013942 - North Hykeham Relief Road\Incoming Information\Managed\MK Surveys\Drainage Survey
31773 A46 CCTC Report.pdf	CCTV Survey Information	pw:\\ramboll-uk-pw.bentley.com:ramboll-uk-pw-03\Documents\Projects\1620013942 - North Hykeham Relief Road\Incoming Information\Managed\MK Surveys\Drainage Survey\A46

The CCTV survey was aimed at the interface with the existing drainage along the A46 roundabout, Lincoln Eastern Bypass, and road crossings along the NHRR highway alignment.

The design is developed and liaised with LLFA and taking into consideration recent updates to national policies relating to the water environment.

5. DESIGN CRITERIA

5.1 Design Standards

The drainage design will be carried out in accordance with National Highways Design Manual for Roads and Bridges (DMRB) unless otherwise agreed, applicable standards include:

- CG502 The certification of drainage design
- CG501 Design of highway drainage systems
- CD 521 Hydraulic design of road edge surface water channels and outlets,
- CD 524 Edge of pavement details
- CD 525 Design of combined surface and sub-surface drains and management of stone scatter
- CD 528 Vortex separators for use with road drainage systems
- CD 533 Determination of pipe and bedding combinations for drainage works.
- CD 534 Chamber tops and gully tops for road drainage and services
- CD 526 Spacing of road gullies
- CD 527 Sumpless gullies
- CD 530 Design of soakaways
- CD 531 Reservoir pavements for drainage attenuation
- CD 532 Vegetated drainage systems for highway runoff
- CD 535 Drainage asset data and risk management
- CS 551 Drainage surveys
- CD 522 Drainage of runoff from natural catchments
- CD 523 Determination of pipe roughness and assessment of sediment deposition to aid pipeline design
- CD 529 Design of outfall and culvert details
- LA 113 Road Drainage and the Water Environment Maintenance Design Manual
- National Highways HEWRAT Assessment.
- Technical Services Partnership (TSP) – Highway Drainage Design Guide

In addition, other standards to be used as applicable are:

- CIRIA Report C753 – The SUDS Manual
- CIRIA 635 Design for Exceedance in Urban Drainage
- CIRIA C753 The SuDS
- Design and Analysis of Urban Storm Drainage; The Wallingford Procedure
- Flood Estimation Handbook; Centre for Ecology and Hydrology
- Sewerage Sector Guidance Appendix C, Design and Construction Guidance (replaced SfA in 2020); Water UK
- Current Environment Agency Bylaws
- Local Authority Local Drainage Standards
- LCC Land Drainage Bylaws
- LLC Standard details

Following design changes have been noted in the drainage strategy to the design input plan.

- Highway catchments 4, 5, 6, and 7 discharge into a system that relies on pumping, with discharge rates limited to 1.4 l/s/ha. Where the discharge rate falls below 5 l/s, a minimum discharge rate of 5 l/s will be applied to ensure proper maintenance of the flow control device as agreed by the LLFA.

5.2 Sustainable Urban Drainage Systems (SuDS)

Edge of road drainage will be designed in accordance with DMRB standards as described above, and embrace where possible the four pillars of SuDS, i.e.:

- Water quantity (Flooding risk)
- Water quality (Pollution control)
- Amenity
- Biodiversity

Drainage networks shall be modelled and assessed for the design storm events to determine the required sizes of continuous assets, such as pipes and chambers. The models will identify flood risk within the design parameters. Attenuation ponds shall be proposed to mitigate any potential flooding. Where minimum flooding does occur, due to a 100-year storm event, flooding is kept at a minimum and within the boundaries of the relief road.

Highway surface water runoff often contains pollutants such as sediment and hydrocarbons. This runoff will be treated through settlement and filtration by vegetation in swales, basins, or other methods before being discharged into the ground or a watercourse. Pollution shall be assessed using LA113 and mitigation measures shall be proscribed as per the CIRIA suds manual and the DMRB.

Landscaping and planting around drainage basins shall be designed to not only provide pollution control but also to provide road users with an enhanced amenity. Information boards and benches will be incorporated along the NMU routes to further provide amenity value as part of the scheme proposals.

Biodiversity gains will come with planting opportunities and will be demonstrated in landscaping environmental statements forming the development of the drainage design.

A separate SuDS Management Plan "NHRR-RAM-HDG-HYKE-RP-CD-05003" has been developed to meet the requirements of the County Planning Authority. The plan outlines essential measures for the effective management and maintenance of SuDS features within the scheme.

6. EXISTING CATCHMENTS

The project route traverses a rural area and intersects several hydrological catchments along its length. These catchments are primarily defined by local topography and existing drainage features, such as watercourses and land drains. To maintain design consistency with the parameters outlined in Chapter 7, Table 6.1 specifies the greenfield runoff rates for each catchment. These rates, agreed upon with the Lead Local Flood Authority (LLFA) and Internal Drainage Board (IDB), have been used to assess existing greenfield runoff rates for the undeveloped site and to control discharge from the proposed road drainage system during the design phase.

Table 6-1: Greenfield Runoff Rates

Catchments	Obar	Area (ha)	Greenfield run off FEH			
			1	30	100	Discharge Rate (l/s)
C1 A46	3.94	2.253	3.43	9.66	14.03	54
C2	4.09	1.983	4.09	11.53	16.75	5
C3	5.92	2.869	5.15	14.51	21.08	5
C4	3.38	1.638	2.94	8.28	12.03	5
C5 N1	1.59	0.771	1.38	3.9	5.66	5
C5 N2	0.49	0.236	0.42	1.19	1.73	5
C5 N3	0.37	0.179	0.32	0.91	1.32	5
C6	9.41	4.485	8.18	23.04	33.48	5
C7	6.39	3.047	5.56	15.65	22.75	5
C8	9.25	4.341	8.04	22.65	32.92	9.3
C9	18.1	8.732	15.75	44.35	64.44	18.1
C10	10.67	6.466	9.28	26.13	37.97	0.038mm/s

The Greenfield runoff rates have been calculated using the Flood Estimation Handbook (FEH) method. Catchments 4, 5, 6, and 7 discharge into a tributary (levy), which over pumps to the river Witham at 1.4 l/s/ha.

As per the agreement with the LLFA, the discharge rate from catchments 4, 5, 6, and 7 will be set at 5 l/s to ensure a minimum hydro-brake size of 100mm. This decision addresses concerns about potential blockages and maintenance issues associated with smaller flow control devices.

WATERCOURSE STRATEGY DRAWINGS NHRR-RAM-HDG-HYKE-DR-CD-05038, NHRR-RAM-HDG-HYKE-DR-CD-05039, NHRR-RAM-HDG-HYKE-DR-CD-05040 illustrate the existing watercourses and shows the strategy taken where watercourses intercept the proposed alignment.

The existing catchments intersected by the Project are shown on Figure 6.1, along with an indicative flow direction indicating the general fall of the catchment.

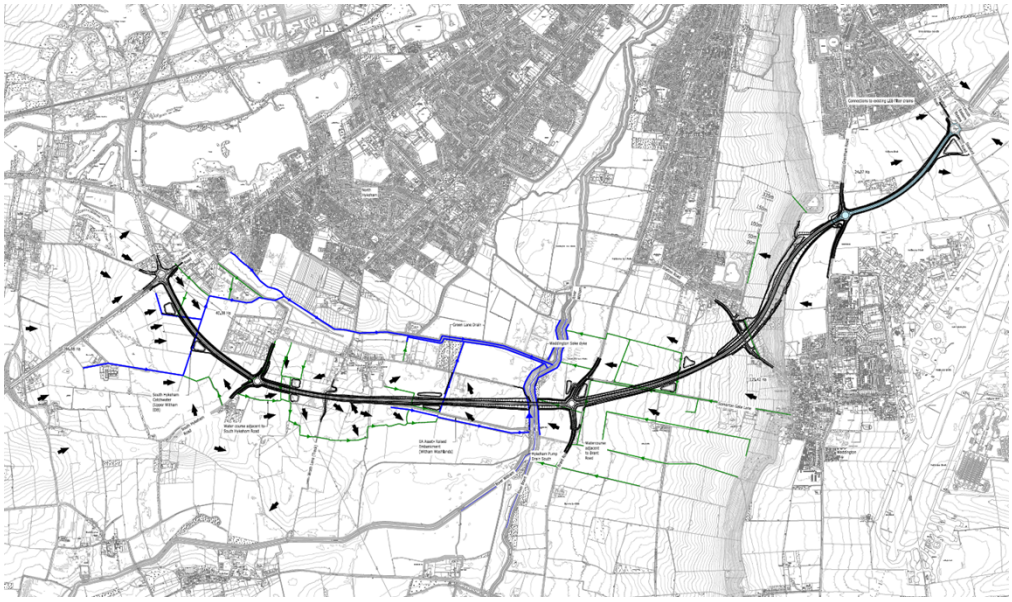

Figure 6-1: Existing Overland Catchments and Flow Paths

There are no significant changes in the areas of the upland and natural catchments pre, and post development as shown on Figure 6.2 below.
The upland natural catchments are illustrated in Figure 6-2, described as follows:

Upland Catchment 1 discharges into the South Hykeham catchwater, part of the Upper Witham IDB drainage system, via the proposed Culvert 3, which outfalls into the Beck. The Beck then discharges directly into the River Witham. Greenfield runoff rates will be applied to the proposed design, discharging to the Beck as agreed with the IDB.

The upland catchment 2 discharges to riparian watercourse between Wath lane & South Hykeham Road roundabout through a proposed culvert 10. These local ditches/riparian watercourses discharges to a levy which is over pumped at a controlled rate to the river Witham.

The upland catchment 3 discharges to the Green Lane drains an IDB maintained watercourse through culvert 11. Green Lane drain discharges to a levy which is over pumped at a controlled rate to the river Witham.

The upland catchment 4 and 5 discharges to Waddington soke dyke through the proposed bat culvert. Waddington soke dyke outfalls directly to the river Witham through flap valves maintaining greenfield runoff rates.

The upland catchment 6 near Sleaford Road roundabout discharges to existing Sleaford road drainage connections

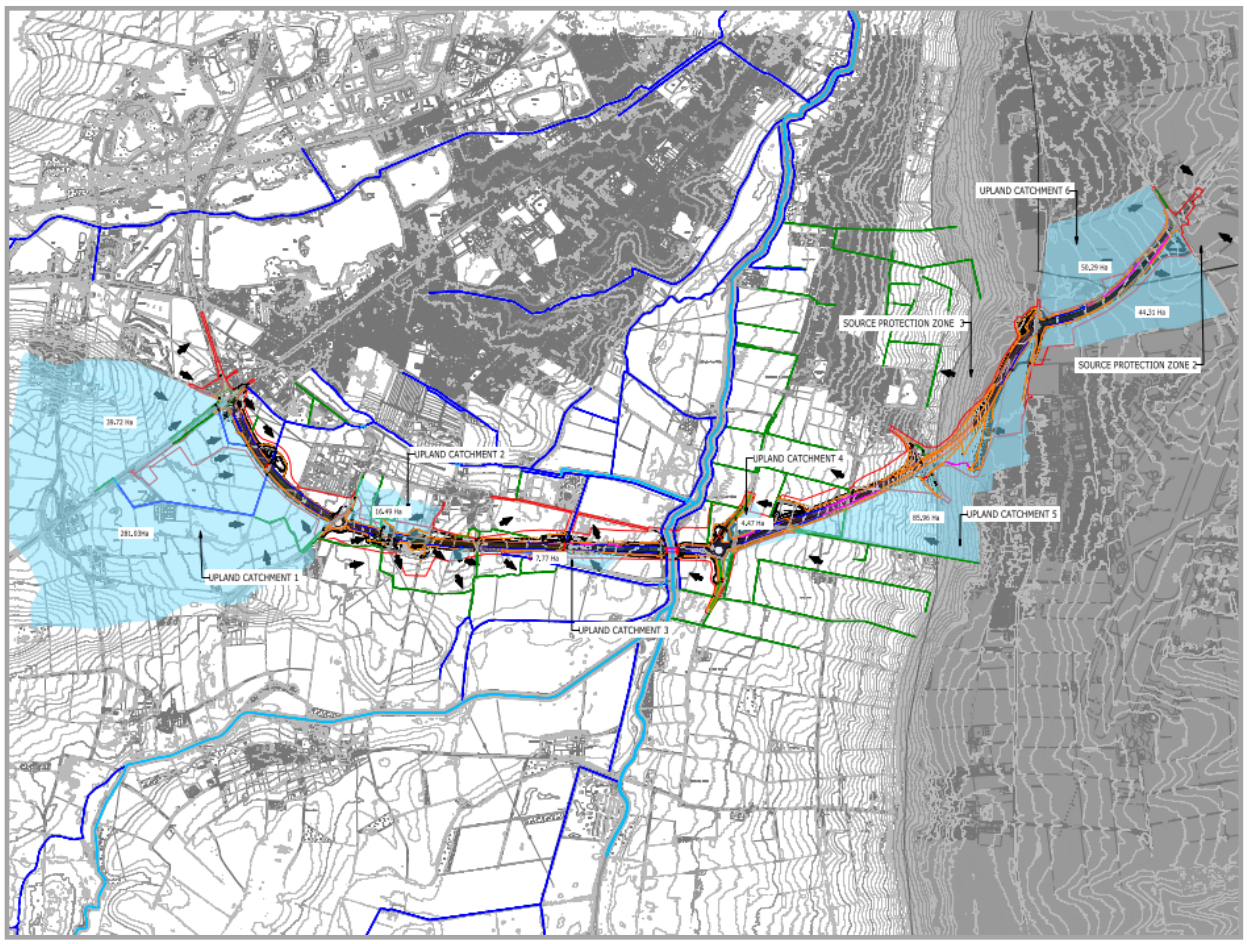

Figure 6-2: Natural Catchment Area Comparison to Developed Highway Catchment Areas

Where the earthworks of the Project intersect a natural catchment, pre-earthwork ditches (PED) and culverts are proposed to intercept natural runoff and convey it away from the external highway earthworks, towards adjacent watercourses or infiltration features where a suitable watercourse outfall is unavailable.

Please refer to WATERCOURSE STRATEGY DRAWINGS NHRR-RAM-HDG-HYKE-DR-CD-05038, NHRR-RAM-HDG-HYKE-DR-CD-05039, NHRR-RAM-HDG-HYKE-DR-CD-05040 for the diverted water courses and proposed ditches. The drawings illustrate the proposed ditches that will capture the natural catchment and direct the catchment runoff to the existing watercourses network.

The existing natural catchments discharge to a network of ditches and water course tributaries. To the west of the river Witham, the natural water courses discharge to the main Tributary of the River Witham called the Beck. The Beck discharges directly into the river Witham. To the east of the river Witham, the ditches and watercourse networks all discharge down to the river Witham.

The last section of the scheme, catchment 10, extends from Grantham Road to Sleaford Road roundabout, with the existing land topology falling towards Sleaford Road. Ditches are proposed to capture any catchment intercepted by the scheme.

A network of sub-surface narrow filter drains or fin drains are proposed along the route of the highway to provide free drainage to the pavement subgrade. Ditches will be laid at the toe of embankment cuttings to provide positive drainage for the embankment and natural runoff.

7. PROPOSED CATCHMENTS

As per the DMRB, the design principles for the design of surface drainage for all-purpose trunk roads shall:

1. Remove surface water from the carriageway as quickly as possible to provide safety and minimum nuisance to the road users;
2. Maximise the longevity of the pavement and its associated earthworks;
3. Minimise the impact of the runoff on the receiving environment in terms of flood risk and water quality; and
4. Manage water flows from earthworks and structures associated with the roads.

The destinations for road runoff, as per the DMRB and the planning guidance in the following destinations in order of preference.

1. Ground.
2. Surface water body.
3. Surface water sewer; and
4. Combined sewer.

The surface water drainage for the project highways has been divided into ten individual sub-catchments. Please refer to drawing Highway Catchment Drawing in Appendix 1. A snippet of it is attached below in Figure 7.1.

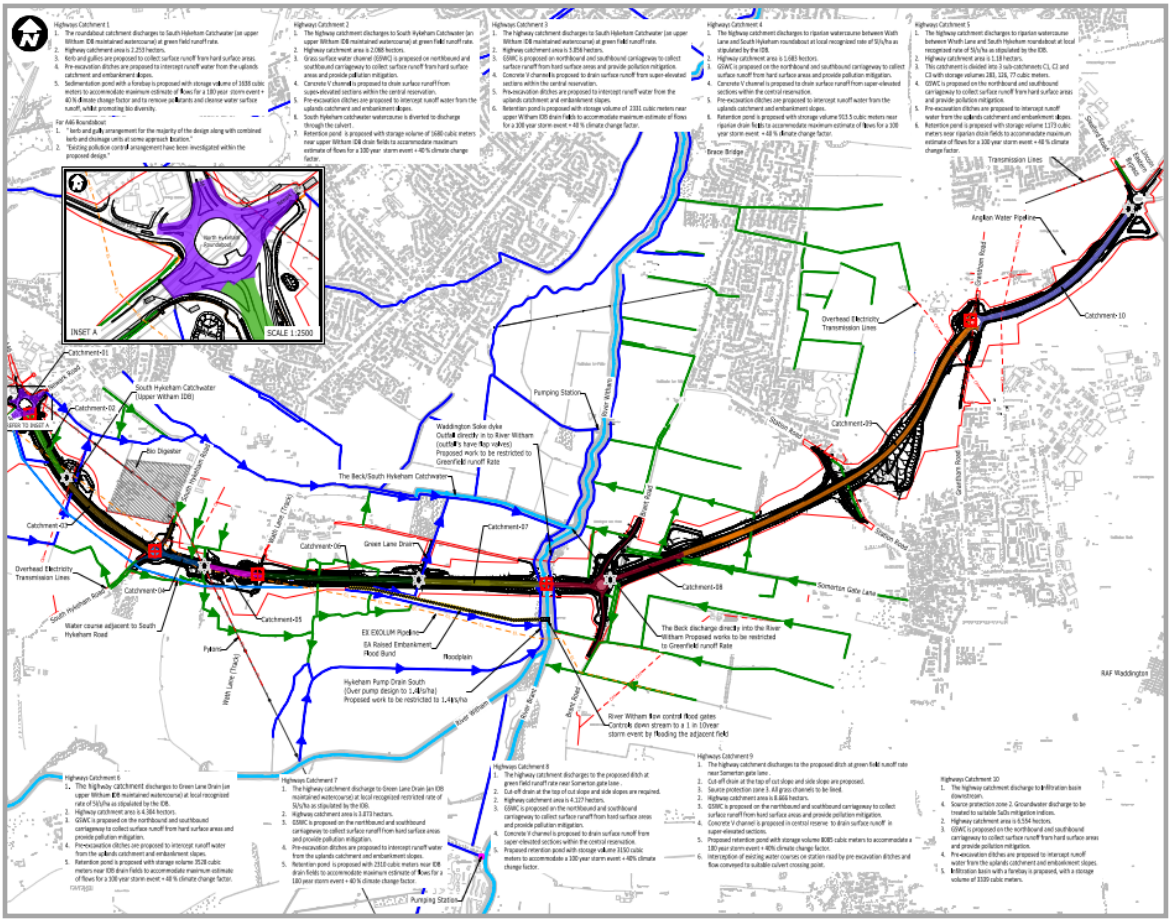

Figure 7-1: Highway Sub-catchments

The sub-catchments serve the NHRR highway from the A46 roundabout through a proposed new roundabout and along the NHRR dual carriageway to the Lincoln Eastern Bypass Roundabout. Reference should be made to Highway Catchment Drawing NHRR-RAM-HDG-HYKE-DR-CD-00532, which identifies these catchments.

The site characterization extract in section 2.5 of this illustrates the ground characteristics for the scheme extent. Based on these characteristics, the scheme extent on the west of Grantham Road has clayey soil, which does not have high infiltration capacities. Therefore, the strategy for this section of the scheme is to discharge to a watercourse.

The scheme's extent, to the east of Grantham Road, is limestone. The fractures within the limestone give this section properties suitable for infiltration. These properties are confirmed with an infiltration test. Therefore, the strategy for this section of the scheme would be to discharge to a soakaway.

There are ten proposed catchments, with the A46 Junction being the first. The Catchments are divided based on the alignment profile and the positions of the existing watercourses.

- Catchment 1 - A46 junction discharges to south Hykeham catchwater, a tributary leading to the Beck, which further discharges into the river Witham. The proposed discharge shall be controlled to a maximum of 5 litres per second (l/s). Kerb and gullies and kerb drainage are proposed to collect surface water from impermeable areas. For pollution mitigation, a sedimentation pond with a forebay is proposed.

- Catchments 2 and 3 are designed to discharge into the South Hykeham catchwater, a tributary that flows into the Beck and ultimately drains into the River Witham. The proposed discharge rate is controlled to a maximum of 5 l/s. To manage surface water runoff, grassed surface water channels (GSWCs) are proposed on the north and south bound of the carriageway. These channels are designed to collect runoff from impermeable surfaces and serve as the initial stage of the treatment process. Additionally, concrete surface water channels (CSWCs) are proposed to drain surface runoff from the superelevated sections within the central reservation. Both the GSWCs and CSWCs will have carrier pipes beneath them to transport the collected runoff to the carrier ditches. The surface water from these carrier ditches will be conveyed through a piping system and ultimately discharged into a retention pond. This pond is designed to attenuate highway runoff, ensuring effective management of the surface water before it is released into the natural watercourse.

- Catchments 4 and 5 discharge into a riparian watercourse located between Wath Lane and the South Hykeham Road Roundabout. This watercourse leads to a tributary that flows into a pumping station, which over pumps to the River Witham. The proposed discharge will be controlled at a rate of 5 l/s. Ground Surface Water Collection (GSWC) systems are planned for both the northbound and southbound carriageways to collect surface runoff from impermeable areas and mitigate pollution. Additionally, a Concrete Surface Water Channel (CSWC) will be installed in the central reservation to drain surface runoff from superelevated sections. A retention pond will attenuate highway runoff, ensuring that flow rates match existing greenfield runoff rate. The discharge rates to the riparian watercourses will remain unchanged. Through the land purchase and Orders process, appropriate easements will be retained, allowing LCC and their maintenance contractor to access NHRR drainage outfalls in the riparian ditches. Maintenance and cleanliness of these ditches will continue to be the responsibility of the ditch owner, with the Internal Drainage Board (IDB) monitoring the effectiveness of maintenance as per the pre-scheme conditions, to ensure the ditches are kept clear.

- Catchments 6 and 7 discharge to green lane drain (an upper Witham IDB-maintained watercourse) leading to a tributary (levy) to the pumping station, which over pumps to the river Witham. The proposed discharge will be controlled to 5 l/s. A grassed surface water channel (GSWC) is proposed on the northbound and southbound carriageways to collect surface runoff from impermeable areas and provide pollution mitigation. A retention pond is proposed to attenuate highway runoff. Based on the current flood maps, the outfalls for catchments 6 and 7 discharge to a flood plain. Hydraulic modelling was conducted with surcharged outfalls to assess the flooding within the carriageway. The flooding was kept to a minimum with maximum flooding of 8m^3 for a 100year +40% storm event.

- Catchments 8 and 9 will discharge into the proposed ditch near Somerton Gate Lane at a greenfield runoff rate, leading to the levy, which in turn discharges directly into the River Witham via a flap valve outfall. The proposed discharge rates are 9.3 l/s and 18.1 l/s for Catchments 8 and 9, respectively. Cut-off drains are required at the top of the cut slopes and side slopes. For surface water management, a grassed surface water channel (GSWC) is proposed along both the northbound and southbound carriageways to collect runoff from impermeable surfaces and provide pollution mitigation. Additionally, a concrete surface water channel (CSWC) will be installed to drain runoff from superelevated sections within the central reservation. In this section, the gradient is steep (1:16). According to the CD521 calculation method, the efficiency of normal chamber outlets falls below 80%, even with a maximum array of 3 outlets, making them unsuitable. To address this, the v-channel will be extended beyond the superelevated section of the carriageway, where the gradient decreases, allowing for the installation of a terminal outlet that meets the required efficiency. A retention pond is also proposed to manage and attenuate highway runoff.

- Catchment 10 discharges to an infiltration basin downstream. A grassed surface water channel (GSWC) is proposed on the northbound and southbound carriageways to collect surface runoff from impermeable areas and provide pollution mitigation. Prior to the infiltration basin, a pollution control chamber (with vortex separator) is proposed for additional pollution mitigation.

The outline design has considered the requirements of Schedule 4 of the Flood and Water Management Act 2010 (updated 2016) and the requirements of The Reservoirs Act 1975, to ensure that the storage volume (including freeboard) above the existing ground level is less than 10,000 cubic meters and therefore such that a failure of the sides of the pond would not release more than 10,000 cubic meters of water after the inclusion of a 300mm freeboard.
Basin's Plans and profiles have been attached as Appendix 3 as follows;

- Pond 1 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05249 Rev P03;
- Pond 2 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05240 Rev P03;
- Pond 3 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05241 Rev P03;
- Pond 4 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05242 Rev P03;
- Pond 5 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05243 Rev P03;
- Pond 6 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05244 Rev P03;
- Pond 7 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05245 Rev P03;
- Pond 8 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05246 Rev P03;
- Pond 9 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05247 Rev P03;
- Pond 10 – Drawing NHRR-RAM-HDG-HYKE-DR-CD-05248 Rev P04;

Table 7-1: Estimated attenuation pond size

Catchments	Area (ha)	Qbar	Existing Discharge Rate IDB 5 l/s	Estimated Attenuation Pond Size (m3)	Outfall
C1 A46	2.253	3.94	5	1638	South Hykeham Catchwater (IDB Ditch)
C2	1.983	4.09	5	1680	
C3	2.869	5.92	5	2331	
C4	1.638	3.38	5	913.5	Riparian Ditch
C5 N1	0.771	1.59	5	283.5	
C5 N2	0.236	0.49	5	126	Riparian Ditch
C5 N3	0.179	0.37	5	77.7	
C6	4.485	9.41	5	3528	Green Lane Drain (IDB Ditch)
C7	3.047	6.39	5	2310	
C8	4.341	9.25	9.3	3150	River Witham (EA)
C9	8.732	18.1	18.1	8085	
C10	6.466	10.67	0.038mm/s	3339	Soakaway

7.1 Carriageway Surface Water Strategy

The alignment throughout the scheme is designed with a grass channel adjacent to the carriageway. The benefit of this is that it will provide linear drainage, and it will provide pollution control at the source. The channels will also be accommodated with pipes, ditches and chambers and the required attenuation. A concrete V-channel shall be proposed in the central reservation, rather than grass, for maintenance purposes.

A linear drainage channel system is proposed for the central reservation on both the east and west sides of the Grantham Road roundabout to facilitate crossover movements. The drainage units are designed to handle surface water runoff, calculated based on a storm return period of 1 in 5 years.

At the roundabout approaches and junctions, kerb and gullies shall be proposed and kerb drainage where required (this shall only be used where other options are not viable, following an agreement with LCC).

At the toe of the cutting adjacent to the carriageway, open ditches i.e. PED’s are proposed to terminate any runoff from adjacent land and carriageway embankments.

To maintain stability in the cutting through the escarpment counterfort drains are required, due to the high-water table (spring line mid-way up the escarpment). These would comprise a series of shallow stone-filled trenches down the cut slope face and would tie into the toe drain at the base

of the cut slope on at eastbound carriageway between chainages 6000 to 6100m. This is included in the geotechnical reports.

8. POLLUTION MITIGATION

All infiltration and attenuation basins that require pollution prevention measures must be agreed through discussion with the EA and LLFA in order to protect the Source Protection Zone 2 and Zone 3 (SPZ2 and SPZ3).

The proposed pollution prevention measures include the following key components: grass surface water channels; ditches, sediment ponds and forebays; pollution control valve (isolation penstocks), vortex grit separators and infiltration basins. The proposed pollution treatment train is discussed further below.

Surface water along most of the NHRR is intercepted by lined grass surface water channels located at the edge of the carriageway and conveyed via carrier ditches or drains to infiltration basins, sedimentation ponds, or attenuation ponds. The exceptions to this system are as follows: concrete surface water channels will be used in the central reservation where grassed channels are not feasible; kerb drainage will be installed at bridge crossings, including the viaduct over the River Witham; and a kerb and gully drainage system will be implemented across the inscribed circle diameter (ICD) of the roundabouts.

All surface water is collected positively from the highway and conveyed via grass surface water channel to a sediment forebay where necessary (catchment 1). The size of the sediment forebay equates to approximately 10% of the volume of the infiltration/attenuation basin - based on a minimum sizing provided in the SuDS Manual (CIRIA C753). The sedimentation pond for catchment 1 has a sediment forebay which is separate from the main pond.

A pollution control valve (isolation penstock) is proposed at the outlet of every drainage system within this scheme.

Safe access has been provided for operations and maintenance of individual chambers, outfalls, penstocks and vortex flow controls.

The proposed SuDS treatment train is consistent with the pollution mitigation indices approach described in CIRIA C753 for surface water discharge from a trunk road. Reference should be made to the following documents, with respect to the validation of the proposed pollution mitigation:

- Environmental Scoping Report;
- Water Framework Directive Assessment; and
- The National Highways Water Risk Assessment (HEWRAT) pollution mitigation. (HEWRAT is undertaken as part of the ES).

The locations of the proposed pollution mitigation measures are already submitted in detailed design drawings and the water quality assessment report is attached as an appendix to this report.

As per the guidance of CIRIA 753 Table 26.2, Motorways and truck roads should follow the guidance and risk assessment process set out by National Highways. The DMRB LA113 would be

best suited to assess the proposed dual carriageway. By conducting the HEWART assessment based on the watercourse properties, suitable mitigation measures have been proposed.

Water quality treatment levels required to treat the discharge can be found in DMRB CG501- Design of Highway Drainage System and CIRIA C753- The SuDS Manual. Suitable treatments are provided to mitigate the Total Suspended Solids, Metal and Hydrocarbons.

The pollution control train is specified in the
Water Quality Assessment Report, NHRR-RAM-HDG-HYKE-RP-CD-05004, and referenced in Appendix 2.

9. CONCLUSIONS

Ground investigation works were done to determine the suitability of a soakaway and to understand the ground conditions at the protection zones within the scheme. Highway catchments 9 and 10 are under SPZ 2, with basin 10 infiltration rate of 0.038mm/s.

All surface water is captured by grass surface channels along the verges or concrete v-channels in the central reservation. The water is then conveyed to proposed attenuation basins, which discharge at the agreed rate into a watercourse or in the case of pond 10, infiltrate into the ground.

All drainage is designed according to the guidance set out by the DMRB and noted in the DIP. Therefore, no surcharge for a 1 in 1 year storm for the drainage system, no flooding for 1 in 5 years and no flooding beyond the highway boundary up to the 1 in 100-year rainfall event including an allowance for climate change.

All attenuation basins have been preliminarily sized to accommodate a 1-in-100-year storm event, with an additional 40% allowance for climate change. For areas where watercourses discharge directly into the River Witham, greenfield runoff rates will be applied. However, if the greenfield runoff rate is below 5 l/s, a minimum discharge rate of 5 l/s will be used to ensure maintenance viability, as a minimum flow control size of 100mm has been agreed upon with the LLFA.

The pollution assessment report is complete, highlighting the mitigation levels required based on CIRIA and the DRMB guidelines. Pollution mitigation measures are proposed and mentioned in Appendix B of this report. Mitigation measures include sediment ponds, grass channels, ditches and grit separators. The treatment train will provide sufficient stages of pre-treatment to satisfy Section 26 of the CIRIA C753 SuDs Manual.

A flood risk assessment shall be undertaken for the surface drainage. Where the surface drainage discharges into a flood zone, surcharged outfalls shall be assessed.

APPENDIX 1
HIGHWAY CATCHMENT AND WATERCOURSE STRATEGY DRAWINGS

APPENDIX 2
WATER QUALITY ASSESSMENT REPORT

APPENDIX 3
BASIN PLAN & PROFILE