M54 to M6 Link Road

TR010054

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

January 2020

Infrastructure Planning

Planning Act 2008

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

M54 to M6 Link Road

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	TR010054
Application Document Reference	6.1
Author	M54 to M6 Link Road Project Team and Highways England

Version	Date	Status of Version
1	January 2020	DCO Application

Table of contents

Chapter **Pages**

List of Tables

List of Figures [TR010054/APP/6.2]

List of Appendices [TR010054/APP/6.3]

Appendix 13.4: Water Framework Directive Assessments
Appendix 13.5: Water Quality Monitoring Results
Appendix 13.6: Sediment Sampling of Lower Pool
Appendix 13.7: Abstractions and Discharge Tables
Appendix 13.8: Groundwater Technical Note

13 Road Drainage and the Water Environment

13.1 Introduction

13.1.1 This chapter presents the results of an assessment of the likely significant effects of the construction and operation of the Scheme on road drainage and the water environment. This follows the methodology set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10, LA 113 Road Drainage and the Water Environment (Ref 13.1). The water environment as assessed by this chapter includes surface water quality and resources, groundwater resources, hydromorphology, flood risk and drainage. This chapter cross-refers to Chapter 9: Geology and Soils, and Chapter 8: Biodiversity where appropriate. Chapter 8 includes details of aquatic ecology surveys and assessments.

13.1.2 This chapter of the Environmental Statement (ES) has been prepared by competent experts with relevant and appropriate experience. The technical lead for the road drainage and water environment assessment has 15 years of relevant experience and has professional qualifications as summarised in Appendix 1.1 [TR010054/APP/6.3].

13.2 Legislative and policy framework

Legislation

13.2.1 The key legislation relevant to this road drainage and the water environment assessment includes:

- The Water Act 2014 (Ref 13.2);
- The Floods and Water Management Act 2010 (Ref 13.3);
- The Land Drainage Act 1991 (as amended) (Ref 13.4);
- The Water Resources Act 1991 (Ref 13.5);
- The Salmon and Freshwater Fisheries Act 1975 as amended (Ref 13.6);
- The Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2017 (Ref 13.7) and 2003 (Ref 13.8);
- The Environmental Permitting (England and Wales) Regulations 2016 (Ref 13.9);
- The Environmental Damage (Prevention and Remediation) Regulations 2015 (Ref 13.10);
- The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (Ref 13.11);
- The Eels (England and Wales) Regulation 2009 (Ref 13.12);
- The Groundwater (England and Wales) Regulations 2009 (Ref 13.13); and
- The Control of Pollution (Oil Storage) (England) Regulations 2001(Ref 13.14).

Planning policy

13.2.2 The primary basis for deciding whether or not to grant a Development Consent Order (DCO) is the National Policy Statement for National Networks (NPSNN)[1] (Ref 13.15) setting out policies to guide how DCO applications should 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 ES chapter information is provided to address these policy requirements.

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

NPSNN para.	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; and • 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). In preparing an FRA [flood risk assessment] 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;	Refer to Section 13.9 'Likely significant effects' and Appendix 13.1 Flood Risk Assessment (FRA) [TR010054/APP/6.3]. The findings of the FRA have been used to assess the impact of the Scheme on flood risk. Refer to Chapter 2: The Scheme, for details of SuDs, and flood alleviation measures proposed as part of the Scheme.

[1] Although other policies can have weight as relevant and important matters in decision making. See Case for the Scheme for more information [TR010054/APP/7.2].

NPSNN para.	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 Water Framework Directive (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.	Refer to Section 13.16 'Baseline conditions' for details on the existing water, water quality and physical characteristics of the water environment. Refer to Section 13.9 'Likely significant effects' for the effects of the Scheme of water resources. Appendix 13.4: WFD Assessment [TR010054/APP/6.3] considers the impact associated with the WFD. Refer to Chapter 15: Assessment of Cumulative Effects.

13.2.3 An assessment of the Schemes conformity with the relevant paragraphs and provisions for water resources in the NPSNN is presented in the NNNPS Accordance Table, Annex A of the Case for the Scheme [TR010054/APP/7.2].

13.2.4 Other relevant policies and guidance have been considered as part of this 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 include:

- The National Planning Policy Framework (NPPF) (Ref 13.16) 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.
- The national Planning Practice Guidance (PPG) (Ref 13.17) with particular reference to 'Planning and flood risk', 'Site-specific flood risk assessment'.
- Future Water (Ref 13.18): The Government's Future Water strategy sets out the Government's long-term vision for water and the framework for water

management in England. It includes sustainable management of the water environment and water quality, to ensure no compromise in environmental quality of future generations.

- 25 Year Environment Plan (Ref 13.19): In 2018 Department of Environment Food and Rural Affairs (Defra) published the 25 Year Environment Plan. The Plan includes specific goals to reduce the environmental impact of water abstraction, meet the objectives of River Basin Management Plans (RBMP) under the WFD, reduce leakage from water mains, improve the quality of bathing waters, restore protected freshwater sites to a favourable condition, and do more to protect communities and businesses from the impact of flooding, coastal erosion and drought.
- Humber River Basin District RBMP (Ref 13.20): Sets out how organisations, stakeholders and communities should work together to improve the water environment. Further details are given in Appendix 13.3: WFD Assessment [TR010054/APP/6.3].
- South Staffordshire Core Strategy (Ref 13.21): Relevant policies which relate specifically to the water environment, flood management and SuDS include Core Policy 2, Policy EQ1, Core Policy 7 and Policy EQ7. The relevant core strategy polices have been addressed through the design-development process set out in Chapter 3: Assessment of Alternatives, and are considered in this assessment. This has included development of a Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]) including utilisation of SuDS where possible, and preparation of a FRA (Appendix 13.1 [TR010054/APP/6.3]).
- Staffordshire County Council (SCC) SuDS Handbook (Ref 13.22). This sets out the role of SuDS in achieving sustainable development across nine Lead Local Flood Authorities (LLFA) including the SCC area.
- SuDS are designed in accordance with the criteria described in DMRB 4.2 HA103/06 (Ref 13.23).
- The SuDS Manual CIRIA C753 (Ref 13.24).
- The Strategic Flood Risk Assessment (SFRA) for South Staffordshire, Cannock Chase, Lichfield, Stafford and Tamworth (Ref 13.25). This informs the Local development plan documents.

13.3 Assessment methodology

General approach

13.3.1 The road drainage and the water environment assessment includes an assessment of impacts on water quality, both surface water and groundwater from potential construction and operational effects, the potential for increased volume and rate of surface water runoff from new impervious area leading to an impact on flood risk, potential for changes in surface water drainage patters, and impacts on hydraulic processes and hydromorphology of the watercourses in the study area.

13.3.2 A WFD assessment (WFDa) has also been undertaken and is presented in Appendix 13.4 [TR010054/APP/6.3]. This considers specifically the impact on relevant WFD objectives for designated waterbodies in the study area, to determine

whether there is potential for deterioration or prevention of improvement in the ecological status of these waterbodies. Although this deals with similar issues as this water environment impact assessment, it determines compliance against WFD objectives rather than significance of effects.

13.3.3 The predominantly qualitative assessment of likely significant effects has considered both construction and operation phases, as well as cumulative effects with other developments. It is based on a source-pathway-receptor approach. For an impact on the water environment to exist the following is required:

- An impact source (such as the release of polluting chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or the loss or damage to all or part of a water body).
- A receptor that is sensitive to that impact (i.e. water bodies and the services they support).
- A pathway by which the two are linked.

13.3.4 The first stage in applying the source-pathway-receptor approach is to identify the causes or 'sources' of potential impact from a development. The sources have been identified through a review of the details of the proposed development, including the size and nature of the development, potential construction methodologies and timescales.

13.3.5 The next step in the model is to undertake a review of the potential receptors, that is, the water environment receptors themselves that have the potential to be affected. Water bodies, including their attributes, have been identified through desk study and site surveys.

13.3.6 The last stage of the model is, therefore, to determine if there is a viable exposure pathway or a 'mechanism' linking the source to the receptor. This has been undertaken in the context of local conditions relative to water receptors within the study area, such as topography, geology, climatic conditions and the nature of the impact (e.g. the mobility of a liquid pollutant or the proximity to works that may physically impact a water body).

13.3.7 Consideration has been given to the activities associated with the future maintenance and management of the Scheme, and whether these have the potential to result in significant effects on the water environment. Annex 1 of the Memorandum of Understanding (Ref 13.50) between Highways England and the Environment Agency covers the water environment. A key commitment as part of this document is that '*The parties have agreed to work together to develop and implement policy and best practice to protect surface water and groundwater and reduce the risk of flooding on the existing road network and new road projects.'.*

13.3.8 Maintenance and management of the Scheme is scoped out as this will be undertaken by the Managing Area Contractor to Highways England best practice guidelines. The maintenance and management of the future Highways England Road Network is currently managed by the Managing Area Contractors – with some aspects of it being taken in house. This will be undertaken to comply with environmental law, and best practice.

13.3.9 A review of the likely maintenance activities (not including road safety in adverse weather conditions) concluded that there would be limited potential of such effects to occur, and that these activities are comparable with standard maintenance operations already being undertaken elsewhere on the strategic and local road networks. Accordingly, the effects associated with this phase of the Scheme were scoped out of the assessment and are not considered further. This approach was agreed with the Environment Agency in a meeting on 6 August 2019.

Establishing baseline conditions

13.3.10 Establishment of the baseline environment has involved reference to existing data sources, consultation with statutory bodies and other organisations, and field surveys. These sources are described in more detail in the following sections.

Desk study

13.3.11 A desk study has been undertaken to establish baseline information, this included a review of the following data sources:

- existing scheme information, topographical data, site reports and consultations;
- Environment Agency data requests, received by them on 10 March 2017, 2 November 2018 and 10 April 2019;
- online Ordnance Survey (OS) and aerial maps (Ref 13.26 and Ref 13.27);
- Met Office website (Ref 13.28);
- British Geological Survey Geoindex website (Ref 13.29);
- Environment Agency Catchment Data Explorer website (Ref 13.30);
- Environment Agency Flood Map for Planning website (Ref 13.31);
- Environment Agency Areas Susceptible to Groundwater Flooding website (AStGwF) (Ref 13.32);
- Highways England Drainage Data Management System (HADDMS) (Ref 13.33);
- Humber River Basin District RBMP (Ref 13.20);
- The findings of a ground investigation and subsequent groundwater monitoring between June and November 2019 (Appendix 9.2 of the ES [TR010054/APP/6.3]);
- Environment Agency (2013) Staffordshire Trent Valley Abstraction Licensing Strategy, (Ref 13.34);
- South Staffordshire Council (SSC) SFRA (Ref 13.25) covering the site; and
- details of private water supplies were supplied by SSC.

Field Surveys

13.3.12 An initial site walkover was undertaken on 11 February 2019 in dry overcast conditions. The aim of the site walkover was to identify water receptors in the study area and to assess them in terms of their character, morphology, and their connectivity to the Scheme in the context of the surrounding topography and receptors. In addition, this site visit helped refine the scope of the topographic

survey, and also gathered additional information to aid modelling structures and the river channel at key locations of interest. In July 2019 an additional walkover survey was completed to conduct a fluvial audit of Latherford Brook.

13.3.13 Subsequent water quality monitoring has taken place in March 2019, June 2019, September 2019 and November 2019 to better understand baseline conditions and provide input data to the quantitative assessment of road runoff impacts. The seasonal water quality programme assessed general physico-chemical parameters that provide an indicator of water quality. In total, five watercourses and three ponds have been sampled as part of the programme. Sampling has captured each watercourse due to be crossed by the Scheme in addition to some lakes that will be physically impacted by the works. The sampling programme provides site specific data not available through Environment Agency water quality monitoring data required for detailed assessment.

13.3.14 Aquatic ecology surveys were completed between 21 May to 3 September 2019. These included invertebrate sampling, Environmental DNA sampling, fish surveys, and white clawed crayfish surveys. More information is provided within Chapter 8: Biodiversity.

13.3.15 The bathymetry, sediment stratigraphy and sediment quality of Lower Pool was investigated by a survey carried out in September 2019. The approach, methods and results of this survey are presented in Appendix 13.6 Sediment Sampling of Lower Pool [TR010054/APP/6.3]. Details of the Lower Pool pond sediment sampling are summarised in paragraphs 13.6.34 to 13.6.35.

13.3.16 To gather suitably detailed data to be able to construct hydraulic models, a river channel topographic survey was undertaken between February and April 2019. Refer to Appendix 13.1 FRA [TR010054/APP/6.3] for further details.

13.3.17 For the purposes of the Drainage Strategy in Appendix 13.2 [TR010054/APP/6.3], drainage surveys were undertaken to inform the strategy and to confirm the assumptions made. The drainage surveys were carried out week commencing 17 June 2019.

Assessment of routine road runoff and accidental spillages

13.3.18 An assessment of the potential impacts of routine runoff on surface waters has been undertaken following the Highways England Water Risk Assessment Tool (HEWRAT version 2.0.4, 2019) methodology as described within DMRB LA 113 Road Drainage and the Water Environment (Ref 13.1), and available for download from the HADDMS website (Ref 13.33). HEWRAT was developed for this purpose and the methodology behind it has been derived from a collaborative research programme undertaken by Highways England and the Environment Agency, which investigated the effects of routine road runoff on receiving waters and their ecology. The assessment helps to determine the risk of routine runoff pollution, and spillage risk to the receiving water body and what treatment measures are required to mitigate this risk. Where there are failures against the short-term metal impacts using HEWRAT, a more detailed assessment using the Metal Bioavailable Assessment Tool (M-BAT) has been undertaken. This tool takes into account additional water

quality parameters to determine what proportion of dissolved metal concentration is in fact bioavailable to aquatic organisms. The quantitative assessment is included within Appendix 13.3 Assessment of Routine Road Runoff and Accidental Spillage Risk (HEWRAT) [TR010054/APP/6.3]. This is an updated methodology from that contained within HD45/09, and the Highways Agency Water Risk Assessment Tool procedure.

13.3.19 Appendix D of LA 113 (Ref 13.1) has been used to assess the risk of pollution of a watercourse from a serious road traffic accident. This method is contained within the HEWRAT programme. This method combines various risk factors, including the volume of traffic flows in a 24-hour period, the percentage of heavy goods vehicles, and the risk attributed to different types of road to determine the probability of an accident resulting in a serious pollution incident. The acceptable standard is measured as a return period with 1 in 100 years (i.e. the probability of an event occurring in any given year) is 1%, as the minimum threshold for non-sensitive water environments. This increases to 1 in 200 years for sensitive receptors (for example Sites of Special Scientific Interest (SSSIs)). Although there are no SSSIs contained within the study area of the Scheme. The assessment is presented in full in Appendix 13.3 [TR010054/APP/6.3].

13.3.20 While the remainder of the ES undertakes the impact assessment with essential and embedded mitigation included, for routine road runoff and accidental spillage risk it is a requirement to determine the extent of pollution impact from the Scheme quantitatively in the absence of mitigation, to confirm that the proposed mitigation is adequate to ensure no residual effects. Therefore, the impact assessment for these elements is presented in the absence of mitigation, and then with mitigation included.

Evaluation of receptor importance

13.3.21 The importance of potentially affected water environment features has been established using a four-point scale (low, medium, high, very high) developed on the basis of Table 3.70 within LA 113 (Ref 13.1). This four-point scale is presented in Table 13.2.

13.3.22 For the purpose of this assessment, receptor ‘importance’ has been identified rather than receptor ‘value’ (see Table 13.2). This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes, is very sensitive to impacts, whereas an important regional scale watercourse, that could have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

Table 13.2: Criteria to determine receptor importance

Importance[1]	Type of Receptor			
	Groundwater	**Surface Water**	**Morphology [2]**	**Flood Risk[3]**
Very High	Principal aquifer providing a regionally important resource and/or supporting a site protected under European Commission (EC) and UK legislation Ecology and Nature Conservation Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems (GWDTE) Source Protection Zone (SPZ) 1	Watercourse having a WFD classification shown in a RBMP and Q95 $\geq$ 1.0 m^3/s. Site protected/designated under EC and UK legislation Ecology and Nature Conservation	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type	Essential infrastructure or highly vulnerable development.
High	Principal aquifer providing locally important resource or supporting river ecosystem. Groundwater supports a GWDTE SPZ2	Watercourse having a WFD classification show in a RBMP and Q95 m^3/s <1.0 m^3/s. Species protected under EC or UK legislation Ecology and Nature Conservation.	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	More vulnerable development
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3	WFD not having a WFD classification shown in a RBMP and Q95 >0.001 m^3/s.	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	Less vulnerable development

Importance[1]	Type of Receptor			
	Groundwater	**Surface Water**	**Morphology [2]**	**Flood Risk[3]**
Low	Unproductive strata	Watercourses not having a WFD classification shown in a RBMP and Q95 <0.001 m^3/s.	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.	Water compatible development

[1] Professional judgement is applied when assigning an importance category to all water features. 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 water body 'Reach Conservation Status' presently being adopted for HS2 (and developed originally by Atkins) and developed from the Environment Agency conservation status guidance (Ref 13.35, Ref 13.36).LA 113 provides advice on hydromorphological assessment but does not provide criteria for determining hydromorphological receptor importance(Ref 13.1).

[3] Vulnerable development, less vulnerable development and water compatible development are defined in the NPPF (Ref 13.16)

Magnitude of impact

13.3.23 The magnitude of impact on the water environment has been established using the criteria outlined in Table 3.71 of LA 113 (Ref 13.1), refer to Table 13.3. These impacts take into consideration the extent that the Scheme would directly or indirectly affect the identified water receptors. The identification of impacts takes account of all embedded and essential mitigation measures described in Section 13.8, Chapter 2: The Scheme and the Outline Environmental Management Plan (OEMP) [TR010054/APP/6.11].

Table 13.3: Criteria to determine magnitude of impact

Magnitude of Impact	Criteria	Description
Major Adverse	Results in a loss of attribute and/or quality and integrity of the attribute.	Surface water: • Failure of both acute-soluble and chronic sediment related pollutants in HEWRAT and compliance failure with Environment Quality Standard (EQS) values. • Calculated risk of pollution from a spillage ≥2% annually (spillage assessment). • Loss or extensive change to a fishery. • Loss of regionally important public water supply. • Loss or extensive change to a designated nature conservation site. • Reduction in water body WFD classification.
		Groundwater: • Loss of, or extensive change to, an aquifer. • Loss of regionally important water supply. • Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater quality and runoff assessment). • Calculated risk of pollution from spillages ≥2% annually (Spillage assessment). • Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. • Reduction in water body WFD classification. • Loss or significant damage to major structures through subsidence or similar effects.
		Flood Risk: • Increase in peak flood level >100 mm.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface Water: • Failure of both acute-soluble and chronic sediment-bound pollutants in HEWRAT but compliance with EQS values. • Calculated risk of pollution from spillages ≥1% annually and <2% annually. • Partial loss in productivity of a fishery. • Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification.

Magnitude of Impact	Criteria	Description
		Groundwater: • Partial loss or change to an aquifer. • Degradation or regionally important public water supply or loss of significant commercial/industrial/agricultural supplies. • 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 GWDTE. • Contribution to reduction in water body WFD classification. • Damage to major structures through subsidence or similar effects or loss of minor structures.
		Flood Risk: • Increase in peak flood level > 50mm.
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability.	Surface Water: • Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. • Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. • Minor effects on water supplies.
		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 an aquifer, GWDTEs, abstractions and structures.
		Flood Risk: • Increase in peak flood level >10mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Surface Water: • No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). • Risk of pollution from spillages <0.5%.
		Groundwater: • No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%.
		Flood Risk: • Negligible change in peak flood level<+/- 10mm.
Minor beneficial	Results in some beneficial effect on attribute or a	Surface Water: • HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a Fail condition. • Calculated reduction in existing spillage risk by 50% or more

Magnitude of Impact	Criteria	Description
	reduced risk of negative impact occurring.	(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). • Reduction or groundwater hazards to existing structures. • Reductions in waterlogging and groundwater flooding.
		Flood Risk: • Creation of flood storage and decrease in peak flood level (>10mm).
Moderate beneficial	Results in moderate improvement of attribute quality	Surface Water: • HEWRAT assessment of both acute-soluble and chronic-sediment related 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). • Contribution to improvement in water body WFD classification.
		Groundwater: • Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). • Contribution in improvement in water body WFD classification. • Improvement in water body catchment abstraction management strategy (CAMS) (or equivalent) classification. • Support to significant improvements in damaged GWDTE.
		Flood Risk: • Creation of flood storage and decrease in peak flood level (>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. • Improvement in water body WFD classification.
		Groundwater: • Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. • Increased recharge to an aquifer. • Improvement in water body WFD classification.
		Flood Risk: Creation of flood storage and decrease in peak flood level (>100mm).
No Change		No loss or alteration of characteristics, features, or elements; no observable impact in either direction.

Significance of effect

13.3.24 The approach to deriving the effects significance from receptor value and magnitude of impacts is based on the significance matrix set out in the DMRB LA 104 (Ref 13.37) and reproduced in Table 4.3, Chapter 4: Environmental Assessment Methodology. The matrix combines receptor importance (Table 13.2) with magnitude of impact (Table 13.3). Where the significance of effect is represented by two descriptors in Table 4.3 (for example large/ very large), professional judgement based on knowledge and experience of similar schemes has been used to determine which of the significance descriptors applies to the effect being assessed.

13.3.25 The matrix has been used to guide the identification and assessment of effects on water resources; however, where professional judgement has resulted in a deviation from the thresholds contained in the matrix, these are explained within the relevant sections of the chapter and are supported by appropriate evidence and explanation. The negligible environmental value (sensitivity) is not included as the importance of receptors for the water environment does not include receptors of negligible importance.

13.3.26 Effects that are anticipated to be moderate, large or very large are considered to be significant (in planning terms).

Flood Risk Assessment

13.3.27 A FRA has been prepared for the Scheme in accordance with NPSNN and NPPF requirements. The assessment related to the flood risk within this chapter draws upon the studies and conclusions made within the FRA. The FRA is provided in Appendix 13.1 [TR010054/APP/6.3].

13.3.28 Any effects identified through the FRA, during either construction or operation phases, have been evaluated and a significance value attributed to each effect in accordance with the methodology outline in this chapter. This impact assessment only considers the potential impact of the Scheme on flood risk, not the suitability of the Scheme in the context of flood risk acting on the site. For an assessment of the suitability of the Scheme in this location please refer to Appendix 13.1 [TR010054/APP/6.3].

13.3.29 The magnitude of impact was determined based on the criteria in Table 13.3 taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely. Likelihood has been considered in the case of water resources only, as likelihood is inherently included within the FRA.

WFD assessment

13.3.30 A WFD assessment has been produced based on a combination of desk study, hydromorphological walkover, aquatic ecology and water quality surveys. This assessment considers whether the Scheme has the potential to:

- cause deterioration in ecological status and potential of waterbodies;
- prevent waterbodies from meeting their objective of ‘Good’ ecological status/ potential; and/or

- prevent or compromise WFD objectives being met in other waterbodies or water dependent protected area downstream of the Scheme.

13.3.31 In undertaking the assessment, consideration has been given to the conservation objectives for any ecologically sensitive sites, where these might be more stringent. The WFDa is presented in Appendix 13.4 [TR010054/APP/6.3].

Scoping response

13.3.32 The proposed scope of the road drainage and water environment assessment was detailed in the EIA Scoping Report (Ref 13.38) submitted to the Inspectorate on 11th January 2019. An overview of the Inspectorate's Scoping Opinion in relation to the road drainage and water environment is presented in Table 13.4. Where the assessment has been undertaken in accordance with the scoping opinion point, a response and the relevant ES section is provided; where an alternative approach has been agreed with the relevant stakeholders, an explanation is provided.

Table 13.4: Scoping opinion and response

Scoping Opinion	Where addressed in the ES
The Inspectorate	
There appears to be two study areas under consideration in terms of distance from the proposed DCO boundary. The Inspectorate recommends that these are clarified, and that, given that the underlying hydrogeology represents a plausible pathway to private drinking water supplies, further consideration is given to these as receptors. The Applicant should ensure that the assessment is consistent with any assessment of significance based on hydrogeology and hydrology criteria adopted for the Geology and Soils assessment. This includes the assessment of Controlled waters. The EA [Environment Agency] provide advice on the sensitivity of the development area in terms of hydrogeology and Controlled waters in their response in Appendix 2.	Refer to Section 13.3 'Assessment methodology' and Section 13.5 'Study area'.
The ES should describe where bridge/ culvert structures are proposed and demonstrate that there is sufficient detail regarding the design as to inform a meaningful assessment of flood risk, and effects on watercourse hydraulics and ecology. The scope of assessment, as well as the location, design, and configuration of bridge and culverting works, must be agreed with the EA [Environment Agency] and Lead Local Flood Authority (or the internal drainage board).	Chapter 2: The Scheme describes the bridges and culvert structures proposed as part of the Scheme. Appendix 13.1 [TR010054/APP/6.3] provides an assessment of flood risk. Refer to Section 13.3 'Assessment methodology' paragraph 13.3.33 to 13.3.34 for details of consultation with the Environment Agency. Any effects on hydromorphology have been assessed within the WFD assessment report within Appendix 13.4 [TR010054/APP/6.3], and summarised within this assessment chapter paragraphs 13.9.122 to 13.9.126.

Scoping Opinion	Where addressed in the ES
Environment Agency	
As a minimum, we ask that the following return periods are modelled; 1 in 20 year, 1 in 100 year, 1 in 100 year plus climate change (50%) and 1 in 1000 year. We require the baseline flood risk (the current state or pre-development flood risk) and the post scheme flood risk, so we are able to see the impact on flood risk in the area.	Refer to Appendix 13.1 FRA [TR010054/APP/6.3].
The FRA needs to include assessment of the appropriate climate change allowances for this catchment and also a floodplain compensation scheme, for any floodplain that may be lost as a result of development or land raising within the 100 year plus climate change floodplain.	The appropriate climate change allowances have been included within the modelling and is stated within the FRA. Refer to Appendix 13.1 FRA [TR010054/APP/6.3].
Our 2016 climate change guidance is available here https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances however it should be ensured the FRA is undertaken in line with any updated guidance which may be made available in the near future.	Refer to Appendix 13.1 FRA [TR010054/APP/6.3].
We recommend you contact Staffordshire County Council as the Lead Local Flood Authority to ascertain their requirements with regards to any flood risk as they may require that hydraulic modelling is undertaken as part of the FRA.	Refer to Section 13.3 'Assessment methodology' para 13.3.33 details of consultation with SCC.
The Strategic Flood Risk Assessment for South Staffordshire is currently under revision in support of the Local Plan Review, and as such it should be ensured any FRA uses the best available information.	Refer to Section 13.3 para 13.3.10 to 13.3.17 for details of data sources.
Measures should be taken to ensure that silt, soil and suspended solids do not enter any watercourses as a result of the development, particularly during the construction phase. Such measures would accord with legal compliance and best practice guidance.	Refer to Section 13.8 'Design, mitigation and enhancement'.
It is essential that no deterioration of Saredon Brooks' water quality, channel, habitat or ecology occurs as a result of construction phase or pollution during the routes use when completed.	Refer to Appendix 13.4 WFD Assessments [TR010054/APP/6.3] and Section 13.9 'Assessment of likely significant effects'.
The final drainage scheme should be designed to maximise water quality benefits, ideally also with consideration of provision for water-based ecology. We would expect the utilisation of settling pools as part of a SUDs scheme to filtrate pollutants from the road runoff prior to discharge and monitoring of these pools to ensure they are effective and maintained in perpetuity.	Refer to Appendix 13.2 Drainage Strategy [TR010054/APP/6.3] and Section 13.8 'Design, mitigation and enhancement'.

Scoping Opinion	Where addressed in the ES
Salmonid spawning season from 1st October to 31st May inclusive for salmonid rivers and any works on existing barriers to Eel Migration would be required to improve eel migration under the Eels (England and Wales) Regulations 2009.	Refer to Section 13.8 'Design, mitigation and enhancement' and Appendix 13.4 WFD Assessment [TR010054/APP/6.3].
Although the initial surveys have not found signs of water vole and otter these are highly mobile species so any crossings should include measures to allow their movement.	Refer to Chapter 8: Biodiversity, Section 8.8 'Design, mitigation and enhancement' and Appendix 13.4 WFD Assessment [TR010054/APP/6.3].
We note mitigation measures such as dust suppression and replacement wildlife ponds are proposed as part of the scheme. If water is required for these purposes, then depending on the source of water and volumes required, abstraction or impoundment licences may be required from us. A licence must be in place before abstraction or impoundment takes place. It can take up to 4 months from receipt of a valid application for a licence to be issued. There is no guarantee that a licence could be granted as it is dependent upon water resource availability. Any licence issued could contain conditions requiring abstraction to cease at times of lower flows.	Refer to Section 13.8 'Design, mitigation and enhancement' relevant licences will be obtained by the contractor prior to works beginning.
As of 1 January 2018, dewatering works may also require an abstraction licence. Only emergency dewatering and small scale temporary dewatering will be exempt from this requirement.	Refer to Section 13.8 'Design, mitigation and enhancement'. Relevant licences will be obtained by the contractor prior to works beginning.
We would also like to highlight that although the construction over bridges over the watercourses will not require a permit from the EA [Environment Agency] as the proposed locations are Ordinary Watercourses only (LLFA responsibility) any proposed surface water discharges will require a permit from us. Development within the mapped floodplain will however require a Flood Risk Activity Permit.	Refer to Section 13.8 'Design, mitigation and enhancement'. Relevant Licences will be obtained by the contractor prior to works beginning.
Public Health England	
The promoter states that impacts on groundwater following disturbance of contaminated ground or groundwater are presented within Chapter 10 Geology and Soils. However, the groundwater abstractions and private water supplies identified within the Road Drainage and Water Environment Chapter have not been identified within the Geology and Soils Chapter. There appears to be two different study areas under consideration in terms of distance from the proposed DCO boundary. We recommend that this is clarified, and that, given that the underlying hydrogeology represents a plausible pathway to private drinking	Refer to Section 13.5 'Study Area'

Scoping Opinion	Where addressed in the ES
water supplies, further consideration is given to these as receptors.	
Staffordshire County Council	
The Scoping Report includes a section on Road Drainage & The Water Environment (S14), which identifies the key watercourses and relevant issues. It confirms that a detailed Flood Risk Assessment, including surface water drainage strategy, will be undertaken in consultation with the LLFA and Environment Agency. This will be presented separately, with summary text included in the Environmental Statement. We are content with this approach from an LLFA perspective.	Refer to Section 13.3 'Assessment methodology' paras 13.3.33 to 13.3.34 for details of consultation. Refer to Appendix 13.1 FRA [TR010054/APP/6.3].

Consultation

13.3.33 The following key consultation has been undertaken to discuss and agree scope, methodology and mitigation measures:

- The Environment Agency has been consulted on the general approach for establishing baseline conditions, which included surface and groundwater abstractions, groundwater aquifer status, surface water quality, ecology data, active discharge consents, water pollution incidents, confirmation of WFD waterbodies, and a review of hydraulic model for the Latherford Brook (Watercourse 4 and 5). Drainage strategy proposals and preliminary structures design information has been discussed with the Environment Agency. Meetings were held on 9 May, 18 July and 6 of August 2019.
- SSC were consulted on the presence of any private water abstractions within the study area.
- The LLFA, SCC attended a consultation meeting on the 10 of June 2019. SCC advised on the requirements of the Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]), as well as agreeing to review the hydraulic models for Watercourse 1,2,3 and 6 along with the FRA report, and the design of culverts/watercourse crossings as the Scheme outline design progressed. (Appendix 13.1 [TR010054/APP/6.3]).
- Sow and Penk Internal Drainage Board were consulted on the 11 July 2019. The Internal Drainage Board had no additional comments concerning the baseline or the development of the Scheme, given that the Scheme boundary does not intersect their area.
- The Environment Agency, LLFA SCC and AECOM attended a meeting on 6 August 2019 to present and discuss the results of the flood modelling and present the proposed structures to be constructed as part of the Scheme.

13.3.34 The Preliminary Environmental Information (PEI) Report for this Scheme was published in May 2019 as part of the statutory consultation. The PEI Report presented the environmental information collected, together with the preliminary findings of the assessment of likely significant environmental effects of the Scheme

at the time. Comments received during public consultation and the associated responses, are detailed within the Consultation Report [TR010054/APP/5.1].

13.4 Assessment assumptions and limitations

13.4.1 The assessment has been based on the Scheme description and limits of deviation described in Chapter 2: The Scheme and the Works Plans [TR010054/APP/2.4] in order to establish a realistic worst-case assessment scenario.

Limits of deviation

13.4.2 This scenario has identified and reported the effect that any lateral and vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components of the Scheme to be brought into closer proximity to water receptors, and therefore potentially resulting in a different effect.

13.4.3 The FRA (Appendix 13.1 [TR010054/APP/6.3]) has considered lateral and vertical deviation during the modelling of the Scheme design, but not modelled such potential changes. In certain circumstances and locations, the downward limit of deviation would not be achievable, these locations would be determined during the detailed design phase, and may include, for example, culvert crossings or areas at potential risk of fluvial flooding.

13.4.4 Notwithstanding any potential deviation, and subject to the above limitation, it is considered all water environment mitigation measures described in Section 13.8 would still be deliverable within the limits of deviation.

Baseline conditions

13.4.5 The assessment has been undertaken with reference to the baseline data, information and records pertaining to the water quality derived from desk study sources. These were subsequently validated and enhanced through field surveys where land access was obtained from landowners.

13.4.6 The assessment is based on the best available water quality data provided by the Environment Agency, supplemented by monitoring undertaken between February 2019 to November 2019.

13.4.7 In the absence of background or field monitoring water quality data for Watercourses 1 and 7 (due to the watercourses being dry during monitoring visits), it is assumed that the data from Watercourse 2 is comparable, based on its nearby catchment location and proximity. The sampling point for Watercourse 2 is also upstream of the assessment location for Watercourse 7. All three watercourses share the same underlying superficial and solid geology, with similar mainly rural catchments, with some inputs from the transport network. The baseline data and records obtained are considered to be a snapshot of conditions present at the time of sampling, but it is considered that these would represent an approximation of the conditions that would exist at the point of commencing Scheme construction, as described in Section 13.6.

13.4.8 Determination of Q95 low flows (i.e. the flow predicted to be exceeded 95% of the time) has been calculated by a desk-based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software. These are estimates of the Q95

flow and do not take account of the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes. However, this is the most robust data available to inform the assessment.

13.4.9 Estimates of channel width used in the assessments have been based on estimations obtained during a combination of site visit undertaken on 25 July 2019, and from online aerial imagery. Channel width, form and gradient have not been surveyed.

13.4.10 A dewatering assessment is presented in the groundwater technical note, Appendix 13.8 [TR010054/APP/6.3] describes relevant assumptions and limitations of that assessment. This assessment was based on groundwater monitoring between July and November 2019. Although there was significant rainfall in November 2019 and thus groundwater levels would be relatively high, groundwater levels usually reach their maximum in the late winter and early spring. Therefore, a sensitivity analysis has been undertaken using higher groundwater levels than recorded.

Mitigation and maintenance

13.4.11 The expected treatment performance of different SuDS options is based on advice reported in the DMRB CG501 (Ref 13.39) and HA103/06 (Ref 13.23). These are estimates and professional judgement has been used when deciding what percentage treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be 'optimum' or 'sub-optimum' due to other constraints.

13.4.12 It is assumed in the assessment that all SuDS and drainage networks will be fully maintained and managed as per standard guidance and practice. Requirements for maintenance and management of vegetated drainage systems are described in HA103/06 (Ref 13.23).

13.4.13 The routine runoff and spillage risk water quality risk assessment is based on traffic data modelled for the Scheme. Assumptions used in this traffic modelling are not re-reported in this chapter.

13.4.14 All of the existing outfalls used within the assessment have been assumed based on the initial results of a drainage survey (see Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3])), plus local topography and the presence of watercourses.

13.4.15 Given that the construction year baseline is anticipated to be two years from the date of assessment, it is considered that the baseline conditions at the start of construction would not be significantly different to the baseline reported in this chapter.

13.4.16 For any planning applications which are granted and begin construction/are completed, it is assumed they would follow all best practice and legislation and would not cause any significant changes to the baseline conditions of the water resources in the area.

13.4.17 A temporary dam would need to be constructed to the west of the existing bridge over Lower Pool, so that water in the area of the pond to be lost could be dewatered

and any soft, wet, organic sediments excavated within a dry working area to minimise any impact on the retained portion of the lake. It is also assumed that wet and soft organic lake sediments would be dewatered on-site in an appropriate way that captures any leachate and/ or prevents infiltration to ground.

13.5 Study area

13.5.1 For the purposes of the water resource (flow and quality) assessment, a study area of approximately 1 km around the Scheme boundary has been considered, in order to identify surface and groundwater bodies that could reasonably be affected by direct impacts associated with the Scheme (i.e. there is a pathway between the Scheme and the waterbody).

13.5.2 Consideration has also been given to any attributes of surface water or groundwater bodies or water dependent ecological sites outside this study area, including the River Penk, as pollutants can propagate downstream. Professional judgment has been applied to identify the extent to which such features are included.

13.5.3 The flood risk study area comprises the 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:

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

13.5.4 The flood risk study area includes the extents of watercourses 1 to 6, 1 km upstream and 1 km downstream of the crossing locations.

13.6 Baseline conditions

13.6.1 Full details of the water environment baseline are provided in Appendix 13.4, the WFDa [TR010054/APP/6.3], with a brief summary provided herein.

Topography, rainfall and land use

13.6.2 Topographic data for the study area has been obtained from the HADDMS and Ordnance Survey mapping. The study area slopes from 190 m above ordnance datum (AOD) just south of the M54 at the Essington Industrial Estate towards the Latherford Brook (Watercourse 5 – refer to Figure 13.1 [TR010054/APP/6.2]) to the north, which flows beneath the M6 to the east of Brookfield Farm (SJ 95930 06067).

13.6.3 Latherford Brook flows from close to the south-east of the M6 Junction 10a, and after initially flowing north-east beneath the M6 it then returns under the M6 south of Junction 11 and flows towards the north-west. At the point Latherford Brook crosses the M6 south of Junction 11, the elevation is between 130 m and 125 m AOD. The land rises to the west of the brook, towards the village of Shareshill (135 m AOD). To the north of the brook land rises towards Saredon Hill (154 m AOD) and Great

Saredon (135 m AOD), and to the east of the brook the land rises towards Holly Bush Farm (158 m AOD), which is to the east of the M6. Westwards from M54 Junction 1 to M54 Junction 2, the topography slopes down towards the west from approximately 134 m AOD to 106 m AOD.

13.6.4 Rainfall data has been collected from an automatic Meteorological Office weather station at Penkridge, 8 km north-east of M6 Junction 11 (NGR SJ 923 141) for the period 1981-2010. The weather station recorded an average of 681 mm of rainfall per year, which is relatively low for the UK, with it raining more than 1 mm on around 125 days per year. The average rainfall varies throughout the year, with it being wettest in the autumn-winter period and driest in late winter and early spring. Within the met data, it is stated there are an average 47 days with air frost per year, with the potential for de-icant use on roads most likely during November to March.

13.6.5 SCC define the A460 as a primary gritting route, and Hilton Lane as a road to be gritted in severe weather only. Typically, de-icant may be applied whenever the temperature is around 4ºC or below.

13.6.6 The Scheme crosses an area of predominantly agricultural land, comprising arable and livestock fields (sheep and equine pasture). There are also some urban land uses to the west around Featherstone, Hilton and Shareshill. In addition, Millride Country Sports Fishery and equestrian centre located adjacent to the southern extent of the study area, whilst Hilton Hall and Park is situated adjacent to the east of the study area. In addition, there are the Kings Pool Fishery located west of the A460 north of Featherstone, Brookfield Fishery towards the north of the Scheme, and Tower House Farm pond (near Old Ride) to the east of M54 Junction 1.

Geology and Soils

13.6.7 Full details of the geology and soils baseline is presented in Chapter 9: Geology and Soils. This section presents a summary of this information.

13.6.8 Made ground is present in the area south of Junction 1 of the M54 which is likely to be colliery spoil. There is also 'worked ground' up to 5 m thick, in the area of Junction 11 of the M6. Superficial deposits are mapped as Devensian Till under much of the area. These are described by the BGS as '*variable lithology, usually sand, silty clay with pebbles, but can contain gravel rich, or laminated sand layers; varied colour and consistency*'. From an assessment of the findings of the 2019 ground investigation (see Ground Investigation Report, Appendix 9.1 [TR010054/APP/6.3]), it is considered that the superficial deposits are dominated by granular deposits of sand with occasional gravel and till (boulder clay). The more extensive and thickest deposits are located in the northern part of the Scheme. The cohesive superficial deposits are present mainly in the south-western area of the Scheme. Alluvial deposits are shown to be present in the area of Watercourse 2. No superficial deposits are present in areas around Tower House Farm, Rosemary House (on Hilton Lane) and the area south of Watercourse 2 alluvial deposits.

13.6.9 The bedrock geology is shown by BGS mapping to be the Chester Formation (Sandstone and Conglomerate Interbedded) of the Sherwood Sandstone Group bedrock geology underlies the majority of the Scheme boundary. Along the eastern

edge of the Scheme boundary there are areas of the underlying Clent Formation and Enville Formation, described by the BGS as undifferentiated mudstone and sandstone.

13.6.10 The bedrock geology of the section from Junction 2 of the M54 towards Junction 1 of the M54 is Helsby Sandstone Formation, which is described by the BGS as '*fine to medium grained locally micaceous, cross bedded and flat bedded sandstones, with weathering to sand near the surfaces*'.

Surface water resources

13.6.11 The following key surface waterbodies have been identified within the 1 km study area (refer to Figure 13.1 [TR010054/APP/6.2]):

- Watercourses 1 to 4; unnamed ordinary watercourses;
- Watercourse 5, Latherford Brook an ordinary watercourse and WFD designated watercourse. Tributary to the WFD designated Saredon Brook (GB 104028046740);
- Watercourse 6 and 7, unnamed ordinary watercourses;
- Watercourse 8; Waterhead Brook an ordinary watercourse;
- River Penk, a main river and WFD designated;
- Saredon Brook a main river and WFD designated;
- Staffordshire and Worcestershire Canal;
- Tower House Farm Pond (near Old Ride);
- Kings Pools Fishery Ponds;
- Lower Pool;
- Chubb Angling Club Fishing Ponds;
- Hilton Hall Pond;
- Brookfield Fishery;
- Fishing Ponds east of Brookfield Farm;
- Millride Country Sports Fishery; and
- Former Sand and Gravel pits.

13.6.12 No further waterbodies with hydraulic connectivity were identified from Ordnance Survey mapping or site surveys further to those outlined above.

13.6.13 During a review of baseline information, no known socio-economic uses of the watercourses has been noted. The known fishing uses are located on specialist ponds/fisheries and not on the watercourses themselves.

13.6.14 Following review of the baseline water environment, impacts to the following receptors have also been scoped out of the assessment:

- The Staffordshire and Worcestershire Canal is located 260 m west of the Scheme boundary. The works in this area of the Scheme boundary consist of alterations to and the addition of new signs only. There is a Priority Outfall taking road drainage into the canal at this location. However, it is classified on

HADDMS (Ref 13.33) as a 'risk addressed' outfall as a study (Ref 13.40) concluded that this outfall (Asset Reference: SJ 9104_2044) discharges only land surface runoff and not highway surface runoff. The Staffordshire and Worcestershire Canal is scoped out of the assessment based on the minor nature of the works in the area between Junction 1 and Junction 2 of the M54. These works represent a low risk of causing water pollution to the canal which would be mitigated by standard construction mitigation measures. No outfalls of road drainage would enter the canal at this location. This approach has been agreed with the Canal and River Trust.

- Watercourse 8 is scoped out of the assessment as Watercourse 8 does not cross the Scheme boundary and it would not be impacted directly or indirectly by the Scheme. This approach has been agreed with the Environment Agency.
- Former Sand and Gravel Pits are scoped out of the assessment based on their location south of M54 Junction 1. These ponds are not online to any watercourses which would receive road drainage and the ponds are located approximately 20 m higher than the drainage pathways for the Scheme, therefore there would be no pathway between Scheme and the receptor via surface or groundwater. This approach has been agreed with the Environment Agency.
- Millride Country Sports Fishery: scoped out based on its location upstream of the M54. This approach has been agreed with the Environment Agency.

13.6.15 The full WFD waterbodies classification is contained within the WFDa (Appendix 13.4 [TR010054/APP/6.3]). A summary of the information contained in that report is given below in the order of the watercourses 1 to 7.

13.6.16 Watercourse 1 is a minor Ordinary Watercourse approximately 600 m in length that flows in a south-east to north-westerly direction, having risen from its source approximately 0.5 km to the south of M54 Junction 1. It flows beneath the M54 and joins an unnamed watercourse (Watercourse 2) to the south of Featherstone. Its form suggests that the watercourse may have been modified (straightened).

13.6.17 Watercourse 2 has its source to the east of M54 Junction 1 close to Tower House Farm. It has a narrow channel and stream corridor that has been previously re-profiled with evidence of the new channel cutting down into the soft substrate. The watercourse is culverted beneath the A460 and flows westward along the southern border of Featherstone. Watercourse 1 joins from the south at the south-west corner of Featherstone. From this confluence, the watercourse continues in a generally easterly direction with Watercourse 7 flowing into it from the south to the east of the Railway Line. Continuing from this confluence, the watercourse crosses beneath the Staffordshire and Worcestershire Canal before joining the Watershed Brook. This then discharges into the River Penk to the south-west of Coven. Watercourse 2 is an Ordinary Watercourse.

13.6.18 Watercourse 3 is an Ordinary Watercourse which emanates from the ponds west of Hilton Hall. The watercourse flows from the Lower Pool area, alongside Dark Lane in a westerly direction, before being culverted under the A460, and alongside the Kings Pool Fishery. After this it continues westwards towards Featherstone Lane

before again flowing north-west towards the direction of the Staffordshire and Worcestershire Canal. It is shown as crossing the canal within a culvert on Ordnance Survey mapping. which it flows beneath. Watercourse 3 is an ephemeral watercourse.

13.6.19 Watercourse 4 is an Ordinary Watercourse which rises to the east of Hilton Ponds and flows north and north-west where it passes through the Fishing Ponds east of Brookfield Farm at high flow, and bypasses the ponds at low flows. It then passes to the south of the ponds at Brookfields Fishery, before flowing in a culvert under the A460, continuing to the north-west to meet Watercourse 5 to the north-east of Shareshill, and south of Little Saredon.

13.6.20 Latherford Brook (Watercourse 5) is an Ordinary Watercourse which is a tributary of the Saredon Brook and is designated under the WFD as 'Saredon Brook from Source to River Penk' (GB104028046740) within the Humber River Basin District. Saredon Brook rises at Wood Common, south-east of Fishley Lane, close to M6 Junction 10a and it flows to the north-east beneath the slip roads at Junction 10a to the east of the Hilton Park Services. A small tributary that rises to the east of the M6 meets Watercourse 5 to the north of Hilton Lane. The watercourse then flows to the north-west and crosses beneath the M6 approximately 600 m south of Junction 11. It continues north-west beneath the A460 before passing the village of Shareshill on its northern side. It then discharges into Saredon Brook at grid reference SJ 928 082 and then flows to the River Penk, north of the village of Coven. It is approximately 25 km in length with a catchment area of around 7050 ha. The brook is crossed by the M6 2 km north of the M6 Junction 10a. It is a heavily modified watercourse and is classified as being at Moderate Potential (due to Moderate Ecological Potential; Chemical Status is Good). The reasons for not achieving Good Potential include:

- Point source pollution from intermittent and continuous sewage discharges associated with the water industry (affecting invertebrates, ammonia, phosphate, and dissolved oxygen classification).
- Diffuse pollution sources associated with livestock farming, urbanisation, transport drainage and industry (affecting invertebrates, dissolved oxygen, phosphate, and ammonia classification).
- Physical modification deriving from urban development (affecting invertebrate classification).

13.6.21 Of these reasons for not achieving Good Status, those that relate to urban development are relevant to the Scheme, while those relating to sewage discharge and livestock are scoped out of further consideration.

13.6.22 Watercourse 6 is an Ordinary Watercourse has its source to the east of M6 Junction 11 and Laney Green. It flows in a north-west direction, passing beneath the A460 and the M6 Toll before taking a more northerly direction, crossing Saredon Road. It continues north to discharge into Saredon Brook north of Wood Lane. The watercourse is ephemeral in nature and deposits of finer sediment within the channel suggested deposition process.

13.6.23 Watercourse 7 is an Ordinary Watercourse and a tributary of the River Penk (from Source to Saredon Brook), rises alongside the railway tracks east of the Wolverhampton Business Park, situated south of the M54 Junction 2. It flows in a northerly direction, crossing beneath the M54 continuing alongside the railway tracks for approximately 510 m before discharging into Watercourse 2.

13.6.24 The River Penk is a Main River and designated under the WFD as 'Penk from Source to Saredon Brook' (GB104028046680) within the Humber River Basin District. At its closest point, the River Penk is 2 km from the Scheme boundary.

13.6.25 The Staffordshire and Worcestershire Canal is located 250 m west of the western extent of the Scheme boundary located to the west of M54 Junction 2. It has an approximate north to south alignment and is a designated WFD Waterbody (GB70410266) under the 'Staffordshire and Worcester Canal, summit to Lower Penn. It has a current overall status of Moderate, and has met its objective of Moderate by 2015.The whole area is part of a surface water Nitrate Vulnerable Zone for water supply to the River Trent. The area does not contain any drinking water safeguard zones – either groundwater or surface water.

Water activity permits

13.6.26 Water Activity Permit (formerly discharge consents) information has been obtained from the Environment Agency. The data received from the Environment Agency includes the location and type of the discharges and this is presented in Appendix 13.7 [TR010054/APP/6.3] Table 2.

13.6.27 The discharge locations are shown on Figure 13.1 [TR010054/APP/6.2]. Within the study area these include discharges from Severn Trent Water for sewage pumping station discharges, settled pumped quarry water, and secondary treated sewage effluent from a Dogs Home.

Water abstractions

13.6.28 Information on licenced abstractions has been obtained from the Environment Agency, and information on Private Water Supplies (PWS) have been provided by SSC. The licenced and private water abstractions are shown on Figure 13.1 [TR010054/APP/6.2] and are labelled as A1 – A28 (with the two unlicensed domestic abstractions also labelled with 'PWS') and differentiated as either groundwater and surface water abstractions. Information on the abstractions, including the PWS are tabulated in Table 1 in Appendix 13.7 [TR010054/APP/6.3].

13.6.29 The following abstractions have been scoped in to further assessment: A3, A4, A7, A8, A9, A20 and A21. SSC confirmed that there are two PWS within the study area. These are a borehole at Latherford Farm, located approximately 1.7 km from the Scheme (A8)), and a spring located at Saredon Hall Farm north east of Junction 11a, approximately 725 m from the Scheme (A9). The remaining abstractions scoped in to the assessment are for industrial process water (A3 GW, A20 GW), spray irrigation/agriculture (A4 SW, A7 GW, A21).

13.6.30 Abstractions (A1, A2, A5, A6, A10 – 19 and A22 – 28) have been scoped out of further assessment in agreement with the Environment Agency.

Water quality monitoring

13.6.31 Surface water quality monitoring has been undertaken on a quarterly basis during 2019 the results are included in Appendix 13.5 [TR010054/APP/6.3]. The water quality sampling was undertaken to support the interpretation of waterbodies with regards to pressures acting on them and overall importance, in the context of existing background water quality data and other baseline information. It also provided site specific information on certain parameters needed for the HEWRAT assessment and application of the M-BAT tool. This also provided initial baseline data against which construction phase monitoring could be compared.

13.6.32 The levels of numerous metals at Watercourse 3 were regularly reported as exceeding the maximum allowable EQS vales. Dissolved iron, dissolved manganese, dissolved zinc, total chromium, total copper, total iron, total lead, total manganese, total mercury, total nickel and total zinc all surpassed the EQS values at least once. Notably, total manganese and total iron levels surpassed the EQS vales in each sample taken to date.

13.6.33 Numerous metals were reported at levels greater than the annual average or maximum allowable EQS at Watercourse 6. Dissolved manganese, dissolved nickel, total chromium, total manganese and total zinc all surpassed EQS values once. Total copper and total iron surpassed the EQS values twice whilst total zinc has surpassed the EQS values in each of the three samples taken. However, these were total concentrations and the dissolved EQS relates to dissolved. June samples recorded considerably higher metal content than any other of the two samples taken.

Lower Pool pond sediment survey

13.6.34 An investigation of sediment quality and quantity was undertaken to inform development of the Scheme. Lower Pool is labelled on Figure 13.1 [TR010054/APP/6.2]. Full details of the pond sediment survey are included within Appendix 13.6 [TR010054/APP/6.3].

13.6.35 An initial Hazwaste assessment has been carried out on the pond sediment samples. This flagged the sediment samples as being potentially hazardous based on the aluminium and iron content. However, this assessment is based on a worst-case scenario for the various aluminium and iron species. Further testing and analysis could result in the assessment of the sediments being classed as non-hazardous due to the metals being actually present as less hazardous species. When the affected part of Lower Pool is deterred and there is greater access to sediments, further sampling and analysis of the sediments should be undertaken in advance of any pond sediments being worked so that their status can be fully determined and whether they are suitable for re-use on site or have to be disposed-of as waste

Groundwater

13.6.36 The Environment Agency Catchment Data Explorer website (Ref 13.30) indicates that a section of the southern half of the study area lies within the Staffordshire Trent Valley – Permo Triassic Sandstone Staffordshire WFD groundwater body (GB40401G300500). Under the 2016 Cycle 2 classification this has an overall Water

Body Status of 'Poor'. The quantitative and chemical classifications are both also Poor. Please refer to the WFD Assessment in Appendix 13.4 [TR010054/APP/6.3] for more details.

13.6.37 The northern section of the study area is within the Staffordshire Trent Valley – Mercia Mudstone East and Coal Measures WFD groundwater body (GB40402G300300). This has an overall waterbody classification for 2016 of 'Good', including 'Good' quantitative and chemical status. Please refer to the WFD Assessment in Appendix 13.4 [TR010054/APP/6.3] for more details.

13.6.38 The majority of the study area is defined as Principal aquifer status associated with the Sherwood Sandstone. The area to the east of this is defined as Secondary A aquifer status.

13.6.39 The study area is not within a groundwater SPZ for a public water supply source, but land to the west of Featherstone (approximately 1 km to the west of the Scheme) is designated as a SPZ3 (i.e. total catchment - defined as the area around a source within which, all groundwater recharge is presumed to be discharging at the source). This abstraction is for a public water supply borehole at Slade Heath, approximately 4.1 km from the study area. This has been scoped out of the assessment due to the distance from the Scheme.

13.6.40 As part of the 2019 ground investigation (see Ground Investigation Report, Appendix 9.1 [TR010054/APP/6.3]), a series of boreholes were equipped for groundwater monitoring of the superficial deposits and the underlying bedrock. Groundwater level monitoring was carried out in 19 boreholes between July and November 2019. Ten of the boreholes facilitate monitoring of the superficial deposits and nine of the underlying bedrock. Borehole BH26 monitors the re-worked ground in the vicinity of M6 Junction 11 and records a water level much higher than the surrounding boreholes in both the superficial deposits and the bedrock. The results of the groundwater level monitoring for September and November 2019 are provided in Table 13.5.

13.6.41 Based on the results of the groundwater level monitoring, it is inferred that the groundwater level beneath the Scheme varies between being artesian (above ground level) and approximately 13 m below ground (m bgl). Overflowing artesian conditions have been recorded in boreholes BH19 and BH22A in the valley of the Latherford Brook (Watercourse 5) and in Watercourse 4, near Brookfields Farm respectively. Apart from borehole BH26, which is in reworked ground, the groundwater level in the superficial deposits and the bedrock is similar, which suggests that there is hydraulic continuity between the two layers, consistent with the dominantly granular nature of the superficial deposits.

13.6.42 From an assessment of the results of the September 2019 monitoring, which generally reflects the lowest levels recorded in each borehole, it is inferred that the groundwater level generally falls to the north-west and west from a level of approximately 138.4 m AOD in borehole BH12 in the vicinity of Hilton Hall Ponds to approximately 131.2 m AOD in borehole BH06 in the vicinity of the new Featherstone overbridge (new M54 Junction 1) and to approximately 122 m AOD in the vicinity of M6 Junction 11. Based on the groundwater levels, it is considered that the main

watercourses, in particular Latherford Brook and Watercourse 4, are in hydraulic continuity with the groundwater and that the groundwater provides baseflow support to the streams.

13.6.43 The final groundwater level monitoring visit was carried out between 18-20 November 2019. It is clear that between September and November 2019, the groundwater level has risen in response to the heavy rainfall during the autumn period. However, the direction of groundwater flow has not changed. In the superficial deposits, the groundwater level has risen by between approximately 0.6 m and a maximum of 2 m in boreholes BH18 and BH25. The groundwater level rise in the sandstone bedrock is less than in the superficial deposits with the groundwater level typically rising by between approximately 0.4 m and 0.8 m apart from borehole BH07 in which a rise of 1.4 m was recorded. It is likely that the groundwater level will rise further over the winter months. However, the expected additional groundwater rise is not considered to be more than 1 m, and as a worst case a further 2 m rise has been allowed for in the assessment presented in Appendix 13.8 [TR010054/APP/6.3].

13.6.44 A series of soakaway tests and falling head permeability tests were carried out as part of the 2019 ground investigation to obtain information on the geotechnical properties of the strata along the route. Soakaway tests were carried out on four trial pits at a depth of up to 2.5 m. The soakaway test on trial pit TP01 was carried out in made ground. The tests on trial pits TP09, TP14 and TP18 were all carried out in predominately natural, granular deposits (sand and sandy clay). The resultant calculated permeability values for the natural deposits varied between 6.6 x 10^{-6}m/sec (0.057 m/day) and 1.0 x 10^{-6}m/sec (0.086 m/day) with an average of 0.0756 m/day.

13.6.45 Eight in-situ falling head tests were carried out in four boreholes at depths between 1.5 m and 4.5 m. All the tests were carried out on sand or sand and gravel. The calculated permeability values for the natural deposits varied between 9.07 x 10^{-8}m/sec (0.008 m/day) and 1.33 x 10^{-5} m/sec (1.149 m/day) with an average of 0.418 m/day, consistent with a fine to coarse sand and gravel.

Table 13.5: Groundwater level: September and November 2019

Borehole	Water level				Range (mbgl)	
	September		November		Highest	Lowest
	Dip (mbgl)	Water level (m AOD)	Dip (mbgl)	Water level (m AOD)		
Superficial deposits						
BH03	4.46	136.32	0.66 (approx.)	No data	4.25	Dry@ 4.50
BH12	1.40	138.39	0.62	139.17	0.62	1.40
BH16	7.77	134.69	6.77	135.69	6.77	7.77
BH18	3.55	134.27	1.55	136.27	1.55	3.55

Borehole	Water level				Range (mbgl)	
	September		November		Highest	Lowest
	Dip (mbgl)	Water level (m AOD)	Dip (mbgl)	Water level (m AOD)		
BH20	12.46	127.08	10.74	128.80	10.74	12.96
BH21	1.98	123.67	1.35	124.30	1.35	1.99
BH24	4.06	121.61	3.01	122.66	3.01	4.13
BH25	9.03	121.76	7.02	123.77	7.02	9.03
BH26	4.87	132.17	5.01	132.03	4.75	5.01
BH27	13.10	123.20	12.48	123.82	12.48	13.10
Bedrock						
BH04	5.48	130.31	5.04	130.75	5.04	5.48
BH05	3.72	130.61	3.27	131.06	3.27	3.79
BH06	3.31	131.20	3.06	131.45	3.06	3.52
BH07	6.46	131.01	5.03	132.44	5.03	6.46
BH08A	3.65	138.52	3.01	139.16	3.01	3.79
BH09	9.21	132.15	8.83	132.53	8.83	9.28
BH10	5.70	131.05	4.89	131.86	4.89	5.80
BH11	4.90	133.38	4.43	133.85	4.33	4.92
BH22A	Artesian	>124.54	Artesian	>124.54	Artesian	
BH19	Artesian	>130.39			Borehole backfilled	
[+] - July to November 2019						

Pollution incidents

13.6.46 Details of pollution incidents as recorded on the National Incident Reporting Systems were provided by the Environment Agency for the period 2013 to 2019. Only five incidents were of note with regards to the water environment, all of which were category 3 minor incidents. These are:

- Pool Farm, Mill Ride Fishing Ponds area, incidents of 'sewage' reported on 28 June 2018, and 9 August 2018. These took place over 1 km from the Scheme boundary. For the August incident, there were no fish kills, and it was listed as minor incident which was reported anonymously. For the June incident, the fisheries manager was not aware of any issues.
- On Dark Lane, 27 July 2016, an incident was reported. This was attributed to 'industry' as the source.
- On 4 September 2017 in the area of the sand and gravel pits to the south of M54 Junction 1, there was an incident 'likely related to sewage in the ponds'.

- On 10 September 2017, there was an accident on M54 Junction 1 which released a diesel spillage.

Aquatic ecology

13.6.47 Full details on the ecology baseline and potential impacts is presented in Chapter 8: Biodiversity. This section provides a summary of information related to the baseline surveys which have been undertaken.

13.6.48 Aquatic surveys have been undertaken within the eight fishing ponds and six watercourses located within the vicinity of the Scheme. The results are summarised below.

13.6.49 Eight fishing ponds were located within the vicinity of the Scheme and were visited during the site walk over to assess if further aquatic surveys were needed. Four ponds all within the Scheme boundary were surveyed for fish and white-clawed crayfish assessment, these were Tower House Pool, Lower Pool, and Brookfield Farm Ponds 1 and 2.

13.6.50 Six waterbodies were scoped in for fisheries surveys, these were Watercourse 2 to 6 (including an additional site on Watercourse outside of the Scheme boundary), while three waterbodies were scoped in for macroinvertebrate and white-clawed crayfish surveys, these were Watercourse 2, 5a and Brookfield Ditch.

13.6.51 White-clawed crayfish, a BAP (UK Biodiversity action plan) species were not captured during the surveys while the habitat present at Watercourse 5 within the Scheme boundary was deemed suitable to support a population. Historical data did not record their presence within the Scheme boundary.

13.6.52 Majority of fish captured at the running waterbodies were common freshwater fish in the UK with no protected status. Bullhead were of interest and captured at Watercourse 2. 3 and 5 downstream of the Scheme boundary. These species are listed on Annex II of the EC Habitats Directive and future mitigation should protected this species from disturbance.

13.6.53 Brown trout, a BAP species are known to be present within Watercourse 5. Fish are mobile species and their presence should be considered when developing mitigation options as they have the ability to move in to the Scheme boundary.

13.6.54 Carp, perch and roach were detected in the Tower House Pool and Lower Pool eDNA samples while roach, carp and perch were detected in Brookfield Farm Fishing Pond 1 and 2, in addition to a low detection of tench in Brookfield Farm Fishing Pond 1. These results were to be expected.

13.6.55 Across the three watercourses and seven ponds surveyed, a total of 145 macroinvertebrate taxa were recorded throughout three survey seasons (spring – autumn for the watercourses, summer for the ponds).

13.6.56 Most of the species recorded were very common, except the lesser water boatman *Sigara iactans* (‘Regionally notable’, Conservation Score 6) in Brookfield Fishery. It was first recorded on the Norfolk coast in 2005, as a presumed recent colonist, and its fairly rapid spread in England represents a natural extension of its range. It is now

considered an established native and consequently has no statutory designations (Cook 2015).

13.6.57 A total of 41 macrophyte species were recorded across the seven ponds surveyed. None of seven ponds sampled support communities of macrophytes of interest, however one of the species recorded is of conversation interest. The 'Nationally Scare' fringed water-lily (*Nymphoides peltata*) was recorded. This species is native to the fens of East Anglian and the Thames basin hence its Nationally Scare designation, however it is widely naturalised outside its native range.

13.6.58 However, two species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) were recorded: Montbretia (*Crocosmia x. crocosmiiflora*) in Chub angling Pond and Canadian waterweed (*Elodea canadensis*) in Lower Pool. In addition, the non-native terrestrial plant *Rhododendron* sp. was recorded on the banks of Brookfield Fishery. Disturbance of non-native invasive species will need to be managed appropriately during construction works in accordance with a Biosecurity Management Plan. Further details of this are provided in the OEMP [TR010054/APP/6.11].

13.6.59 None of the ponds were of good or excellent quality, nor identified as priority ponds. Out of the seven ponds that underwent a standard analytical technique, two were of poor quality with of Biotic Integrity score of 44% and 33 % for Brookfield Fishery and Brookfield Farm Pond 1. Brookfield Farm Pond 1 has a low macrophyte diversity and low macroinvertebrate diversity. However, although Brookfield Fishery had a low diversity of macrophyte species, it had a moderate macroinvertebrate diversity and the presence of *Sigara iactans* increases its value. Five other ponds were determined as being of moderate quality ranging from 56% to 67% of Biotic Integrity score. The Lower Pool fishing pond scored highest overall quality out of the seven ponds, due to high number of macroinvertebrate families present (27) and high macrophyte species diversity.

13.6.60 Although no species of conservation interest were recorded within the three watercourses surveyed, Watercourse 2 supports a diverse macroinvertebrate community, while Watercourse 5 had a lower taxonomic diversity. In addition, Watercourse 2 and Watercourse 5 support macroinvertebrate communities adapted to relatively fast flowing conditions and likely to be sensitive to pollution and sedimentation, as indicated by the high average score per taxa (ASPT) (5.1 to 5.3) and the proportion of sediment-sensitive invertebrates (PSI) scores (indicative of 'Slightly sedimented' to 'Moderately sedimented' conditions). The analyses demonstrated that the Unnamed Ditch supports communities more adapted to slow flowing conditions and likely to be more tolerant to pollution and sedimentation, as indicated by the lower ASPT (4.4) and the PSI score indicative of 'Sedimented' conditions.

Water dependent ecological sites

13.6.61 Using Defra's online MAGIC map (Ref 13.42), and with reference to Chapter 8: Biodiversity, the following designated sites of ecological importance were identified within the vicinity of the Scheme:

- Lower Pool Site of Biological Importance (SBI), the pond.
- Brookfield Farm SBI, wet woodland.

13.6.62 The Lower Pool SBI has been taken into consideration in the assessment of impacts on the water body in terms of surface water pollution and morphological change. However, an investigation of pond sediments has been carried out (reported in Appendix 13.6 Sediment Sampling of Lower Pool [TR010054/APP/6.3]) and this showed that the pond is founded on clay-rich substrate restricting any connectivity with groundwater.

13.6.63 Brookfield Farm SBI is an area of wet woodland close to watercourse 5, Latherford Brook, and just east of the alignment of the new link road. It is understood that the site has been drying out for unknown reasons. The Site does inundate during flood conditions but during the highest frequency events (e.g. 1 in 2 year event), the change is almost imperceptible (see FRA presented in Appendix 13.1 [TR010054/APP/6.3]. The difference is slightly greater for the 1 in 20 year event, but this is not thought to be significant in habitat terms. Finally, during the 100 year plus 50 % climate change events the extent of flooding is significantly greater, but this frequency of event is unlikely to be a driver for the habitat types present. From observations of groundwater monitoring within boreholes BH20, 21 and BH24 the gradient of the water table, and therefore, groundwater flow can be estimated. The groundwater gradient to the north of Latherford brook is from north to south and to the south of Latherford Brook is south to north. The hydraulic gradient in the area of Brookfields Farm SBI, which is south of Latherford Brook, will be towards the north and Latherford Brook. On this basis, no further assessment of the Brookfields Farm SBI is included in this assessment, as groundwater reaching the site will be from the south where no construction activities are taking place. Additionally, the Scheme will be constructed on embankment through this area, and therefore there will be no impact to groundwater levels in this area. On this basis, no further assessment of the Brookfields Farm SBI is included in this assessment.

13.6.64 Other water dependent ecological sites are located within 1 km to 2 km from the Scheme boundary but have been scoped out due to distance and lack of hydrological connectivity.

13.6.65 Overall, no GWDTE have been identified that require assessment.

Flood risk

13.6.66 A FRA is provided in Appendix 13.1 [TR010054/APP/6.3], which assesses the present risk of flooding from all sources including fluvial, surface water, groundwater, artificial sources and sewer and water supply infrastructure. Refer to the FRA for a full description of the flood risk baseline summarised below.

Watercourse 1 and 2

13.6.67 According to the Environment Agency's Flood Map for Planning (Ref 13.31), land directly adjacent to both Watercourse 1, Watercourse 2 and the wider area is located entirely within flood zone 1 (i.e. at low risk of fluvial flooding). This classification is due to there being no river models which cover these watercourses. Hydraulic modelling of these watercourses was undertaken as part of the FRA (Appendix 13.1

[TR010054/APP/6.3]). This modelling found that the channel in the vicinity of the Scheme does not exceed capacity in the 1 in 100 year rainfall event (or 1% Annual Exceedance Probability (AEP)) and as such the land surrounding the channel is not located in flood zone 3. However, the capacity of the channel would be marginally exceeded with a 1% AEP event plus 50% allowance for climate change, and the 0.1% event at the existing A460 culvert, potentially resulting in localised flooding. As such the land surrounding the channel is located within flood zone 1 (refer to Section 3 of Appendix 13.1 [TR010054/APP/6.3]).

Watercourse 3

13.6.68 According to the Environment Agency's Flood Map for Planning (Ref 13.31), land directly adjacent to the watercourse and the wider area is located entirely within flood zone 1 (i.e. at low risk of fluvial flooding). This classification is due to there being no river models which cover these watercourses. Hydraulic modelling of these watercourses was undertaken as part of the FRA (Appendix 13.1 [TR010054/APP/6.3]). This modelling found that the channel in the vicinity of the Scheme does not exceed capacity in the 1 in 100 year event (1% AEP), 1 in 100 year event plus 50% allowance for climate change or the 1 in 1000 year event (0.1% AEP), and as such the land surrounding the channel is located within flood zone 1.

Watercourse 4 and 5

13.6.69 The land immediately surrounding Watercourse 4 and 5 is classified as flood zone 2 and 3. flood zone 2 comprises of land having between a 1 in 100 (1% AEP) and 1 in 1,000 (0.1% AEP) annual probability of river flooding. flood zone 3 consists of land having a 1 in 100 (1.0% AEP) or greater annual probability of river flooding. As such, the Latherford Brook is considered at a medium and high risk of flooding. The modelling undertaken as part of the FRA (Appendix 13.1 [TR010054/APP/6.3]) shows a lesser flood zone 2 and 3 extent to the JFLOW modelling used to create the Environment Agency's flood mapping (Ref 13.31). These flood extents are believed to be more accurate given the resolution of the input data, along with the topographic channel survey and hydrology assessments undertaken as part of the FRA.

Watercourse 6

13.6.70 According to the Environment Agency's Flood Map for Planning, land directly adjacent to Watercourse 6 and the wider area is located entirely within flood zone 1 (i.e. at low risk of fluvial flooding). This classification is due to there being no river models which cover these watercourses. Hydraulic modelling of these watercourses was undertaken as part of the FRA (Appendix 13.1 [TR010054/APP/6.3]). This modelling found that the channel in the vicinity of the Scheme does not exceed capacity in the 1 in 100 year event (1% AEP), 1 in 100 year event plus 50% allowance for climate change or 1 in 1000 year event (0.1% AEP), and as such the land surrounding the channel is located in flood zone 1.

Watercourse 7, 8 and the Staffordshire and Worcestershire Canal

13.6.71 Although Watercourse 7, Watercourse 8 and the Staffordshire and Worcestershire Canal are located within the study area, they would not be impacted or altered by

the construction of the Scheme. Due to their distance from the Scheme boundary the Scheme would not alter the existing hydrological sub-catchments. Therefore, these waterbodies have not been included in the baseline flood model.

Surface water flood risk

13.6.72 The updated Flood Map for Surface Water (uFMfSW map) indicates that the majority of the study area is at very low risk of surface water flooding. There are areas of medium risk of surface water flooding located at a pond at Old Ride, Hilton Park, and at Brookfield Farm. There is also an area within Hilton Park with a high risk of surface water flooding. Watercourses 4 and 5 have a very narrow band at a high risk of surface water flooding which corresponds to the line of the channel. However, there is a low risk of surface water flooding on the banks in the immediate vicinity of all the watercourses. Please refer to Figure 3.5 of the FRA (Appendix 13.1 [TR010054/APP/6.3]) for further information on the location and extend of surface water flood risk across the study area.

Flooding from artificial waterbodies

13.6.73 The Environment Agency's long-term flood risk map (Ref 13.31) indicates that there is no risk of flood from reservoirs. Although there are several ponds identified within the study area that may be impacted by the Scheme, any potential change to flood risk is considered to be low. None of these ponds are designated as statutory reservoirs, according to the Reservoirs Act of 1975 (Ref 13.43).

13.6.74 The nearest canal to the Scheme is the Staffordshire and Worcestershire Canal, which is located approximately 1.6 km to the north of the Scheme boundary. The risk of flooding from artificial sources is therefore considered to be very low.

Flooding from groundwater

13.6.75 The Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWF) map (Ref 13.32) as published in the SSC Level 1 SFRA (Ref 13.25) splits the UK into 1 km grid squares. Of the grid squares that are located within the Scheme >25 - <50% of their area is considered to be susceptible to groundwater emergence. The type of groundwater flooding the area is at risk from is due to permeable superficial deposits which tend to have a relatively high water table.

13.6.76 Groundwater level information for the Scheme is provided in Table 13.5. This shows that apart from the areas in close proximity to the existing watercourses, the groundwater is generally more than 3 m bgl and it is considered unlikely that the groundwater level would naturally rise sufficiently to cause groundwater flooding across most of the Scheme boundary.

13.6.77 Overall, the risk from groundwater flooding to the Scheme is considered as low. Further information about ground conditions at the site and details regarding soakaway testing undertaken can be found in the Ground Investigation Report, Appendix 9.1 [TR010054/APP/6.3].

Tidal flooding

13.6.78 Due to the distance from the coast and lack of tidal influence on the identified watercourses there is considered to be no risk of tidal flooding from sources

including the sea and estuaries. The risk of tidal flooding is therefore not considered further in this ES.

Flooding from drains and sewers

13.6.79 Data provided by Severn Trent Water shows that there are few sewers and drains in the vicinity of the Scheme. There is a foul combined sewer along Hilton Lane, which crosses the Scheme footprint. Given the rural nature of the area surrounding the Scheme, the current flood risk from sewers and drains is considered to be low.

Future baseline

13.6.80 As detailed in Chapter 4: Environmental Assessment Methodology, in order to identify the effects of the Scheme on environmental features, it is important to understand the baseline conditions at the year of construction commencement and at the year the Scheme becomes operational. The baseline conditions for these years may be different to the current conditions and such changes could alter the sensitivity of existing environmental receptors, as well as introduce new sensitive receptors.

Construction year baseline (2021)

13.6.81 The future baseline has been determined qualitatively by considering the possibility of changes in the attributes that are considered when deciding the importance of water bodies in the Study area.

13.6.82 Given that the construction year baseline is just two years from the date of writing, it is considered that the baseline conditions at the start of construction would not be significantly different to the baseline reported in this chapter.

13.6.83 Any planning applications which are granted and begin construction/are completed, it is assumed they would follow all best practice and legislation and would not cause any significant changes the baseline conditions of the water resources in the area.

13.6.84 It is unlikely that baseline conditions for flood risk of all types will change significantly between the publication of this ES, and the year of construction. However, the guidance by which the FRA (Appendix 13.1 [TR010054/APP/6.3]) has been undertaken is likely to change, along with updates to supporting documents. In particular, there is an update which is currently in progress by the Environment Agency concerning the assessment of climate change for flood risk to new developments (Ref 13.44). The Environment Agency has been consulted as to the appropriate climate change factors to include in the Scheme design, however this should be reviewed upon the publication of the updated guidance.

13.6.85 Environmental baseline conditions are not anticipated to change significantly by 2021 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. However, there are no developments within the study area which are anticipated to be operational by 2021. For further details of developments refer to Appendix 15.1 [TR010054/APP/6.3].

Opening year baseline (2024)

13.6.86 Generally, there is an improving trend in surface water quality and the environmental health of waterways in the UK since the commencement of significant investment in sewage treatment in the 1990's, the adoption of the WFD from 2003, and the application of ever more stringent planning policies. In terms of water quality impacts, the future baseline assumes that all WFD water bodies achieve their final target status.

13.6.87 It is likely that through the action of new legislative requirements and ever more stringent planning policy and regulation, that the health of the water environment will continue to improve post-2027, and therefore towards 2024, although there are significant challenges such as adapting to a changing climate and pressures of population growth that could have a retarding impact. However, it is difficult to forecast these changes with any certainty, and in any case the way the importance of the water environment is determined considers a wide range of attributes, some of which are unlikely to change.

13.6.88 Given that the opening year baseline is just five years from the date of writing, it is considered that the baseline conditions would be similar to that of the date of writing.

13.6.89 Any planning applications which are granted and begin construction/are completed, it is assumed they would follow all best practice and legislation and would not cause any significant changes the baseline conditions of the water resources in the area.

13.6.90 It is unlikely that baseline conditions for flood risk of all types will change significantly between the year of construction and the opening baseline.

Design year baseline (2039)

13.6.91 It is not possible to accurately predict baseline environmental conditions for the design year (year 15) of the Scheme (2039). However, it is anticipated that baseline conditions in 2039 in the vicinity of the Scheme and within the associated water environment study area will largely be the same as at 2021.

13.6.92 Using the traffic conditions predicted for 2039, any future increases in traffic have already been used within the HEWRAT assessment for the design of mitigation for routine runoff.

13.6.93 Due to the changing nature of the climate, there is the potential for more intense rainfall events. This possibility has been included within the design of the mitigation measures for flow attenuation of road runoff to the receiving watercourses.

13.7 Potential impacts

13.7.1 The process of scoping identified that the introduction and/or modification of road infrastructure associated with the Scheme would potentially result in different types and durations of impact on water resources, during both the construction and operational phases.

13.7.2 Mitigation measures are being incorporated in to the design and construction of the Scheme, these are described in Section 13.8 and Chapter 2: The Scheme. These are part of the Scheme design and the potential water environment impacts (both

beneficial and adverse) associated with the construction and operation of the Scheme are outlined below, taking into account the Scheme design with these embedded measures.

Construction

13.7.3 Temporary construction impacts on the water environment that would last for all, or part of, the construction phase are likely to include the following:

- Reduction in water quality, both surface and groundwater, due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site run-off.
- Alteration in fluvial, overland and groundwater flow paths, and potential increase in flood risk, as a result of localised dewatering and storing construction materials in the floodplain.
- Increased risk of blockage of drains as a result of increased material (sands, gravels etc.) transported in runoff from the Scheme into watercourses, land drains and sewers.
- Increased discharge to local watercourses leading to an increase in flood risk due to a temporary increase in impermeable area and removal of vegetation during construction.

13.7.4 Construction activities such as earth works, excavations, site preparation, levelling and grading operations result in the disturbance of soils. Exposed soil is more vulnerable to erosion during rainfall events due to loosening and removal of vegetation to bind it, compaction and increased runoff rates. Surface runoff from such areas can contain excessive quantities of fine sediment, which may eventually be transported to watercourses where it can result in adverse impacts on various water attributes including water quality, flora and fauna. Construction works within, along the banks and across watercourses can also be a direct source of fine sediment mobilisation.

13.7.5 Contamination of surface waters, groundwater and soil could result from leakage and spills of fuels, oils, chemicals and concrete during construction affecting watercourses indirectly via site runoff or directly where works are close to and within a water body. Contamination may reduce water quality and impact aquatic fauna and flora.

13.7.6 Any construction works on the floodplain or drainage to watercourses or to ground have the potential to increase the rate and volume of runoff and increase the risk of blockages in watercourses that could lead to flow being impeded, and a potential rise in flood risk. Changes to ground levels and vegetation clearance works may also increase the risk of surface water flooding. Finally, excavations can potential damage existing sewers leading to flooding.

13.7.7 The design for the Scheme includes the construction of three cuttings with the road level being 5 m to 7 m bgl. A borrow pit may also be required north-west of Dark Lane, up to 10 m in depth, to supply suitable aggregate for the Scheme construction.

Temporary or permanent dewatering associated with these earthworks could result in an adverse impact on groundwater flow.

13.7.8 Impacts on groundwater quality from construction activities are similar to those identified above for surface water.

Operation

13.7.9 Operational and permanent construction impacts of the Scheme on the water environment are likely to include the following without appropriate mitigation:

- Impacts on the surface water and groundwater quality from routine highway run-off (including the use of de-icants) or as a result of accidental spillages.
- Changes in the natural form of the landscape, which may have a subsequent effect on surface water and groundwater drainage patterns, including adverse impacts on local nature conservation sites.
- Increased risk of fluvial flooding to the Scheme and surrounding area due to loss of floodplain storage.
- Increase in flood risk (fluvial, surface water, sewer and drainage infrastructure) due to an increase in surface water runoff from the Scheme, and increased risk of fluvial flooding over the lifetime of the Scheme from climate change effects (increased peak river flows).
- Impacts on hydraulic processes and sediment dynamics in watercourses and their floodplains.
- Modification to groundwater flow as a result of permanent dewatering or groundwater drainage.
- Loss of or changes to the morphology of water bodies that could have both temporary and long-term impacts on the hydromorphological conditions of the water bodies. This includes the total and permanent loss of two ponds, one west of Tower House Farm and one east of Brookfield Farm as well as the partial loss of Lower Pool.

13.8 Design, mitigation and enhancement measures

Embedded mitigation

13.8.1 The Scheme has been designed, as far as possible, to avoid and minimise impacts and effects on the Road drainage and the water environment through the process of design-development (refer to Chapter 3: Assessment of Alternatives) considering good design principles. Embedded mitigation, defined within the DMRB as 'Design measures which are integrated into a project for the purpose of minimising environmental effects,' is reported as part of the scheme description in Chapter 2: The Scheme. The following section reports the essential mitigation required in addition to embedded mitigation to reduce and offset likely significant adverse environmental effects.

Essential mitigation

13.8.2 A number of essential mitigation measures have been identified to reduce, remediate or compensate likely significant adverse environmental effects.

Construction

13.8.3 The OEMP [TR010054/APP/6.11] details the measures that would be undertaken during construction to mitigate temporary effects on the water environment. This includes a range of measures, 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 (Ref 13.45). The measures detailed within the OEMP would be developed into a Construction Environmental Management Plan (CEMP) which would be implemented by the selected construction contractor. These measures broadly focus on:

- Managing the risk of pollution to surface waters and groundwater.
- Measures to control the storage, handling and disposal of potentially polluting substances during construction. Measures relating to the control of small or more significant spillages are included in the Outline Water Management Plan (OWMP) which would be included with the CEMP.
- The management of activities within floodplains in the area of Watercourse 5 (i.e. kept to a minimum) with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable or allowances made for floodplain control measures and contingency actions.
- Management of water removed from cuttings and the borrow pit for construction dewatering activities.
- Managing the risk from groundwater flooding through appropriate working practices (during excavations) and with adequate plans and equipment in place for de-watering to ensure safe dry working environments.

Works to Lower Pool

13.8.4 The methodology for works within Lower Pool would be developed during the detailed design stage of the Scheme, and would include best practice measures outlined within the OEMP. A temporary dam would be constructed to the west of the bridge structure, so that water in the area of the lake to be lost could be dewatered and soft sediments to be excavated within a dry working area to minimise any impact on the retained portion of the lake. It is also assumed that wet and soft organic pond sediments would be dewatered on-site in an appropriate way that captures any leachate and/ or prevents infiltration to ground. Further testing of sediments and leachates are required in accordance with waste management legislation prior to any re-use or disposal of this material. Please refer to Chapter 9: Geology and Soils, and the OEMP [TR010054/APP/6.11].

13.8.5 These would ensure the area of pond to be lost would have any fish removed from the pond before construction activities begin, and measures would be put in place to ensure no sediment plumes or contaminated water (i.e. during dewatering) are released downstream into Watercourse 3 as far as is practicable. Survey of Lower Pool has confirmed the presence of populations of carp and ghost carp, therefore, the use of fish rescue procedures would be required. Canadian pondweed, a non-native invasive macrophyte is also believed to be present, and measures to minimise

the risk of its spread would be required (to be described in a Biosecurity Management Plan).

13.8.6 It may be possible to discharge the water from Lower Pool at a controlled rate into Watercourse 3, subject to the agreement of the Environment Agency, and the correct permits. Lower Pool currently discharges over a weir to Watercourse 3. Due to the standing nature of the water the dissolved organic carbon within Lower Pool is higher than that within the watercourse downstream (35 mg/l compared with <2 – 15 mg/l downstream), and the pH is more alkaline within the pool (pH 9 compared with pH 7.4 – 8.1 downstream). Ammoniacal Nitrogen within the pool was higher at 0.93 mg/l compared with 0.37-0.67 mg/l downstream in Watercourse 3. Therefore, dependent on the water quality within Lower Pool at the time of construction it may or may not be possible to discharge downstream. It is assumed that the methodology for the draining of the pool would be in accordance with, and with the agreement of, the Environment Agency.

Management of dewatering activities

13.8.7 In order to minimise the impact of the dewatering on groundwater and surface water resources, a scheme of groundwater control would be implemented to ensure water levels in adjacent water bodies are maintained and any discharge is of a suitable quality. This would involve a programme of water monitoring and controlled discharges. It is proposed that four monitoring boreholes are drilled on the north-western and south-western boundaries of the borrow pit and another on the opposite side of the A460 between the upper pond of Kings Pool Fishery and the A460 and that gauge boards are installed in each of the fishery ponds and on Watercourse 3 adjacent to the borrow pit at least six months before any excavation starts at the borrow pit. Water level monitoring should be carried out in all of the boreholes and of the gauge boards to establish the natural fluctuations in groundwater, stream and pond levels. Dataloggers to facilitate continuous monitoring should be installed in the boreholes and in the upper fishery pond.

13.8.8 Once dewatering starts in the borrow pit, the water should be discharged following settlement to remove suspended solids, to Watercourse 3 adjacent to the southwestern corner of the borrow pit to maintain the flow in the stream downstream of the site. Although the discharge would maintain the flow in the stream, this may not maintain the water level in the Kings Pool Fishery ponds, particularly during periods of prolonged warm weather. An assessment of the results of the monitoring would establish whether the dewatering has lowered the water level in the fishery ponds. If such an impact is identified, it would be necessary to provide a compensatory water supply to the Kings Pools Fishery. It is proposed that a pumped supply from the water collecting in the base of the borrow pit is laid to the upper pond to provide a continuous supply of water to maintain the fishery. Paddle boards or similar measures would be required to dissipate the discharge to avoid any risk of erosion. The discharge would help to oxygenate the pool and ameliorate the adverse impacts of low water levels and high temperatures. This would require crossing of the A460, which may be achieved within the existing culvert carrying Watercourse 3 beneath the A460.

13.8.9 In addition, it is likely that dewatering and discharge of water from the borrow pit may require an Abstraction Licence and a Water Activity Permit from the Environment Agency. Applications for these would be made following the DCO application.

13.8.10 It is also expected that temporary storage basins would be required on the site of the borrow pit in the event that there is a pump failure or discharge to Watercourse 3 is not possible. The storage basins would allow for the settlement of suspended fine sediment, and in combination with other measures (e.g. straw bales) the filtration of dewaters. The bed of the temporary storage basins should be above the maximum recorded groundwater levels. Multiple storage basins may also be required to maintain storage as they would silt up over time and a basin would need to be unused in order for this silt to be dried and removed. Other measures that could be used in combination with temporary storage may include lamella clarifiers and chemical dosing using flocculants.

Operation

Highway drainage

13.8.11 Maintenance of the drainage network and assets is required as part of the operation of the Scheme. The maintenance requirements for vegetative systems is included within the Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]). No further essential mitigation is considered to be required during operation of the Scheme.

13.8.12 A number of wet ponds, filter drains, swales, new highway ditches and HVS have been incorporated into the overall water management strategy. These have been designed to mimic natural drainage as far as practicable, and to provide a number of other benefits to ecological habitat creation (see Chapter 8: Biodiversity). Penstocks would also be installed upstream of all wet ponds to allow isolation in the event of a spillage on the highway. The spillage would then be contained within the highways carrier drain system where it could be pumped out.

13.8.13 Attenuation has been incorporated to control any increase in the rate of flow towards the impacted watercourses resulting from increased impermeable road areas. A greenfield runoff rate of 5 l/s/ha has been agreed with SSC for use with the preliminary drainage calculations. Without attenuation increased flows may result in bank erosion, increased sediment loading, greater flooding and increased pollution to the impacted watercourses. The specific treatment train for each road catchment has been designed to reflect the need for flow attenuation and the pollution risk, as well as to reflect any stakeholder concerns.

13.8.14 The existing outfalls would not be affected by the Scheme. Proposed earthworks drainage would be located at the top of cuttings or toe of embankments to capture surface flows from natural catchments. These would be discharged into the same catchment via road drainage.

13.8.15 The treatment train specifications for each road catchment are summarised in Table 13.6 below, and described in more detail in the Drainage Strategy (Appendix 13.2 [TR010054/APP.6.3]).

Table 13.6: Treatment train for drainage networks

Road network catchment and description	Receiving waterbody (Watercourse =WC)	Existing treatment	Additional treatment train
1 - M54 existing westwards only	Drains to existing M54 drainage westwards to Watercourse 7	Filter Drains within existing M54 drainage	HVS connecting into existing M54 drainage.
2 - M54 existing eastwards only	Drains to existing M54 drainage westwards to Watercourse 7	Filter Drains within existing M54 drainage	HVS connecting into existing M54 drainage.
3 - New roundabout and link roads north of M54 J1	Discharge to Watercourse 1 new outfall	No current treatment – new catchment	Penstock upstream of wet attenuation Pond followed by a swale/grassed channel (lined) (approximately 70-80m) via open ditch.
4 - New roundabout and link roads south side of M54 J1	Watercourse 1 - existing	No current treatment – new catchment	HVS and filter drains
5 - Remodelled roundabout north east of M54 J1	Watercourse 2 new outfall	No current treatment – new catchment	Penstock upstream of wet attenuation pond.
6 - Section of existing A460	Watercourse 2 existing	No current treatment – new catchment	None required.
7 - Section of existing A460	Watercourse 3 existing	No current treatment – existing catchment	None as part of Scheme, The A460 is part of SCC network.
8 - Link road from new roundabout to existing A460	Watercourse 3 new	No current treatment – new catchment	Penstock upstream of wet attenuation pond.
9 - Existing A460, with remodelled Hilton Lane flyover	Watercourse 4 existing	No current treatment – new catchment	Length of filter drain on altered Hilton Lane.
10 - Main line of Scheme	Watercourse 4 new	No current treatment – new catchment	Filter drains where possible to approximately 60-70 m grass swale / ditch channel leading to a penstock then wet attenuation pond. Pond discharging via a ditch.
11 - Existing A460	Watercourse 5 existing	No current treatment – new catchment	None required.
12 - Permeable only	Watercourse 5 New A	No current treatment – new catchment	None as not draining highway (embankment only) but separate outfall.
13 - Permeable only	Watercourse 5 New B	No current treatment – new catchment	None as not draining highway (embankment only) but separate outfall.

Road network catchment and description	Receiving waterbody (Watercourse =WC)	Existing treatment	Additional treatment train
14 - Mainline Scheme and slip road to existing A460	Watercourse 5 New C	No current treatment – new catchment	Filter drains to penstock, to wet attenuation pond.
15 - A460 north of M6 J11	Watercourse 6	filter drains	Filter drains and roadside ditch
16 - West roundabout and slip roads of M6 J11	Via M6 northbound drainage northwards to Watercourse 6	Existing filter drains within the mainline M6	Filter drains within the new remodelled roundabout, and followed by swales on base of slip roads (serving slip roads). Mainline not included in new drainage provision). The swales will only take a proportion of the runoff from the roundabout, and half the mitigation potential of these has been used in the calculations accordingly.
17 - East roundabout and slip roads of M6 J11	Via M6 southbound drainage northwards to Watercourse 6	Existing filter drains within the mainline M6	As above.

13.8.16 The Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]) has been designed in accordance with CG501 (Ref 13.39), ensuring no surcharge for a 1 in 1 year return period and no flooding in a 1 in 5 year return period. The network has been designed including a 40% increase in rainfall intensity to consider the effects of climate change. Peak discharge rates are to be controlled and SuDS that discharge to a watercourse would accommodate the 1 in 100 year return period event +40% for climate change. For culverts that convey permanent watercourses beneath roads the flow rate has been assessed for return periods of up to 100 years +50% for climate change.

13.8.17 The number of new surface water outfalls has been minimised where possible and the drainage strategy makes use of existing outfalls from the M54, M6 and A460, in order to prevent construction of unnecessary structures along the river bank.

13.8.18 Pre-earthworks drainage would be installed to convey land runoff/intercepted existing land drainage. This would take the form of filter drains or ditches and would be particularly important at the top of cuttings and the toe of embankments. These would capture surface flows from natural catchments. This runoff would be unlikely to have a high pollutant load when compared to road runoff and does not require further treatment.

13.8.19 Ditches are simpler to construct and maintain, fit in with the existing drainage philosophy and have higher capacities than typical filter drains but require more land so are not viable at constrained locations. They also tend to collect litter, although

litter picking would be included in the requisite maintenance schedules for the Scheme. Filter drains use stone resources which typically need to be cleaned or replaced every ten to 15 years, as is standard practice for highway maintenance.

13.8.20 In general, the pre-earthworks ditches tie in to the existing road outfalls that are being utilised by the Scheme or to those new outfalls that are included for drainage of the new link road. This reduces the number of new outfalls required on the surrounding watercourses. The exception is for network catchments 11 and 12, which drain the embankments of the mainline of the Scheme to new outfalls on Watercourse 5, Latherford Brook.

Watercourse crossings

13.8.21 A new 10 m clear-span bridge is proposed for the crossing of Latherford Brook, reflecting the need to minimise any impact on channel flow and sediment processes, as well as riparian habitat, of this more significant and naturally functioning watercourse. The detailed design of the structure will be carried out at the detailed design stage. This would ensure the form and flow of the watercourse are maintained as close as possible to its natural state. Please refer to the OEMP [TR010054/APP/6.11] for further details of these commitments.

13.8.22 Other than Watercourse 5 (Latherford Brook), new culverts are proposed on some of the smaller and more minor watercourses in the study area. Two culverts are proposed on Watercourse 2 at approximately 182 m and 58 m in length. A new culvert would be provided on Watercourse 3 at approximately 60 m in length. Finally, a new culvert would be provided on Watercourse 4 at approximately 55 m in length. To minimise the impact of these, the invert of the culvert would be sunken beneath the existing bed level so that a naturalised bed can form through the structure and so that there are no gradient step changes that can impact flows (especially under low flow conditions) or interrupt the transport of any coarse sediment or encourage erosion of the bed. Where possible existing structures have also been used.

13.8.23 It would be necessary to divert Watercourse 2 to ensure that the new culvert beneath the M54 Junction 1 is kept to a minimum length. The design of this diversion would be undertaken during the detailed design stage, but would be informed by hydromorphological and ecology surveys to ensure that where enhancement on the existing channel is possible this is provided.

13.8.24 Within the constraints of the Scheme, mitigation for the loss of aquatic habitats includes provision of 12 new ecological mitigation ponds and a total of 408 m of watercourse habitat (exceeding the 355 m of watercourses that would be culverted). This includes 32 m of new ditchcourse to Watercourse 2, 280 m to Watercourse 3, and 96 m to Watercourse 4. The Scheme is also proposing incorporation of five new attenuation ponds, which although not proposed with ecological benefit as a primary function, would provide some ecological benefit as a secondary function. Where these ponds discharge to the local stream network they would be connected by new ditches rather than pipes. This avoids the need for engineered outfalls, extends existing green corridors, and provides greater connectivity with the proposed treatment and attenuation ponds. These ditches would be carefully designed following best practice, informed by project ecologists and geomorphologists so that

the final form avoids a uniform cross section and maximises biodiversity opportunities. This may potentially be achieved by having a low flow channel alternating between berms on either bank. These ditches would be maintained by Highways England as part of the drainage system. A commitment for the design of these drainage ditches is included within the OEMP [TR010054/APP/6.11].

13.8.25 For new highway outfalls the drainage design includes new ditchcourses to convey treated runoff to the receiving watercourses avoiding the need for pipe outfalls supported by concrete headwalls. The design of new ditches would be informed by a geomorphologist and would include where practicable 'natural' features such as a sinuous low flow channel (albeit along a straight corridor) incorporating shallow berms and occasional sections where the channel is narrowed to improve flow.

Watercourse realignment

13.8.26 The detailed design of the realignment and diversion of Watercourse 2, 3, 4 and 5 would be undertaken within the detailed design stage, as detailed in the OEMP [TR010054/APP/6.11]. The OEMP also includes commitment to ensure that the culverts used to realign Watercourse, 2, 3 and 4 are to be as a minimum, those specified within the FRA, Appendix 13.1 [TR010054/APP/6.3] and associated hydraulic modelling. The culvert dimensions are reported in Chapter 2: The Scheme.

13.8.27 For Watercourse 2 the realignment and regrading of this minor watercourse would be required as it passes through the remodelled M54 Junction 1. Realignment and culverting of this watercourse through the junction would ensure conveyance of flow. This minor watercourse would be diverted to a new flow route located approximately 80 m north of its current route. The anticipated route to the location of the proposed culverts would be consistent with a flow route following local topography. The location of the culverts is dictated by limitations on where the watercourse flow route could be directed.

13.8.28 The detailed design of the realignment of Watercourse 3 would be undertaken within the detailed design stage. The OEMP includes commitment to ensure the culvert is located to ensure the new course of the naturalised channel upstream and downstream of the Scheme maintain flow and function [TR010054/APP/6.11].

13.8.29 For Watercourse 4 there may be minor realignment of the watercourse in order to construct a culvert crossing of the watercourse under the Scheme and because of the new impoundment and overflow from Lower Pool. The OEMP includes commitments to ensure that realignment is minimised, with the culverts used of a minimum to be those specified within the FRA, Appendix 13.1 [TR010054/APP/6.3] and associated hydraulic modelling. The channel realignment itself is to be minimised, and the design undertaken to maintain flow and function and maximise biodiversity improvements.

Relevant permits, consents, and licences

13.8.30 The Scheme does not intersect with a Main River, therefore, no flood risk activity permits are required from the Environment Agency. During consultation with the Environment Agency on 18 July 2019, it was confirmed that no Environment Agency

permits would be required for any Flood Zone 3 works, and all flood risk permissions would be determined by the LLFA (SSC).

13.8.31 An environment permit may also be required for the discharge to surface waters or ground of any 'unclean' construction site runoff, again where exemptions do not apply. However, local highways authorities do not require permission from the Environment Agency to discharge runoff from highways to controlled waters (i.e. all watercourses, canals, lakes, groundwater etc.) under the Highways Act 1980 providing they do not cause pollution.

13.8.32 The diversion of a watercourse could require a transfer licence from the Environment Agency. Similarly, the need to construct a new dam across Lower Pool may require an impoundment licence from the Environment Agency. Furthermore, during construction any significant dewatering, principally from the borrow pit, would be subject to an abstraction licence issued by the Environment Agency. The discharge of the dewatering water may also require a Water Activity Permit from the Environment Agency where the water is discharged to the surface water system. The Environment Agency will be consulted post DCO to obtain the necessary licences.

13.8.33 Under the Floods and Water Management Act 2010 (Ref 13.3) and Section 23 of the Land Drainage Act 1991 (Ref 13.4) consent may be required for certain works that may affect the flow in Ordinary Watercourses (i.e. all watercourses that are not Main Rivers) from the LLFA, which in this case is SCC.

13.9 Assessment of likely significant effects

13.9.1 The prediction of impacts and the assessment of effects has taken account of the embedded mitigation measures and the essential measures identified within Section 13.8. It is based on the Scheme description in Chapter 2: The Scheme, and associated design drawings, assessments and reports generated for this proposed development. A summary of all residual risks is included in Table 13.7.

Importance of receptor

13.9.2 Based on the baseline data, and assessed against Table 13.2, the local water resources receptors within the study area have been attributed the following importance (please refer to Figure 13.2 [TR010054/APP/6.2] for locations of where Q95 low flows have been estimated):

- The River Penk is located a minimum distance of 2 km away and thus will not be directly impacted by the Scheme, but could be indirectly impacted via connecting tributaries. The River Penk is of a regional scale and is designated as a Main River and under the WFD. There are no international and national designated ecological sites within 10 km of the confluence with the Saredon Brook. We do not have any data on aquatic ecology receptors present in the River Penk, although it is assumed that there is fisheries and macroinvertebrate interest and potentially protected mammals using the banks. According to the National River Flow Archive website (Ref 13.51), the Q95 at the gauging station located just north of Penkridge (and approximately 7 km from the confluence with the Saredon Brook) is 0.55 m^3/s. The River Penk is

therefore considered to be of High importance for water quality. Although the Q95 flow will be substantially smaller closer to the Site as this is upstream of a number of important tributaries, it is unlikely to be less than 1 m^3/s, which would be required for the medium importance category.

- Watercourses 1 and 4 are of a local scale and are tributaries of the River Penk and joining the river channel approximately 5 km downstream of the Scheme. The River Penk is a WFD water body and these tributary watercourses are associated with it by virtue of being within its catchment. At the point taken for assessment the Q95 was estimated to be 0.001 m^3/s. Therefore, these are considered to be low importance watercourses (from a water quality perspective) based on the criteria in Table 13.2. Attributes for Watercourses 1 and 4 include conveyance of flow, and dilution and removal of waste products, and water supply for downstream abstractions.
- Watercourses 2 and 3 are also local and small tributaries of the River Penk with estimated Q95s above 0.001 m^3/sec. However, unlike Watercourses 1, 4, 6 and 7, bullhead have been found to be present downstream of the Scheme. Therefore, these watercourses are considered to be of high importance (for water quality) based on the criteria in Table 13.2. Attributes for Watercourses 2 and 3 include conveyance of flow, and dilution and removal of waste products, and water supply for downstream abstractions.
- Watercourse 5 (Latherford Brook) is a designated WFD waterbody, with a Q95 calculated to be 0.004 m^3/sec. Watercourse 5 is also important for water supply. There is a surface water abstraction for agricultural spray irrigation located nearly 1 km downstream (labelled A4 on Figure 13.1 [TR010054/APP/6.2]). Furthermore, Latherford Brook is also important for conveyance of flow and biodiversity with the presence of bullhead and trout fish species, as well as otters and water voles. Therefore, this watercourse is considered to be of high importance based on the criteria shown in Table 13.2.
- Watercourses 6 and 7 are also local and tributaries of the River Penk. The estimated Q95s are above 0.001 m^3/sec. Therefore, these are considered to be of medium importance based on the criteria in Table 13.2 (for water quality). Attributes for Watercourses 1 and 4 include conveyance of flow, dilution and removal of waste products, and water supply for downstream abstractions.
- Ponds and Lakes: There are several ponds within the study area. These are considered in separate groups. The known commercial fishery ponds at Brookfield Farm Fishery are considered to be receptors of high importance by virtue of their socio-economic use. The remaining ponds in the area, including the pond at Tower House Farm Pond (near Old Ride), Kings Pool Fishery Lower Pool, Angling Club Fishing Ponds (mainly chubb fishing), and Hilton Hall Pond (the last three being part of the Hilton Hall ponds), and the fishing ponds east of Brookfield Farm, are considered to be of medium importance.
- Hydromorphology: All of the watercourses, with the exception of Watercourse 5 (Latherford Brook), are considered to be of low importance, as each appears to be a heavily modified agricultural ditch. Watercourse 5 (Latherford Brook) is

considered to be of medium importance, as although it shows signs of historic alteration it does retain some natural features.

- Groundwater: considered to be a receptor of high importance due to the presence of a Principal Aquifer (Triassic Sandstone Group) beneath the majority of the Scheme.

Floodplain sensitivity for impact assessment

13.9.3 The channel of Watercourse 1 does not overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Low.

13.9.4 The channel of Watercourse 2 does overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. The locations where this occurs are isolated and flood depths are shallow, however modelling has shown a potential flood depth of 4cm across the existing A460 during a 1% AEP plus 50% allowance for climate change. This is the main road through route and therefore, the sensitivity of the floodplain for impact assessment purposes is considered Medium.

13.9.5 The channel of Watercourse 3 does not overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Low.

13.9.6 The channel of Watercourse 4 does overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. However, the area crossed by the Scheme is agricultural land with no buildings nearby. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Low.

13.9.7 The channel of Watercourse 5 does overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. However, the area crossed by the Scheme is agricultural land with no buildings nearby. In addition, the Environment Agency's flood map shows flood zone 2 and 3 adjacent to the watercourse Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Medium.

13.9.8 The channel of Watercourse 6 does not overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Low.

13.9.9 The channel of Watercourse 7 does overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. In addition, the Environment Agency's flood map shows flood zone 2 and 3 adjacent to the watercourse. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Medium.

13.9.10 The channel of Watercourse 8 channel does overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. In addition, the Environment Agency's flood map shows flood zone 2 and 3 adjacent to the watercourse. However, the area crossed by the Scheme boundary is agricultural land with no buildings nearby. Therefore, the sensitivity of the floodplain for impact assessment purposes is considered Low.

13.9.11 The criteria described in Table 13.2 do not provide examples of sensitivity for other forms of flood risk and so the sensitivity is based on the existing baseline risk as

described in the FRA (Appendix 13.1 [TR010054/APP/6.3]). For the purpose of this impact assessment the sensitivity of non-fluvial forms of flood risk is as follows:

- Surface Water – Mainly Low Sensitivity, with localised areas of Medium and High Sensitivity associated with watercourses;
- Flooding from Artificial Sources (Reservoirs) – Very Low Sensitivity;
- Flooding from Artificial Sources (Other Artificial Water Bodies) – Very Low Sensitivity;
- Flooding from groundwater – Medium Sensitivity in localised areas with a high water table, principally adjacent to existing watercourses; and
- Flooding from Sewers and Water Supply Infrastructure – Low Sensitivity.

Magnitude of impacts and significance of effect

Construction

13.9.12 The prediction of impacts and the assessment of significance of effects have taken account of the embedded and essential mitigation measures identified within Section 13.8 and Chapter 2: The Scheme.

Surface water quality

13.9.13 Where construction works are undertaken in close proximity to waterbodies, close to existing land drains providing a pathway to surface watercourses or ponds, or on steeper terrain angled towards a waterbody, there is the potential for direct adverse effects on water quality due to deposition or spillage or soils, sediments, oils, fuels, or other construction chemicals spilt on site. There may also be indirect water quality impacts from works further from water bodies via existing land drains / sewers. There may also be indirect impacts to downstream receptors, including the River Penk.

13.9.14 Construction of road outfalls for the Scheme would require some works close to and within the receiving watercourses. There would be potential for conveyance of spills and fine sediment during any works to these outfalls to result in direct impacts on the receiving watercourses. New outfalls are proposed to be constructed outfalling to Watercourses 2, 3, 4 and 5. Existing outfalls are to be utilised for Watercourse 1, 6 and 7. The outfalls would be in the form of ditches which would feed into the watercourses, rather than a concrete headwall structure. The existing outfalls would be utilised without any construction works at the outfall. There may also be indirect effects to downstream receptors including the River Penk (for the location of these watercourses refer to Figure 13.1 [TR010054/APP/6.2].

13.9.15 The construction works for watercourse crossing structures, as described in Chapter 2: The Scheme, have the potential to cause reduction in water quality through contaminated construction runoff, and the risk of chemical spillages from plant, equipment and materials. Some of these crossings require diversion and realignment of watercourses (e.g. Watercourse 2). In addition, the Scheme alignment would result in the loss of a part of Lower Pool, which would need to be dewatered and require the realignment of Watercourse 3. Morphological impacts would also be likely and are considered under operational impacts.

13.9.16 It is likely that dewatering would be required for any cuttings or excavations, such as the construction of the borrow pit, as well as the need to drain down part of Lower Pool. These activities locally may affect the flows in adjacent watercourses.

13.9.17 As described in Chapter 2: The Scheme, construction of the Scheme would require two construction compounds, one located to the north-west of M6 Junction 11, and a secondary compound located to the east of Featherstone. Satellite welfare facilities may also be established at two locations, close to Hilton Lane and Ride Lane.

13.9.18 The design of the site drainage for construction compounds has not been determined at the current time. It is likely that the secondary compound at Featherstone would connect to the foul network for foul drainage, and for the main compound it may be necessary to use a small self-contained treatment plant (depending on cost, duration and practicality) for the foul drainage if connection to the public sewer is not possible. Any discharge from a self-contained treatment plant would require a Water Activity Permit from the Environment Agency for discharge of treated final effluent to a controlled water and may require a Land Drainage Consent for the temporary outfall to an Ordinary Watercourse. These applications would be made once the construction contractor has determined how foul waste water from the compounds would be managed. Discharge to a watercourse would require adequate treatment and potential water quality monitoring during the period it is in use.

13.9.19 Surface water drainage from temporary compounds would be directed to the existing land drainage system and outfall to a local watercourse. For the main compound this would likely be Watercourse 5, Latherford Brook, and for the satellite compound this would likely be Watercourse 2 or 3. As such there would be potential for conveyance of spills and fine sediment in these watercourse that may also propagate downstream (e.g. the River Penk).

13.9.20 Any connections to foul sewer would be controlled by a trade discharge consent from the statutory undertaker Severn Trent Water, and any discharges to local surface water receptors would be controlled by an Environment Agency permit and a Land Drainage Consent from the LLFA (as all watercourses are Ordinary Watercourses).

13.9.21 During construction, areas of temporary topsoil/ earthworks storage would be required in close proximity to the Scheme. Implementation of standard mitigation measures defined within the OEMP [TR010054/APP/6.11] would avoid or reduce the potential for adverse surface water quality impacts from the compound areas. All discharges to surface water of ‘unclean runoff’ and discharges from dewatering would take place under Water Activity Permits from the Environment Agency. All discharges to foul sewer would take place under a Trade Discharge Consent from Severn Trent Water.

13.9.22 For Watercourse 1 and Watercourse 6 the works to be undertaken within the catchment include the remodelling of M54 Junction 1 and M6 Junction 11 respectively, with no additional culverting works to be undertaken as existing culverts are to be utilised. With the implementation of essential mitigation measures

outlined in Section 13.8 it is considered that the construction works would have a negligible impact upon the attributes of Watercourse 1 (low importance) and 6 (medium importance), which include the water quality, dilution and removal of waste products and conveyance of flow. This would result in a neutral effect (not significant).

13.9.23 For Watercourse 2, the works to be undertaken within the catchment include the construction of two culverts, as described in Chapter 12, to take the watercourse beneath M54 Junction 1, together with a diversion to the north of the existing watercourse route. Measures to avoid, minimise and reduce the potential adverse impact to water quality and flow would include construction of the diversion off-line, allowing water into the new course slowly and preferably from the downstream end. Watercourse 2 may also receive treated foul effluent from a self-contained treatment plant serving a works compound, which may introduce sanitary pollutants (e.g. suspended sediments and organic matter) into the watercourse resulting in increased turbidity, oxygen demand, and total suspended sediments and odours for the duration of while the compound is being used. Overall, construction works and various discharges would result in a temporary minor adverse magnitude of impact to the watercourse, due to the need to work within the watercourse itself and divert the flow route, and from site runoff and possible discharges of treated foul waste water if connection to the public sewer is not possible. As a receptor of high importance a slight adverse temporary effect (not significant) is anticipated.

13.9.24 For Watercourse 3 the works within the catchment include the draining of Lower Pool, the construction of a new profiled channel upstream and downstream of where the watercourse crosses the Scheme in a culvert, and the construction of a temporary borrow pit. This would result in a temporary minor adverse magnitude of impact to the watercourse, due to the need to work within the watercourse itself which due to the high receptor importance of the watercourse, is considered to result in a slight adverse temporary effect (not significant) upon the attributes of Watercourse 3, which include water quality and conveyance of flow. Impacts associated with the excavation and dewatering of the borrow pit on Watercourse 3 are discussed in the Section entitled ‘Groundwater Flow.’

13.9.25 Watercourse 4 would be culverted beneath the Scheme, with areas of temporary earthworks storage in the area to the north-east and south-west of the location of the new culvert. This would result in a temporary minor adverse magnitude of impact to the watercourse, due to the need to work within the watercourse itself. Due to the low receptor importance of this watercourse, this is considered to result in a neutral temporary effect (not significant) on the attributes of Watercourse 4, which include water quality, water supply, and conveyance of flow.

13.9.26 For Watercourse 5 (Latherford Brook), the Scheme would cross the brook on a 10 m wide clear span structure, which would allow the existing course to be maintained. There would need to be some construction works to the margins of the primary channel to install the new bridge abutments, and dewatering (with fish rescue) of any wetted areas that make up the secondary channel, which will require careful planning of the works and appropriate measures to prevent pollution of the main flow. With these measures in place a negligible and temporary impact to the

attributes of the watercourse would occur. However, as with Watercourse 2 it may be necessary to discharge treated foul waste water from welfare facilities at the temporary compound to Watercourse 5, which may result in a minor adverse impact on water quality for the duration of the compounds use. Due to the high receptor importance of the watercourse this is considered to result in a slight adverse temporary effect (not significant) on the water quality, water supply and conveyance of flow of Watercourse 5.

13.9.27 For Watercourse 7, the works within the catchment include new traffic signage along the existing M54 soft estate with very little changes to the majority of the catchment. This is considered to result in a negligible temporary impact due to the minor nature of the works taking place. Due to the medium receptor importance of the watercourse, this is considered to result in a neutral temporary effect (not significant) on the water quality, dilution and removal of waste products and conveyance of flow of Watercourse 7.

13.9.28 Due to the distance downstream, and the dilution effect, the impact on the River Penk is considered to be negligible, resulting in a slight adverse effect (not significant).

Groundwater flow

13.9.29 A large portion of the Scheme is in cutting, it is assumed that the construction level is 1 m below the final road level.

13.9.30 Through the new M54 Junction 1 the 690 m long cutting up to with the ground level reduced by up to 6.2 m (allowing 1 m for construction). The Scheme would rise in a northerly direction from approximately 136.5 m AOD to approximately 138.2 m AOD. Based on the results of the groundwater level monitoring, it is concluded that the groundwater level varies between 131 m AOD and 133 m AOD. As the groundwater level is approximately 4 m below the assumed construction level, no dewatering would be required. Accordingly, it is concluded that the construction of the cutting for the mainline of the Scheme through the new M54 Junction 1 would have no impact on groundwater flow.

13.9.31 At the Hilton Lane Overbridge, the mainline of the Scheme would be in a cutting approximately 695 m long with the ground level reduced by up to 7.8 m, (allowing 1m for construction). The topography of the Scheme would fall to the north-east from approximately 137.6 m AOD to approximately 133.3 m AOD. Based on the results of the groundwater level monitoring, it is concluded that the groundwater level varies between approximately 138 m AOD beneath most of the proposed cutting to approximately 134 m AOD beneath the north-eastern end of the cutting.

13.9.32 Locally the groundwater level would be above the assumed construction level and construction dewatering would be required during the construction of the cutting. There are no groundwater abstractions in close proximity to this section of the Scheme and hence the dewatering would have no impact on existing groundwater sources. Watercourse 4 flows in a north-westerly direction approximately 60 m north of the cutting. The groundwater level in the vicinity of Watercourse 4, is similar to the watercourse level and it is likely that there is hydraulic continuity between the

groundwater and the surface water, with groundwater providing baseflow to the stream and the associated ponds.

13.9.33 Preliminary calculations indicate that only limited groundwater inflows would occur during construction, as the drawdown required is only approximately 1.5 m. The calculated groundwater inflow to the cutting during dewatering is small at between approximately 6 m^3/day and 10 m^3/day.

13.9.34 It is likely that dewatering during construction of the cutting would affect groundwater flow and potentially cause a reduction in the volume of baseflow discharge to Watercourse 4. However, as the water levels of the ponds are generally lower than the assumed depressed groundwater level of approximately 132 m AOD, a drawdown of the groundwater level beneath the ponds is considered unlikely. The dewatering associated with the construction of the cutting has potential to reduce baseflow discharge to Watercourse 4, and therefore mitigation measures will be required.

13.9.35 In order to minimise the impacts on Watercourse 4 and its associated ponds, water from the dewatering operations would be discharged to Watercourse 4 upstream of the crossing of the stream to maintain the flow in the stream and the levels in the ponds. It would be necessary to settle the water to reduce the suspended solids concentration prior to discharge to the stream. The construction abstraction would require an abstraction licence and the discharge would be the subject of an Environmental Permit both issued by the Environment Agency. With implementation of the proposed mitigation, the significance of the effect of dewatering on groundwater flow and on baseflow discharge to the surface water system is reduced to neutral (not significant).

13.9.36 The cutting to the north-east of Brookfields Farm approximately 345 m in length with the ground level reduced by up to 6.6 m (allowing 1 m for construction). The topography of the Scheme would fall to the north-east from approximately 132.9 m AOD to approximately 131.2 m AOD. Based on the results of the groundwater level monitoring, it is concluded that the groundwater level varies between 129 m AOD in the south west and 124.5 m AOD in the north east. As the groundwater level is approximately 3 m to 6 m below the assumed construction level, no dewatering would be required. Accordingly, it is concluded that the construction of the cutting would have no impact on groundwater flow.

13.9.37 The borrow pit adjacent to Dark Lane would cover a maximum area of 59,800 m^2 in area and up to 10 m deep. No ground investigation has been carried out at the proposed borrow pit. Based on a review of the logs of the nearest boreholes, it is considered likely that the borrow pit would be excavated into sand, possibly extending into the underlying sandstone aquifer. The ground level at the borrow pit is approximately 1 m AOD. The extrapolated groundwater level is shallow, within 2 m of the ground surface, and hence significant dewatering would be required to maintain a dry operational area irrespective of natural seasonal variations in the groundwater level. It is likely that dewatering of up to 8 m may be required. It is likely that Watercourse 3 and the ponds of Kings Pools Fishery are reliant, at least in part, on baseflow discharge from the sandstone aquifer. Dewatering of the borrow

pit locally would lower the groundwater level around the borrow pit and have a moderate impact on both groundwater and surface water resources.

13.9.38 Based on the highest groundwater levels recorded, preliminary calculations show that the estimated groundwater inflow to the borrow pit would be approximately 740 m^3/day and 1233 m^3/day for the maximum required drawdown of 9 m.

13.9.39 With the implementation of these mitigation measures, it is considered that the magnitude of the impact of dewatering of the borrow pit on water resources is reduced to minor and the residual significance of the effect is reduced to moderate for groundwater and slight (not significant) for surface water.

13.9.40 There are two PWS within the study area a significant distance from the Scheme. The spring at Saredon Hall Farm is approximately 725 m north of the Scheme but more than 2 km from any location where groundwater dewatering would be required for construction and operation. The spring is at a level of approximately 131 m AOD more than 13 m above the points of road runoff discharge. Based on its level above the Scheme, it is concluded that the source is not at risk of contamination from construction activities or from the operational phase of the Scheme. As no dewatering for the Scheme construction is proposed in the vicinity of the spring, it is concluded that the flow of the spring would not be affected by the Scheme.

13.9.41 The borehole at Lower Latherford Farm is more than 1.4 km from the scheme and approximately 2 km from any areas of proposed dewatering (Hilton Lane Overbridge and the borrow pit). Only a limited drawdown of approximately 1 m is anticipated in the vicinity of Hilton Lane Overbridge cutting to facilitate construction. As the amount of drawdown would decrease rapidly from the point of dewatering, it is considered highly unlikely that a drawdown would be recorded in this borehole as a result of the dewatering for the cutting. The proposed borrow pit is a similar distance from the borehole supply.

13.9.42 A maximum drawdown of approximately 9 m is required to maintain a dry extraction area in the borrow pit. Although a significant drawdown is likely in the immediate vicinity of the borrow pit, it is considered that the amount of drawdown would reduce significantly with increased distance from the point of dewatering. The ponds in Kings Pools Fishery are located between the borrow pit and the borehole. It is proposed that the water level in the ponds would be maintained during dewatering by a piped discharge from the borrow pit. Maintaining the water level in the ponds would limit the drawdown effects of the dewatering and hence the cone of depression would not extend as far as Lower Latherford Farm and there would be no impact on the borehole supply (A8: PWS on Figure 13.1 [TR010054/APP/6.2], approximately 1.5 km to the northwest of the Scheme Boundary). In addition, there is a large fault running approximately north-south, which may act as a barrier to groundwater flow and further protect the private water supply. Accordingly, it is concluded that the private water supply borehole at Lower Latherford Farm would not be adversely affected by the Scheme.

Groundwater quality

13.9.43 Where construction works are undertaken in areas of high aquifer status, especially where these involve breaking into the ground such as excavations and the formation of cuttings, there is the potential for adverse effects on groundwater quality due to the deposition or spillage of oils, fuels or other construction chemicals spilt on site. Impacts on groundwater quality from construction activities are similar to those identified above for surface water.

13.9.44 Within the study area the groundwater is considered to be of high importance, due to the presence of the Principal Aquifer (Triassic Sandstone Group). This is overlain by fluvio-glacial deposits of varying thickness in some areas, with some alluvial deposits. The fluvio-glacial deposits are mainly granular across the Scheme, apart from in the southwestern part where more cohesive, clay-rich deposits are present. Where the superficial deposits are mainly sandy, the aquifer is of high vulnerability to contamination from surface activities. With the implementation of the embedded mitigation measures, the potential impact on groundwater quality from the deposition of sediment and leaks of fuels and chemicals is considered to be minor. Due to the high importance of the groundwater in the sandstone aquifer, this would result in a slight adverse effect on groundwater quality, which is not significant.

Potential risk of flooding from fluvial sources during construction

13.9.45 The construction phase of the Scheme would involve works in areas close to and within the floodplains of Watercourse 2, 4 and 5. Should a fluvial flood event occur during construction this could be a significant risk to construction workers in the vicinity of watercourse crossings and on the floodplain, with the greatest risk occurring around Watercourse 5.

13.9.46 The baseline risk could be exacerbated during construction works by the temporary increase in the rate and volume of surface water runoff from an increase in impermeable areas such as compacted soils, any on-going in channel works that may constrict or alter the flow within it, and the presence of stockpiled materials and equipment temporarily stored on the floodplain. Sediment, construction materials and equipment may also be washed downstream where it may block the channel and lead to or increase the risk of flooding.

13.9.47 However, with the implementation of standard construction methods and mitigation as described in the OEMP and OWMP [TR010054/APP/6.11] this risk can be effectively managed (for example by monitoring weather forecasts and Environment Agency flood warnings, by undertaking works close to watercourses during periods of dry weather, by ensuring an adequate temporary drainage system was in place and maintained throughout the construction phase, and avoiding stockpiling material on floodplains). As such, the magnitude of flooding from these sources during construction, on site and further downstream, is considered to be negligible resulting in a neutral effect (not significant).

Potential risk of flooding from surface water sources during construction

13.9.48 The Scheme would in general be at a low risk from surface water flooding, although in some areas associated with watercourses there are areas of medium and high

risk. However, during the works existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare earth and the construction of new embankments and impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures as outlined in the OEMP [TR010054/APP/6.11], this risk can be effectively managed. As such, the magnitude of flooding from these sources during construction is considered to be negligible resulting in a neutral effect (not significant).

Potential risk of flooding from artificial sources during construction

13.9.49 The Staffordshire and Worcestershire Canal is within 1 km of the Scheme boundary. This is regularly inspected by the Canal and River Trust, which also undertakes maintenance along this canal. Given the topography and distance from the Scheme, no flood impact is predicted from these canals.

13.9.50 There are several ponds in the study area but flooding from these ponds would be localised and would not pose a significant flood risk to the Scheme. Based on this information, the current risk of flooding from artificial sources is considered to be negligible, resulting in a neutral effect (not significant).

Potential risk of flooding from groundwater sources during construction

13.9.51 The 'Areas Susceptible to Groundwater Flooding' maps (Ref 13.32) provided by the Environment Agency indicates that the site lies within 1 km grid squares of which >25 - <50% of the area is susceptible to groundwater emergence. Groundwater flood risk in the area is due to permeable superficial deposits which tend to have a relatively high-water table.

13.9.52 Groundwater level within the Scheme boundary is provided in Table 13.5. This shows that apart from the areas in close proximity to the existing watercourses, the groundwater generally is more than 4 m below ground level and it is considered unlikely that the groundwater level would naturally rise sufficiently to cause groundwater flooding across most of the Scheme boundary.

13.9.53 Generally, groundwater levels are far below the vertical impact of the Scheme. However, given the range of groundwater levels observed, some cutting excavations may liberate groundwater in some areas in the form of seepages from any higher permeability zones of superficial deposits that are intercepted. Open excavations in some locations may also be more prone to becoming inundated by groundwater. Given ground water levels observed across the Scheme boundary, the magnitude of flooding from these sources during construction is considered to be minor resulting in a neutral effect (not significant), providing adequate drainage and dewatering facilities are provided.

13.9.54 The impact of dewatering the borrow pit is unlikely to have an adverse impact on flood risk along Watercourse 3 providing flow rates to the watercourse are controlled over a period of time, ensuring that this discharge does not occur while water levels are elevated in the channel as a result of heavy rain. The Contractor would therefore be required to maintain sufficient storage on site to continue dewatering operations

of the borrow pit during these periods. Controls on dewatering rates (and treatment required) would be agreed with the Environment Agency and LLFA when applications for the necessary permissions are made.

Potential risk of flooding from drainage infrastructure during construction

13.9.55 The Scheme is at low risk of flooding from sewers and other water supply infrastructure. However, during the construction works a number of water and waste water assets would be locally diverted or protected as follows:

- A foul combined sewer along Hilton Lane, which crosses the Scheme footprint.
- A water main which is located at the edge of the existing roundabout of the M54 Junction 1 and continues north along the existing A460 road.

13.9.56 It is assumed that the appointed Contractor would liaise closely with the appropriate utility provider regarding the diversion and protection of these assets. As such, the magnitude of flooding from these sources during construction is considered to be negligible resulting in a neutral effect (not significant).

Operation

Surface water quality: Routine road runoff

13.9.57 The HEWRAT assessment is presented in Appendix 13.3 [TR010054/APP/6.3]. The following presents a summary of the results.

13.9.58 New road catchments of the Scheme all pass the combined HEWRAT simple assessment and M-BAT metal bioavailability assessment with the mitigation treatment train as stated in Section 13.8.

13.9.59 The initial assessment without mitigation was carried out for any failing outfalls with incorporation of mitigation measures, using the treatment efficiencies outlined in DMRB CG501 [Ref 13.39], and summarised in Table A4 in Annex A within Appendix 13.3 [TR010054/APP/6.3].

13.9.60 All results initially show a failure of the long-term copper EQS due to high ambient copper results used within the assessment. Therefore, an M-BAT assessment was undertaken and the results reported in Table A6 within Appendix 13.3 [TR010054/APP/6.3]. This shows what the maximum concentrations of total dissolved copper within the receiving watercourses would have to be before the bioavailable copper EQS (i.e. I µg/l) is reached taking into account highway runoff. All Annual EQS results within the HEWRAT analysis are below these concentrations for the receiving watercourses.

13.9.61 Results of the assessment of routine road runoff including mitigation are shown in Table A6 in Annex A within Appendix 13.3 [TR010054/APP/6.3]. Most with Scheme road catchments pass the assessment for acute dissolved metal impacts, with the exception of individual road catchments 4 and 9, and the cumulative assessment of catchments 1+2 (existing failure), 3+4 (existing failure from road catchment 3), and 15+16+17 (existing failure).

13.9.62 The provision of filter drains and an HVS on road catchment 4 (to Watercourse 1) would mitigate the sediment-bound pollutant impact to an acceptable level, but these

would not mitigate dissolved metals. With the Scheme, road catchment 4 shows a potential for 7.5 exceedances of acute copper concentrations per year. This is an improvement on the estimated 8.8 dissolved copper exceedances for the existing situation. The point of the original assessment for this catchment was chosen close to the outfall location, which is close to the head of the catchment where there is very low flows and dilution (i.e. Q95 of just 1 l/s). This is therefore a worst case. HEWRAT was not intended to be applied to 'ditches' as this would lead to excessive failures. There is no specific guidance on the 'point of assessment along the receiving watercourse and professional judgement must be applied. Having undertaken an assessment at the point of discharge, it was decided to also assess the impact at a point slightly further downstream, after the confluence with Watercourse 2 and 7. At this point the increased dilution means that no failures against any HEWRAT standards occur for road catchment 4 individually, and cumulatively with road catchment 3.

13.9.63 Individual catchment 9 is the existing A460, with an AADT in 2039 predicted to be just 3,338 vehicles. The lowest traffic band used within the assessment is >10,000 to < 50,000 vehicles AADT. Therefore, the assessment would overestimate the effects of traffic for this road catchment. The exceedances of short term copper in the existing situation are calculated to be 2.5 times annually, which does not change with the Scheme in the proposed situation. However, in reality, the traffic would be much lower than the current situation and the traffic band used in the assessment, and thus although not quantified the number of exceedances would be expected to be lower (i.e. an improvement on existing).

13.9.64 Cumulative assessment of the existing road catchments 1+2 factors in the existing filter drains alongside the M54, and with new filter drains provided by the Scheme within M54 Junction 1. An HVS has also been added to reduce potential impact from suspended fine sediments (including particulate metals and any absorbed hydrocarbons associated with fine sediments). However, HVSs do not provide any treatment of dissolved metals and thus there is still a failure against the acute copper EQS. With the Scheme, 2.2 exceedances of short-term copper per year is predicted (which is slightly worse than the two allowable exceedances per year), which is the same as the existing situation (i.e. no worsening of the baseline). This is because the works being carried out within this area are signage works only as part of the Scheme with no changes to the road drainage catchment.

13.9.65 The cumulative assessment for road catchments 15+16+17 with the Scheme fail against the short-term copper EQS. In the existing situation, the results suggest that there is a potential for 6.3 exceedances per year (which is above the two allowable exceedances per year). In the with Scheme scenario, it is predicted that only 4.8 exceedances per year would likely occur. So, whilst there are predicted to be potential acute copper concentration exceedances above the EQS, with the Scheme there is an improvement over the existing situation. This is due to the additional mitigation provided by the swales at the toe of embankments (for road catchments 16 and 17) and the filter drains and roadside ditch added to road catchment 15.

13.9.66 The cumulative assessment point for road catchments 15+16+17 is close to the Scheme location, which is towards the head of the catchment, with an estimated

very low Q95 flow to dilute highway runoff. As for road catchment 4, a flow sensitivity analysis has been undertaken to determine the risk at a point further downstream. At this point, the number of short term copper EQS exceedances reduced from 4.8 per year to 3.7 per year, but was still above the two allowed annually.

13.9.67 Currently there are no Priority Outfalls noted for Catchments 1 and 2, and it is recommended that once the results of the drainage survey are known that the local MAC investigate these outfalls as locations of potential improvement for installation of mitigation measures.

13.9.68 Overall, there are considered to be no significant adverse effects on receiving watercourses from routine runoff from new outfall from the Scheme, or worsening of the current situation for existing outfalls, with the application of the proposed treatment measures. Please refer to Table 13.7 for full details of the impact magnitude and significance of effects.

Routine road runoff assessment: Impacts on groundwater

13.9.69 Road network catchments that drain to Watercourses 1 and 4 (Catchment 3, 8 and 9) discharge to small drainage ditches that have predicted Q95 flows of 0.001 m^3/s, meaning that they can also be considered for groundwater assessment as soakaways.

13.9.70 Results of the Method C assessment for network catchments 3, 8 and 9 are shown in Appendix 13.3 [TR010054/APP/6.3] Tables A8 and A9. All of the sites are assessed as presenting a medium risk to groundwater, due to being located on granular deposits of sand with gravel with a low clay content and a thin unsaturated zone.

13.9.71 As the groundwater risk assessment returns the result of a medium risk to groundwater, further assessment has been undertaken to determine the potential risk to groundwater in the area of Watercourse 1 and Watercourse 4. Additionally, the risk to groundwater from infiltration in the area of M6 Junction 11 has been assessed due to the use of grassed channels/swales in this area.

13.9.72 Based on the results of the groundwater level monitoring, it is considered that the groundwater in the superficial deposits and in the sandstone aquifer is in continuity with the existing surface water system and that groundwater provides baseflow discharge to the watercourses. Accordingly, in most situations the groundwater level is above the water level in the ditch and water in the ditch, including road drainage, cannot infiltrate to the groundwater. In this situation, the ditch does not perform as a soakaway and the groundwater assessment is invalid.

13.9.73 In the upper reaches of the ditches, it is possible that the invert of the ditch is above the groundwater level especially during drought periods. In this situation, it is likely that the ditches are dry and the ditches could act as a soakaway during road runoff events. Further downstream, the invert of the ditch would intercept the groundwater level and any water that has infiltrated upstream would discharge to the ditchcourse as baseflow. Accordingly, it is considered that any impacts on groundwater in this situation would be negligible and limited to the short section of the dry ditchcourse.

13.9.74 As the sites are of medium risk of road runoff, mitigation measures should be considered to protect groundwater. As described above, treatment measures have been identified for these networks in Appendix 13.2 [TR010054/APP/6.3], and CG501 indicates that the use of attenuation ponds and swales are suitable mitigation. Therefore, the mitigation measures identified in Section 13.8 would provide protection of both groundwater resources as well as surface watercourses.

13.9.75 Additionally, there would be spill protection in the form of penstocks located upstream of all wet attenuation ponds in catchments 3, 5, 8, 10, and 14.

13.9.76 Based on the above assessment the impact of routine road runoff the impact of the Scheme is predicted to be negligible for groundwater waterbodies with the application of mitigation as has been described in the Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]). This would result in a slight effect (not significant) for all groundwater from routine runoff.

Surface water quality: Accidental spillages

13.9.77 The probability that an accidental spillage would lead to a serious pollution incident has been calculated for each road catchment and for the cumulative outfalls. All the catchments have returned as acceptable standard of spillage risk. Full results are included within Appendix 13.3 [TR010054/APP/6.3].

13.9.78 It is considered the potential impact on the receiving watercourses is negligible, resulting in a slight effect on Watercourses 2, 3 and 5, and a neutral effect on the remaining Watercourses 1, 4, 6 and 7 (not significant).

13.9.79 Due to the distance downstream, the risk to the River Penk is considered to be negligible, resulting in a slight adverse effect (not significant).

Surface water quality: Surface de-icing

13.9.80 When temperatures are around 4°C or less, de-icing salts would likely be applied (when required) to the Scheme to maintain a safe driving surface and to help clear away any snow fall. The application of de-icant salts tends to be intermittent and can be very variable between years depending on how many cold days there are, and how long the cold period lasts. During this time, highway runoff (that may also include snow melt) may contain sodium chloride (NaCl) and lesser amounts of clay, cyanide, sediment, and a number of metals. De-icing salts can also be corrosive to metals and may potentially increase the mobilisation of heavy metals in sediments (such as in highway treatment ponds). Similarly, NaCl can potentially trigger the release into solution of accumulated nutrients and heavy metals absorbed to suspended solids.

13.9.81 Generally, it is considered that because de-icing salts are used only infrequently and in the colder months, over short periods and with frequent higher flows in between in which to dilute and disperse ‘salty’ water, and when flora tends to have died back and fauna less active and dormant, as such, significant long term adverse effects are not likely to occur. SuDS systems may also provide some dilution of salt, although they are not generally considered to reduce salinity and there is a risk that the ‘salty’ water can re-mobilise metals deposited in the sediments.

13.9.82 While de-icing salts have often been linked to detrimental impacts to aquatic ecosystems, and macroinvertebrates in particular (Ref 13.46), there are also numerous scientific reports indicating that road salts do not induce significant acute negative responses on macroinvertebrate communities, but that responses are variable at the species level, where different tolerances are observed (Ref 13.47 and 13.48). These latter studies considered short term/pulsed exposures of road salt on macroinvertebrate communities where there were short residence times for the de-icant. It was considered that salt could accumulate and have more detrimental impacts in more restricted-flow systems leading to potential chronic effects on fauna.

13.9.83 The de-icing regime would be purely weather dependent, with decisions made regarding when to grit the road based on three weather updates per day. As abroad indication of spreading rates, the Highways Winter Maintenance: A Practical Guide (Ref 13.49) suggests 10 to 20 g/m^2 of salt in a precautionary salting, increasing to 20-40 g/m^2 prior to snowfall or rain followed by freezing. Given that there are numerous existing outfalls to the watercourses in the study area, and notably Latherford Brook, it is expected that the aquatic communities of these watercourses may already be adapted to seasonal exposure to de-icant salts.

13.9.84 For the existing highway outfalls that have little change in catchment surface area under the Scheme (i.e. Catchments 1, 2, 14, 15 and 16) there is likely to be a negligible magnitude of impact to water quality from surface de-icing in comparison to the existing situation, resulting in a neutral effect (not significant). This would be the case for all the watercourses crossed by the Scheme as the current salting route travels on the M54, A460, and M6, and road drainage from these roads discharge currently to all watercourses crossed by the Scheme. It is anticipated that effects from de-icing salts would be greatest where receiving waterbodies are small and have limited dilution, such as is the case with the smaller drainage ditches, especially where they receive new highway discharges.

13.9.85 The Q_{95} flows for these watercourses (estimated from Lowflows software analysis) are in the region of 0.001 – 0.006 m^3/s for Watercourses 1 to 6. For Watercourses 1 and 4 where the estimated Q95 flow is in the region of 0.001 m^3/s, there is considered to be minor adverse magnitude of impact on the receiving watercourses when road salts are washed off the carriageway. This minor magnitude of impact would result in a neutral or slight adverse effect (not significant) for the low importance Watercourses 1 and 4. However, given the temporary, intermittent nature of the impact this is considered to be a slight adverse effect (not significant).

13.9.86 For the high importance watercourses (Watercourses 2, 3 and 5) and medium importance watercourses (Watercourses 6 and 7) the minor adverse magnitude of impact would give a slight adverse effect (not significant). Thereby giving a not significant effect on the receiving watercourses as a whole.

River Morphology: Culverts and clear span structure

13.9.87 The Scheme design includes four new culverts, and one clear-span bridge. There are no existing culverts which require extension or improvement works. The existing culvert on Watercourse 2 which crosses the A460 culvert would require cleansing

and a new screen to be installed, however the culvert itself does not require other extension or improvement.

13.9.88 Detailed design for the culverts/ watercourse crossings aim to minimise changes in river alignment and length as much as is feasible. Although Watercourse 2 would be diverted to the north over a distance of approximately 80 m, this is considered the most appropriate and shortest route given the local topographical constraints. Furthermore, once constructed the channel bed of all new culverts would be naturalised to minimise impacts on ecology, hydrology and sediment transport processes.

13.9.89 Despite embedding design mitigation to minimise adverse impacts from new culverts by attempting to maintain fluvial processes and light penetration, each culvert will result in the permanent loss of a section of the channel and surrounding riparian habitat depending on the length of the culvert. With reference to Table 13.3 this would result in a moderate adverse magnitude of impact to river morphology.

13.9.90 Two new culverts are proposed on Watercourse 2 totalling approximately 240 m. Watercourse two is a first order tributary that rises from a series of ponds to the south of the M54 and is approximately 2,100 m in length before the first small tributary joins it (Watercourse 1) at the southeast corner of Featherstone. Along its course Watercourse 2 is already culverted for approximately 400 m beneath the M54, and approximately 125 m beneath the A460 as it diverges on approach to the roundabout with the M54. It flows for approximately a further 2 km from the confluence with Watercourse 1 until it joins Watershed Brook. As a percentage of the first order reach, the new culverts would be approximately 12% of the channel length, which added to the existing culverts beneath the M54 and the A460 would make just more than a third of the first order channel culverted in total. However, as a percentage of the total channel length to Watershed Brook the new culverts would only be approximately 6%. This percentage will reduce further as these minor watercourses are part of the Penk WFD waterbody where the monitored reach along is >14 km long, and so represents only small amounts of the total drainage network channel length in that catchment. The loss of channel from the installation of these two new culverts will also be offset slightly by around 125-150 m of new channel with enhancements on existing channel form and riparian habitat.

13.9.91 Overall, new culverts would be installed on Watercourse 2, 3 and 4, all of which are considered to be of low importance for morphology. With the embedded mitigation measures this results in a slight adverse effect (not significant).

13.9.92 Latherford Brook, Watercourse 5, would be crossed by a 10 m wide clear span structure. This would include banks of 0.5 m either side of the current watercourse to allow for the banks to be contained within the crossing without adaptation or impact. Latherford Brook is a WFD waterbody and is considered to be of high importance for some attributes, and medium importance for hydromorphology. The additional width on the crossing would allow the watercourse to maintain river processes without significant impact. Based on the 10 m clear span bridge, it is considered there would be a minor adverse impact on the watercourse morphology. Using the significance matrix in Chapter 4: Environmental Assessment

Methodology, Table 4.3 and taking account of the morphological importance of Watercourse 5, this is considered to result in a slight adverse effect (not significant) due to the presence of bridge abutments, loss of a secondary high flow channel, and some constriction of the primary channel.

River morphology: Outfalls

13.9.93 The outfalls from the new road catchments and attenuation ponds would by a new ditchcourse thus avoiding the need for a pipe outfall supported by a concrete headwall. This will ensure the outfalls would not have an adverse impact on the morphology and character of Watercourses 2, 3, and 4. However, two new pipe outfalls will be constructed to Watercourse 5 for the drainage of embankments as the link road approaches the M6. Due to the limited size of each outfall, with good design, a negligible magnitude of impact is predicted resulting in a slight effect as Watercourse 5 is at medium importance for hydromorphology (not significant).

Groundwater flow

13.9.94 The Scheme includes the excavation of three cuttings. The invert of both the southern and northern cuttings are considered to be above the groundwater level in the sandstone aquifer. Accordingly, it is concluded that no groundwater control would be required in these two cuttings and hence there would be no change in groundwater flow, resulting in a neutral effect (not significant).

13.9.95 The cutting beneath Hilton Lane Overbridge would be up to 5.8 m bgl. The proposed road level will fall to the north east from approximately 137.6m AOD to approximately 133.3m AOD. Based on the results of groundwater level monitoring up to November 2019, it is considered that the groundwater level is close to the proposed road level and it is likely that the road drainage will intercept groundwater. Currently, there is no information on the maximum winter groundwater levels, which would be expected to be higher than those recorded to date. Accordingly, drainage of the cutting will be needed at least on an intermittent basis to lower the groundwater level and maintain the groundwater below the road level.

13.9.96 Preliminary calculations indicate that very small groundwater inflows will occur during operation, as the drawdown required is only less than 0.5 m. The calculated groundwater inflow to the cutting during operational drainage is small less than 1.5 m^3/day.

13.9.97 Groundwater in the area of the proposed Hilton Lane Overbridge cutting currently flows in a northerly direction towards watercourse 4, where it provides baseflow discharge to the stream and the associated ponds. The drains alongside the cutting will intercept the groundwater, reducing the flow towards watercourse 4. However, as the road drains along the cutting will discharge to watercourse 4 maintaining the input of water to the stream, it is considered that the impact on the flow in the stream would be minor. As Watercourse 4 is of low importance, the significance of the effect is slight (not significant). Other than Watercourse 4, there are no other groundwater receptors in the vicinity of the cutting. The impact on regional groundwater resources of the drainage is negligible, resulting in a slight adverse effect (not significant).

13.9.98 The dewatering of the borrow pit during construction was considered to have a moderate effect on groundwater resources. As it is proposed that the borrow pit is restored to original ground level, permanent dewatering would not be required during the operational phase of the Scheme and there would be no impact on groundwater resources.

13.9.99 While there would be potential for groundwater flows to be intercepted during construction of the cuttings and excavations for the Scheme, once the Scheme is operational and the ground reprofiled, impacts would be limited to the Hilton Lane Overbridge cutting, resulting in a negligible impact and a slight adverse effect on groundwater flow.

Ponds: Impacts on morphology and surface water quality

13.9.100 There are a number of ponds of low importance located within the footprint of the Scheme. Two would be lost during construction, Tower House Farm pond (near Old Ride), and a pond east of Brookfield Farm. The third and fourth pond, Lower Pool and a second pond east of Brookfield Farm, would be partially lost as a result of the Scheme.

13.9.101 Twelve new ecology ponds would be constructed as part of the Scheme. It is considered that these would mitigate for the loss of the two ponds, and partial loss of Lower Pool. Therefore, on balance it is considered there would be a negligible impact on pond morphology and habitat provision. This would result in a neutral effect (not significant).

Flood risk effects

Potential increased risk of fluvial flooding

13.9.102 A hydraulic model and capacity assessment was undertaken for Watercourses 1, 2, 3, 4, 5 and 6 to establish flood zone extents and the capacity of the watercourse channel for the Scheme post construction.

Watercourse 1

13.9.103 The Scheme would not impact the fluvial flood risk for Watercourse 1. No modifications are being made to the existing culverts and given that no out of bank flooding is predicted to occur in the vicinity of the Scheme there is no impact of changing the floodplain. Therefore, the change in fluvial flood risk is negligible, resulting in a neutral effect (not significant).

Watercourse 2

13.9.104 The baseline model predicts that there is flood risk to the A460 during the 1% AEP plus 50% climate change storm, indicating that a flood depth of 4 cm could occur on the A460 road surface. The Scheme has been designed to not worsen flood risk to the A460 keeping flood depths to the same as the baseline scenario (there is no change to the size of the existing culvert). Therefore, the change in fluvial flood risk is negligible, resulting in a neutral effect (not significant).

Watercourse 3

13.9.105 The Scheme would dramatically re-shape the outline of Lower Pool, and includes a culvert underneath the new carriageway. However, the Scheme would not impact the fluvial flood risk for this watercourse as the remaining Lower Pool is retained as an online pond. Water levels within the channel would increase in the section of watercourse between the culvert crossing and the Dark Lane culvert, as a result of reprofiling the upstream river reach. However, retaining part of the Lower Pool would protect properties at Dark Lane, as well as the existing A460 from potential flood risk. Therefore, the change in risk is negligible, resulting in a neutral effect (not significant).

Watercourse 4

13.9.106 The Scheme would not impact flood risk at this location. Some minor out of bank flooding is predicted at this location, however the depths and extents are comparable to the baseline scenario.

13.9.107 A fishing pond to the south-east of Brookfield Farm would be lost as a result of the Scheme, as well as the potential partial loss of a second pond. However, the FRA [TR010054/APP/6.3] has shown this would not have a significant impact on fluvial flood risk. Therefore, the impact of the Scheme in this location is negligible, resulting in a neutral effect (not significant).

Watercourse 5

13.9.108 Hydraulic modelling has shown that land adjacent to Watercourse 5 (Latherford Brook) to the south the of M6 Junction 11 is located in flood zone 1 rather than flood zone 3, as indicated on the Environment Agency's online indicative Flood Map for Planning. Therefore, flood zone 3 is less extensive than previously thought.

13.9.109 Whilst the Scheme would alter the depths and extents of the floodplain during larger magnitude storms (1% and 0.1% AEP events), the floodplain is largely unaffected for higher frequency events (50% and 5% AEP events). The only receptor to this change in floodplain is the existing woodland to the south of the watercourse. Woodland habitats are generally resilient to flooding but can experience changes if flooding frequency increases. The FRA has shown that the depths and extents of flooding are largely unchanged in the higher frequency events (50% and 5% AEP), therefore the impact of flooding is considered to have a minor adverse impact, resulting in a neutral effect (not significant).

Watercourse 6, 7 and 8

13.9.110 The Scheme would not impact the fluvial flood risk for these watercourses. Whilst the watercourse intersects the Scheme boundary, no modifications are proposed to the existing culverts. Given that no out of bank flooding is predicted to occur in the vicinity of the Scheme there would be no impact of changing the floodplain. Therefore, the change in fluvial flood risk is negligible, resulting in a neutral effect (not significant).

13.9.111 Overall, a minor impact is predicted on fluvial flood risk as a result of the Scheme. This would result in a neutral effect (not significant) on all watercourses crossed by the Scheme.

Potential increased risk of surface water flooding

13.9.112 The Scheme boundary is generally at low risk from surface water flooding, although there are some areas of medium and high risks associated with watercourses.

13.9.113 The Scheme alignment is predominantly on undeveloped (greenfield) land currently used for agricultural purposes. Given that the Scheme would increase the impermeable area along the entirety of its length, there would be the potential for the surface water flood risk, both to the highway alignment and surrounding area to increase.

13.9.114 Data gathered as part of the Ground Investigation, Appendix 9.1 [TR010054/APP/6.3] indicates that infiltration to ground would be unsuitable for drainage of the Scheme and instead surface water runoff would be discharged to local watercourses through 16 outfalls (see Table 13.5. Various attenuation measures have been incorporated into the Scheme which include attenuation storage and wetlands. Peak runoff would be attenuated up to the 1% AEP (1 in 100 year) rainfall event plus 40% climate change in accordance with the NPPF and Environment Agency guidance. Attenuation storage is also designed to accommodate the 1 in 100 year return period with 40% allowance for climate change.

13.9.115 With the implementation of the Drainage Strategy (Appendix 13.2 [TR010054/APP/6.3]) there should be no increase in surface water flood risk from the Scheme. Overall, a negligible magnitude of impact is predicted, resulting in a neutral effect (not significant).

Potential increased risk of flooding from groundwater

13.9.116 The majority of the site is considered to be at low risk of groundwater flooding as it is located in an area having >25 - <50% risk of groundwater emergence on the Environment Agency's Areas Susceptible to Groundwater Flooding (Ref 13.32).

13.9.117 The ground investigation indicates that groundwater levels are variable across the Scheme, with recorded depths ranging from 0.27 m to 12.96 m bgl. The lowering of land may pose an increased risk of groundwater flooding, however generally observed groundwater levels are far below the vertical impact of the Scheme.

13.9.118 Groundwater was found nearest surface at BH12 which is to the southern edge of the Lower Pool. At this location water was found between 0.27 m and 1.4 m bgl, however the Scheme is designed to be set within a 1.5 m cutting, approximately 5 m to the west of this location. Whilst this borehole is not directly in the footprint of the Scheme, the water level here may indicate a higher local perched water table in the area, possibly due to the proximity of Lower Pool. The next borehole closest to this area is BH11, which shows depths between 4.33 m and 4.92 m bgl. It is likely that the results for BH12 are therefore influenced by the close proximity to Lower Pool. The area would require de-watering as part of the construction process, as this section of Lower Pool is to be lost as a result of the Scheme. Therefore, it is

considered that this isolated high groundwater does not pose a risk to the operation of Scheme.

13.9.119 Similarly, groundwater is found at a depth of 0 m at BH22A. This borehole is directly adjacent to Watercourse 5, where the crossing structure would be constructed. This area is known to consist of 'wet woodland', with a high water table. This area is also within fluvial Flood Zone 2 and 3. The area would require de-watering as part of the construction process, and the watercourse is to be modified in this location. However, it is considered that this high groundwater does not pose a risk to the Scheme, given that ground levels would not be changed in this area.

13.9.120 Groundwater level monitoring shows that the groundwater level is generally below the base levels of the Scheme and hence there is a negligible risk that the groundwater level would rise to intercept the Scheme. During the operation of the Scheme, groundwater control would be required in the cutting beneath Hilton Lane Overbridge cutting to maintain the groundwater level below road level, where the level is below the groundwater level. The drainage from the cutting would be discharged to surrounding surface watercourses. Thus, the impact on groundwater flooding mechanisms due to the Scheme is considered to be minor in the operational phase. Overall, a negligible magnitude of impact is predicted resulting in a neutral effect (not significant).

Potential increased risk of flooding from artificial sources/drainage infrastructure

13.9.121 The Scheme boundary is at low risk of flooding from artificial sources, sewers and other water supply infrastructure. As the proposed drainage strategy is to discharge directly into watercourses at an attenuated rate via a dedicated highway drainage network (i.e. no runoff would be discharged to nearby sewers during operation of the Scheme) there should be no impact to the flood risk from existing sewers and drainage infrastructure, resulting in a neutral effect (not significant).

WFD Assessment

13.9.122 A WFD Assessment has been completed and is included in Appendix 13.4 [TR010054/APP/6.3]. This WFD assessment provides a description of the relevant water bodies with the study area and how they could be impacted by the Scheme. The assessment is based on a combination of existing data and site survey.

13.9.123 The WFD assessment indicates that only localised temporary and permanent impacts to WFD relevant bodies are expected providing the mitigation measures embedded in the design are implemented. This would include the design of drainage systems, new watercourse crossings, and outfalls, and implementation of construction phase mitigation measures.

13.9.124 The future design of the clear-span bridge across Watercourse 5 (Latherford Brook) and any minor watercourse diversions to new culverts will be informed by appropriate hydromorphological and ecological surveys. Where possible, the diversion of minor watercourses will deliver enhancement on the existing artificially modified channel form.

13.9.125 Mitigation measures including those to be adopted during construction to manage all pollution risks are outlined in the OEMP [TR010054/APP/6.11].

13.9.126 Based on the conclusions of the WFD assessment included in Appendix 13.4 [TR010054/APP/6.3], it is considered there would be a negligible impact to the WFD waterbodies within the study area as a result of the Scheme.

Summary of residual effects

13.9.127 A summary of residual effects once embedded and essential mitigation measures have been taken into account are listed in Table 13.7.

Table 13.7: Summary of residual effects

Receptor	Receptor importance	Nature of impact and scale	Magnitude of impact	Residual effect (statement of Significance)
Surface water (runoff and spill risk) impacts during construction				
River Penk	High	Localised and temporary	Negligible	Slight adverse (not significant)
Watercourse 1	Low	Localised and short term	Negligible	Neutral (not significant)
Watercourse 2	High	Localised and short term	Minor adverse	Slight adverse (not significant)
Watercourse 3	High	Localised and short term	Minor adverse	Slight adverse (not significant)
Watercourse 4	Low	Localised and short term	Minor adverse	Neutral (not significant)
Watercourse 5, Latherford Brook	High	Localised and short term	Negligible	Slight adverse (not significant)
Watercourse 6	Medium	Localised and short term	Negligible	Neutral (not significant)
Watercourse 7	Medium	Localised and short term	Negligible	Neutral (not significant)
Groundwater impacts during construction				
Groundwater - Hilton Lane Overbridge Cutting dewatering	High	Localised and short term	Negligible	Neutral (not significant)
Groundwater - Borrow pit dewatering	High	Localised and temporary	Minor adverse	Moderate adverse (significant)
Private water supplies - Cutting and borrow pit construction dewatering	Medium	Localised and temporary	Negligible	Neutral (not significant)

Receptor	Receptor importance	Nature of impact and scale	Magnitude of impact	Residual effect (statement of Significance)
Watercourse 3 - Borrow pit dewatering	Medium	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 4 - Hilton Lane Overbridge Cutting dewatering	Low	Localised and short term	Negligible	Neutral (not significant)
Construction Flooding				
Watercourse 2	Medium	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 3	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 4	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 5, Latherford Brook	Medium	Localised and temporary	Negligible	Neutral (not significant)
Operation Water Road Runoff				
Watercourse 1	Low	Localised and Permanent	Minor adverse	Slight adverse (not significant)
Watercourse 2	High	Localised and Permanent	Negligible	Slight adverse (not significant)
Watercourse 3	High	Localised and Permanent	Negligible	Slight adverse (not significant)
Watercourse 4	Low	Localised and Permanent	Negligible	Neutral (not significant)
Watercourse 5, Latherford Brook and Brookfield Fishery	High	Localised and Permanent	Negligible	Slight adverse (not significant)
Watercourse 6	Medium	Localised and Permanent	Minor adverse	Slight adverse (not significant)
Watercourse 7	Medium	Localised and Permanent	Minor adverse	Slight adverse (not significant)
Groundwater (via infiltration from Watercourse 1 and 4)	High	Localised and Permanent	Negligible	Slight adverse (not significant)

Receptor	Receptor importance	Nature of impact and scale	Magnitude of impact	Residual effect (statement of Significance)
Operations Spillage Risk				
River Penk	High	Localised and temporary	Negligible	Slight adverse (not significant)
Watercourse 1	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 2	High	Localised and temporary	Negligible	Slight adverse (not significant)
Watercourse 3	High	Localised and temporary	Negligible	Slight adverse (not significant)
Watercourse 4	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 5, Latherford Brook and Brookfield Fishery	High	Localised and temporary	Negligible	Slight adverse (not significant)
Watercourse 6	Medium	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 7	Medium	Localised and temporary	Negligible	Neutral (not significant)
Groundwater (via infiltration from Watercourse 1 and 4)	High	Localised and Permanent	Negligible	Slight adverse (not significant)
Impact from de-icants				
Watercourse 1	Low	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 2	High	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 3	High	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 4	Low	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 5, Latherford Brook and Brookfield Fishery	High	Localised and temporary	Minor adverse	Slight adverse (not significant)
Watercourse 6	Medium	Localised and temporary	Minor adverse	Slight adverse (not significant)

Receptor	Receptor importance	Nature of impact and scale	Magnitude of impact	Residual effect (statement of Significance)
Watercourse 7	Medium	Localised and temporary	Minor adverse	Slight adverse (not significant)
Operational: Morphological Impacts				
Watercourse 2	Low	Localised and Permanent	Moderate adverse	Slight adverse (not significant)
Watercourse 3	Low	Localised and Permanent	Moderate adverse	Slight adverse (not significant)
Watercourse 4	Low	Localised and Permanent	Moderate adverse	Slight adverse (not significant)
Watercourse 5, Latherford Brook	Medium	Localised and Permanent	Minor adverse	Slight adverse (not significant)
Loss and partial loss of ponds	Medium	Localise and Permanent	Negligible	Neutral (not significant)
Operational: Changes to groundwater and water body levels				
Groundwater	High	Localised and Permanent	Negligible	Slight adverse (not significant)
Watercourse 4	Low	Localised and Permanent	Minor adverse	Slight adverse (not significant)
Operational: River morphology: outfalls				
Watercourse 2	Low	Localised and Permanent	Negligible	Neutral (not significant)
Watercourse 3	Low	Localised and Permanent	Negligible	Neutral (not significant)
Watercourse 4	Low	Localised and Permanent	Negligible	Neutral (not significant)
Watercourse 5, Latherford Brook	Medium	Localised and Permanent	Negligible	Neutral (not significant)
Operational: Flood Risk				
Watercourse 2	Medium	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 3	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 4	Low	Localised and temporary	Negligible	Neutral (not significant)
Watercourse 5, Latherford Brook	Medium	Localised and temporary	Minor adverse effect	Slight adverse (not significant)

13.10 Monitoring

13.10.1 DMRB LA 104 (Ref 13.37) sets out the requirements of monitoring. Proportionate monitoring should be carried out where there are significant adverse impacts. These are discussed more below under construction and operation.

Construction

13.10.2 The OEMP [TR010054/APP/6.11] 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.

13.10.3 A programme of water quality monitoring will be undertaken prior to and during construction to ensure that no detrimental effect of the water environment occurs, and to allow any pollution incidents to be identified and remedied. This would also build data on the effectiveness of design and mitigation measures within the drainage strategy to drive improvement in environmental performance for future projects. The water quality monitoring would consist of regular site visits to make visual and olfactory observations, the use of in-situ water quality monitoring and regular sampling for laboratory analysis. During site visits any evidence of unnatural sediment accumulation that may be attributed to the construction works would also be recorded and action taken if required.

13.10.4 This would include monitoring Lower Pool and Watercourse 3 to ensure no adverse effect on water quality as a result of the construction within Lower Pool, and upstream of Watercourse 3.

Operation

13.10.5 No significant operation effects are predicted. However, it is recommended that post-construction a survey is undertaken of all new culverts and bridges to review the effectiveness of embedded mitigation and the function along any new diverted channel reaches. If there is any evidence of excessive erosion or sedimentation further actions should be considered to remedy that impact in as sustainable a way as possible.

13.10.6 No likely significant adverse effects are identified for flood risk, therefore no monitoring is required.

13.11 References

Ref 13.1 Highways England (2019) Design Manual for Roads and Bridges, Volume 11, Section 3, LA 113 Road Drainage and the Water Environment

Ref 13.2 Water Act 2014, Available online at: http://www.legislation.gov.uk/ukpga/2014/21/contents/enacted

Ref 13.3 The Floods and Water Management Act (2010), Available online at: https://www.legislation.gov.uk/ukpga/2010/29/contents

Ref 13.4 The Land Drainage Act 1991, Available online at: https://www.legislation.gov.uk/ukpga/1991/59/contents

Ref 13.5 The Water Resources Act 1991, Available online at: https://www.legislation.gov.uk/ukpga/1991/57/contents

Ref 13.6 The Salmon and Freshwater Fisheries Act 1975 (as amended) Available online at: https://www.legislation.gov.uk/ukpga/1975/51

Ref 13.7 The Water Environment (Water Framework Directive) (England Wales) Regulations (2017), Available online at: http://www.legislation.gov.uk/uksi/2017/407/contents/made

Ref 13.8 The Water Environment (Water Framework Directive) (England Wales) Regulations (2003) Available online at: http://www.legislation.gov.uk/uksi/2003/3242/contents/made

Ref 13.9 The Environmental Permitting (England and Wales) Regulations 2016. Available online at: http://www.legislation.gov.uk/uksi/2016/1154/contents/made

Ref 13.10 The Environmental Damage (Prevention and Remediation) Regulations (2015). Available online at: https://www.legislation.gov.uk/uksi/2015/810/contents

Ref 13.11 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. Available online at: http://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en_003.pdf

Ref 13.12 The Eels (England and Wales) Regulation 2009 Available online at: http://www.legislation.gov.uk/uksi/2009/3344/contents/made

Ref 13.13 The Groundwater (England and Wales) Regulations (2009) Available online at: https://www.legislation.gov.uk/ukdsi/2009/9780111480816/contents

Ref 13.14 The Control of Pollution (Oil Storage) (England) Regulations 2001. Available online at: http://www.legislation.gov.uk/uksi/2001/2954/contents/made

Ref 13.15 Department for Transport (2014) National Policy Statement for National Networks https://www.gov.uk/government/publications/national-policy-statement-for-national-networks

Ref 13.16 Department for Communities and Local Government (2019) National Planning Policy Framework

Ref 13.17 The Stationary Office (2012), Department for Communities and Local Government (2012), National Planning Practice Guidance, London

Ref 13.18 Department for Environment, Food and Rural Affairs (Defra) (2011) Future Water, the Government's water strategy for England. Available online at: London, The Stationary Office, https://www.gov.uk/government/publications/future-water-the-governments-water-strategy-for-england

Ref 13.19 Department for Environment, Food and Rural Affairs (2018) A Green Future: Our 25 Year Plan to Improve the Environment Plan. Available online at: https://www.gov.uk/government/publications/25-year-environment-plan

Ref 13.20 Department for Environment, Food and Rural Affairs (2015) Humber River Basin District River Basin Management Plan. Available online at: https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan

Ref 13.21 South Staffordshire Council (2012) South Staffordshire Local Plan: Core Strategy Development Plan Document. Adopted 11th December 2012. Available online at: https://www.sstaffs.gov.uk/planning/the-adopted-core-strategy.cfm

Ref 13.22 Staffordshire County Council (2017) Sustainable Drainage Systems (SuDS) Handbook. Available online at: https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Documents/SuDS-Handbook.pdf

Ref 13.23 Highways Agency (2006), Design Manual for Roads and Bridges Volume 4, Section 2, Part 1 HD103/06, Vegetation Treatment Systems for Highway Runoff, http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol4/section2.htm

Ref 13.24 The SuDS Manual 2015, CIRIA C753 https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx accessed October 2019.

Ref 13.25 Southern Staffordshire Councils Level 1 Strategic Flood Risk Assessment Final Report October 2019. Accessed November 2019

Ref 13.26 Ordnance Survey maps https://www.bing.com/maps

Ref 13.27 Aeriel maps https://www.bing.com/maps

Ref 13.28 Meteorological Office, Source: http://www.metoffice.gov.uk/public/weather/climate/gcqe2n19b

Ref 13.29 British Geological Survey Geoindex website https:// https://www.bgs.ac.uk/geoindex/ accessed July 2019

Ref 13.30 Environment Agency Catchment Data Explorer Website http://environment.data.gov.uk/catchment-planning/ accessed July 2019

Ref 13.31 Environment Agency Flood Map for Planning website https://flood-map-for-planning.service.gov.uk/ accessed July 2019

Ref 13.32 Environment Agency Areas Susceptible to Groundwater Flooding (AStGwF) https://data.gov.uk/dataset/f0329412-b46a-49b0-9f30-abef8c4b807e/groundwater-flooding-susceptibility accessed July 2019

Ref 13.33 Highways England Drainage Data Management System (HADDMS), www.haddms.com

Ref 13.34 Environment Agency (2013) Staffordshire Trent Valley abstraction licensing strategy, https://www.gov.uk/government/publications/cams-staffordshire-trent-valley-abstraction-licensing-strategy

Ref 13.35 Environment Agency (1998a) River Geomorphology: a practical guide. Available online at: http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide.aspx

Ref 13.36 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,

Ref 13.37 Highways England (2019) Design Manual for Roads and Bridges Volume 11, Section 2, LA 104 Environmental Assessment and Monitoring

Ref 13.38 Highways England (2018) M54-M6/M6 Toll Link Road PCF Stage 3 EIA Scoping Report

Ref 13.39 Highways England (2019) Design Manual for Roads and Bridges CG501 Design of Highway Drainage Systems.

Ref 13.40 Highways England (September 2018), M54/A4510 Waterhead Brook Outfall Study

Ref 13.41 Troels-Smith, J, (1955) Karakterisering af løse jordarter. Geological Survey of Denmark, Copenhagen.

Ref 13.42 Defra's online MAGIC map www.magic.gov.uk (accessed July 2019)

Ref 13.43 Reservoirs Act 1975 http://www.legislation.gov.uk/ukpga/1975/23 accessed October 2019

Ref 13.44 Environment Agency's Guidance Flood risk assessments: climate change allowances https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances (Accessed August 2019)

Ref 13.45 NetRegs website, Guidance for Pollution Prevention (GPPs) website, available at http://www.netregs.org.uk/environmental-topics/pollution-

prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/, accessed October 2019.

Ref 13.46 Fleetwood, M.J. (2017) Effects of winter road salt application and episodic pulses on southern Appalachian headwater stream macroinvertebrates. Appalachian State University Thesis.

Ref 13.47 Bent, C. (2009) The effects of road salt on the composition of macroinvertebrate fauna in three different streams receiving highway runoff. Masters Thesis, Norwegian University of Life Sciences

Ref 13.48 Blasius, B.J. and Merritt, R.W. (2002). Field and laboratory investigations on the effects of road salt (NaCl) on stream macroinvertebrate communities. Environmental Pollution, 120: 219-231

Ref 13.49 Institution of Civil Engineers (2000) Highway Winter Maintenance: A Practical Guide.

Ref 13.50 Highways Agency and Environment Agency (2009): Memorandum of Understanding between the Environment Agency and the Highways Agency, Annex 1 – Water Environment https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/341284/MoU_Env_Agency.pdf

Ref 13.51 National River Flow Archive https://nrfa.ceh.ac.uk/