A38 Derby Junctions
TR010022
Volume 6
6.1 Environmental Statement
Chapter 13 – Road Drainage and the Water Environment

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

April 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A38 Derby Junctions Development Consent Order 202[ ]

6.1 Environmental Statement
Chapter 13 Road Drainage and the Water Environment

Regulation Number	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	6.1
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	April 2019	DCO Application

Table of Contents

Chapter **Page**

List of Tables

List of Figures [TR010022/APP/6.2]

List of Appendices [TR010022/APP/6.3]

Appendix 13.1: Assessment of Routine Road Runoff and Accidental Spillage Risk (HAWRAT)

Appendix 13.2: Flood Risk Assessments (FRAs for Kingsway junction (Appendix 13.2A), Markeaton junction (Appendix 13.2B) and Little Eaton junction (Appendix 13.2C))

Appendix 13.3: Water Framework Directive Assessments (for Kingsway junction (Appendix 13.3A) and Little Eaton junction (Appendix 13.3B))

Appendix 13.4: Road Drainage Strategy

13. Road Drainage and the Water Environment

13.1 Introduction and competent expert evidence

13.1.1 This chapter assesses the potential impacts on road drainage and the water environment associated with the construction and operation of the Scheme. The water environment includes surface and groundwater quality and flows, flood risk, drainage and hydromorphology. The assessment follows the methodology set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 HD45/09 (Highways Agency, 2009), which has been extended herein where necessary to include hydromorphology aspects not covered by HD45/09.

13.1.2 Potential impacts associated with the potential release of contaminants from contaminated land to the water environment are assessed in Chapter 10: Geology and Soils.

13.1.3 The chapter details the methodology followed for the assessment, summarises the regulatory and policy framework related to road drainage and the water environment and describes the existing environment in the area surrounding the Scheme. Following this, the design and mitigation measures proposed to manage and minimise potential impacts are specified, after which residual water environment effects of the Scheme are presented. Details of any assumptions and limitations made during the assessment are provided.

13.1.4 This road drainage and the water environment assessment is supported by Appendices 13.1 to 13.4 [**TR010022/APP/6.3**] which provide the following:

- Appendix 13.1: Assessment of Routine Road Runoff and Accidental Spillage Risk (HAWRAT).
- Appendix 13.2: Flood Risk Assessments (FRAs for Kingsway junction (Appendix 13.2A), Markeaton junction (Appendix 13.2B) and Little Eaton junction (Appendix 13.2C)).
- Appendix 13.3: Water Framework Directive (WFD) assessments (for Kingsway junction (Appendix 13.3A) and Little Eaton junction (Appendix 13.3B)).
- Appendix 13.4: Road Drainage Strategy.

13.1.5 All figures cited within this chapter are included within Environmental Statement (ES) Volume 2 [**TR010022/APP/6.2**].

13.1.6 This chapter of the ES has been prepared by competent experts with relevant and appropriate experience. The technical lead for the road drainage and the water environment assessment has 20 years of relevant experience and is an Affiliate member of the Institute of Environmental Management and Assessment (IEMA) as detailed in Appendix 1.1 [**TR010022/APP/6.3**].

13.2 Legislative and policy framework

13.2.1 As discussed in Chapter 1: Introduction, the primary basis for deciding whether or not to grant a Development Consent Order (DCO) is the National Policy Statement for National Networks (NPSNN) (Department for Transport (DfT), 2014). NPSNN Sections 4 and 5 set out policies to guide how DCO applications will be decided and how the impacts of national networks infrastructure should be considered. Table 13.1 identifies the NPSNN policies relevant to the road drainage and the water environment assessment and where in this chapter of the ES information is provided to address these policy requirements.

Table 13.1: Relevant NPSNN policies for the road drainage and water environment assessment

Relevant NPSNN para. Ref.	Requirement of the NPSNN	Location where information addresses policy requirements
Flood Risk paragraphs 5.90 – 5.115	- The Secretary of State should be satisfied that flood risk will not be increased elsewhere and should only consider development appropriate in areas at risk of flooding where it can be demonstrated that : the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; development is appropriately flood resilient and resistant, including safe access and escape routes where required; that any residual risk can be safely managed, including by emergency planning; and that priority is given to the use of sustainable drainage systems (SuDs). Applications for projects should be accompanied by a FRA to assess all risks of flooding and take climate change into account. In preparing an FRA an applicant should: - Consider the risk of all forms of flooding arising from the project (including in adjacent parts of the United Kingdom), in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime; - Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made; - Consider the vulnerability of those using the infrastructure including arrangements for safe access and exit; - Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken in to account and demonstrate that this is acceptable for the particular project;	Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**] provide FRAs for each junction. The findings of the FRAs have been used to assess the impacts of the Scheme on flooding (refer to Section 13.10). The FRAs identify mitigation which has been incorporated into the Scheme design to appropriately manage the flood risks associated with the Scheme.

Relevant NPSNN para. Ref.	Requirement of the NPSNN	Location where information addresses policy requirements
	- Consider if there is a need to remain operational during a worst case flood event over the development's lifetime; and - Provide the evidence for the Secretary of State to apply the Sequential Test and Exception Test as appropriate.	
Water quality and resources paragraphs 5.219 – 5.231	With regard to water quality, the Secretary of State should be satisfied that a proposal has had regard to the River Basin Management Plans and the requirements of the WFD (including Article 4.7) and its daughter directives, including those on priority substances and groundwater. Any environmental statement should describe: - The existing quality of waters affected by the proposed project; - Existing water resources affected by the proposed project and the impacts of the proposed project on water resources; - Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project, and any impact of physical modifications to these characteristics; - Any impacts of the proposed project on waterbodies or protected under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions; and - Any cumulative effects.	Existing water resources, water quality and physical characteristics of the water environment are provided in Section 13.7. Impacts of the Scheme on water resources and waterbodies are detailed in Section 13.10. Impacts associated with the WFD are considered in Appendices 13.3A and 13.3B [**TR010022/APP/6.3**] and Section 13.10. Impacts of the Scheme on SPZs around potable groundwater abstractions are detailed in Section 13.10. Scheme cumulative effects are assessed in Chapter 15: Assessment of Cumulative Effects.

13.2.2 Other relevant policies have been considered as part of the road drainage and the water environment assessment where these have informed the identification of receptors and resources and their sensitivity; the assessment methodology; the potential for significant environmental effects; and required mitigation. These policies are as detailed below.

- National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2019) – with particular reference to 'Meeting the challenge of climate change, flooding and coastal change', paragraphs 155 – 165; and 'Conserving and enhancing the natural environment', paragraph 170e.
- Future Water: the Government's water strategy for England (Defra, 2011) – which sets out the Government's long-term vision for water and the framework for water management in England. It includes the sustainable management of the water environment and water quality.
- Humber River Basin Management Plan: 2015 (Environment Agency, 2016) – River Basin Management Plans (RBMPs) describe how the aims of the WFD will be achieved within each region or river basin district. RBMPs are prepared by the Environment Agency for 6-year cycles and set out how organisations, stakeholders and communities will work together to improve the water environment. The Scheme area is covered by the Humber RBMP which will remain in place until 2021.

13.2.3 Key legislation relevant to this road drainage and the water environment assessment includes:

a) The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

b) The Water Act, 2014. Relevant paragraphs include: paragraph 59 – Main rivers in England and Wales; and paragraph 61 – Regulation of the water environment.

c) The Floods and Water Management Act, 2010.

d) The Land Drainage Act 1991(as amended).

e) The Water Resources Act 1991.

f) The Environmental Permitting (England and Wales) Regulations 2016.

g) The Environmental Damage (Prevention and Remediation) Regulations 2015.

h) The Control of Pollution (Oil Storage) (England) Regulations 2001.

13.2.4 Local planning policies of relevance to this road drainage and the water environment assessment which have been taken into account include:

- Derby City Local Plan – Part 1 Core Strategy (2017) (Derby City Council (DCiC)). This forms the statutory development plan for the city. Relevant DCiC commitments and policies which relate specifically to flood management and sustainable drainage systems (SuDS) include: Policy CP2 - Adapting to Climate Change: Flood Risk and Water Management, paragraphs (k) to (p) and Flood Risk and Sustainable Drainage, paragraphs 5.2.17 to 5.2.22; Policy AC7 – The River Derwent Corridor: paragraphs 6.7.4; and Policy AC8 – Our City Our River.

- Erewash Core Strategy (March 2014) (Erewash Borough Council (EBC), 2014), Policy 1 Climate Change – paragraphs 5 to 9 relate to Flood Risk and Sustainable Urban Drainage.

13.2.5 The policies and legislation identify the need for site-specific FRAs to inform the assessment of flood risk from all types of flooding to and from the Scheme at each of the three junctions. They require the FRAs to consider the vulnerability of users of the proposed infrastructure, to consider the impacts of climate change and to confirm whether flood risk is increased elsewhere. The policies also identify measures to mitigate flood risk through sustainable surface water management. FRAs for each junction are provided in Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**].

13.2.6 With regard to water quality and water resources, the policies and legislation require consideration of the impacts of pollution from development on the water environment, including impacts on surface water courses, water bodies such as lakes and ponds, groundwater, drinking water safeguard zones, groundwater Source Protection Zones (SPZs) and ecological sites. Appendices 13.3A and 13.3B [**TR010022/APP/6.3**] contain WFD compliance assessments, whilst impacts upon safeguard zones, water protection zones, SPZs around potable groundwater abstractions are considered in Section 13.10. Chapter 8: Biodiversity considers Scheme effects upon ecological sites, including those associated with the water environment.

13.3 Assessment methodology

13.3.1 The road drainage and the water environment assessment has been prepared taking into account guidance in the DMRB, Volume 11, Section 3, Part 10, HD45/09 Road Drainage and the Water Environment (Highways Agency, 2009).

13.3.2 DMRB provides guidance on the methodology for predicting the potential impacts of construction and operation of highways schemes on the water environment and seeks to identify if such impacts would result in a potentially significant effect (adverse or beneficial).

13.3.3 A HAWRAT[1] assessment (Highways Agency, 2011) has been carried out to assess the potential risks to receiving water bodies due to highway discharges from the Scheme at each of the three junctions. The assessment has used predicted traffic flows and the methodology set out in DMRB Volume 11, Section 3, Part 10 HD45/09 Road Drainage and the Water Environment – HAWRAT. Quantitative assessments of spillage risk at each of the three junctions have also been undertaken and are reported herein (refer to Section 13.10). The HAWRAT tool uses a 'source-pathway-

[1] Highways Agency is now Highways England. The tool was developed by the Highways Agency hence the acronym HAWRAT.

receptor' approach whereby for a pollutant to cause an impact there must be a pathway between the pollutant source and a sensitive receptor (in this case a watercourse, waterbody or groundwater). The HAWRAT results are presented in Appendix 13.1 [**TR010022/APP/6.3**].

13.3.4 Separate FRAs have been prepared for each junction (A38 Kingsway junction FRA (Highways England, 2019); A38 Markeaton junction FRA (Highways England, 2019); A38 Little Eaton junction FRA (Highways England, 2019)) in accordance with NPPF and DMRB guidance. The main aim of the FRAs is to demonstrate the concept that flood risks can be suitably managed associated with the Scheme design and to allow suitable mitigation measures to be defined where required. These FRAs are provided in Appendices 13.2A, 13.2B and 13.2C ([**TR010022/APP/6.3**]), whilst reference to the findings and conclusions of these FRAs are made as applicable within this chapter.

13.3.5 The assessment of flood risk both to the Scheme and as a result of the Scheme was undertaken using Methods E and F as defined in HD45/09 (Highways Agency, 2009). For Kingsway junction, hydraulic modelling was undertaken using DCiC's Derby Integrated Catchment Model (DCIM) model. This model was updated to include local data in order to establish the baseline flood risk to the existing junction with greater confidence and to establish the flood risk with the Scheme in place. For Little Eaton junction, hydraulic modelling was undertaken using the Environment Agency's Milford to Allestree and Lower Derwent models. No hydraulic modelling was required for Markeaton junction. Further details regarding the flood risk modelling methodologies applied are provided in the applicable FRA reports (refer to Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]).

13.3.6 WFD compliance assessments have been prepared for Kingsway junction and Little Eaton junction. Copies of the WFD compliance assessment reports are provided in Appendices 13.3A and 13.3B [**TR010022/APP/6.3**]. The WFD compliance assessments have considered potential risks to waterbodies at Kingsway junction (Bramble Brook) and Little Eaton junction (the River Derwent and Dam Brook) and have identified water environment mitigation measures for inclusion in the Scheme design (refer to Section 13.9). A WFD assessment was screened out for Markeaton junction as the Scheme would not require any physical changes to watercourses or water bodies which would pose a risk to WFD objectives. Of the three affected waterbodies at Kingsway junction and Little Eaton junction, only the River Derwent through Derby has specific WFD monitoring and status classifications within the Humber River Basin Management Plan (HRBMP). Bramble Brook and Dam Brook are not independent WFD waterbodies, but the WFD applies to all inland waters, so local effects on these WFD tributaries were also assessed.

13.3.7 Water environment mitigation measures, including road drainage attenuation and pollution control/reduction measures, measures to mitigate flood risks and WFD compliance, are included in the Scheme design (refer to Section 13.9) and are discussed within this chapter.

Evaluation of receptor importance/sensitivity

13.3.8 The road drainage and water environment assessment initially entails defining the importance/sensitivity of identified water environment receptors. The importance of potentially affected water environment features was established using a four point scale (low, medium, high, very high) developed on the basis of Table A4.3 within HD45/09 (Highways Agency, 2009) – this four point scale is presented in Table 13.2.

13.3.9 Existing flood risks at each of the junctions was characterised by reference to data published by the Environment Agency, from DCiC's Level 1 Strategic Flood Risk Assessment (SFRA) Review undertaken in April 2013 and DCiC's DCIM. Further details are provided in the FRA reports for each of the three junctions (refer to Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]).

Table 13.2: Criteria for estimating the importance of water environment attributes

Importance[1]	Criteria	Typical examples
Very high	Attribute has a high quality and rarity on regional and national scale	• **Surface water:** – EU designated salmonid/cyprinid fishery, WFD class 'High', site protected/designated under EU or UK habitat legislation (e.g. Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI), Water Protection Zone (WPZ), Ramsar site, salmonid water), species protected by EU legislation. • **Groundwater:** – Principal aquifer providing a regionally important resource or supporting a site protected under EU and UK habitat legislation, Source Protection Zone 1 (SPZ1). • **Flood risk:** – Floodplain or defence protecting more than 100 residential properties. • **Hydromorphology[2]:** – Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type.
High	Attribute has a high quality and rarity on local scale	• **Surface water:** – WFD class 'Good', major cyprinid fishery, species protected under EU or UK habitat legislation. • **Groundwater:** – Principal aquifer providing locally important resource or

Importance[1]	Criteria	Typical examples
		supporting a river ecosystem, SPZ2. • **Flood risk:** – Floodplain or defence protecting up to 100 residential properties or industrial premises. • **Hydromorphology:** – Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures.
Medium	Attribute has a medium quality and rarity on local scale	• **Surface water:** – WFD class 'Moderate'. • **Groundwater:** – Aquifer providing water for agricultural or industrial use with limited connection to surface water, SPZ3. • **Flood risk:** – Floodplain or defence protecting up to 10 industrial premises. • **Hydromorphology:** – Shows signs of previous alteration and/or minor flow regulation, but still retains some natural features, or may be recovering towards conditions indicative of the higher category.
Low	Attribute has a low quality and rarity on local scale	• **Surface water:** – WFD class 'poor'. • **Groundwater:** – Unproductive strata. • **Flood risk:** – Floodplain with limited constraints and a low probability of flooding of residential and industrial properties. • **Hydromorphology:** – Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (for example trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.

Importance[1]	Criteria	Typical examples
(1): Professional judgement is applied when assigning an importance category to all water features. The WFD status of a watercourse is not an overriding factor and in many instances it may be appropriate to upgrade a watercourse which is currently at poor or moderate status to a category of higher importance to reflect its overall value in terms of other attributes and WFD targets for the watercourse. Likewise, a watercourse may be below Good Ecological Status, this does not mean that a poorer quality discharge can be emitted. All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulations 2016 and the Water Resources Act 1991 (as amended), and future WFD targets also need to be considered.		
(2): Based on the criteria used for water body 'Reach Conservation Status' presently being adopted for HS2 and developed from Environment Agency conservation status guidance (Environment Agency 1998a, 1998b) as HD45/09 does not provide any criteria for morphology.		

Identification and assessment of potential impacts

13.3.10 The magnitude of identified impacts upon water environment attributes was determined on the basis of a seven point scale (taking into account guidance given in HD45/09 (Highways Agency, 2009)), as presented in Table 13.3. The determination of the magnitude of potential impacts used the HAWRAT methodology is described in HD45/09 (Highways Agency, 2009) (refer to Appendix 13.1 [**TR010022/APP/6.3**]).

Table 13.3: Criteria for defining the magnitude of impact on water environment features

Magnitude	Criteria	Typical examples
Major adverse	Results in a loss of attribute and/ or quality and integrity of the attribute	• Surface water: – Failure of **both** soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) and compliance failure with Environmental Quality Standards (EQS) values (Method B). – Calculated risk of pollution from a spillage >2% annually (Spillage Risk Assessment, Method D, Annex I). – Loss or extensive change to a fishery. – Loss or extensive change to a designated nature conservation site. • Groundwater: – Loss of, or extensive change to, an aquifer. – Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater Assessment, Method C, Annex I). – Calculated risk of pollution from spillages >2% annually (Spillage Risk Assessment, Method D, Annex I). – Loss of, or extensive change to, groundwater supported designated wetlands. • Flood risk: – Increase in peak flood level (1% annual probability) >100 mm (Hydrological Assessment of Design Floods and Hydraulic Assessment, Methods E and F, Annex I).

Magnitude	Criteria	Typical examples
Moderate adverse	Results in effect on integrity of attribute, or loss of part of attribute	• Surface water: – Failure of **both** soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I), but compliance with EQS values (Method B). – Calculated risk of pollution from spillages >1% annually and <2% annually. – Partial loss in productivity of a fishery. • Groundwater: – Partial loss or change to an aquifer. – Potential medium risk of pollution to groundwater from routine runoff – risk score 150 - 250. – Calculated risk of pollution from spillages >1% annually and <2% annually. – Partial loss of the integrity of groundwater supported designated wetlands. • Flood risk: – Increase in peak flood level (1% annual probability) >50mm.
Minor adverse	Results in some measurable change in attribute's quality or vulnerability	• Surface water: – Failure of **either** soluble **or** sediment-bound pollutants in HAWRAT. – Calculated risk of pollution from spillages >0.5% annually and <1% annually. • Groundwater: – Potential low risk of pollution to groundwater from routine runoff – risk score <150. – Calculated risk of pollution from spillages >0.5% annually and <1% annually. – Minor effects on groundwater supported wetlands. • Flood risk: – Increase in peak flood level (1% annual probability) >10mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	The Scheme is unlikely to affect the integrity of the water environment. • Surface water: – No risk identified by HAWRAT (pass both soluble and sediment-bound pollutants). – Risk of pollution from spillages <0.5%. • Groundwater: – No measurable impact upon an aquifer and risk of pollution from spillages <0.5%. • Flood risk: – Negligible change in peak flood level (1% annual

Magnitude	Criteria	Typical examples
		probability) <+/- 10mm.
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	• Surface water: – HAWRAT assessment of **either** soluble or sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition. – Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually). • Groundwater: – Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually). • Flood risk: – Reduction in peak flood level (1% annual probability) >10mm.
Moderate beneficial	Results in moderate improvement of attribute quality	• Surface water: – HAWRAT assessment of **both** soluble and sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition. – Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually) • Groundwater: – Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). • Flood risk: – Reduction in peak flood level (1% annual probability) >50mm.
Major beneficial	Results in major improvement of attribute quality	• Surface water: – Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse. • Groundwater: – Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. – Recharge of an aquifer. • Flood risk: – Reduction in peak flood level (1% annual probability) >100mm.

Identification of significant effects

13.3.11 The significance of an effect has been obtained by combining the importance of the attribute (Table 13.2) and the magnitude of the impact (Table 13.3) that it would experience in accordance with the matrix presented in Table 13.4.

Table 13.4: Criteria for defining the significance of effects on the water environment

Importance of attribute	**Very high**	Neutral	Moderate/Large	Large/Very Large	Very Large
	High	Neutral	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight/Moderate
		Negligible	**Minor**	**Moderate**	**Major**
		Magnitude of impact			

13.3.12 Potential water environment effects can be either beneficial or adverse. Effects predicted to be minor or negligible are considered to be manageable and are therefore not significant, whereas effects assessed as moderate or major are considered to be significant.

13.3.13 In accordance with Chapter 4: Environmental Impact Assessment Methodology, Section 4.3, when assessing the potential significance of water environment effects, impact avoidance measures embedded in the Scheme design have been taken into account, as have standard environmental management activities (refer to Section 13.9). Where potentially significant effects have been predicted, further mitigation and management actions have been defined and the significance of effects with the additional mitigation in place has also been assessed (as applicable).

Scoping

13.3.14 The proposed scope of the water environment assessment was detailed in the EIA Scoping Report (Highways England, 2018) submitted to The Inspectorate on 15 March 2018 (refer to Chapter 1: Introduction, para. 1.3.5).

13.3.15 An overview of the Inspectorate's Scoping Opinion (refer to Appendix 4.1 [**TR010022/APP/6.3**]) in relation to the water environment assessment is presented in Table 13.5. Where assessment has been undertaken in accordance with the Scoping Opinion point, a response and the relevant ES section (and/or supporting documents) is provided; where an alternative approach has been agreed with the relevant stakeholders, an explanation is provided.

Table 13.5: Scoping opinion and response

Scoping Opinion	Where addressed within the ES
Planning Inspectorate	
Study area: The ES should clearly describe the study area and the criteria used to establish it including the approach that will inform this determination.	Refer to Section 13.6 and Figures 13.1 to 13.5 [**TR010022/APP/6.2**].
Desk study data/baseline data sources: Any data relied on for the purposes of the assessment of significant effects should be made available as part of the ES.	Refer to Section 13.7, Appendices 13.2 to 13.3 and Appendix 10.2 [**TR010022/APP/6.3**].
Surface water safeguard zone at Little Eaton: The CEMP should include measures to ensure protection of the surface water safeguard zone. Measures should be agreed with the EA and Severn Trent Water, where possible. The ES should provide a description of any progress made in relation to obtaining permits and licences for works affected watercourses.	Refer to the Outline Environmental Management Plan (OEMP) (Appendix 2.1 [**TR010022/APP/6.3**]). The Environment Agency has been consulted in relation to the requirement for fish permits associated with works that would be undertaken in Dam Brook (refer to Chapter 8: Biodiversity). The Environment Agency indicated that permits to catch fish and permits to move fish should be applied for pre-construction. Details of other licenses related to the water environment are details in para. 13.9.2.
Sensitivity assessment: Receptor sensitivity is proposed to be based on criteria within DMRB HD45/09 Table A4.3. The ES should clearly state which criteria have been applied in the assignment of sensitivity to particular features.	Refer to Section 13.3, Table 13.2; Section 13.7 and Table 13.6.
NPPF: The flood risk assessment methodology should reference amendments to the NPPF arising from the 2018 consultation, where relevant.	Refer to Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**].
Method C assessment: A method C assessment is ruled out, since drainage discharges are intended to be to surface watercourses rather than groundwater. Should the drainage design change to include soakaways, the requirement for method C assessments should be reviewed and any likely significant effects should be assessed.	No discharges to groundwater are proposed by the Scheme.

Scoping Opinion	Where addressed within the ES
Environment Agency	
In its response to the consultation, the Environment Agency made the following comments: Flood risk: The scoping report covers what we would expect to see in the Flood Risk Assessment. Any loss in floodplain capacity will need to be considered and level for level compensation provided where possible. We would expect the relevant climate change allowances to be used and any recommendations from our modelling review to be completed. This development may require a permit under the Environmental Permitting (England and Wales) Regulations 2010 from the Environment Agency for any proposed works or structures, in, under, over or within eight metres of the top of the bank of any watercourse which is designated a 'main river'. This was formerly called a Flood Defence Consent. Some activities are also now excluded or exempt. Further details and guidance are available on the GOV.UK website: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.	Refer to Section 13.9 and Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]. Refer to Section 13.9 and the OEMP (Appendix 2.1 [**TR010022/APP/6.3**]).
Water quality: The information provided in this Chapter (Road Drainage and the Water Environment) adequately covers the risks to the water environment during the construction and operational phases of the new junctions. The proposed mitigation measures are appropriate.	Refer to Sections 13.9 and 13.10.
Derbyshire County Council (DCC)	
As the Lead Local Flood Authority (LLFA) covering that part of the Scheme which is at Little Eaton junction, consultation was undertaken with DCC's Flood Team. The LLFA had no comments to make on the Scoping Report but stated that it '*looked forward to the opportunity to comment further on the flood risk impacts of the Scheme upon production of the detailed design phase.'*	Refer to Sections 13.7, 13.9, 13.10 and the Little Eaton junction FRA (Appendix 13.2C [**TR010022/APP/6.3**]).
Breadsall Parish Council	
Stated that it would '*like the report to specifically consider……4. Flood risk*'	Refer to Sections 13.7, 13.9, 13.10 and the Little Eaton junction FRA (Appendix 13.2C [**TR010022/APP/6.3**]).
Public Health England	
'*Consideration should also be given to environmental receptors such as the surrounding land, watercourses, surface and groundwater, and drinking water supplies such as wells, boreholes and water abstraction points.'* '*Additional points specific to emissions to water:* *When considering a baseline (of existing water quality) and in the assessment and future monitoring of impacts these:* • *should include assessment of potential impacts on human health and not focus solely on ecological impacts* • *should identify and consider all routes by which emissions may lead to population exposure (e.g. surface watercourses;*	Refer to Sections 13.7 and 13.10. Refer to Sections 13.7 and 13.10. Refer also to Chapter 10: Geology and Soils.

Scoping Opinion	Where addressed within the ES
recreational waters; sewers; geological routes etc.) • *should assess the potential off-site effects of emissions to groundwater (e.g. on aquifers used for drinking water) and surface water (used for drinking water abstraction) in terms of the potential for population exposure* • *should include consideration of potential impacts on recreational users (e.g. from fishing, canoeing etc) alongside assessment of potential exposure via drinking water'.*	

13.4 Consultation

13.4.1 Throughout the development of the Scheme design, discussions have been held with DCiC, DCC and the Environment Agency with regards to flood risk and the drainage design, as applicable. DCiC, DCC and the Environment Agency have been consulted upon regarding the FRAs provided in Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]. DCiC was able to facilitate the provision of the DCIM hydraulic model used to define a flood risk mitigation strategy at Kingsway junction. Similarly, the Environment Agency provided the flood risk models used to assess the flooding issues associated with the Scheme at Little Eaton junction. Correspondence with the Environment Agency in June 2018 confirmed their contention with the proposed approach to flood risk mitigation and floodplain compensation proposals at Little Eaton junction (refer to Section 13.9), and that residual flood impacts would be acceptable. DCC was also consulted with regard to flood modelling of Dam Brook at Little Eaton junction. Details of consultation with regards to flood risk is provided within the relevant FRA reports (refer to Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]).

13.4.2 The Preliminary Environmental Information Report (PEIR) was published in September 2018 (Highways England, 2018) and presented the environmental information collected together with the preliminary findings of the assessment of likely significant environmental effects of the Scheme at the time. Consultee comments to the PEIR are recorded in Table 13.6.

Table 13.6: Consultee comments on the PEIR

Consultation comment	Outcome
Derby City Council (DCiC)	
DCiC provided a number of comments on land drainage in its consultation response (dated 16 October 2018) following statutory consultation. These included the following: • At Markeaton junction there is too little provision for SuDS which should be open water features and that there is insufficient area to provide the level of attenuation required to deliver discharge rate reduction. • The Scheme will need to demonstrate that it passes both the sequential and exception tests and, in accordance with paragraph 160 of the NPPF should not increase flood risk elsewhere and, where possible, should reduce flood risk overall. • The A38 discharges significant levels of silt and other pollutants into both the Bramble and Littleover Brooks. The Scheme should demonstrate a significant reduction in these discharges through the use of SuDS. • Part of the Little Eaton junction is sited within the City boundary and that any impacts on Our City Our River (OCOR) will need to be understood and any impacts on the World Heritage Site considered.	Highway drainage details are provided in the Drainage Strategy Report (Appendix 13.4 [**TR010022/APP/6.3**]), noting that the design includes surface attenuation ponds and swale ditches. Refer to the FRAs provided in Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]. Highway drainage details are provided in the Road Drainage Strategy (Appendix 13.4 [**TR010022/APP/6.3**]). Flood risk modelling indicates that the Scheme would not impact upon flooding downstream of the A38 at Little Eaton junction and would thus not impact upon the OCOR proposals. Scheme impacts upon the World Heritage Site are detailed in Chapter 6: Cultural Heritage.
Derbyshire County Council (DCC)	
DCC's statutory consultation response (17 October 2018) was the same as that received as part of the Scoping Opinion.	Refer to responses provided in Table 13.5.
Environment Agency	
The Environment Agency commented on the statement in the PEIR: "*Appropriate road treatments would be in place to minimise impacts from salt spray e.g. calcium magnesium acetate which is a low corrosion, and more environmentally sensitive alternative to road salt.*"(PEI report, 8.7.5, page 95). In its response (dated 5 October 2018), the Environment Agency stated: '*Whilst calcium magnesium acetate avoids the issues road salt can cause, due to the material's high Biochemical Oxygen Demand (BOD) it can cause bacterial growths ("sewage fungus") and oxygen depletion if it enters surface waters. The impact of the potential use of this de-icing material therefore requires further assessment*.' The Environment Agency also commented that the Environment Agency must have an opportunity to review and provide comments on the Detailed Quantitative Risk	Discussions with East Midlands Asset Delivery team (Highways England) indicates that the de-icing agents used on the network are sodium chloride (NaCl) and sodium chloride brine. There are no proposals to replace these de-icing agents with calcium magnesium acetate. The use of de-icing agents is standard highway maintenance practice and would be undertaken in accordance with the Severe Weather Plan for the existing A38 Derby junctions (Highways England, 2018)

Consultation comment	Outcome
Assessments of risk to controlled water from contaminants.	Refer to Chapter 10: Geology and Soils for the assessment related to ground contamination, plus associated risk assessments. Refer to Section 13.10 and Appendix 13.1 [**TR010022/APP/6.3**] for the assessment of risks to surface water bodies from road drainage.

13.4.3 It should be noted that the assessment presented in this chapter (and the supporting documentation) takes into account any requirements that have been agreed with the relevant stakeholders during the development of the Scheme design, for example the inclusion of allowances for future climate change within the highways drainage design and the FRAs.

13.5 Assessment assumptions and limitations

13.5.1 This road drainage and the water environment assessment has been undertaken using available baseline data, the Scheme design (as described in Chapter 2: The Scheme) and associated land take requirements.

13.5.2 Information regarding construction activities and methodologies has been obtained by taking advice from the Highway England's appointed buildability advisors for the Scheme.

13.5.3 Determination of Q95 low flows for Bramble Brook and Dam Brook (i.e. the flow predicted to be exceeded 95% of the time) as used in the HAWRAT assessment has been calculated by a desk-based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software (refer to Appendix 13.1 [**TR010022/APP/6.3**]). For the River Derwent, a Q95 low flow for the River Derwent at St Mary's Bridge was obtained from the National River Flows Archive (refer to Appendix 13.1 [**TR010022/APP/6.3**]).

13.5.4 The channel dimension and gradients used in the HAWRAT assessments are based on estimations made during site visits. The outcomes of the assessment are such that detailed field measurements are not necessary.

13.5.5 At Markeaton junction, the receiving water environment, Mill Pond, is one of low flow. The accepted methods for calculation of Q95 flows, which are required for the HAWRAT calculations use the catchment characteristics upstream of the discharge location. However, upstream of the discharge location for Markeaton junction is Markeaton Lake and the watercourse system within Markeaton Park, which is artificially managed through a variety of variable sluices and weirs. This means that these calculation methods are not wholly applicable. A Q95 of 0.001m^3/s has therefore been used to undertake the HAWRAT calculation, which reflects the low flow of

the receiving water environment (i.e. Mill Pond) and is considered to be a reasonable worst case.

13.5.6 The expected treatment performance of different SuDS options are based on advice reported in DMRB (Highways Agency, 2016).

13.5.7 The routine runoff and spillage risk water quality risk assessment is based on traffic modelling data generated for the Scheme. Assumptions regarding the traffic modelling are detailed in the Transport Assessment Report [**TR010022/APP/7.3**].

13.6 Study area

13.6.1 The study area for the assessment of impacts on road drainage and the water environment is shown in Figures 13.1 to 13.5 [**TR010022/APP/6.2**].

13.6.2 The general topography, land use, soils and climate are described in Chapter 7: Landscape and Visual Impact Assessment; Chapter 10: Geology and Soils and Chapter 14: Climate.

13.6.3 The process of scoping identified that a 1km study area around the Scheme boundary would be appropriate to identify any potential effects on the water environment. Within this study area the known surface water features and their attributes have been identified, the extent of known flood risk has been determined and the current groundwater conditions described. Factors such as historical contamination that may influence the hydrology of the study area have also been considered (refer to Chapter 10: Geology and Soils).

13.6.4 Water features located outside the study area but immediately within its surrounds have been included where it appears that there is hydraulic connectivity to features within the study area and there is a possibility that they could be significantly affected by the Scheme. These include surface and groundwater abstractions.

13.6.5 The study area for the flood risk assessments, reported in the FRA reports provided in Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**] comprises Environment Agency Flood Zones along the watercourses that may be affected by the Scheme. The Environment Agency designates flood risk zones on the basis of the annual probability of a flood event to occur as follows:

- Flood Zone 1 is less than 0.1% annual probability of flood risk (i.e. a very low risk of flooding).
- Flood Zone 2 is between 0.1 to 1 % annual probability of flood risk (i.e. a low risk of flooding.
- Flood Zone 3 is more than a 1% annual probability of flood risk (i.e. a medium risk of flooding).

13.7 Baseline conditions

13.7.1 The following tasks have been undertaken to establish baseline conditions that exist within the adopted water environment study area (refer to Section 13.6):

- A review of relevant legislation, planning policy and guidance concerning the surface water, groundwater and hydromorphology of water bodies.
- A desk-based review of water resource records obtained from third party sources including: the Environment Agency, DCiC, Severn Trent Water (STW) and Ordnance Survey mapping.
- A review of published studies undertaken to inform Scheme optioneering.
- Site visits undertaken in 2015, 2016, 2017 and 2018 to allow water receptors in the area to be identified and assessed in terms of their character and morphology and their connectivity to the Scheme.
- Groundwater level monitoring at Markeaton junction (between December 2017 and April 2018) (refer to Appendix 10.2 [**TR010022/APP/6.3**]).
- Groundwater level monitoring undertaken at Kingsway junction between November 2016 and October 2017 (refer to Appendix 10.2 [**TR010022/APP/6.3**]).
- Topographic survey, including 13 channel cross-section surveys within the River Derwent (2017) (refer to FRA report in Appendix 13.2C [**TR010022/APP/6.3**]).

13.7.2 Data sources are referenced where appropriate in the following sections of this chapter. Applicable data sources are also referenced in the supporting appendices – namely the FRA reports (Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]), the WFD compliance assessments (Appendices 13.3A and 13.3B [**TR010022/APP/6.3**]), groundwater monitoring report (Appendix 10.2 [T**R010022/APP/6.3**]), and the Road Drainage Strategy (Appendix 13.4 [**TR010022/APP/6.3**]).

13.7.3 The study area lies within the Derwent Derbyshire Management Catchment within the Humber River Basin District (refer to Figure 13.4 [**TR010022/APP/6.2**]).

13.7.4 Surface and groundwater resources in the study area are shown in Figures 13.1 to 13.5 [**TR010022/APP/6.2**]. The following sections describe the key existing water environment features at Kingsway and Markeaton junctions and at Little Eaton junction, respectively.

Kingsway and Markeaton junctions

Surface water bodies

13.7.5 The following key surface water bodies have been identified within the study area for Kingsway and Markeaton junctions (refer to Figures 13.1, 13.2 and 13.4 [**TR010022/APP/6.2**]):

- Bramble Brook: an ordinary watercourse, flowing through Kingsway junction.
- Mackworth Brook: an ordinary watercourse north-west of Markeaton junction.
- Markeaton Lake: within Markeaton Park, north-west of Markeaton junction.
- An ordinary watercourse flowing from Markeaton Lake under the A38 via Markeaton Lake Culvert and into Mill Pond.
- Middle Brook: an ordinary watercourse flowing from Markeaton Lake and under the A38 via Middle Brook Culvert.
- Mill Pond: east of the A38, north of Markeaton junction.
- Markeaton Brook: an ordinary watercourse, flowing under the A38 north of the A38/Kedleston Road junction.

13.7.6 Bramble Brook and its associated tributaries are the only water features within the vicinity of Kingsway junction (see Figure 13.1 [**TR010022/APP/6.2**]).

13.7.7 There are three overland surface water flow paths through the public open space (Mackworth Park) to the west of Kingsway junction, including a flow path within the disused railway cutting to the immediate west of the junction (part of Mickleover Railway Cutting Local Wildlife Site (LWS) – refer to Chapter 8: Biodiversity). The most southerly of these flow paths joins Bramble Brook prior to its upstream culvert beneath the A38. The flow path through the centre of the park has an existing culvert beneath the western carriageway of the A38. The flow path within the disused railway has an existing embankment and restricted culvert that is shown to attenuate overland flow upstream of the junction. There is an existing 0.8m diameter culvert from the railway cutting through to the centre of Kingsway junction.

13.7.8 Bramble Brook flows eastwards at the bottom of a deep depression within the centre of the existing Kingsway junction roundabout. The brook initially flows in open channel from the south-west and then passes beneath the A38 within a culvert that extends approximately 500m east. Downstream of the junction, the brook again passes into culvert, with around 50% of the flow diverted into a 1,200mm diameter STW sewer. The remainder flows through the city and is almost entirely culverted, receiving a series of surface water inflows.

13.7.9 Bramble Brook is an ordinary watercourse and has no WFD waterbody identification (ID). It is not a WFD water body in its own right but is a tributary of Markeaton brook, which is designated under the WFD. The Environment Agency holds no water quality data for this brook. Markeaton Brook is heavily modified and designated as water body GB104028052 of the HRBMP (Environment Agency, 2015). It is currently at moderate ecological potential and good chemical status, with a target of good ecological potential by 2027. It flows from a north-west to south-east direction and passes under the A38 approximately 55m north of the proposed junction improvement works near Kedleston Road junction. It then continues eastwards, where it eventually discharges into Mill Fleam located outside the study area.

13.7.10 The section of Markeaton Brook that passes beneath the A38 just north of the A38/Kedleston Road junction (refer to Figure 13.2 [**TR010022/APP/6.2**]), is identified within the RBMP as 'Markeaton Brook from Mackworth Brook to Derwent' (ID GB104028052830). It was classified as having moderate ecological and good chemical status in 2016, with an objective of achieving good overall and ecological potential status by 2027. The limiting factors on the status of this waterbody are moderate scores for macrophytes and phytobenthos combines, and fish. Other watercourses which form part of the Markeaton Brook system include the two culverted watercourses which flow out of Markeaton Lake and pass under the A38 via the Markeaton Lake culvert and Middle Brook culvert (refer to Figure 13.2 [**TR010022/APP/6.2**]). The latter watercourse is referred to as Middle Brook within this ES chapter. Neither of these two watercourses is classified within the RBMP. Markeaton Lake is within the Scheme boundary, however, it is upstream of the A38 and upstream of any associated road drainage.

13.7.11 Mill Pond discharges into a second pond – the Mill Dam, with a further channel also taking flows back into Markeaton Brook, south-east of Kedleston Road. The watercourse which flows under the A38 at Middle Brook culvert also flows back into Markeaton Brook at this location (refer to Figure 13.2 [**TR010022/APP/6.2**]).

13.7.12 The Earl of Harrington's Angling Club has fishing rights on Markeaton Lake and on Mill Dam.

13.7.13 Within the RBMP, Mackworth Brook is identified as a tributary of Markeaton Brook with water body ID GB104028052840. It is located upstream and north-west of the proposed junction works and flows directly into Markeaton Lake within Markeaton Park. In the RBMP (Environment Agency, 2015), Mackworth Brook is classified as having good chemical and moderate ecological status in 2016, with an objective of achieving good ecological status by 2027. Mackworth Brook is not considered further in this assessment due to its location approximately 540m upstream from the Scheme.

13.7.14 The Environment Agency holds no records of surface water abstractions within the study area at Kingsway and Markeaton junctions.

Groundwater

13.7.15 At Kingsway and Markeaton junctions, the bedrock underlying the Scheme comprises strata of the Mercia Mudstone Group and the Tarporley Siltstone Formation (Siltstone, Mudstone and Sandstone) (refer to Chapter 10: Geology and Soils).

13.7.16 At Kingsway junction, the bedrock is overlain by topsoil and Made-Ground, with a strip of Alluvium running through the junction, associated with Bramble Brook. The Made Ground comprises existing embankment fill to depths of up to approximately 2.3m, whilst the alluvium is described as clay and silt material to depths of approximately 2.6m. Some of this material may be weathered Mercia Mudstone Group material. The Mercia Mudstone Group material is likely to comprise a weathered profile, typically becoming less weathered with depth. The near surface material is described as stiff and very stiff, friable clay with mudstone fragments. The less weathered material, typically at greater depths, is described as a weak mudstone and includes bands of grey siltstone and sandstone.

13.7.17 At Markeaton junction, the bedrock is overlain by Made-Ground, whilst north-east of the junction the bedrock is overlain by River Terrace Deposits and Alluvium. The Made Ground comprises embankment fill and previous road construction material up to a depth of approximately 3.2m. It is likely that the Mercia Mudstone Group material comprises a weathered profile, typically becoming less weathered with depth. The material is typically described as red and grey stiff to hard, sometimes soft. The less weathered material, typically found at greater depths is described as a very weak mudstone and includes laminations and bands of grey siltstone and sandstone. To the north-east of the junction, the Alluvium is indicated to be up to 4.1m thick and is typically very soft to firm silty clay or sandy silty clay. The River Terrace Deposits are typically fine to coarse, sand and/or gravel with a thickness of up to 4.1m.

13.7.18 According to the Environment Agency's groundwater mapping (Defra, 2018), the bedrock aquifer designation at Kingsway and Markeaton junctions is Secondary B. Secondary B aquifers predominantly comprise lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. Superficial deposits associated with Bramble Brook at Kingsway junction and to the north of Markeaton junction are all designated as Secondary A aquifer. Secondary A aquifers comprise permeable layers capable of supporting water supplies at a local rather than a strategic scale and in some cases forming an important source of baseflow to rivers. Groundwater vulnerability at Kingsway and Markeaton junctions is shown on Figure 13.5 [**TR010022/APP/6.2**].

13.7.19 Groundwater monitoring undertaken at Kingsway junction between November 2016 and October 2017 recorded groundwater at 3.9 to 7.4m below ground level (bgl) within Made Ground and at 2.6 to 13.3m bgl within the Mercia Mudstone (refer to Appendix 10.2 [**TR010022/APP/6.3**]).

13.7.20 Groundwater monitoring undertaken at Markeaton junction from November 2016 to October 2017 and from December 2017 to April 2018 (refer to Appendix 10.1 and Appendix 10.2 [**TR010022/APP/6.3**]) recorded average groundwater levels in the vicinity of the junction as being approximately 1.0m to 10.0m depth below original ground level.

13.7.21 There are no groundwater abstractions within the study area at Kingsway and Markeaton junctions, whilst neither junction is located within a groundwater SPZ or a Nitrate Vulnerable Zone.

Flood risk

13.7.22 The flood risk baseline is based on publically available information including Environment Agency Interactive Maps (online), the DCiC SFRA and consultation with the Environment Agency and with DCiC, as discussed within the FRA reports (Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**]).

13.7.23 At Kingsway junction, the Environment Agency flood risk mapping indicates that the junction is within Flood Zone 1 and therefore at low risk of flooding from Main River or tidal sources. However, as Bramble Brook is an ordinary watercourse, the brook comes under local authority jurisdiction and is not mapped accurately for river flooding by the Environment Agency. DCiC, as the LLFA has responsibility for managing the flood risk from the brook. DCiC local knowledge and modelling indicates that there are flood risk and storage issues at Kingsway junction. The DCiC Level 1 SFRA Review undertaken in April 2013 identified that Bramble Brook through Kingsway junction is actually located within Flood Zone 3 and, as such, the risk of fluvial flooding from Bramble Brook is considered to be high. Environment Agency flood risk maps also suggest that there is a high risk of surface water flooding in places adjacent to the junction (refer to Appendix 13.2A [**TR010022/APP/6.3**]).

13.7.24 At Markeaton junction, the Environment Agency flood risk mapping indicates that Markeaton junction roundabout is located within Flood Zone 1, classified as having a ‘low’ risk of flooding from Main River fluvial or tidal sources, with an associated annual probability of less than the 1 in 1,000 year return period. The roundabout is also at low risk of surface water flooding. However, to the north of the Markeaton footbridge, most of the Scheme is within Flood Zone 2 or 3, with areas in Flood Zone 3 primarily being associated with Markeaton Lake, Mill Pond and an area of land at Derby University, between Markeaton Brook and Mill Pond (refer to Appendix 13.2B [**TR010022/APP/6.3**]).

Hydromorphology

13.7.25 The 2015 Humber RBMP classifies Markeaton Brook as a Heavily Modified Water Body (HMWB). There are no other hydromorphology elements specified within the 2015 Humber RBMP which are relevant to watercourses at Kingsway and Markeaton junctions. Given the potential for the Scheme to impact upon the hydromorphology of Bramble Brook at Kingsway junction, a River Habitat Survey of Bramble Brook was undertaken to inform the WFD compliance assessment. Where it passes through Kingsway junction, Bramble Brook is a heavily modified channel including sections of culvert and bank reinforcement. Further details are provided in Section 6.2 of the WFD compliance assessment report for Kingsway junction (refer to Appendix 13.3A [**TR010022/APP/6.3**]).

Pollution incidents

13.7.26 No major (Category 1) or significant (Category 2) pollution incidents were recorded on the National Incident Reporting System (NIRS) within the study area between 2015 and 2019, within the study area.

Water-dependent ecological sites

13.7.27 There are a number of statutory and non-statutory designated sites of ecological importance within the vicinity of the Scheme at Kingsway and Markeaton junctions, some of which are designated on the basis of water-dependent habitats or have a hydraulic connection to the Scheme site. These are:

- A38 Roundabout LWS located within the Scheme boundary at Kingsway junction. This is an area of semi-improved grassland in the centre of the roundabout through which Bramble Brook flows.
- Mickleover Railway Cutting LWS located adjacent to the Scheme boundary at Kingsway junction and is designated for its habitat mosaic. The LWS has hydrological links to the Scheme.
- Bramble Brook and Margins LWS is located adjacent to and within the Scheme boundary at Kingsway junction and is designated for its secondary broad-leaved woodland.
- Markeaton Brook System LWS is located within the Scheme boundary at Markeaton junction. The LWS is designated for its invertebrate assemblage.

13.7.28 Further details on these sites are provided in Chapter 8: Biodiversity, which also discusses the protected species associated with these sites and the water bodies referred to within this chapter.

Little Eaton junction

Surface water

13.7.29 The following key surface water bodies have been identified within the study area at Little Eaton junction (refer to Figures 13.3 and 13.4 [**TR010022/APP/6.2**]):

- River Derwent: a Main River, flowing in a generally north-south direction, west, north and south of the A38 at Little Eaton junction.
- Dam Brook: an Ordinary watercourse and tributary of the River Derwent, flowing under the A61 south of Little Eaton junction.
- Boosemoor Brook: an Ordinary watercourse with a confluence with Dam Brook north-east of Little Eaton junction.
- An unnamed tributary of Dam Brook which flows in a south-westerly direction from the vicinity of Breadsall Manor. This enters a culvert under the existing A38 and then runs in an open channel to the north of Little Eaton junction. It then enters another culvert back under the A38 and discharges into Dam Brook.
- The former Derby Canal, which is located along the western edge of the B6179 Alfreton Road, between Little Eaton junction and Little Eaton.
- A pond immediately north of the existing A38 roundabout and ponds to the south of the former sewage works west of the B6179 Alfreton Road.

13.7.30 In addition to the water bodies listed above, there is an area to the south of the A38 and west of the A61 which has standing water for a large part of the year (also refer to Chapter 8: Biodiversity).

13.7.31 The reach of the River Derwent in the vicinity of Little Eaton junction is part of the WFD water body with ID GB104028053240 - 'River Derwent from Bottle Brook to River Trent'. It is heavily modified, and is classified as being of good chemical and moderate ecological potential in 2016. The WFD objectives for this waterbody are the same as the current classification i.e. no improvement is expected, but nor should there be any deterioration. Dam Brook and Boosemoor Brook do not have their own WFD waterbody IDs, so in WFD terms are considered to be part of the River Derwent. Dam Brook has been known in the past to support a small population of white-clawed crayfish, although these are now considered to be absent (refer to Chapter 8: Biodiversity).

13.7.32 Dam Brook is a small tributary of the River Derwent and flows in a westerly direction entering the study area to the east of Breadsall, before passing through Breadsall and then flowing south to pass beneath Alfreton Road (A61) approximately 250m south of Little Eaton junction. Boosemoor Brook flows in a south-westerly direction and joins Dam Brook approximately 100m east of the junction. Boosemoor Brook is upstream of the Scheme boundary and flows into Dam Brook at the Scheme boundary. As such, it is just outside the area of the proposed junction improvement works and is not anticipated to be directly affected by the Scheme. Boosemoor Brook is, therefore, not considered further in this assessment, although the brook has been considered as part of the hydraulic modelling of Dam Brook.

13.7.33 At Little Eaton junction, records indicate that there is one surface water abstraction located along the River Derwent in the vicinity of the Scheme. This relates to the spray irrigation system used by Talbot Turf Supplies. In addition, approximately 600m north of the junction there are two licences held by Severn Trent Water (STW) for potable water abstractions from the River Derwent (refer to Figure 13.3 [**TR010022/APP/6.2**]) – as these surface water abstractions are located approximately 500m north of the A38 River Derwent bridge, they would not be impacted by the Scheme and thus are not considered further herein.

13.7.34 Little Eaton junction is within a surface water safeguard zone i.e. an 'area in which the use of certain substances must be carefully managed to prevent the pollution of raw water sources that are used to provide drinking water'. In this instance the substances of concern are pesticides, the use of which must be managed to facilitate the safe abstraction of drinking water by STW. An action plan for responsible use of pesticides within the safeguard zone is available via the Environment Agency webpages (Environment Agency, 2018; Voluntary Initiative, 2018) and is referenced within the Outline Environmental Management Plan (OEMP) (refer to Appendix 2.1 [**TR010022/APP/6.3**]).

Groundwater

13.7.35 At Little Eaton junction, the bedrock comprises the Millstone Grit Group (Mudstone, Siltstone and Sandstone) overlain by Sand and Gravel, Alluvium and Made-Ground (refer to Chapter 10: Geology and Soils).

13.7.36 The Made Ground primarily comprises embankment fill of the current road construction, whilst the Alluvium comprises firm silt and clay components to a thickness of up to 2.6m. This is then underlain by a predominantly sand and gravel component. The Millstone Grit Group materials encountered predominantly comprise fissured or laminated hard mudstone overlain further north by weak siltstone. To the north of the junction typically weak sandstone has also been recorded.

13.7.37 According to the Environment Agency's groundwater mapping, the bedrock aquifer designation at Little Eaton junction is Secondary A (refer to Figure 13.6 [**TR010022/APP/6.2**]). Superficial deposits at Little Eaton junction are all designated as Secondary A aquifer. These are permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers.

13.7.38 Groundwater used for drinking water is protected by the Environment Agency which classifies zones around potable groundwater abstraction points as groundwater SPZs. These are designed to limit potential pollution activities and have implications for how surface water is managed e.g. by infiltration. Environment Agency groundwater SPZs are defined as follows:

- Inner Zone (Zone 1): Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50m.
- Outer Zone (Zone 2): Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250m or 500m around the source, depending on the size of the abstraction.
- Total Catchment (Zone 3): Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

13.7.39 According to the Environment Agency, the majority of the Scheme boundary at Little Eaton junction lies within a Zone 3 SPZ (Total Catchment). However, the Envirocheck report (Ref: 60386902, dated September 2014 – refer to Appendix 10.3 [**TR010022/APP/6.3**]) indicates that part of the junction encroaches into SPZ1 (Inner Zone) and SPZ2 (Outer Zone), associated with the River Derwent (refer to Figure 13.6 [**TR010022/APP/6.2**]).

13.7.40 The STW surface water abstractions referred to in para. 13.7.33 and shown in Figure 13.3 [**TR010022/APP/6.2**], are protected by the inner zone of the groundwater SPZ which extends parallel to the River Derwent from approximately 1.5km upstream to nearly 1km downstream on the river A38 crossing. This SPZ corresponds to the location of historic STW filter tunnels located each side of the river which are no longer used for potable water abstraction (STW, pers. comm. 2016, 2018). These filter tunnels are understood to be constructed of brickwork, laid over gravel beds within groundwater, are approximately 1.2m in diameter, and buried approximately 3m bgl. They were installed in the 1850s and extended in 1890 and 1903 and were used for drinking water supply. These tunnels traverse either side of the River Derwent and connect to a number of air vents either side of the A38. Given that these filter tunnels have not been used for decades, they have no STW maintenance schedule.

13.7.41 There are no current groundwater abstractions within the study area.

13.7.42 Groundwater monitoring undertaken between November 2016 and October 2017 in the vicinity of Little Eaton junction recorded groundwater at 0.42 to 3.7m bgl (refer to Appendix 10.1 [**TR010022/APP/6.3**]), principally within the Alluvium.

13.7.43 Little Eaton junction is within a groundwater nitrate vulnerable zone.

13.7.44 The WFD status objective is for the groundwater waterbody to be 'good' by 2027.

Flood risk

13.7.45 Little Eaton junction is located within Flood Zone 2 and Flood Zone 3 (Environment Agency, 2018). Land to the west of the junction is shown on Environment Agency flood risk mapping to be at high risk of river flooding, while land to the east is at low risk. Land to the south of the junction is generally mapped as being at high risk of flooding from surface water, while land to the east is at low to high risk of surface water flooding (refer to the FRA report in Appendix 13.2C [**TR010022/APP/6.3**]).

Hydromorphology

13.7.46 The 2015 Humber RBMP does not specify any hydromorphology elements for the watercourses within the study area at Little Eaton junction, other than describing the River Derwent system in the vicinity of the junction as an HMWB. To inform the WFD compliance assessment, a desk-based study and River Habitat Survey of Dam Brook and the unnamed tributary of Dam Brook were undertaken. The River Derwent at Little Eaton junction is a single-thread meandering channel with limited surface water diversity and bed forms, set in a well-connected floodplain. It has a contemporary fixed geometry in contrast to an actively meandering natural typology and aerial imagery suggests minimal bed forms (pools, bars, riffles) as would be expected for a heavily modified channel. Dam Brook, a tributary of the River Derwent, is a heavily constrained single thread channel, the present day channel downstream of the Little Eaton junction having been realigned against the existing A38 embankment within a straight planform, resulting in loss of sinuosity and in-channel features. Further details regarding the hydromorphology of these watercourses is provided in Section 6.2 of the WFD compliance assessment report for Little Eaton junction (refer to Appendix 13.3B [**TR010022/APP/6.3**]).

Pollution incidents

13.7.47 There is one major (Category 1) and two significant (Category 2) pollution incidents within the study area recorded on the NIRS between 2015 and 2019, one of which related to oils and fuels.

Water-dependent ecological sites

13.7.48 As detailed in Chapter 8: Biodiversity, there are a number of statutory and non-statutory designated sites of ecological importance within the vicinity of the Scheme at Little Eaton junction, some of which are designated on the basis of water or wetland based habitats or have direct hydraulic connections to the Scheme site. These include:

- Alfreton Road Grassland LWS located to the south of the A38 at Little Eaton junction. The site is designated for its floodplain grassland which is semi-improved.
- The River Derwent LWS located adjacent to the western boundary of Little Eaton junction. The site is designated for its flowing water, river and associated streams.
- Watermeadows Ditch LWS located within approximately 400m and to the south of Little Eaton junction. The site is designated for its standing open water and has hydrological links to the Scheme site through connecting watercourses.
- Nooney's Pond LWS located approximately 750m south of Little Eaton junction. The site is designated for its standing open water and has hydrological links to the Scheme site through connecting watercourses.

13.7.49 The sites identified above are those which are designated on the basis of their water dependent habitats and/or they are downstream of the Scheme and in direct hydraulic connectivity with the Scheme – these are therefore considered to be most likely to be affected by construction and operation of the Scheme. Other ecological sites which would be in close proximity to the Scheme construction works, but which are not designated for water or wetland based habitats, may also be at risk of pollution during the Scheme construction phase, for example due to accidental spillages. Further details of these and other statutory and non-statutory designated ecological sites in the vicinity of the Scheme are provided in Chapter 8: Biodiversity.

Importance/sensitivity of identified water resources

13.7.50 The importance of identified water environment features as described above are detailed in Table 13.7. Importance has been assigned using professional judgement on the basis of the criteria provided within Table 13.2 taking into account factors discussed above. The importance of ecological sites and surface water ponds are detailed in Chapter 8: Biodiversity, and thus they have been excluded from Table 13.6.

Table 13.7: Importance of water environment attributes

Junctions	Receptors	Importance/ sensitivity of receptors
Kingsway junction	**Surface Water**	
	• Bramble Brook and its tributaries	Medium
	Groundwater	Medium
	Flood risk	
	• Bramble Brook	High
	Hydromorphology	
	• Bramble Brook and its tributaries	Low
Markeaton junction	**Surface Water**	
	• Markeaton Brook and its tributaries	High
	• Markeaton Lake	High
	• Mill Pond	High
	Groundwater	Medium
	Flood risk	
	• Markeaton Brook floodplain	High to low
	Hydromorphology	
	• Markeaton Brook and its tributaries	Medium
	• Markeaton Lake	Low
	• Mill Pond	Low
Little Eaton junction	**Surface Water**	
	• River Derwent	High
	• Dam Brook and its tributaries	High
	• Surface water abstractions	High
	• Ponds	Medium
	Groundwater	Low
	Flood risk	
	• River Derwent floodplain	High
	• Dam Brook floodplain	Low
	Hydromorphology	
	• River Derwent	Medium
	• Dam Brook and its tributaries	Low

Future baseline

13.7.51 As detailed within Chapter 4: Environmental Impact Assessment Methodology, to identify the effects of the Scheme on water environment features, it is important to understand the baseline (at year of construction) and future baseline (at year of opening/operation), as these may be different from those that currently exist. Such changes could alter the sensitivity of existing water environment features, as well as introduce new sensitive water environment features.

Construction year baseline (2020)

13.7.52 The baseline details as reported in the sections above describes the water environment features as they were in the years that surveys/desk top baseline studies were undertaken (2015 to 2018).

13.7.53 Preliminary works associated with the Scheme are anticipated to start in late 2020, subject to securing a DCO (refer to Chapter 2: The Scheme, Section 2.6), with the main works starting in early 2021.

13.7.54 The majority of the land that would be impacted by the Scheme (and in its vicinity) at Kingsway junction and Markeaton junction comprise the existing A38 highway and other highway infrastructure, as well as surrounding residential areas and areas of public open space. At Little Eaton junction, the majority of the land that would be impacted by the Scheme (and in its vicinity) comprises agricultural land as well as the existing A38 highway and other highway infrastructure, plus residential and commercial areas. As such, environmental baseline conditions are not anticipated to change significantly by 2020 from the conditions as detailed above. However, as detailed in Chapter 15: Assessment of Cumulative Effects, a number of development projects are ongoing, or are planned, that have the potential to change baseline conditions. Whilst these are not likely to significantly change baseline conditions within the study area, the following key changes are anticipated by the construction baseline year (2020) (the number in brackets refers to the development numbers as detailed in Appendix 15.2 [**TR010022/APP/6.3**]):

- A new footpath within Mackworth Park (No 5) will be operational.
- The development at Radbourne Lane (Langley Country Park) (No 48) will have been completed. Developments within the Mackworth College site (No 6), within the Kingsway hospital site (No 21) and land north of Mansfield Road (Breadsall) (No 39/47) will be further progressed.
- The NHS carpark for 600 cars located to the west of Kingsway Hospital and north of Northmead Drive (No 22) will have been fully developed and will be operational.

- Residential developments at Hackwood Farm (No 29/41), land south of Mansfield Road (Breadsall) (No 40), and land at Kedleston Road (No 50) are anticipated to have been started with resultant land clearance.

13.7.55 Other minor developments in the vicinity of the Scheme which are considered to have been completed by late 2020, and thus will be part of the prevailing baseline, are detailed in Appendix 15.2 [**TR010022/APP/6.3**].

13.7.56 It is anticipated that the various developments as detailed above will not significantly change the prevailing water environment conditions within the Scheme boundary, nor baseline conditions within the defined study area. Thus no changes to the WFD status of surface watercourses or groundwater bodies are expected for the construction baseline year of 2020.

Opening year baseline (2024)

13.7.57 It is not possible to accurately predict baseline environmental conditions for the year of Scheme opening (2024); however, it is anticipated that baseline conditions in the vicinity of the Scheme and within the associated study area will largely be the same as at 2020, although most of the developments as detailed in Appendix 15.2 [**TR010022/APP/6.3**] are anticipated to have been completed by 2024. In addition, urban pressures associated with an increased population may result in the further expansion of the built environment.

13.7.58 Planned future developments have been taken into consideration during the assessment. For example, changes in future traffic baseline flows have been modelled both with and without the Scheme taking into account future development patterns. Modelling outcomes have been used in order to determine the potential effect of Scheme opening on the environment surrounding the Scheme e.g. noise, air quality, severance, water quality effects, biodiversity. Assessment of in-combination effects with climate change have also been taken into consideration.

13.7.59 Overall, no changes to the WFD status for surface water bodies or groundwater bodies are expected in the vicinity of the Scheme during the opening year in 2024. The 2015 Humber RBMP objectives are for all waterbodies are to achieve good status by 2027.

13.7.60 However, by 2024 Dam Brook would have been diverted by the Scheme, whilst works would have been completed on the realignment of Bramble Brook within Kingsway junction. With the implementation of construction methods and environmental management practices as detailed herein, the water quality status of both Dam Brook and Bramble Brook should be at least the same as the current baseline.

13.7.61 The status of abstraction licences may alter for the operational year baseline, but the operational Scheme is not anticipated to have any adverse impacts on any new licensed abstractions.

13.7.62 Climate change has potential to exacerbate flood risk in the future due to increased rainfall and frequency of extreme rainfall events. The FRAs presented in Appendices 13.2A, 13.2B and 13.2C [**TR010022/APP/6.3**] indicate that climate change allowances have been made with regard to the definition of flood mitigation measures (40% allowance for climate change at Kingsway junction and 50% allowance for climate change at Little Eaton junction), whilst Appendix 13.4 [**TR010022/APP/6.3**] also indicates that climate change allowances have been made with respect to the Scheme drainage design (40% allowance for climate change), as agreed with the Environment Agency and DCiC as applicable.

13.7.63 No other changes to the 2024 baseline are currently foreseen.

13.8 Potential impacts

13.8.1 Mitigation measures incorporated into the Scheme design and measures to be taken to manage water environment effects during Scheme construction and operation are set out in Section 13.9. Prior to implementation of such mitigation measures, the Scheme has the potential to affect road drainage and the water environment negatively, both during construction and once in operation, in the following ways.

Construction

13.8.2 Potential impacts arising from Scheme construction (in the absence of effective mitigation) are:

a) Risks to the water environment due to:

- Deposition of soils, sediment or other construction materials which may enter water bodies during excavation and construction works and cause pollution.
- Spillage of fuels or other contaminating liquids, which may enter water bodies and cause pollution.
- Temporary physical modifications which interrupt the natural passage of surface and sub-surface water flows.
- Mobilisation of contaminants following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff.

b) Risks to groundwater associated with cuttings or foundations due to:

- Contamination risk to underlying aquifers.
- Temporary dewatering, for example during cutting construction at Kingsway and Markeaton junctions, leading to changes to groundwater flow.
- Release or leaching of substances (e.g. cement or grout) used during construction which may negatively impact groundwater quality.

c) Potential for an increase in flood risk due to:

- Construction work taking place within the floodplain which may temporarily impact on the function of the floodplain.
- Temporary and/or permanent deposition of excavated/ embankment fill material may impact on existing flood flow paths, flood storage areas or lead to blockages in existing watercourses.
- Construction activities within the floodplain which could result in an increase in flood risk elsewhere.

13.8.3 Details of ground conditions, including the likelihood of encountering contaminated ground or groundwater during the Scheme construction phase, are provided in Chapter 10: Geology and Soils.

Operation

13.8.4 Potential impacts on the water environment during Scheme operation (in the absence of effective mitigation) are:

- Impacts on surface water arising from vehicle-derived pollutants e.g. oils from fuel combustion/accidental spillages, and salts or herbicides from road maintenance.
- Direct physical and hydromorphological impacts from watercourse crossings and other hydraulically linked surface water features with potential for direct effects on the biological, chemical and physical WFD parameters for both surface waters and groundwater bodies.
- Permanent dewatering of the cutting at Markeaton junction, which has the potential to depress local groundwater levels.
- Pumping of surface water and groundwater required for the operation of the cutting at Markeaton junction, which could cause changes in flows within receiving water bodies.
- Discharges from new sections of highway that have the potential to increase flood risk downstream.
- Any road structures, highways cuttings, embankments or other landscaping features constructed in the floodplain which have the potential to alter flood flows and increase flood risk.

13.9 Design, mitigation and enhancement measures

13.9.1 Where possible, proportionate measures to avoid or minimise impacts on the water environment have been embedded within the Scheme design (refer to Chapter 2: The Scheme). Measures taken to avoid Scheme impacts upon the water environment include the following:

- Design of the Scheme at Markeaton junction has avoided the need to extend the culverts from Markeaton Lake to Mill Pond and to Middle Brook.
- Design of the Scheme at Little Eaton junction has avoided the need to alter the River Derwent bridge.

Construction

13.9.2 This section provides details of measures included in the Scheme design and best practice techniques (comprising legal requirements and construction guidance) which would be implemented in order to mitigate and/or manage, as far as is practicable, potential impacts to the water environment during Scheme construction:

- Construction of the Scheme would be subject to measures and procedures as defined within the OEMP for the Scheme (refer to Appendix 2.1 [**TR010022/APP/6.3**]). This includes a range of measures to mitigate potential impacts on the water environment, which accord with legal compliance and good practice guidance when working with or around sensitive water resources. Such measures include relevant water environment mitigation measures as taken from applicable Guidance for Pollution Prevention (GPP) documents (http://www.netregs.org.uk/environmentaltopics/pollution-prevention-guidelines-ppgs-and-replacment-series/guidance-for-pollution-prevention-gpps-full-list/). The measures detailed within the OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]) would be developed into a Construction Environmental Management Plan (CEMP) which would be implemented by the selected construction contractor (refer to Chapter 2: The Scheme, para. 2.6.107).
- During the Scheme construction phase, any discharges of 'unclean' water to Controlled Waters would require an Environmental Permit for Water Activities. The conditions attached to such consent, and limits on oils, suspended solids and other pollutants, would need to be adhered to by the construction contractor. Works undertaken above or within 8m of a Main river would also require an environmental permit from the Environment Agency. Works that would affect an Ordinary watercourse would require consent from the LLFA. Works at Little Eaton junction within 8m of the River Derwent, would require a permit from the Environment Agency. Permits from the LLFA would be required for works at Kingsway junction, Markeaton junction and Little Eaton junction – namely for works within 8m of Bramble Brook and its tributaries, the Markeaton Brook system and Dam Brook and its tributaries.

- Diversions of Bramble Brook at Kingsway junction and of Dam Brook at Little Eaton junction (refer also to para. 13.9.3) would take place at the start of construction (pre-construction activities – refer to Chapter 2: the Scheme, Table 2.3). Method statements for the diversion of these brooks, including measures required to manage ecological constraints within Dam Brook associated with lamprey and potentially water voles (refer to Chapter 8: Biodiversity) would be required as identified in the OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]). In addition, the recommended flood storage areas at Kingsway junction and the floodplain compensation area at Little Eaton junction (refer to para. 13.9.3) would be constructed at the start of the construction phase (pre-construction activities) such that they would mitigate potential flooding impacts during Scheme construction phase.
- There would be a requirement to protect construction plant, materials and construction workers from impacts due to potential flooding. The Little Eaton junction construction compound area to the north of the junction and most other locations selected for use as satellite compounds and material storage are not susceptible to flooding. The area proposed for material storage to the south-west of the existing Little Eaton junction (refer to Figure 2.11c [**TR010022/APP/6.2**]) is currently at risk from surface water flooding. However, following Dam Brook diversion works, the area's flood risks would be such that it could be used for material storage (with appropriate surface water management). The implementation of such measures would also avoid any potential pollution of local watercourses by construction materials in the event of flooding.
- At Markeaton junction, where the Scheme requires construction of a cutting which would extend below the depth of monitored groundwater levels (refer to Section 13.10), a secant form of pile construction would be used, combined with a water excluding reinforced concrete base slab.
- As detailed in Chapter 8: Biodiversity, soils would be translocated from Kingsway junction (i.e. the A38 Roundabout LWS) to Markeaton Park in order to create a new species-rich grassland. The area selected for habitat creation is located adjacent to Markeaton Lake (refer to Environmental Masterplan Figure 2.12d [**TR010022/APP/6.2**]) in an area defined as being within Flood Zone 2 – as such, the works in this area would not raise ground levels (e.g. with an equivalent volume of soils being removed before translocated soil placement), whilst the works would only be undertaken when there would be an absence of flood risks. As such, these works would be in a manner that would prevent any silt-laden runoff from discharging into Markeaton Lake.

- The proposed access into the main construction compound at Little Eaton junction would need to cross over the remains of the former Derby Canal (Little Eaton branch) (refer to Figure 13.3 [**TR010022/APP/6.2**]). In order to avoid direct effects upon the former canal, a temporary bridge would to be used to traverse the area which would not require any disturbance or earthworks to the former canal. Foundations for such temporary bridge structures could be installed back from the edge of the watercourses to avoid impacting on the existing vegetation and watercourse profile. The design of the foundations would be dependent on ground conditions and loading requirements, but may comprise pad foundations or a simple piled foundation. The bridging systems would be removed upon completion of the works, with the affected footprint areas being reinstated to their former conditions. Further details of temporary bridge structures are provided in Chapter 2: The Scheme, paras. 2.6.101 to 2.6.105.

Scheme design and operation

13.9.3 A number of mitigation measures are embedded within the Scheme design in order to mitigate impacts upon the water environment. This includes the following (also refer to the Environmental Masterplans as illustrated in Figures 2.12a to 2.12h [**TR010022/APP/6.2**]):

- The Scheme would increase the impermeable area at each of the three junctions, which in turn would give rise to an increase in road run-off (refer to Chapter 2: The Scheme, para. 2.5.59). A new highway drainage system would be installed to manage surface water as detailed in the Road Drainage Strategy (refer to Appendix 13.4 [**TR010022/APP/6.3**]). This system would replace the existing pavement and drainage collection systems and has been designed to be in compliance with DMRB and the Manual of Contract Document for Highways Works (MCHW). Surface water runoff rates from the new highway arrangement would be controlled to the appropriate rates using SuDS, taking into account potential climate change (40% allowances). At Kingsway junction, there would be a highway runoff wet attenuation pond within the junction footprint, with a second underground highway runoff storage tank located on the edge of Mackworth Park. Further attenuation would be provided through the use of oversized carrier pipes and two underground cellular storage tanks/crates within each of the junction dumbbell roundabouts. At Markeaton junction, flow attenuation would be provided within the carrier pipe network and within two underground storage tanks and a wet attenuation pond (refer to Figure 2.3 [**TR010022/APP/6.2**] in Appendix 13.4 [**TR010022/APP/6.3**]). At Little Eaton junction, two highway runoff attenuation ponds would be constructed, to the south-east of the junction, between the diverted Dam Brook and the A38, with further flow attenuation provided through the use of oversized pipes.

Surface water would outfall to local watercourses, with flow rates limited in accordance with DCiC requirements.

- The highway runoff attenuation ponds would provide for spillage containment wherever necessary. Whilst routine operation and maintenance of the Scheme would not include any activities that are likely to generate contaminants that could pose significant risk to controlled waters (refer to Section 13.10), there would be potential for environmental risks associated with spillages due to road accidents or faulty vehicles. To mitigate the impacts on controlled waters during Scheme operation, the highway drainage design incorporates measures to minimise impacts associated with accidents and spillages. These include the provision of carrier pipes or lined ditches to convey drainage, lined attenuation tanks, petrol interceptors and penstocks. Any spillages following road accidents on the Strategic Road Network would be routinely managed by Highways England as the East Midlands Asset Delivery team responsible for the maintenance of trunk road assets with the Area 7 East Midlands Region. Road drainage and spillages on local roads would continue to be managed by the local authorities, noting that one of the highway drainage attenuation ponds at Little Eaton junction which would receive road drainage from the A61 would be managed by DCC.
- The Scheme design requires the realignment of Bramble Brook at Kingsway junction and Dam Brook at Little Eaton junction. The channel designs for these watercourse diversions (refer to Environmental Masterplans as illustrated in Figures 2.12a and 2.12f [**TR010022/APP/6.2**]) have been supported by hydraulic modelling which indicates that flow conditions within the channels be maintained such that there would be no significant effects on area flooding characteristics (in combination with other flood risk mitigation features (see bullet points below)) (refer to Appendices 13.2A and 13.2C [**TR010022/APP/6.3**]).
- The flood risk modelling undertaken for Kingsway junction identified that flood storage provision is required to mitigate for potential flooding of the new highway (refer to Section 13.10 and Appendix 13.2A [**TR010022/APP/6.3**]). As such, three flood storage areas would be provided adjacent to Bramble Brook within the Kingsway hospital site, whilst a further flood storage area would be provided within the junction (refer to refer to Environmental Masterplan as illustrated in Figure 2.12a [**TR010022/APP/6.2**]).

- The Scheme includes mitigation measures at Kingsway junction designed to avoid deterioration of WFD elements (refer also to Appendix 13.3A [**TR010022/APP/6.3**]) due to loss of open channels. In addition to the realignment of Bramble Brook, additional lengths of culvert would be installed through Kingsway junction and between the southbound merge slip and northbound diverge slip roads. To mitigate for the loss of open channel and the potential adverse effect on the WFD elements of Bramble Brook, the following mitigation measures would be provided (refer to Environmental Masterplan as illustrated in Figure 2.12a [**TR010022/APP/6.2**]):
  - Culverts would be designed with the culvert base set below the channel bed to allow substrate conveyance, improved flow capacity and improved species passage.
  - The base of the flood storage areas would be designed to remain wet, thereby providing wetland habitat within the riparian corridor. The system would be designed such that it would not cause Bramble Brook to dry out during low flow periods.
  - Berms would be included within the realigned Bramble Brook channel within the junction, to improve flow variation, reduce fine sediment deposition and provide suitable habitat for in-channel macrophytes.
  - Attenuated surface water from the underground storage tanks within Mackworth Park would discharge via a 20m swale (rather than being piped) into the periodically dry tributary of Bramble Brook through the park (refer to Appendix 13.3A [**TR010022/APP/6.3**]).
- At Markeaton junction, the low point of the proposed new dual carriageway would be lower than the existing drainage outfall level and the Markeaton Lake level. The Scheme design, therefore, includes a pumping station adjacent to the southbound diverge slip road, which would pump highway runoff from the mainline of the Scheme where it would be in cutting. The pumping station has been designed to accommodate a 1 in 100 year storm event with climate change without flooding the carriageway.
- At Markeaton junction, the secant form of pile construction within the cutting, combined with a water-excluding reinforced concrete slab, would provide groundwater exclusion and avoid post-construction groundwater pumping.

- Highway drainage from Markeaton junction would be attenuated within an underground storage tank, followed by attenuation in a surface attenuation pond (designed to remain wet) and a second underground storage tank prior to being discharged via a vegetated ditch to Mill Pond (refer to Environmental Masterplans as illustrated in Figures 2.12c and 2.12d [**TR010022/APP/6.2**]). Treatment within the wet pond would reduce the levels of potential soluble pollutants, as well as levels of suspended sediments.
- At Little Eaton junction, the Scheme would result in permanent loss of floodplain associated with the River Derwent. As such, a floodplain compensation area would be provided to the south of the A38 on the western (right) bank of the River Derwent (refer to Figure 2.10 and Environmental Masterplan Figure 2.12e [**TR010022/APP/6.2**]) – this area would provide 'like-for-like' compensation for floodplain losses associated with the Scheme. This area would be excavated, appropriately profiled, re-grassed and returned to the landowner for continued agricultural use. The landform design of the floodplain compensation area has been developed with input from landscape, ecological and cultural heritage specialists with the aim that it creates a naturalistic profile that blends in with the surrounding valley profile, as well as enabling the land to be returned to agricultural use. Correspondence with the Environment Agency in June 2018 has confirmed that it is content with the proposed approach to fluvial flood risk mitigation/compensation proposals at Little Eaton junction and that residual flood impacts would be acceptable (refer to Appendix 13.2C, [**TR010022/APP/6.3**]).
- In order to mitigate surface water flood risks associated with an unnamed stream emanating from Breadsall Manor, a multi-stage flood alleviation channel would be created which would connect the stream with the realigned Dam Brook (refer to Environmental Masterplan as illustrated in Figure 2.12f [**TR010022/APP/6.2**]). A new 600mm diameter culvert from the watercourse under the new A38 embankment would also be provided that would connect into an existing culvert in order to take convey flows from the flood alleviation channel when it exceeds its storage potential (also refer to Appendix 13.2C [**TR010022/APP/6.3**]).
- The Scheme design requires the realignment of Dam Brook at Little Eaton junction. The design for the Dam Brook realignment would create a more sinuous channel form within a vegetated corridor, which would bypass a major weir and existing culvert located adjacent to Little Eaton junction (refer to Environmental Masterplan as illustrated in Figure 2.12f [**TR010022/APP/6.2**]). This would improve river connectivity, whilst the installation of in-channel features such as berms and point bars would improve bed and bank structure. The

reinstatement of a more natural bed formation would also improve floodplain connectivity and create new wetland habitat (also refer to Appendix 13.3B [**TR010022/APP/6.3**]).

13.10 Assessment of likely significant effects

Construction phase

13.10.1 Potential impacts during Scheme construction have been described in Section 13.8. The following sections consider the magnitude of potential impacts at each of the three junctions, and whether or not these would give rise to likely significant effects, taking into account the embedded mitigation measures and management actions as detailed in Section 13.9.

Impacts on surface water quality

13.10.2 Surface water receptors that would be at risk of contamination during Scheme construction include Bramble Brook (and its tributaries), Markeaton Lake, Mill Pond, Markeaton Brook and its tributaries (including Middle Brook), Dam Brook and its tributaries, the River Derwent, surface water abstractions, LWSs downstream of the Scheme (and with hydrological connectivity to the Scheme) and ponds within the Scheme boundary or ponds downstream and which are in hydrological connectivity to the Scheme (refer to Section 13.7). The ponds referred to in para. 13.7.29 at Little Eaton junction are considered to be of low sensitivity (refer to Chapter 8: Biodiversity). Bramble Brook is of medium sensitivity, whilst each of the other receptors are considered to be of high sensitivity (refer to Table 13.7).

13.10.3 Bramble Brook (and its tributaries) would potentially be at risk of contamination during the construction works at Kingsway junction, including culverting works, works to realign the brook, construction of the flood storage areas, as well as during the construction of the highway in close proximity to the realigned brook.

13.10.4 Markeaton Brook and its tributaries and Mill Pond would potentially be at risk of contamination during the construction works at Markeaton junction, including works to construct a new connection into Middle Brook culvert, a new connection into the Markeaton Lake culvert and a new discharge point in Mill Pond. In addition, works to create a new species rich grassland within Markeaton Park would potentially be a risk to Markeaton Lake.

13.10.5 Dam Brook and the River Derwent would potentially be at risk of contamination during the construction works at Little Eaton junction, including the works to divert Dam Brook, works to construct new highway drainage outfalls, excavation of the floodplain compensation area and highway construction works in close proximity to both watercourses. Dam Brook could also be affected by runoff from the materials storage area to the south-east of the junction (refer to Figure 2.11c [**TR010022/APP/6.2**]). The former Derby Canal, the ponds referred to in para. 13.7.29, and the

area to the south of the A38 and west of the A61 which has standing water for a large part of the year would potentially be at risk of contamination from uncontrolled runoff and spillages within the main construction compound (refer to Figure 2.11c [**TR010022/APP/6.2**]) or by highway construction activities in close proximity to these waterbodies.

13.10.6 Within the area of Little Eaton junction there are two sensitive water abstractions from the River Derwent for public water supply. As detailed in Section 13.7, these abstractions are protected by the inner zone of the groundwater SPZ. As the inner SPZ is located both upstream and downstream of the A38, it is considered to potentially be at risk from the construction works. There is also one surface water abstraction in the vicinity of the Scheme which is for spray irrigation (see Section 13.7 and Figure 13.3 [**TR010022/APP/6.2**]).

13.10.7 With the implementation of measures and procedures defined within the OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]) and as detailed in Section 13.9, any impacts on the physio-chemical water quality of surface watercourses during the construction works would be temporary and of no more than minor magnitude. Thus effects would be no more than slight adverse and would not be significant. The magnitude of impacts on surface water abstractions would be negligible and thus effects would be neutral and not significant.

Impacts on surface water flow and flood risk

13.10.8 Construction plant, materials and construction workers would be at risk from impacts due to potential flooding. Whilst not strictly part of the water environment, people and property are high sensitivity receptors. Without any mitigation, the magnitude of potential impacts on such receptors due to flooding could be moderate to major and the pre-mitigation effects could, therefore, be significant.

13.10.9 Measures to mitigate flood risks are detailed in Section 13.9 (also refer to refer to Appendix 3.2 [**TR010022/APP/6.3**]). This includes the early installation of the flood storage areas at Kingsway junction, the excavation of a floodplain compensation area at Little Eaton junction, together with the diversion works to Bramble Brook and Dam Brook. With these measures in place, significant flooding effects would be avoided.

13.10.10 Construction of the Scheme would sequentially result in the installation of additional impermeable areas which would increase surface water runoff flows. The drainage system, which includes the provision for the attenuation of increased highway runoff (refer to Section 13.9 and the Road Drainage Strategy provided in Appendix 3.4 [**TR010022/APP/6.3**]) would also be sequentially constructed, whilst measures (refer to Section 13.9) detailed in the OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]) would ensure that uncontrolled sediment laden runoff would not be directed into receiving watercourses. Impacts on surface water flows and flood risk as a

consequence of Scheme construction would, therefore, be negligible and not significant.

Impacts on groundwater quality

13.10.11 Potential risks to groundwater from contamination during Scheme construction would be greatest in areas characterised by permeable soils, relatively high water table or where excavation works are to be undertaken, as at Kingsway junction and Markeaton junction. Some locations along the Scheme are also suspected of containing potentially contaminated material (refer to Chapter 10: Geology and Soils). Potential contaminants could be mobilised during the construction works which could impact upon controlled water receptors e.g. by disturbance or exposure of contaminated materials; direct release of contaminants or through the creation of preferential pathways. There would be a risk that any hydrocarbon contamination found at the existing fuel station at Markeaton junction would be mobilised and/or caused to migrate during construction works at the junction. Groundwater in bedrock and superficial aquifers are considered to be of medium sensitivity.

13.10.12 Impacts associated with suspected or known ground contamination are covered in Chapter 10: Geology and Soils. The implementation of measures (refer to Chapter 10, Section 10.9 and Section 13.9 (of this chapter)) included within the OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]) would minimise the risk of contamination of groundwater during the construction works such that impacts on groundwater quality would be negligible and not significant.

Impacts on groundwater flows

13.10.13 At Kingsway junction, existing groundwater levels are several metres below the current carriageway level. As such, it is considered that there would be a negligible impact upon groundwater levels and flows during the construction phase, such that significant effects would be avoided (neutral effects).

13.10.14 At Markeaton junction, construction of the underpass has the potential to affect groundwater flows during dewatering of the excavation works. The proposed underpass would fall to a low point of 54.7m above ordnance datum (AOD). In this area the ground level is currently 62.2m AOD. Therefore, the depth of the underpass would be up to 7.6m bgl. Groundwater in the vicinity of the junction is approximately 1.0 - 10.0 m bgl, and at approximately 1 to 2m bgl within sand and gravels (refer to Appendix 10.1 and Appendix 10.2 [**TR010022/APP/6.3**]). Construction of the underpass, therefore, has the potential to form a barrier to groundwater flow. However, the groundwater flow direction within the area is eastwards towards Markeaton Lake and Markeaton Brook. This is parallel to the alignment of the underpass such that groundwater flows would not be obstructed by underpass construction and thus long-term significant effects on groundwater flows would be avoided (neutral effects). During the

construction phase, there may be a requirement for dewatering, which could cause a temporary reduction in groundwater levels. The potential temporary impact on groundwater flow due to dewatering is considered to be a minor adverse effect, and thus not significant.

13.10.15 At Little Eaton junction, no major below ground construction works are proposed, other than the excavation of the floodplain compensation area. It is considered that such works would have a negligible impact on groundwater levels and flows. Effects would thus be neutral and not significant.

13.10.16 As all impacts on groundwater levels and flows would be minor to negligible, effects on groundwater levels and flows during construction would not be significant (effects being neutral to minor adverse).

Impacts on water-dependent ecological sites

13.10.17 The assessment of impacts and effects of Scheme construction on sites of ecological importance are covered in Chapter 8: Biodiversity and thus not repeated here.

Operational phase

13.10.18 Potential impacts during Scheme operation are described in Section 13.8. The Scheme design includes measures to mitigate for increased highway runoff discharges from new sections of highway, as well as features to mitigate for the loss of flood storage and floodplain (refer to Section 13.9). The following sections consider the magnitude of potential impacts during Scheme operation and whether these would give rise to likely significant effects, taking into account the embedded mitigation measures as detailed in Section 13.9.

Surface water quality

13.10.19 As described in Section 13.3, DMRB Volume 11 Section 3 Part 10 HD45/09 (Highways Agency, 2009) provides methods to assess potential pollution impacts from routine road runoff (Method A) and to assess the risk of a pollution incident occurring in the event of an accidental spillage (Spillage Risk Assessment (Method D)). Methods A and D have both been applied to each of the three junctions using HAWRAT. Summaries of the parameters used in the calculations, together with the results of the assessments, are presented in Appendix 13.1 [**TR010022/APP/6.3**].

13.10.20 The assessment of impacts from routine runoff takes into account traffic flows, impermeable contributing area, climatic conditions, the Q95 low flow (i.e. flows that are exceeded for 95% of the time) and the water hardness within the receiving watercourse. The assessment output indicates whether the outflow discharge passes soluble copper and zinc EQS concentrations, and whether the annual average copper and zinc concentrations are met. Additionally, it provides an assessment of any chronic impact from sediment associated contaminants.

13.10.21 The assessment of spillage risk takes into account predicted traffic flows, impermeable contributing areas and the geometry of the junctions. Different risk factors, referred to as spillage rates, are applied to different sections of road dependent upon whether it is mainline, slip-road, roundabout etc.

13.10.22 The pollution impact and spillage risk assessment results for each of the three junctions are discussed below.

Kingsway junction

13.10.23 The HAWRAT assessment for Kingsway junction indicates that there would be no exceedances of the Run-off Specific Threshold (RST), but that there is potential for sediment to accumulate in the receiving watercourse (Bramble Brook) from one of the highway drainage catchments (C1 – refer to Table A13.1.2 in Appendix 13.1 [**TR010022/APP/6.3**]). Mitigation in the form of 30% settlement would be required. This would be provided by the highway run-off attenuation pond that is included within the highway drainage design for the junction (refer to Section 13.9) and which would provide settlement upstream of the outfall (refer to the Road Drainage Strategy (Appendix 13.4 [**TR010022/APP/6.3**])) to the receiving watercourse (Bramble Brook).

13.10.24 Information on the performance of attenuation ponds is provided within Table 8.1 - Indicative Treatment Efficiencies of Drainage Systems in HD33/16 (Highways England, 2016). For a wet attenuation pond, the indicative % removal of suspended solids (i.e. sediment) is 60%. It is anticipated that the attenuation pond at Kingsway junction would be of sufficient size to provide sufficient mitigation for suspended solids from catchment C1. The other attenuation ponds/storage tanks included within the Scheme drainage design for Kingsway junction would provide additional settlement for suspended solids and of sediment-bound pollutants from highway runoff from the other drainage catchments. Based on this assessment, it is considered that routine highway runoff would result in a negligible impact to water quality in receiving surface watercourses.

13.10.25 The spillage risk assessment for Kingsway junction indicates that spillage risk would be less than 1% (0.01), which is considered to be acceptable, and thus no additional pollution reduction measures would be required.

13.10.26 Overall, potential impacts on surface water quality within Bramble Brook and tributaries at Kingsway junction would be negligible and hence effects would not be significant (effects being neutral).

Markeaton junction

13.10.27 At Markeaton junction, the receiving water environment, Mill Pond, is one of low flow. The results of the HAWRAT assessment (refer to Appendix 13.1 [**TR010022/APP/6.3**]) indicated that there would be an exceedance of the RST value for soluble copper, indicating that further mitigation would be required to reduce the levels of soluble pollutants such as copper being discharged into the receiving waterbody (refer to Table 4 in Appendix 13.1 [**TR010022/APP/6.3**]). The low flow through Mill Pond would also encourage highway sediment and sediment-bound pollutants to be deposited and to accumulate over time.

13.10.28 The assessment shows that for the low flow receiving environment in Mill Pond, mitigation with a settlement of 24% and a reduction in soluble copper levels of about 9% would be required in order to pass the assessment with regard to sediment accumulation and soluble copper. This would be provided by a wet sedimentation pond provided within the highway drainage design for Markeaton junction (refer to Section 13.9). The pond would be sized to accept the first flush for a 1 in 10 year rainfall event, with at least a 24 hour retention time and is anticipated to result in a 19% reduction in soluble copper and a 30% reduction in suspended solids (refer to Appendix 13.1 [**TR010022/APP/6.3**]). Based on this assessment, it is considered that routine highway runoff would result in a negligible impact to water quality in receiving surface watercourses.

13.10.29 The spillage risk assessment indicates that spillage risk would be less than 1% spillage risk (0.01), which is considered to be acceptable, and thus no additional pollution reduction measures would be required.

13.10.30 Overall, potential impacts on surface water quality at Markeaton junction during Scheme operation would be negligible and hence any effects would not be significant (effects being neutral).

Little Eaton junction

13.10.31 At Little Eaton junction, the HAWRAT assessment (Appendix 13.1 [**TR010022/APP/6.3**]) indicates that there would be no exceedances of the RST values for soluble copper and zinc, but that for one of the highway drainage catchments (C12 – refer to Table 13.1.6 in Appendix 13.1 [**TR010022/APP/6.3**]) there is potential for sediment to accumulate in the receiving watercourse (Dam Brook). Mitigation in the form of 9% and 46% settlement would be required to mitigate for sediment accumulation from catchments C12 and from catchment C12 in combination with catchment C13 respectively. This would be provided by the two highway run-off attenuation ponds included within the highway drainage design (refer to Section 13.9 and the Road Drainage Strategy in Appendix 13.4 [**TR010022/APP/6.3**]). Based on this assessment, it is considered that routine highway runoff would result in a negligible impact to water quality in receiving surface watercourses.

13.10.32 The spillage risk assessment indicates that spillage risk would be less than 1% (0.01), which is considered to be acceptable, and thus no additional pollution reduction measures are required.

13.10.33 Overall, potential impacts on surface water quality at Little Eaton junction during Scheme operation would be negligible and hence any effects would not be significant (effects being neutral).

Impacts on surface water flows and flood risk

13.10.34 As detailed in Section 13.9, the Scheme design includes the provision of highway run-off attenuation features which would control surface water run-off to appropriate run-off rates, taking into account a 40% allowance for climate change (refer to the Road Drainage Strategy, Appendix 13.4 [**TR010022/APP/6.3**]).

13.10.35 At Markeaton junction, as described in Section 13.9, the drainage design includes a pumping station which would drain the Scheme and has been designed to accommodate a 1 in 100 year storm event allowing for climate change, without flooding the carriageway.

13.10.36 With the provision of the highway drainage design as detailed in Section 13.9 and the Road Drainage Strategy (Appendix 13.4 [**TR010022/APP/6.3**]), there would be negligible impact on surface water flows at all three junctions as a consequence of highway run-off from the Scheme and thus the effects would not be significant (effects being neutral).

13.10.37 At Kingsway junction, flood risk modelling as reported in the FRA (refer to Appendix 13.2A [**TR010022/APP/6.3**]) demonstrates that there would be a high risk of fluvial flooding of the Scheme from Bramble Brook. Such flooding could affect the road infrastructure and potentially vehicle travellers using the road. For the purposes of this assessment, it is considered that the potential magnitude of unmitigated impacts would be moderate to major. As the road infrastructure and vehicle travellers are considered to be receptors of high sensitivity, the potential effect would be significant and additional mitigation is required. Thus it is proposed that mitigation for the potential impacts of fluvial flooding would be provided in the form of three flood storage areas within the Kingsway hospital site, and one flood storage area within the junction (refer to Environmental Masterplan as illustrated in Figure 2.12a [**TR010022/APP/6.2**]). With the provision of these flood storage areas, which have been designed with a 40% allowance for climate change, potential impacts from flooding at Kingsway junction would be reduced to negligible and thus the effect would not be significant (effects being neutral). With regard to downstream flood effects, as a result of the Scheme, flow reductions would be achieved downstream of the junction due to the reduced culvert size through Kingsway junction and the provision of the flood storage areas. It is considered that the Scheme would have a benefit on downstream flood risk for Derby, although these benefits are

likely to only be seen during extreme events (refer to Appendix C in the Kingsway junction FRA in Appendix 13.2A [**TR010022/APP/6.3**]). It is thus considered that the Scheme would have a slight beneficial effect (not significant) on downstream flooding.

13.10.38 Markeaton junction is at low risk from fluvial flooding as associated with Markeaton Brook/Middle Brook (refer to Appendix 13.2B [**TR010022/APP/6.3**]). The Scheme would not affect flows within these watercourses such that impacts on flood risk at Markeaton junction would be negligible. The flood risk effect would, therefore, not be significant (effects being neutral).

13.10.39 At Little Eaton junction, the Scheme would result in permanent land-take from the floodplain of the River Derwent. There would, therefore, be a reduction in the floodplain storage capacity. Flood modelling undertaken for Little Eaton junction indicates that, for a 1 in 100 year event including a 50% allowance for climate change, the flood extent would be similar to the flood extent without the Scheme (refer to Appendix 13.2C [**TR010022/APP/6.3**]). The main flooding differences would be immediately to the south of the junction. Changes in flood levels would generally be limited to a maximum increase of up to 20mm, although some areas local to the Scheme would be subject to increases in flood depth of up to 50mm (refer to Table 5.1 and Figure 5.1 in the Little Eaton Junction FRA provided in Appendix 13.2C [**TR010022/APP/6.3**]). There are also some areas where flood levels would reduce in comparison to the without Scheme scenario; these would be immediately to the south of Little Eaton junction and also to the east of the railway line. However, marginal changes (i.e. ±30mm) are considered to be within the tolerance of the hydraulic model. The Scheme would not affect flooding depths in Breadsall village.

13.10.40 The changes in flood risk demonstrated by the fluvial flood risk modelling represent a potential negligible to minor adverse impact on the flood risk (increases in flood depth less than 50mm) in the immediate vicinity of the Scheme, and a negligible impact elsewhere (refer to Appendix 13.2C [**TR010022/APP/6.3**]). Such impacts upon a high sensitive receptor are considered to have neutral to slight adverse effect which is not significant. Nonetheless, appropriate floodplain compensation for the loss of River Derwent floodplain storage due to the Scheme is required, on the basis that the Environment Agency requires projects that result in floodplain volume losses to provide appropriate compensation.

13.10.41 To mitigate for the loss of floodplain storage at Little Eaton junction, a floodplain compensation area would be provided to the south of the A38 on the western (right) bank of the River Derwent (refer to Environmental Masterplan as illustrated in Figures 2.12e [**TR010022/APP/6.2**]). This area would be excavated, re-profiled and grassed over and returned to the landowner for continued agricultural use. This floodplain compensation area would provide ‘like-for-like’ compensation for the floodplain losses

associated with the Scheme. Correspondence with the Environment Agency in June 2018 has confirmed that they agree with the proposed approach to fluvial flood risk mitigation and floodplain compensation proposals at Little Eaton junction, and that residual flood impacts would be acceptable. With the provision of floodplain compensation, there would be a negligible impact upon the River Derwent floodplain, which is not significant (effects being neutral).

13.10.42 In addition to above flood risks associated with the River Derwent, the eastern extent of the Scheme encroaches into an area considered to have a 'High' risk of surface water flooding, according to the Environment Agency's surface water flood maps associated with Dam Brook (noting that the Scheme requires the diversion of Dam Brook). Further to the north there is also significant attenuation of surface water runoff adjacent to the existing A38 associated with a stream emanating from Breadsall Manor. Hydraulic modelling indicates that implementation of the Scheme would result in attenuation of surface water on the upstream face of the proposed embankments, to the south-west of Breadsall Manor, resulting in an increased risk of flooding outside of the Scheme boundary (refer to Appendix 13.2C [**TR010022/APP/6.3**]).

13.10.43 As detailed in Section 13.9, mitigation would be provided by:

- Realignment of Dam Brook to create a more sinuous channel form with a vegetated corridor which would create a more natural bed formation that would improve floodplain connectivity and create new wetland habitat.
- Provision of a multi-stage flood alleviation channel adjacent to the new A38 embankment that would connect the unnamed surface watercourse downstream of Breadsall Manor with the realigned Dam Brook (plus a new 600mm diameter culvert from the watercourse under the new A38 embankment that would connect into the existing culvert in order to convey flows from the flood alleviation channel when it exceeds its storage potential).

13.10.44 With these mitigation measures in place, flood risks associated with Dam Brook and the stream emanating from Breadsall Manor, during Scheme operation would not be significant (effects being neutral).

Impacts on hydromorphology

13.10.45 As described in Section 13.9, a number of mitigation measures are included in the Scheme design for Kingsway junction to mitigate for potential adverse impacts on WFD elements. The measures proposed would mitigate for loss of open channel and would also enhance the riparian zone of Bramble Brook through the provision of formal flood storage areas which would remain wet and provide wetland habitat within the riparian corridor. The realigned Bramble Brook channel would also be

enhanced through the creation of inset alternate berms which would provide improved flow variation, reduce fine sediment deposition and provide habitat for bankside and emergent vegetation.

13.10.46 At Little Eaton junction, the Scheme would result in a collective loss of existing open channel of approximately 279m (loss of approximately 155m of Dam Brook and approximately 124m loss of the unnamed watercourse). However, provision of the 260m long flood alleviation channel and a new approximately 216m long swale would result in the creation of approximately 476m of new open channel. Therefore, these collective works would result in a net gain in open channel of approximately 197m associated with Dam Brook and its tributaries. These mitigation measures would minimise potential adverse impacts, and improve the local water environment.

Impacts on groundwater quality

13.10.47 Scheme operation would not include routine activities that would pose a significant risk to groundwater. During routine operation of the Scheme, highway run-off would be directed into the proposed highway drainage system which would discharge to receiving surface watercourses (with no discharges going to groundwater). Accidental spillages associated with traffic accidents would similarly enter and be contained within the highway drainage system. Given the provision of an appropriate highway drainage system, operation of the Scheme would have a negligible impact upon groundwater quality, and thus effects would not be significant (effects being neutral).

Impacts on groundwater levels and flows

13.10.48 Scheme operation would have negligible impacts upon groundwater levels and flows at Kingsway junction and at Little Eaton junction. At Markeaton junction, the alignment of the underpass would be east-west, which is parallel to the direction of the groundwater flow. Therefore, Scheme operation at Markeaton junction would have negligible impact on groundwater levels and flows. Overall, the effect on groundwater levels and flows would not be significant (effects being neutral).

Impacts on sites of ecological importance

13.10.49 The assessment of impacts and effects of Scheme operation on sites of ecological importance is covered in Chapter 8: Biodiversity and thus not repeated here.

13.11 Monitoring

13.11.1 As no likely significant adverse effects are identified for the water environment or for flood risk, no monitoring of significant effects is proposed during Scheme operation.

13.11.2 The OEMP (refer to Appendix 2.1 [**TR010022/APP/6.3**]) sets out monitoring to be undertaken during the Scheme construction phase to ensure that the mitigation measures embedded in the Scheme design are appropriately implemented and to ensure compliance with the WFD.

13.12 Summary of assessment

13.12.1 With the implementation of the mitigation measures as detailed in Section 13.9, the Scheme would have no more than a slight adverse effect on surface water quality and groundwater flows during the construction phase. Such effects are not significant. Impacts on surface water flows, flood risk and groundwater quality during Scheme construction would be negligible and the effects would, therefore, not be significant (effects being neutral).

13.12.2 During Scheme operation, with the implementation of the mitigation measures as detailed in Section 13.9, there would be negligible impacts on surface water and groundwater quality, flood risk and floodplain storage (effects thus being neutral). There would, therefore, be no significant effects associated with road drainage and the water environment during Scheme operation.

13.12.3 A summary of the road drainage and the water environment impact assessment is provided in Table 13.8.

Table 13.8: Road drainage and the water environment - summary of effects

Receptor	Attribute	Receptor sensitivity	Impact description	Design and mitigation measures	Impact magnitude	Residual effect
Construction phase						
Surface water quality	Bramble Brook and its tributaries	Medium	Adverse impact on water quality due to runoff from working areas, or accidental spillage or uncontrolled runoff.	Measures as detailed in Section 13.9. Includes: • Best practice construction methods implemented through the CEMP (refer to OEMP, Appendix 2.1 [**TR010022/APP/6.3**]). • Appropriate design of culverting and realignment works (Bramble Brook and Dam Brook).	Minor	Slight adverse (not significant)
	Markeaton Brook and its tributaries	High				
	Markeaton Lake	High				
	Mill Pond	High				
	River Derwent	High				
	Dam Brook and its tributaries	High				
	Surface water abstractions (Little Eaton junction)	High				
	Ponds at Little Eaton junction	Low			Negligible	Neutral (not significant)
Surface water flow	Bramble Brook and its tributaries	Medium	Adverse impact on surface water flows during culverting and/or realignment works. Potential for reduction in flows or interruption	Measures as detailed in Section 13.9. Includes: • Best practice construction methods implemented through the CEMP (refer to OEMP, Appendix 2.1 [**TR010022/APP/6.3**]). • Appropriate method statements for	Negligible	Neutral (not significant)
	Bramble Brook floodplain	High				
	Markeaton Brook and its tributaries (including Middle	High				

Receptor	Attribute	Receptor sensitivity	Impact description	Design and mitigation measures	Impact magnitude	Residual effect
	Brook)		of flow path due to blockages or discharges of sediment/silt.	culverting and realignment works to ensure natural flows within watercourses are maintained during construction. • Sequential construction of Scheme drainage system which would provide attenuation of increased highway runoff from new impermeable areas.		
	Markeaton Lake	High				
	Mill Pond	High				
	Dam Brook and its tributaries	High				
	River Derwent floodplain	High				
Conveyance of flow (fluvial flood risk)	Bramble Brook and its tributaries	High	Adverse impact on flood storage due to construction works within floodplain/areas at risk of flooding.	Measures as detailed in Section 13.9. Includes: • Early installation of the flood storage areas at Kingsway junction, the floodplain compensation area at Little Eaton junction, together with the realignment works to Bramble Brook and Dam Brook.	Negligible	Neutral (not significant)
	Dam Brook and its tributaries	High				
	River Derwent	High				
Groundwater quality	Groundwater in bedrock and superficial aquifers	Medium	Adverse impact on groundwater quality due to accidental spillages or encountering potentially contaminated material.	Measures as detailed in Chapter 10: Geology and Soils, Section 10.9 and Section 13.9 (of this chapter). Includes: • Best practice construction methods implemented through the CEMP (refer to OEMP, Appendix 2.1 [**TR010022/APP/6.3**]).	Negligible	Neutral (not significant)

Receptor	Attribute	Receptor sensitivity	Impact description	Design and mitigation measures	Impact magnitude	Residual effect
Groundwater flow	Groundwater in bedrock and superficial aquifers	Medium	Interruption of groundwater flows and/or adverse impact on groundwater levels due to construction works below natural groundwater level.	Measures as detailed in Section 13.9. Includes: • Best practice construction methods implemented through the CEMP (refer to OEMP, Appendix 2.1 [**TR010022/APP/6.3**]).	Minor adverse to negligible	Slight adverse (not significant)
Operational phase						
Surface water quality	Bramble Brook and its tributaries	Medium	Adverse impact on water quality due to routine runoff from road and/or accidental spillages.	Measures as detailed in Section 13.9. Includes: • Drainage design to incorporate SuDS including attenuation ponds to reduce suspended solids and soluble metals in road drainage (refer to Appendix 13.4 [**TR010022/APP/6.3**]).	Negligible	Neutral (not significant)
	Markeaton Brook and its tributaries	High				
	Markeaton Lake	High				
	Mill Pond	High				
	River Derwent	High				
	Dam Brook and its tributaries	High				
	Surface water abstractions (Little Eaton junction)	High				

Receptor	Attribute	Receptor sensitivity	Impact description	Design and mitigation measures	Impact magnitude	Residual effect
Surface water flow and flood risk	Bramble Brook and its tributaries	Medium	Increased flows due to increased runoff from the road (increased impermeable area)	Measures as detailed in Section 13.9. Includes: • Drainage design incorporates SuDS including attenuation ponds, to allow discharge rates to surface watercourses to be managed. There would be no exacerbation of flooding due to increased runoff from the road (refer to Appendix 13.4 [**TR010022/APP/6.3**]).	Negligible (although minor beneficial impact upon downstream flooding)	Neutral (not significant) (although slight beneficial effects upon downstream flooding)
	Bramble Brook floodplain	High				
	Markeaton Brook and its tributaries (including Middle Brook)	High				
	Markeaton Lake	High				
	Mill Pond	High				
	Dam Brook and its tributaries	High				
	River Derwent floodplain	High				
Floodplain storage	Bramble Brook and its tributaries	High	Loss of flood storage due to the Scheme requiring land take	Measures as detailed in Section 13.9. Includes: • Flood storage areas provided at Kingsway junction.	Negligible	Neutral (not significant)
	River Derwent	High		Measures as detailed in Section 13.9. Includes: • Floodplain compensation area to be provided at Little Eaton junction.	Negligible	Neutral (not significant)

Receptor	Attribute	Receptor sensitivity	Impact description	Design and mitigation measures	Impact magnitude	Residual effect
	Groundwater in bedrock and superficial aquifers	Medium		• Routine runoff and accidental spillages would be directed to highways drainage system which would discharge to surface watercourses only (no discharges to groundwater).	Negligible	Neutral (not significant)
Groundwater quality	Groundwater in bedrock and superficial aquifers	Medium	Adverse impact on water quality due to routine runoff from road and/or accidental spillages	Measures as detailed in Section 13.9.	Negligible	Neutral (not significant)
Groundwater flow	Groundwater in bedrock and superficial aquifers	Medium	Adverse impacts on groundwater flows or levels due to structures below groundwater levels.	Measures as detailed in Section 13.9.	Negligible	Neutral (not significant)

13.13 References

Defra (2008) Future Water – the Government's water strategy for England. Available at: https://www.gov.uk/government/publications/future-water-the-governments-water-strategy-for-england [accessed 12.02.19]

Defra (2018) MAGiC website. Available at: https://magic.defra.gov.uk/ [accessed 12.12.18]

Department for Transport (2014) National Policy Statement for National Networks. The Statutory Office. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

Environment Agency (1998a) River Geomorphology: a practical guide http://evidence.environment- agency.gov.uk/FCERM/en/FluvialDesignGuide.aspx Environment Agency (2018) Aquifer designation maps. Available at: https://magic.defra.gov.uk/MagicMap.aspx [accessed 12.12.18]

Environment Agency (1998b) Geomorphological approaches to river management. Project record W5A/i661/1, prepared by Thorne, C., Downs, P.W., Newson, M.D., Clarke, M.J., and Sear, D.A., EA, Bristol.

Environment Agency (2018) Flood map for planning. Available at: https://flood-map-for-planning.service.gov.uk/confirm-location?easting=436827&northing=339619&placeOrPostcode=Breadsall [accessed 12.12.18]

Environment Agency (2018) Check for Drinking Water Safeguard Zones and NVZs. Available at: https://environment-agency.cloud.esriuk.com/farmers/. Accessed 20.12.18.

Environment Agency (2016) Humber River Basin Management Plan. Available at: https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan [accessed 12.12.18]

Highways Agency (2006) Design Manual for Roads and Bridges (DMRB) Volume 4, Section 2, Part 1, HA 103/06 Vegetated Drainage Systems for Highway Runoff.

Highways Agency (2009) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10, HD45/09.

Highways Agency (2011) HD45 Highways Agency Water Risk Assessment Tool spreadsheet and user manual version 1.0a

Highways England (2016) Design Manual for Roads and Bridges (DMRB) Volume 4, Section 2, Part 3 HD 33/16.

Highways England (2018) A38 Derby Junctions - Monitoring Report. Report Number: HE514503-ACM-VGT-A38_SW_PR_ZZ-RP-GE-003 P01 S0, August 2018.

Highways England (2018) A38 Derby Junctions - Ground Investigation Report (Stage Approval). HA GDMS No. 30092. Report Number: HE514503-ACM-VGT-

A38_SW_PR_ZZ-RP-GE-0001 P05 S4, 2018.

Highways England (2018) A38 Derby Junctions – Environmental Impact Assessment Scoping Report. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010022/TR010022-000036-38DY%20-%20Scoping%20Report.pdf

Highways England (2018) A38 Derby Junctions – Preliminary Environmental Information Report https://highwaysengland.citizenspace.com/he/a38-derby-junctions-statutory-consultation/supporting_documents/A38%20Derby%20Junctions%20%20Preliminary%20Environmental%20Information%20Report%20PEIR.pdf

Highways England (2018) Asset Delivery, East Midlands. Severe Weather Plan 2018/2019.

Highways England (2019) A38 Derby Junctions - Kingsway Junction Flood Risk Assessment, 2018.

Highways England (2019) 38 Derby Junctions - Markeaton Junction Flood Risk Assessment, 2018.

Highways England (2019) A38 Derby Junctions - Little Eaton Junction Flood Risk Assessment, 2018.

Highways England (2019) WFD Assessment Report – Kingsway Junction, 2018.

Highways England (2019) WFD Assessment Report – Little Eaton Junction, 2018.

Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework (NPPF). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf

STW (2016) Severn Trent Facilities Adjacent to River Derwent at Little Eaton, Derby. Email A Howell (STW) to SR Wild (AECOM), 14.04.2016.

STW (2018) A38 Derby Junctions: Severn Trent Facilities Adjacent to River Derwent at Little Eaton, Derby. Email A Howell (STW) to SR Wild (AECOM), 24.01.2018.

Voluntary Initiative (2018) Promoting responsible pesticide use. Available at: https://voluntaryinitiative.org.uk/water/advice/responsible-use/. Accessed 20.12.18.