TRANSPORT

LCC 03(i)

Scheme Name:
North Hykeham Relief Road

Promoting Authority:
Lincolnshire County Council

Orders:
The Lincolnshire County Council (A1461 North Hykeham Relief Road) Compulsory Purchase Order 2024; and **The Lincolnshire County Council (A1461 North Hykeham Relief Road) (Classified Road) (Side Roads) Order 2024.**

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Drainage

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NORTH HYKEHAM RELIEF ROAD LINCOLNSHIRE COUNTY COUNCIL

DRAINAGE – PROOF OF EVIDENCE

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1. INTRODUCTION

1.1 Qualifications

1.1.1 My name is Moneeb Munir. I am a Chartered Engineer with a bachelor's degree in civil engineering from the University of Liverpool. I am a member of the of Chartered Institution of Highways and Transportation. I have extensive experience in civil engineering, with a specialisation in drainage design, flood risk assessment, and water quality studies.

1.2 Relevant Experience

1.2.1 I am currently the Director of Courous, a specialist civil engineering consultancy, where I lead a team of drainage engineers in delivering comprehensive drainage solutions for major infrastructure projects. Prior to this role, I held positions as Drainage Manager at Kier, Drainage Lead at Mott MacDonald, and Civil Engineer at Amey and Mouchel, contributing to numerous high-profile projects across the UK.

1.2.2 My professional expertise includes:

- **Drainage Design & Flood Risk Management:** Leading drainage and flooding assessments for National Highways projects, including feasibility studies, detailed designs, and pollution control strategies.
- **Hydraulic Modelling & Water Quality Studies:** Conducting hydraulic assessments using industry-standard software (MicroDrainage, Infodrainage, Autodesk Civil 3D) and implementing sustainable drainage systems (SuDS).
- **Infrastructure Development & Compliance:** Ensuring adherence to Design Manual for Roads and Bridges **[CD6.1]** (DMRB) standards and

overseeing drainage design approvals for Highways England, including S278 checks for HS2.

- **Project & Team Leadership:** Managing multi-disciplinary engineering teams, overseeing project delivery, and ensuring cost-effective solutions while maintaining regulatory compliance.

1.2.3 Some of my key projects include:

- **Managing drainage design projects for National Highways:** Development of drainage schemes to resolve flooding, including hydraulic modelling, pipe renewal, culvert design, resolving land drainage issues and pollution mitigation for highway run off.
- Checking HS2 designs on behalf of National highways: Checking multiple projects, to meet the requirements set of by the Design manual for road and bridge (DMRB) **[CD6.1]**. Checking included highways, Geotech and structural drainage.
- A49 Marsh brook Bends: Mitigating land drainage flooding by proposing new culverts and new surface drainage.
- Chown Mills Roundabout: Drainage design of Chown Mill roundabout and all the link roads, designed to the DMRB. Design including surface drainage, attenuation and land drainage.
- Highways Depot: designing to mitigate discharge from washdown areas and fuel stations.
- A66 Threlkeld: Mitigating Land drainage flooding to the A46 from the Threlkeld hill within the lake district.

1.3 Record of standards

No.	Standards	Description

1	CIRIA C753	The SuDS manual, SuDS Design Principles
2	DMRB CD521	Hydraulic design of road edge surface water channels and outlets
3	DMRB CD532	Vegetated drainage systems for highway runoff
4	DMRB CD522	Drainage of runoff from natural catchments
5	DMRB CD529	Design of outfall and culvert details
6	DMRB CG501	Design of highway drainage systems
7	DMRB LA113	Road drainage and the water environment

1.4 Abbreviations

1	SuDS	Sustainable drainage Systems
2	DMRB	Design Manual for roads and bridges
3	CIRIA	Construction Industry Research and Information Association
4	AEP	Annual Exceedance Probability
5	EQS	Environmental Quality Standards
6	GSWC	Grass Surface water channel
7	CSWC	Concrete surface water channel
8	HEWRAT	Highways England water risk assessment tool
9	IDB	Internal Drainage Board
10	LLFA	Lead Local Flood Authority
11	NPPF	National Planning Policy Framework
12	PED	Pre Earthwork Ditches
13	EA	Environment Agency
14	CC	Climate Change
15	CH	Chainage- the distance of measurement along the centreline of the scheme.

16	NHRR	North Hykeham Relief Road
17	FEH	Flood Estimation Handbook
18	SPZ	Groundwater source protection zone

1.5 Terms and Definitions

No.	Term	Definition
1	Flow path	The route taken by rainfall runoff from the point at which it falls on the carriageway surface to the carriageway edge
2	Source protection zone	Areas marked around places where drinking water is taken or other important sites, showing how likely it is that pollution from nearby activities could cause harm.
3	Sedimentation tank/Pond/ Forebays	Contained structure that allows suspended particles to settle out of water as it flows slowly through the tank/Pond, providing a degree of purification
4	Retention pond	Pond that generally retains some water at all times. Can have permeable base or banks. Primarily designed to attenuate flows by accepting large inflows but discharging slowly. Can also treat water by allowing suspended solids to settle out.
5	Penstock	Flat plate, fitted to a pair of guide slots on a headwall or chamber wall, which can be raised and lowered using a screw thread operated by a wheel, to control spillages
6	Kerb Drainage	Kerb units with inlets to an enclosed internal drainage channel
7	Groundwater	All water that is below the surface of the ground in the saturation zone (below the watertable) and in direct contact with the ground or subsoill
8	Infiltration basin	Dry basin designed to promote infiltration of surface water into the ground

No.	Term	Definition
9	Kerb and gully drainage	System of drainage whereby surface water is directed by edge of pavement kerbs into gullies that are connected to a longitudinal carrier drain or pipe set within the road verge
10	Soakaway	Subsurface structure into which surface water is conveyed and which aids infiltration
11	Surface water channel (including channel blocks)	Triangular, trapezoidal or rectangular cross-section channel, formed from asphalt or concrete, located near the edge of the carriageway, used to collect and convey surface water from the road
12	Grass channel	Wide shallow grassed channel, normally located adjacent to a carriageway but often separated by a section of verge
12	Internal Drainage Boards (IDBs)	Local public bodies responsible for land drainage in areas of special drainage need.
14	Surcharged	When the outfall (where the water leaves the system) is partially or fully submerged, water inside the system can't escape easily, causing a backup.
15	Riparian Watercourse	A watercourse is any flow of water in a natural or artificial channel, including rivers, streams, ditches, brooks, becks and culverts.
16	Polycyclic aromatic hydrocarbons	Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals formed when materials like coal, oil, gas, or wood are burned incompletely. They are commonly found in car exhaust, smoke, soot, and some contaminated soils.
17	Wallingford Procedure	The Wallingford Procedure is a UK method for designing urban surface water drainage systems. It helps calculate rainfall runoff and assess drainage network performance.

No.	Term	Definition
18	Catchment area	A catchment area is the land area from which all rainfall drains to a common outlet like a river, lake, or drainage system.
19	Vortex Separator	A vortex separator is a device that uses circular (vortex) motion to separate solids and pollutants from stormwater.
20	Flood Estimation Handbook	The Flood Estimation Handbook (FEH) is the UK's standard methodology for estimating river and surface water flood flows—used in flood risk assessments, drainage design, and infrastructure planning—based on long-term rainfall and river flow records from gauging stations, and digital catchment data from sources like the Met Office.

2. INVOLVEMENT WITH THE SCHEME AND CONTRIBUTION MADE

2.1 My role and responsibilities

2.1.1 I have been involved with the NHRR project since January 2023. I have acted as the lead drainage designer for the North Hykeham Relief Road scheme throughout its development, from early concept through to detailed design. My responsibilities have included producing the drainage strategy, developing to the design input plan, and delivering the water quality and pollution risk assessments. I have coordinated with multiple stakeholders, including Lincolnshire County Council who are the Lead Local Flood Authority (LLFA), the Environment Agency (EA), and the Upper Witham Internal Drainage Board (IDB), to ensure the design meets all regulatory and technical requirements.

2.1.2 As part of this role, I have led the development of the following key technical deliverables:

2.1.3 Detailing the proposed drainage system, SuDS approach, design standards and discharge criteria.

2.1.4 Setting out the drainage design philosophy and performance criteria with the agreement with the LLFA and Water Quality Assessment as per the SuDS manual C753 **[CD6.3]** including Highways England water risk assessment tool (HEWRAT) analysis and pollution risk mitigation.

2.1.5 Drainage catchment and watercourse strategy drawings, attenuation basin layouts, and integration of the scheme with natural and artificial drainage systems.

2.2 Scope of Work

2.2.1 The scope of my involvement included the full drainage design for the entire NHRR alignment, which comprises approximately 8km of new dual carriageway with multiple side roads, roundabouts, and non-motorised user routes. This included:

- Defining 10 drainage sub-catchments based on topography and watercourse alignments.
- Designing surface water runoff systems using grassed channels, filter drains, and attenuation ponds.
- Integrating pre-earthwork drainage and culverts to maintain upland catchment flows.
- Proposing infiltration systems and vortex separator to protect groundwater in Source Protection Zones 2 and 3.
- Ensuring pollution control via sedimentation ponds, vortex separators, and a full SuDS treatment train in accordance with the Ciria SuDs Manual **[CD6.3]**.

2.2.2 I have developed the drainage design for the North Hykeham Relief Road in full compliance with standards, including the Design Manual for Roads and Bridges (DMRB) **[CD6.1]**, CIRIA SuDS Manual (C753) **[CD6.3]**, and LLFA detail design Standards. I have ensured that the design aligns with the principles of the National Planning Policy Framework (NPPF) **[CD3.5]** by managing surface water sustainably, minimising flood risk, and protecting water quality. Throughout the design process, I have applied relevant DMRB standards such as CD 523, CD 528, CG 501, and LA 113 **[CD6.1]** to deliver a compliant drainage solution that meets planning requirements, accommodates climate change allowances, and integrates with both the engineered and natural drainage systems along the route.

2.2.3 In summary, I have been responsible for delivering a comprehensive, compliant, and sustainable drainage solution for the NHRR scheme. My input has been central to the design of surface water management systems that achieve the goals of flood risk mitigation and water quality protection.

3. POLICY AND STANDARDS

3.1 Planning and Legislative Framework

3.1.1 The drainage strategy for the North Hykeham Relief Road has been developed in accordance with a comprehensive suite of national policies, technical standards, and local authority (EA and IDB as LLFA for Lincoln County Council) requirements. The following key planning documents and legislative frameworks have informed the design:

3.1.2 National Planning Policy Framework (NPPF), December 2024 **[CD3.5]**: Emphasises sustainable development and sets clear goals for the management of flood risk and surface water through robust design measures. Developments should incorporate Sustainable Drainage Systems (SuDS) where feasible, ensure flood resilience, and not increase flood risk elsewhere.

3.1.3 DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (2015) **[CD6.14]**: Establishes peak flow and volume control requirements for surface water discharge in greenfield and brownfield developments. Designs must accommodate extreme rainfall events (up to the 1 in 100-year storm, with climate change allowance), prevent flooding within critical infrastructure, and ensure any remaining risk is managed safely.

3.1.4 Flood and Water Management Act 2010 (Schedule 3) **[CD2.8]** and Reservoirs Act 1975 **[CD2.9]**: Provide statutory guidance on the design, approval, and maintenance of SuDS, particularly where drainage structures (such as attenuation ponds) have significant storage volumes. Drainage features within the NHRR scheme are designed to fall below the thresholds for additional inspection under the Reservoirs Act.

3.2 Local and Authority Standards

3.2.1 Consents and agreements have been obtained or are in progress with the following stakeholders:

- Upper Witham Internal Drainage Board (IDB) who are acting as the Lead Local Flood Authority (LLFA) on behalf the Lincolnshire County Council (LCC)
- Environment Agency (EA)
- National Highways (NH)

3.2.2 Discharges into IDB-controlled watercourses and works within the IDB assets require consent under the Land Drainage Act 1991 **[CD3.17]**. Catchment discharge rates have been reviewed and agreed with the IDB, with limitations applied where discharges flow into pumped systems.

3.3 Technical Design Standards

3.3.1 The drainage design has been carried out in full accordance with National Highways Design Manual for Roads and Bridges (DMRB) **[CD6.1]**. The applicable standards include, but are not limited to:

- CG501 –Design of highway drainage systems
- CD521 – Hydraulic design of road edge surface water channels
- CD532 – Vegetated drainage systems for highway runoff
- CD522, CD529 –Culverts and runoff from natural catchments
- LA113 – Road Drainage and the Water Environment

3.3.2 Additional technical references used in the design process:

- CIRIA C753 – The SuDS Manual **[CD6.3]**
- Flood Estimation Handbook (FEH) (for water course flow rates)**[CD6.16]**

3.4 Design Parameters

- Design Life: 60 years minimum for general drainage infrastructure; 120 years for culverts >900mm (treated as structures)
- Climate Change Uplift: Up to +40% applied for 1% annual exceedance probability rainfall events
- Rainfall Events: Design scenarios range from 1 in 1-year (no flooding) to 1 in 100-year (+40% climate change)
- Pollution Control: Designed in accordance with HEWRAT and CIRIA SuDS Manual **[CD6.3]**, including the use of sedimentation ponds, forebays, and GSWCs
- Drainage Modelling: Performed using MicroDrainage, incorporating FEH rainfall data and CD521 flow calculations **[CD6.1]**

3.5 Sustainable Drainage Systems (SuDS)

3.5.1 The design embraces the four pillars of SuDS: water quantity, water quality, amenity, and biodiversity. These are achieved through:

- Grassed surface water channels
- Attenuation and infiltration basins with sediment forebays
- Pollution control via settlement and filtration
- Enhancements to biodiversity and visual amenity through landscaping design

3.5.2 A separate SuDS Management Plan **[CD8.73]** has been prepared to outline the operational and maintenance strategy in line with planning requirements.

4. DRAINAGE DESIGN DEVELOPMENT

4.1 Drainage Strategy

4.1.1 As the lead drainage designer for the North Hykeham Relief Road (NHRR) scheme, my primary role was to develop a comprehensive and sustainable drainage strategy that effectively manages surface water runoff, mitigates flood risk, and preserves existing land drainage systems. Given the route's interaction with multiple watercourses, flood zones, and Source Protection Zones (SPZs), the drainage design had to be both technically robust and environmentally sensitive.

4.1.2 The strategy was structured around ten catchments, defined by the alignment's geometry, surrounding topography, existing watercourses, and discharge points. Each catchment was designed to manage highway runoff locally, using sustainable drainage systems (SuDS) such as GSWCs, attenuation ponds, and infiltration basins. These measures were carefully selected to limit runoff rates to agreed discharge levels and maintain natural flow paths, ensuring that existing agricultural and overland flow networks were not disrupted.

4.1.3 To preserve existing drainage patterns and manage surface water sustainably, the design incorporated pre-earthworks drainage, cut-off ditches, and culverts. Pollution control and groundwater protection measures, particularly important in SPZs, were integrated in line with CIRIA **[CD6.3]** and DMRB guidance **[CD6.1]**.

4.1.4 Climate change resilience was embedded throughout by designing all drainage infrastructure to accommodate a 1 in 100-year storm event plus a 40% climate change allowance. Hydraulic modelling confirmed that downstream systems would not be overwhelmed, and that the new infrastructure would not make existing flood risk worse.

4.1.5 The catchment areas are illustrated in the North Hykeham Relief Road Highways Catchment Drawing **[CD8.74]**, and are summarised as follows:

Catchment 1 – A46 Junction to South Hykeham Catchwater [CH0]

4.1.6 The A46 roundabout is an asset of National Highways and must remain independent from the Lincolnshire County Council (LCC) network to ensure clarity in ownership, maintenance responsibilities, and adherence to the relevant design standards. All discharges, including those to the attenuation pond, have been designed separately from the LCC system in accordance with the Design Manual for Roads and Bridges (DMRB) **[CD6.1]**, facilitating adoption by National Highways without compromising their operational or regulatory requirements. This separation is critical to avoid cross-authority management conflicts and to support long-term maintainability.

4.1.7 Due to the roundabout's geometric layout and the unavailability of hardstrips on its approaches, kerb drainage units have been proposed. This solution has been agreed with National Highways and is in line with the DMRB **[CD6.1]**. The catchment collects runoff from the A46 roundabout and conveys it via kerb drainage to a sedimentation pond, which includes a forebay for pollution control. The pond discharges at a controlled rate of 5 l/s into the South Hykeham catchwater, a tributary of The Beck, which ultimately drains into the River Witham. This approach ensures compliance with Internal Drainage Board (IDB) requirements, supports environmental quality standards, and helps mitigate flood risk to downstream watercourses. National Highways drainage systems are maintained for water drained from outside of NHRR works via extension of existing pipe work, ditches and culverts to outfall into IDB systems.

Catchments 2 and 3 – Tributaries to The Beck [CH50 to CH1133]

4.1.8 Catchments 2 and 3 collect surface water runoff from the dual carriageway (NHRR, link1) and discharge to the same catchwater system as Catchment 1, ultimately outfalling into The Beck. These catchments lie at a natural low point, which already receives runoff from the surrounding land. To maintain this natural drainage pattern and avoid increasing flood risk downstream, runoff is attenuated in proposed designed ponds to match greenfield discharge rates. Where this is compatible with maintainability. Where this is not the case, slightly higher discharge rates have been agreed with the IDB.

4.1.9 Drainage is conveyed via grassed surface water channels (GSWCs) along both carriageway edges and concrete surface water channels (CSWCs) in the central reservation, which directly flow through a network of ditches and pipes to the attenuation ponds. HEWRAT assessments identified a requirement for sediment removal, and a treatment train has been incorporated using GSWCs, ditches, vortex separators units, and ponds to reduce pollutants prior to discharge. This approach supports both water quality objectives and long-term system resilience.

4.1.10 Outfall locations into the existing land drainage network are within the permanent NHRR scheme boundary and so are accessed via the maintenance routes in place to access the attenuation basins and other drainage systems. The IDB will be granted rights to use these access routes as necessary to inspect and to access adjacent areas in order to undertake their duties.

Catchments 4 and 5 – Riparian Watercourse (Wath Lane Area) [CH1133 to CH1800]

4.1.11 Catchments 4 and 5 discharge into a riparian watercourse located between Wath Lane and the South Hykeham Roundabout. This watercourse

ultimately connects to a pumped system maintained by the Internal Drainage Board (IDB), which has limited capacity. To protect this system and prevent downstream flooding, discharge from both catchments is restricted to the locally agreed rate of 5 l/s.

4.1.12 These catchments lie at a natural low point, which already receives runoff from the surrounding land. To maintain this natural drainage pattern and avoid increasing flood risk downstream, runoff is directed to retention ponds located near the riparian drain fields. These purpose-designed ponds provide the necessary attenuation for storm events, including allowances for future climate change, and ensure flows are released at controlled rates in line with IDB requirements.

4.1.13 Surface water runoff from the carriageway is collected using grassed surface water channels (GSWCs) along both the northbound and southbound carriageways, providing initial treatment and pollution mitigation. Concrete surface water channels (CSWC) are proposed in the central reservation to collect runoff from super-elevated sections. Pre-excavation ditches are also included to intercept runoff from upland areas and embankment slopes before it reaches the main drainage system.

4.1.14 Due to the inclusion of a proposed bat bridge in the area, Catchment 5 has been split into three smaller sub-catchments, each with its own pond. This approach enabled the required attenuation volume to be spread around the ecological feature, while still achieving the necessary control of runoff to meet agreed discharge rates. This design ensures both environmental protection and effective surface water management.

4.1.15 Long-term access to outfall locations has been secured through easement agreements, and the IDB will continue to maintain the functionality of the receiving ditches under pre-scheme conditions.

4.1.16 Outfall locations into the existing land drainage network are within the permanent NHRR scheme boundary and so are accessed via the maintenance routes in place to access the attenuation basins and other drainage systems. The IDB will be granted rights to use these access routes as necessary to inspect and to access adjacent areas in order to undertake their duties.

Catchments 6 and 7 – Green Lane Drain [CH1800 to CH3600]

4.1.17 Catchments 6 and 7 collect surface water runoff from the dual carriageway and discharge into the Green Lane Drain, an Internal Drainage Board (IDB) maintained watercourse. As with other outfalls along the scheme, discharge is regulated via attenuation and flow control to meet the greenfield runoff rate agreed with the IDB.

4.1.18 These catchments lie within a low-lying area and are situated close to a designated floodplain. The crest point of the highway alignment is located at the River Witham Bridge, meaning flows from either side of this high point drain into their respective downstream catchments. Surface water runoff from the bridge deck is captured using bridge deck kerb drainage units and is discharged into the drainage network for Catchment 7, contributing to the overall runoff volume managed in that catchment.

4.1.19 Due to the topography and floodplain proximity, the proposed outfalls for Catchments 6 and 7 were modelled under surcharged conditions to reflect higher downstream water levels during severe storm events. Hydraulic modelling confirmed that, even under these restricted assumptions, the drainage system

limits flooding within the highway corridor to less than 8 cubic metres during a 1-in-100-year rainfall event with a 40% climate change allowance.

4.1.20 To effectively manage runoff, the strategy includes retention basins for each catchment, offering temporary storage and controlled discharge. GSWC along both carriageway edges provide initial runoff collection, flow, and water quality treatment. Additionally, high-capacity outlets are used to maintain efficient flow under surcharged conditions, ensuring system resilience during peak storm events.

4.1.21 This design approach maintains compliance with IDB discharge requirements, ensures flood mitigation, and integrates climate change adaptation measures. It also ensures that bridge infrastructure drainage is seamlessly incorporated into the wider surface water network, supporting safe operation and long-term functionality of the highway.

Catchments 8 and 9 – Direct Discharge to the River Witham [CH3600 to CH6803]

4.1.22 Catchments 8 and 9 are situated in a favourable topographical position, enabling gravity-fed drainage. Surface water from these catchments is conveyed to IDB-managed ditches located on the eastern side of the River Witham. Further downstream, the land drainage system discharges directly into the River Witham via flap-valve-protected outfalls, which prevent backflow during periods of high river levels. The discharge rates for Catchments 8 and 9 have been agreed in consultation with the Internal Drainage Board (IDB) and align with the greenfield runoff rates.

4.1.23 The low point of the carriageway is located east of Brant Road Roundabout, a result of the crest point being at the River Witham Bridge. This

natural fall in levels means that runoff in this area is directed toward the lower eastern side of the scheme. The area contains a number of existing ditches, which serve as outfall locations for the proposed drainage infrastructure. Attenuation ponds have been designed to store and control the runoff before discharging into these ditches at greenfield rates, helping to preserve the existing drainage function and prevent increased flood risk downstream.

4.1.24 The highway alignment within these catchments features steep gradients, which posed a challenge for surface water collection and flow. To manage the rapid runoff, extended CSWC have been incorporated into the central reservation, particularly on super-elevated sections. These channels direct water toward terminal drainage points at flatter areas where it can be collected efficiently and safely conveyed onward. In addition, cut-off ditches along steep embankments are lined to prevent erosion.

4.1.25 To the east of Brant Road, a Bat Culvert forms part of the environmental mitigation, with the highway vertical alignment rising to accommodate the culvert. As such, the drainage system and attenuation strategy in this area has been split into two separate networks, each with its own attenuation pond. This approach allows the system to maintain effectiveness across the varied terrain, accommodate the ecological infrastructure, and meet required storage volumes without impacting sensitive features.

4.1.26 Surface water is routed through GSWC and carrier ditches prior to entering the ponds, providing both flow attenuation and pollution mitigation. The staged treatment of runoff helps to improve water quality before discharging into the IDB ditch to the east of the river before ultimately outfalling into the River Witham, ensuring compliance with SuDS principles and environmental regulations.

4.1.27 This integrated design solution responds effectively to the site's gradient, and natural drainage paths, ensuring long-term functionality, flood resilience, and environmental protection.

Catchment 10 – Infiltration Basin in Source protection zone 2 [CH6803 to CH8090]

4.1.28 This final catchment, located at the eastern end near Sleaford Road Roundabout, drains to an infiltration basin situated in a Source Protection Zone 2 (SPZ2). To ensure groundwater protection, GSWC, ditches and vortex separator (sediment tanks) are proposed for pollution control and mitigation. This complies with DMRB **[CD6.1]** and CIRIA guidance **[CD6.3]**. Infiltration tests confirmed the viability of this design, and groundwater risk was further assessed in the accompanying Water Quality Assessment **[CD8.80]**.

4.1.29 Throughout the development of these catchments, I ensured that each design addressed:

- Surface water collection and conveyance,
- Attenuation and discharge control,
- Pollution mitigation (in line with HEWRAT and CIRIA C753 **[CD6.3]**),
- Maintenance access and asset resilience.

4.1.30 This strategy allows the scheme to safely manage surface water runoff, prevent increased flood risk, and integrate effectively with the natural and engineered water environments along the alignment.

4.2 Land Drainage and Existing Overland Catchment Areas

4.2.1 The North Hykeham Relief Road passes through rural, low-lying agricultural land that is currently drained by a combination of natural overland flow paths and field drainage ditches. At the outset of the drainage design, I undertook a detailed

review of existing overland catchment extents, flow directions, and discharge points, supported by topographical surveys and hydrological modelling.

4.2.2 The proposed highway alignment intersects several of these natural catchments, and a key design objective was to ensure that the construction of the road would not alter the existing hydrological regime or increase flood risk to adjacent landowners or third parties.

4.2.3 To achieve this, I incorporated a network of cut-off ditches and pre-earthworks drainage (PED) channels along the toe of embankments and the crest of cuttings. These features intercept natural overland flows before they reach the highway, conveying the water along its existing route toward established watercourses or IDB-managed drains. These PED's are designed to intercept any easting field drainage and convey intercepted water back into the existing ditch system.

4.2.4 Where the road embankments or cuttings cross existing flow paths or watercourses, I designed and located culverts to maintain uninterrupted flow beneath the carriageway. The size and hydraulic capacity of these culverts were determined based on the contributing catchment area and local rainfall data, ensuring they can convey flows under a 1 in 100-year event with appropriate freeboard and the accommodation of sedimentation.

4.2.5 In certain areas, particularly where land naturally drains toward the River Witham or The Beck, the intercepted runoff is directed back into the natural drainage system via short culverts or carrier ditches. This maintains flow while keeping upland land drainage separate from the highway drainage network.

4.2.6 All land drainage measures were designed in compliance with DMRB CD 522 **[CD6.1]** and in agreement with the IDB and LLFA. These elements ensure that all pre-existing catchments continue to drain effectively with no additional flood

risk introduced as a result of the scheme's construction. They also safeguard the scheme's long-term stability by preventing unmanaged water ingress into the highway earthworks.

4.2.7 Watercourse strategy drawings **[CD8.75 & 8.76 & 8.77]**, show all EA watercourses, as well as Internal Drainage Board (IDB) and Lead Local Flood Authority (LLFA) ditches and watercourses, are illustrated. Where the proposed scheme crosses these ditches or watercourses, their continuity has been maintained. Culverts have been proposed to carry flows beneath the carriageway and have been designed to accommodate a 1 in 100-year storm event plus climate change allowance. The capacity of each ditch has also been checked, and where flows are fast-moving, the channels have been lined to prevent erosion.

4.2.8 Existing Overland Catchment and flow direction drawing **[CD8.78]** identifies the large overland catchment areas. The proposed culverts have been designed to convey flows from these catchments to their original discharge points, thereby ensuring no alteration to the existing natural drainage regime.

4.3 Design Refinement and Supporting Documentation

4.3.1 As part of my role, I led the preparation of key technical documents that form the evidence base for the drainage proposals, including:

- **Design Input Plan** – setting out the design methodology, drainage philosophy, and compliance requirements.
- **Drainage Strategy Report [CD8.79]** – detailing catchment management, SuDS features, pollution control, attenuation sizing, and discharge mechanisms.

- **Water Quality Assessment [CD8.80]**– using HEWRAT to assess the potential impacts on receiving watercourses and identifying necessary mitigation measures.
- **Catchment and Watercourse Strategy Drawings [CD8.74 to 8.78]**– illustrating the hydraulic connectivity and infrastructure layout across the scheme.

4.3.2 The design has undergone several iterations to reflect updated ground investigations, topographical surveys, and the evolving highway alignment, with all elements reviewed to ensure continued compliance and functionality. These iterations have included formal reviews with the Highway Authority and the Lead Local Flood Authority (LLFA), as well as collaborative reviews with the Environment Agency (EA) and the Internal Drainage Board (IDB).

5. ASSESSMENT OF SCHEME PROPOSAL

5.1.1 The drainage proposals for the North Hykeham Relief Road (NHRR) have been thoroughly assessed to ensure they meet national and local policy requirements, comply with engineering standards, and deliver a sustainable drainage solution. This section summarises the technical performance of the scheme in terms of hydraulic capacity, flood risk, water quality, groundwater protection, and operational safety.

5.2 Surface Water Management and Flood Risk

5.2.1 The proposed drainage strategy has been modelled to manage runoff from a 1 in 100-year storm event with an additional 40% climate change allowance, in line with Environment Agency guidance. This was also agreed with IDB and the Highway Authority. Each of the ten highway drainage catchments have been comprehensively designed and thereafter thoroughly assessed with appropriately sized features, including:

- Grassed surface water channels for initial collection and conveyance.
- CSWC for the central reservation and kerb drainage where linear solutions were not feasible.
- Carrier ditches, and attenuation ponds for controlled storage.
- Culverts and pre-earthworks ditches (PEDs) to maintain overland flow routes and land drainage.

5.2.2 All drainage systems have been assessed to ensure:

- No flooding occurs within the highway boundary up to the design event (1 in 100-year + CC).
- No flood risk is transferred to third-party land.

- All runoff is either safely infiltrated or discharged at greenfield rates or agreed IDB limits.

5.2.3 In areas discharging into pumped IDB systems, such as Catchments 4 to 7, outfalls are restricted to 5 l/s minimum to ensure functionality of flow controls and compliance with IDB expectations. Where outfalls are surcharged, hydraulic modelling has demonstrated that flood volumes are minimal and contained within the highway drainage boundary.

5.3 Integration with Existing Land Drainage

5.3.1 A key consideration throughout the design has been the retention of existing overland flow paths and field drainage networks. As detailed in Section 3.7, cut-off ditches, culverts, and natural flow path diversions have been incorporated to ensure the continuation of pre-existing land drainage without interruption. These measures prevent upstream ponding and maintain hydrological connectivity, particularly in agricultural areas adjacent to the alignment.

5.3.2 Where natural upland catchments intersect the scheme, separate pre-earthwork drainage systems ensure this runoff is excluded from the highway drainage network and conveyed to appropriate receiving waters, typically existing IDB ditches or watercourses.

5.4 Water Quality and Pollution Control

5.4.1 Water quality impacts have been assessed in accordance with DMRB LA 113 **[CD6.1]** and the Highways England Water Risk Assessment Tool (HEWRAT). The assessment considered the following pollutant types:

- Soluble metals (copper and zinc) – for acute and chronic toxicity.
- Sediment-bound pollutants – such as hydrocarbons and polycyclic aromatic hydrocarbons (PAHs).

- Total suspended solids – for ecological impacts.

5.4.2 HEWRAT assessments were carried out for each individual catchment and, where applicable, cumulative discharges. The results demonstrated that all outfalls either passed in isolation or required straightforward mitigation measures such as:

- Sedimentation pond with forebay (e.g., Catchment 1).
- GSWCs, carrier ditches, and vortex separators (Catchments 2 and 3).
- Linear drainage features and vegetated channels (Catchments 4–9).
- Infiltration basin and vortex separator in SPZ2 (Catchment 10).

5.4.3 These features collectively provide a compliant SuDS treatment train, consistent with the pollution mitigation indices set out in CIRIA C753 **[CD6.3]** and DMRB CG 501 **[CD6.1]**. The scheme's design ensures that all discharges meet Environmental Quality Standards (EQS) and pose no significant risk to receiving water bodies or ecosystems.

5.5 Groundwater Protection

5.5.1 Catchment 10 falls within a Source Protection Zone 2 (SPZ2), requiring careful consideration of groundwater contamination risk. Ground investigations confirmed the suitability of infiltration at this location, with measured infiltration rates of 0.038 mm/s.

5.5.2 To safeguard groundwater:

- GSWC and ditches are proposed as a first stage of treatment
- Before the infiltration basin vortex sediment separator are proposed as a second stage of treatment.
- The drainage layout avoids any direct connection between the carriageway and infiltration surface.

- The design complies with LA 113 **[CD6.1]**, EA groundwater guidance, and SuDS Manual best practice.

5.5.3 As a result, the proposed infiltration solution is appropriate and does not pose an unacceptable risk to groundwater quality.

5.6 Spillage Risk Assessment

5.6.1 A spillage risk assessment was undertaken using the LA 113 **[CD6.1]** methodology to evaluate the likelihood of a pollution event due to vehicle accidents involving tankers or hazardous materials.

5.6.2 The Key findings are summarised as follows:

- All catchments returned a spillage probability of <1% Annual Exceedance Probability (AEP).
- No outfall exceeded the 1 in 100-year threshold requiring mitigation.
- Therefore, no additional spillage containment measures (e.g., shut-off valves or interceptors) are required.

Notwithstanding this, isolation penstocks are included at the outlets of each drainage system as a precautionary measure, allowing future operational control should a serious incident occur.

5.7 Operational Considerations and Maintenance

5.7.1 All drainage components have been designed to ensure ease of access and maintainability in line with CD 535 (Drainage asset data and risk management) **[CD6.1]**. Key considerations include:

- Off-carriageway locations for manholes and inspection chambers.
- Safe access routes for attenuation features.
- Durable flow controls (minimum 100 mm orifice) to minimise blockage risk.

- Long-term easement provisions to facilitate IDB maintenance where applicable.

5.7.2 The scheme's approach supports Lincolnshire County Council's obligations as the Highway Authority and aligns with asset management principles for lifecycle performance.

5.8 Ponds

5.8.1 The drainage design incorporates a series of attenuation and infiltration ponds strategically located across the scheme to manage surface water runoff from the highway. These ponds serve a dual function: providing controlled storage to limit discharge rates and delivering effective treatment of pollutants prior to discharge. Each pond has been designed based on catchment-specific hydrological modelling, sized to accommodate a 1 in 100-year storm event plus a 40% allowance for climate change, in accordance with Environment Agency and DMRB CG501 guidance **[CD6.1]**. The attenuation ponds discharge to existing watercourses or IDB-managed ditches at agreed flow rates, typically 5 litres per second, or as dictated by greenfield runoff calculations.

5.8.2 In Catchment 10, which lies within a Source Protection Zone 2 (SPZ2), an infiltration basin is proposed with a vortex separator to safeguard groundwater quality. Separately, a Forebay is proposed within Catchment 1 pond to promote sediment settlement and improve water quality, supporting compliance with CIRIA SuDS Manual (C753) **[CD6.3]** treatment requirements. All ponds have been designed with safe access, maintenance easements, and appropriate freeboard to ensure long-term operational performance and regulatory compliance.

6. SUMMARY AND CONCLUSIONS

6.1.1 Planning permission **[CD 1.1]** has been granted for the North Hykeham Relief Road (NHRR), a major infrastructure scheme supported by a comprehensive Environmental Statement. This document sets out the evidence in relation to drainage and water environment, demonstrating how the drainage strategy has been developed to meet national and local planning requirements, technical standards, and stakeholder expectations. The summary below provides a clear explanation of the process, from initial investigation through to assessment and mitigation, and ends with the justification of the proposed solution.

6.1.2 The strategy began with a detailed understanding of the site context, including its topography, geology, and hydrology. The Scheme passes mainly through agricultural land, crossing several watercourses, ditches, and flow paths, and includes sensitive zones such as Source Protection Zones (SPZ2). At the earliest stage, comprehensive data gathering was undertaken, including topographical and geological surveys, existing watercourse mapping, and review of local drainage systems. This early work was essential to understand the existing drainage conditions and help shape the initial design.

6.1.3 Key baseline activities included defining existing hydrological catchments, understanding existing overland flow paths, and calculating greenfield runoff rates using the Flood Estimation Handbook methodology. The existing catchments were mapped using site survey data and supplemented by LiDAR. Engagement began at this stage with Lincolnshire County Council as Lead Local Flood Authority (LLFA), and the Upper Witham Internal Drainage Board (IDB) to ensure the baseline understanding and design approach were acceptable.

6.1.4 The initial concept for the drainage strategy was shaped by the principles of sustainable development as set out in the National Planning Policy Framework (NPPF) **[CD3.5]**, the non-statutory SuDS standards issued by DEFRA, and the requirements of DMRB **[CD6.1]** and CIRIA C753 **[CD6.3]**. A key design objective from the outset was to ensure that surface water runoff from the new road would be safely managed, flood risk would not be increased elsewhere, and water quality would be protected or enhanced.

6.1.5 To enable effective and location-sensitive design, the highway alignment was divided into ten drainage catchments. These were defined based on natural topography, watercourse locations, and infrastructure requirements such as bridges and bat crossings. Each catchment was then developed independently, incorporating a bespoke blend of drainage features appropriate to the scheme section. These included grassed surface water channels (GSWC), concrete surface water channels (CSWC), pre-earthworks ditches (PEDs), culverts, and attenuation or infiltration ponds.

6.1.6 Throughout the Scheme, runoff is managed through the SuDS treatment train concept. This begins with collection in vegetated channels or kerb drainage, conveyed via carrier ditches or pipes, and attenuated in ponds with appropriate flow control. Where infiltration was possible, such as in Catchment 10, it was used based on the results of infiltration testing. In sensitive groundwater areas, such as SPZ2, additional pollution controls were incorporated, including a vortex separator.

6.1.7 The drainage design accounts for climate change by incorporating a 40% allowance in all hydraulic modelling. Each system is sized to manage a 1 in 100-year rainfall event without flooding the highway boundary or affecting adjacent

land. Discharge rates were agreed with the LLFA at green field run off rates and capped at 5 l/s to ensure the long-term viability of flow control devices.

6.1.8 Protecting existing land drainage was a key part of the design. Pre-earthworks drainage channels and carefully sized culverts were included to capture runoff from higher ground and carry it safely under the road. This prevents the water from flowing into the highway drainage system. These measures help keep natural drainage patterns intact, reduce the risk of flooding on nearby land, and stop the road structure from becoming waterlogged.

6.1.9 The proposed design was refined through an iterative process of review and consultation with key stakeholders. Drainage models were updated based on detailed ground investigations, CCTV surveys, and topographical changes. Critical outfalls were assessed under both normal and surcharged conditions to validate their performance. Feedback from the LLFA and IDB was integrated to ensure design compliance, obtain approvals in principle, and confirm long-term maintainability.

6.1.10 A detailed water quality assessment **[CD8.80]** was carried out using the Highways England Water Risk Assessment Tool (HEWRAT), supported by CIRIA guidance **[CD6.3]** and DMRB LA 113 **[CD6.1]**. This confirmed that all discharges meet the required Environmental Quality Standards. Where pollutant levels warranted it, multiple treatment stages were introduced, including sedimentation forebays, grassed channels, and vortex separators.

6.1.11 The spillage risk assessment concluded that no outfall exceeded the threshold requiring dedicated spillage containment measures. Nonetheless, penstocks were included at every outfall as a precautionary control, enhancing operational resilience.

6.1.12 Each drainage component has been designed to be accessible and maintainable, with safe access routes and appropriate separation from the carriageway. Attenuation ponds have been designed below the volume threshold of the Reservoirs Act, ensuring proportionate regulation. The SuDS Management Plan **[CD8.73]** provides further guidance for the long-term operation of the system.

6.1.13 In conclusion, the drainage strategy for the North Hykeham Relief Road has been developed in full accordance with national and local planning policy, technical guidance, and environmental standards. It addresses the specific topographical, hydrological, and geological characteristics of the site through a clearly defined, catchment-based approach. Sustainable Drainage Systems (SuDS) have been integrated throughout, providing robust surface water management while ensuring resilience to future climate change.

6.1.14 The design ensures that flood risk is not increased, water quality is protected, and natural drainage patterns are respected. Mitigation measures, including attenuation and infiltration features, sedimentation forebays, and vortex separators, have been applied based on-site conditions and environmental sensitivity—particularly within Source Protection Zones. All discharges have been assessed using HEWRAT and meet the required Environmental Quality Standards. My assessments confirm that landowners and adjacent agricultural areas will continue to drain as they did pre-scheme, with no detrimental hydrological impacts arising from the proposed works.

6.1.15 I have ensured that all drainage features are accessible, maintainable, and coordinated with the responsibilities of both Lincolnshire County Council and the Internal Drainage Board. This ensures that the system can be operated safely and efficiently over its design life.

6.1.16 Overall, the drainage design for the North Hykeham Relief Road is not only technically sound, but environmentally responsible, fully compliant with planning policy, and developed through strong collaboration with key stakeholders. I am satisfied that the scheme will deliver its intended function without increasing flood risk and will contribute positively to the surrounding water environment.