A47 Wansford to Sutton Dualling

Scheme Number: TR010039

Volume 6
6.1 Environmental Statement
Chapter 13 – Road Drainage and the Water Environment

APFP Regulation 5(2)(a)

Planning Act 2008

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

March 2022~~August 2021~~

Deadline 3

Infrastructure Planning

Planning Act 2008

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

A47 Wansford to Sutton Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT
Chapter 13 – Road Drainage and the Water Environment

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010039
Application Document Reference	TR010039/APP/6.1
Author:	A47 Wansford to Sutton Project Team, National Highways

Version	Date	Status of Version
Rev 0	July 2021	Application Issue
Rev 1	August 2021	Updated following PINS Advice
Rev 2	March 2022	Deadline 3

Prepared for:

Galliford Try
Cowley Business Park
Cowley
Uxbridge
Middlesex
UB8 2AL

Prepared by:

Sweco UK Ltd
Grove House
Mansion Gate Dr
Leeds
LS7 4DN

Table of contents

Tables

13. Road Drainage and the Water Environment

13.1. Introduction

13.1.1. Highways England (the Applicant) has submitted an application for a development consent order (DCO) for the A47 Wansford to Sutton Scheme (hereafter referred to as 'the Proposed Scheme'). The Proposed Scheme comprises the dualling of a section of the A47 between Wansford to Sutton; improvements to the A47 Wansford junction; creation of the A47 Sutton Heath roundabout to replace the Nene Way roundabout; associated side road alterations; and walking, cycling and horse-riding connections.

13.1.2. This section of A47 road is currently unable to cope with the high traffic volume and there are limited opportunities to overtake slower moving vehicles on the single carriageway. The Proposed Scheme aims to reduce congestion related delay, improve journey time reliability and increase the overall capacity of the A47. Full details of the Proposed Scheme are provided in Environmental Statement Chapter 2 (The Proposed Scheme) (**TR010039/APP/6.1**).

13.1.3. The key elements of the Proposed Scheme include:

- approximately 2.6km of new dual carriageway constructed largely offline of the existing A47, including the construction of two new underpasses
- a new free-flow link road connecting the existing A1 southbound carriageway to the new A47 eastbound carriageway
- a new link road from the Wansford eastern roundabout to provide access to Sacrewell Farm, the Petrol Filling station and the Anglian Water pumping station
- closure of the existing access to Sacrewell Farm with a new underpass connecting to the farm from the link road provided
- a new slip road from the new A47 westbound carriageway also providing access to the Petrol Filling station
- a link road from the new A47 Sutton Heath roundabout, linking into Sutton Heath Road and Langley Bush Road
- new junction arrangements for access to Sutton Heath Road and Langley Bush Road
- closure of the existing accesses to the A47 from Sutton Heath Road, Sutton Drift and Upton Road
- new passing places and limited widening along Upton Drift (also referenced as Main Road)
- new walking and cycling routes, including a new underpass at the disused railway

- new safer access to the properties on the A1, north of Windgate Way
- installation of boundary fencing, safety barriers and signage
- new drainage systems including:
  - two new outfalls to the River Nene
  - a new outfall to Wittering Brook
  - extension of the A1 culvert at the Mill Stream
  - realignment and extension of the A47 Wansford Sluice
  - drainage ditch interceptors
  - new attenuation basins, with pollution control devices, to control discharges to local watercourses
- River Nene compensatory flood storage area
- works to alter or divert utilities infrastructure such as electricity lines, water pipelines and telecommunications lines
- temporary compounds, material storage areas and vehicle parking required during construction
- environmental mitigation measures

13.1.4. Under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, the Proposed Scheme is an Environmental Impact Assessment (EIA) development and as such requires submission of an Environmental Statement (ES) presenting the likely significant environmental effects of the Proposed Scheme.

13.1.5. As part of the Environmental Impact Assessment (EIA) process, this ES chapter reports the potential significant effects for the road drainage and the water environment as a result of the Proposed Scheme. This assessment includes a review of the existing baseline conditions, consideration of the potential impacts and identification of proportionate mitigation and enhancement.

13.1.6. The approach to this assessment follows the Scoping Report (February 2018) (**TR010039/APP/6.5**) and subsequent agreed Scoping Opinion (March 2018) (**TR010039/APP/6.6**) for the Proposed Scheme, in combination with the most up to date standard of the Design Manual for Roads an Bridges (DMRB), Volume 11, Section 3, LA 113 Road Drainage and the Water Environment (Highways England, 2020).

13.1.7. The main chapter text is supported by Figures 13.1 to 13. 8 (**TR010039/APP/6.2**), and Appendices 13.1 to 13.5 (**TR010039/APP/6.3**), which contain:

Figures (TR010039/APP/6.2)

- 13.1 Surface water features, abstractions and fluvial flood risk

- 13.2 Water Framework Directive (WFD) Surface water bodies
- 13.3 Aquifer and environmental designations
- 13.4 Water Framework Directive (WFD) groundwater bodies
- 13.5 Groundwater abstractions, discharges and source protection zones
- 13.6 Surface water flood risk
- 13.7 Susceptibility to groundwater flooding

Appendices (TR010039/APP/6.3)

- 13.1 Flood risk assessment
- 13.2 Drainage strategy
- 13.3 Surface water quality assessment
- 13.4 Groundwater assessment
- 13.5 Geomorphological assessment

13.2. Competent expert evidence

13.2.1. The surface water and flood risk competent expert (Ph.D, B.Sc (Hons)) has 24 years of experience in the water sector and has successfully delivered many environmental impact assessments and supporting technical assessments for large infrastructure projects.

13.2.2. The hydrogeological competent expert (M.Sc, B.Sc. (Hons), C.Geol) has 17 years of experience in groundwater resources, including hydrogeological impact assessments and provision of technical support on large infrastructure projects.

13.2.3. Both competent experts have used their EIA knowledge, experience with DMRB and road infrastructure projects and professional judgement in identifying the likely significant impacts associated with the Proposed Scheme and providing technical guidance through the assessment process.

13.3. Legislation and policy framework

National legislation and policy

National Policy Statement for National Networks

13.3.1. The National Policy Statement for National Networks (NPSNN) (Department for Transport, 2014), under the Planning Act (2008), sets out the need for, and Government's policies to deliver the development of nationally significant infrastructure projects on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State. NPSNN is used as

the primary basis for making decisions on development consent applications for national networks nationally significant infrastructure projects in England.

- Relevant to the road drainage and the water environment assessment, the NPSNN states:
- With regard to flood risk, if a Flood Risk Assessment (FRA) is required, the 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 would 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 into account and demonstrate that this is acceptable for the particular project;
  - consider if there is a need to remain operational during a worst case flood event over the development's lifetime
  - provide the evidence for the Secretary of State to apply the Sequential Test and Exception Test as appropriate
- The Secretary of State should be satisfied that flood risk would not be increased elsewhere and should only consider development appropriate in areas at risk of flooding where it can be demonstrated that:
  - within the site, 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)
- With regards to water quality the Secretary of State should be satisfied the proposal considers the River Basin Management Plans and the requirements of the Water Framework Directive (WFD) (including Article 4.7) and its daughter directives. This includes requirements on priority substances and groundwater.
- Where a development is subject to EIA and the development is likely to have significant adverse effects on the water environment, the applicant should ascertain its existing status and carry out impact assessments. These are included as part of the ES and 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 zones under the Water Framework Directive and source protection zones around potable groundwater abstractions
- any cumulative effects

Water Framework Directive

13.3.2. The Water Framework Directive (WFD) establishes a framework for the management of water resources throughout the European Union (EU). The WFD was transposed into UK law through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, which came into force in January 2004. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 came into force in April 2017. These replace the 2003 regulations, consolidating amendments made since then, and primarily affect the management of water quality by the Environment Agency. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 has been amended by the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019/558 so as to continue to have effect now the United Kingdom has left the EU.

13.3.3. The key objectives of the WFD, provided for in the area River Basin Management Plan (RBMP), are to:

- Prevent deterioration, enhance and restore bodies of surface water, achieve good chemical and ecological status of such water and reduce pollution from discharges and emissions of hazardous substances.
- Protect, enhance and restore all bodies of groundwater, achieve good chemical and quantitative status of groundwater, prevent the pollution and deterioration of groundwater, and ensure a balance between groundwater abstraction and replenishment.
- Preserve protected areas.

The Environmental Permitting Regulations

13.3.4. The Environmental Permitting Regulations (EPR) 2016, and the 2018 amendment, aim to protect groundwater and surface waters from pollution by controlling the inputs of potentially harmful and polluting substances. The Environmental Permitting (England and Wales) Regulations 2016 have been amended by the Environmental Permitting (England and Wales) (Amendment)

(EU Exit) Regulations 2019 so as to continue to function after the United Kingdom leaves the EU.

Flood and Water Management Act

13.3.5. The Flood and Water Management Act 2010 was a response to pressure to introduce legislation to address the threat of flooding and water scarcity, both of which are predicted to increase with climate change.

13.3.6. The Act requires better management of flood risk, it creates safeguards against rises in surface water drainage changes and protects water supplies for consumers. It gives responsibility to the Environment Agency for developing a National Flood and Coastal Risk Management Strategy, and gives responsibility to local authorities, as Lead Local Flood Authorities, to co-ordinate flood risk management in their area. Duties include investigating significant flooding incidents, maintaining a register of designated flood assets and provision of information.

Land Drainage Act

13.3.7. The Land Drainage Act 1991 requires that a watercourse be maintained by its owner in such a condition that the free flow of water is not impeded. The riparian owner must accept the natural flow from upstream but need not carry out work to cater for increased flows resulting from some types of works carried out upstream, for example, a new housing development. The Act sets out the functions of Internal Drainage Boards and Local Authorities in relation to land drainage, giving them permissive powers under Section 25 of the Act to ensure that appropriate maintenance is carried out by riparian landowners on ordinary watercourses.

13.3.8. The Land Drainage Act 1991 is also relevant to manage flood risk for any works on or adjacent to an ordinary watercourses and to the discharge of surface water drainage to ordinary watercourses.

The Highways Act

13.3.9. Under the Highways Act 1980 (Section 100), Highways England has a right to discharge runoff from highways into inland and tidal waters, subject to the requirement not to pollute controlled waters. This includes groundwaters, as defined under the Water Resources Act 1991.

The Water Resources Act

13.3.10. Section 93 of the Water Resources Act 1991 provides for the establishment of groundwater protection zones. The requirements of Section 93 are implemented

and set out in the Environment Agency's approach to groundwater protection (Environment Agency, 2017a) and the Environment Agency's groundwater protection guides covering: requirements, permissions, risk assessments and controls (Environment Agency, 2017b).

13.3.11. The Environment Agency's approach to groundwater protection includes the Environment Agency's position statements, which provide information about its approach to managing and protecting groundwater. They detail how the Environment Agency delivers government policy for groundwater and adopts a risk-based approach where legislation allows. Many of the approaches set out in the position statements are not statutory but may be included in, or referenced by, statutory guidance and legislation.

13.3.12. Source protection zones are defined for groundwater supplies used for human consumption. The Environment Agency's position statement relating to the use of sustainable drainage systems can be found in The Environment Agency's approach to groundwater protection (Environment Agency, 2018a).

Environmental Damage (Prevention and Remediation) Regulations

13.3.13. The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 only apply to damage after the Regulations come into force, and they only apply to operators of economic activities. There is a legal duty to immediately notify regulators and to prevent damage. Environmental damage is classified as damage to:

- Adverse effects on the integrity of a Site of Special Scientific Interest (SSSI) or on the conservation status of species and habitats protected by EU legislation outside SSSIs
- Adverse effects on surface water or groundwater consistent with a deterioration in the water's status (Water Framework Directive term)
- Contamination of land that results in a significant risk of adverse effects on human health

13.3.14. Remediation of damage to species, habitats or water must remove any significant risk to health. The objective is to achieve the same level of natural resources or services as would have existed if the damage had not occurred. This may involve primary remediation, complementary remediation or compensatory remediation.

The National Planning Policy Framework

13.3.15. The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2019) applies to this Scheme under:

- Chapter 14 “Meeting the challenge of climate change, flooding and coastal change”. This is supported by the Planning Practice Guidance (PPG) (Ministry of Housing, Communities and Local Government, 2016), in relation to flood risk. It states that where development is located in areas which are vulnerable to flooding, care should be taken to ensure that risks can be managed.
- Chapter 15 “Conserving and enhancing the natural environment” noted the development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

Floods Directive

13.3.16. The European Floods Directive 2007/60/EC came into force in 2008 aiming to provide a consistent approach to flood risk management across all of Europe. The Directive provides a framework for managing all sources of flood risk which take place as part of a six year cycle and requires:

- preliminary flood risk assessments
- flood risk and flood hazard maps
- flood risk management plans
- co-ordination of flood risk management at a strategic level
- improved public participation in flood risk management
- co-ordination of flood risk management with the Water Framework Directive.

13.3.17. The Flood Risk Regulations 2009 transpose the EU Floods Directive into law in England and Wales.

Local Policies

Peterborough Local Plan 2016-2036

13.3.18. The relevant policies within the strategy in relation to the water environment are summarised below:

- Policy LP24- Nene Valley. Development which would increase flood risk, compromise the performance of flood defence or existing navigation facilities, or restrict access to such facilities will not be permitted.
- Policy LP28- Biodiversity and Geodiversity in Development. All development proposals should, where necessary, protect and enhance the aquatic environment within or adjoining the site, including water quality and habitat.
- Policy LP32- Flood and Water Management. Development proposals should adopt a sequential approach to flood risk management, taking

into account the requirements of the NPPF and the further guidance and advice set out in the council's Flood and Water Management SPD.

- Policy LP32- Development located in areas known to be at risk from any form of flooding will only be permitted following: The incorporation of Sustainable Drainage Systems (SuDS) into the proposals.
- Policy LP33- Development on Land Affected by Contamination. All new development must take into account:
  - the potential environmental impacts on people, buildings, land, air and water arising from the development itself; and
  - any former use of the site, including, in particular, adverse effects arising from pollution.

13.4. Assessment methodology

13.4.1. The methodology follows the standard provided in DMRB LA 113 for assessing the significance of effects of proposed road schemes on the road drainage and the water environment. The procedures and the appropriate methods that must be used when assessing the potential impacts from the road projects on the water environment are described in the DMRB LA 113.

13.4.2. The following methods have been adopted:

- A simple assessment of groundwater levels and flow, as described in Appendix A of DMRB LA 113. This is a qualitative assessment that identifies all potential features which are susceptible to groundwater level and flow impacts from the Proposed Scheme, based on a hydrogeological conceptualisation of the surrounding area and the regional groundwater body status. The results of this assessment are included in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).
- A simple assessment of groundwater dependent terrestrial ecosystems, as described in Appendix B of LA 113. This is a stepped, risk-based approach which establishes linkages between potential impacts from the Proposed Scheme on the hydrological and hydrogeological regime and a groundwater dependent terrestrial ecosystem (GWDTE). The results of this assessment are included in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).
- A detailed assessment of groundwater quality and runoff, as described in Appendix C of LA 113, and using the groundwater risk assessment matrix provided in Highways England Water Risk Assessment Tool (HEWRAT) for the assessment of routine runoff to groundwater. The groundwater risk assessment matrix is based on the 'source-pathway-receptor' pollutant linkage principle. It considers the annual average daily traffic (AADT), annual average rainfall depth, drainage area ratio, and parameters of the receiving ground conditions to give a banded risk score. The detailed assessment also considers infiltration capacity,

water quality and spillage containment, as agreed with the Environment Agency. The results of this assessment are included in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).

- A simple assessment of pollution impacts from routine runoff to surface waters using Highways England Water Risk Assessment Tool (HEWRAT) as described in Appendix D of DMRB LA 113. The HEWRAT assessment uses updated drainage information and annual average daily traffic (AADT) data to establish potential impacts of pollutants in routine highway runoff and impacts from spillages for the Proposed Scheme upon the watercourses within the study area and the requirement for mitigation measures to adequately reduce the risk. The results of this assessment are included in Appendix 13.3 Surface water quality assessment (**TR010039/APP/6.3**).
- Assessment of pollution impacts from spillages using HEWRAT as described in Appendix D of DMRB LA 113. The method initially estimates the risk that there will be an incident causing the spillage of a potentially polluting substance somewhere on the length of road being assessed. It then calculates the risk, assuming a spillage has occurred, that the pollutant will reach and impact on the receiving watercourse or groundwater. The results of this assessment are included in Appendix 13.3 Surface water quality assessment (**TR010039/APP/6.3**).
- A Water Framework Directive (WFD) assessment for both surface water and groundwater, as described in section 3.50 of DMRB LA 113. This identifies how the Proposed Scheme has the potential to impact each of the waterbodies' quantity and quality elements and whether it could lead to non-compliance of the WFD. The WFD assessment is incorporated into this chapter and is based on the findings of the other assessments.
- A hydromorphological assessment, as described in Appendix E of DMRB LA 113. A simple assessment, supplemented by a site survey, identifies the natural river processes that would have operated before any development had affected the river or catchment and determines whether the degree of hydromorphological change is acceptable. If it is not, a detailed assessment shall be undertaken which should include further surveys and may include modelling. The results of this assessment are included in Appendix 13.5 Geomorphological assessment (**TR010039/APP/6.3**).

13.4.3. The approach takes into consideration comments from the Planning Inspectorate in response to the Scoping Report (Appendix 4.1 **TR010039/APP/6.3**).

13.4.4. As directed in DMBR LA113 E/1.4, the FRA (Appendix 13.1 (**TR010039/APP/6.3**)) has been undertaken in accordance with the requirements of the NPPF (Ministry of Housing, Communities and Local Government, 2016; 2019), and the Environment Agency's climate change allowances (Environment Agency, 2020a). A detailed hydrological and hydraulic assessment has been undertaken as part of this assessment.

13.4.5. A Drainage Strategy (Appendix 13.2 (**TR010039/APP/6.3**)) has been developed in order to outline the proposed drainage design and mitigation measures to reduce impacts upon the water environment from the Proposed Scheme.

Update to guidance and scope of assessment

13.4.6. Following a review of changes to DMRB LA 113, the scope presented in the Scoping Report (**TR010039/APP/6.5**) is still valid and no change is required.

13.4.7. Upton Drift Road has been scoped out of this assessment as the proposed construction works are considered to be minor and would have negligible impact upon the water environment. It is proposed to include passing places along the single lane road, which would result in a negligible increase in impermeable area (Appendix 13.2 Drainage strategy (**TR010039/APP/6.3**)).

13.4.8. The drainage on this road would remain as existing, which is identified as 'over the edge' drainage. There is an existing drainage ditch along the northern edge of the carriageway. The drainage ditch would remain as existing unless the passing places would encroach on the ditch. In this case, and if this cannot be avoided, the ditch would be culverted or diverted as detailed in Appendix 13.2 (Drainage strategy) (**TR010039/APP/6.3**).

13.4.9. The traffic forecast for the design year (2040) is below 650 (two way AADT), which is significantly below the minimum threshold of 10,000 used in the HEWRAT assessment (Highways England, 2020). On such lightly trafficked roads, pollutants would occur at low concentrations. Therefore, it is considered there is no pollution risk to surface water or groundwater.

Determination of baseline conditions

13.4.10. This chapter has been completed based on the information contained within the following reports and sources of information:

- Scoping Report (February 2018) (**TR010039/APP/6.5**)
- British Geological Survey (BGS) 1:50,000 and 1:625,000 superficial and bedrock geological map (BGS, 2020)
- Defra's 'Magic' interactive map (Defra, 2020)
- Environment Agency Catchment Data Explorer (Environment Agency, 2020b)
- Environment Agency consented discharges and abstraction data
- Highways Agency Drainage Data Management System (HA DDMS) (Highways England, 2021)
- Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study (Royal Haskoning DHV, 2018)

- Peterborough Flood Risk Management Strategy (FRMS), adopted 2015 (Peterborough City Council)
- Huntingdon District Council Level 1 and 2 Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2017)
- The findings of a 2018 ground investigation for the Proposed Scheme. Further details of this ground investigation are included in Appendix 13.4 (Groundwater Assessment) (**TR010039/APP/6.3**).

Site walkover

13.4.11. A site walkover was carried out in May 2020. The walkover was undertaken to:

- ground truth surface water features identified within the study area from Ordnance Survey mapping
- understand the hydraulic connectivity across the Proposed Scheme
- understand the geomorphology surrounding the Proposed Scheme

Consultation

13.4.12. The Environment Agency, Anglian Water and Peterborough City Council (as Lead Local Flood Authority) responded to the Scoping Report (**TR010039/APP/6.5**) via the Planning Inspectorate. Their responses are summarised below and the comments have been addressed in this chapter and associated appendices:

Anglian Water

13.4.13. Consideration should be given to all potential sources of flooding including sewer flooding (where relevant) as part of the ES and related FRA. Anglian Water would also wish to be consulted on the content of the proposed FRA if a connection to the public sewerage network is required. Further consultation is needed to ensure access can be maintained to Anglian Water's existing asset, Anglian Water pumping station.

13.4.14. Adequate safeguards must be put in place to ensure that the proposed highway improvements to the A47 do not adversely affect the continued operation of Anglian Water's existing assets or pollution of the river Nene. In addition, there are existing Anglian Water water mains within the boundary of the site which potentially could be affected by the Proposed Scheme. It is therefore suggested that the ES should include reference to existing Anglian Water water mains as well as the Anglian Water pumping station.

Environment Agency

13.4.15. Since the surrounding land to the site is located in Flood Zones 2 and 3, a FRA will therefore need to be included in the ES to demonstrate that the Proposed

Scheme is safe. The FRA will need to confirm that there would be no loss of floodplain as a result of the Proposed Scheme and provide details on how this can be achieved on a volume for volume basis. The Environment Agency have a river level monitoring station present between the proposed scheme and the River Nene, adjacent to Anglian Water Pumping Station. The FRA would need to ensure that this is not affected at any point during the works. The FRA will also need to consider the design of the surface water management network for the Proposed Scheme to avoid where possible any increase in flood risk to people or property.

13.4.16. The WFD status of the surface water and groundwater bodies located within the Proposed Scheme boundary of the Proposed Scheme must not deteriorate as a result of the Proposed Scheme. The Environment Agency would like the ES to go further and consider how measures could be undertaken to improve the status of the WFD waterbodies.

13.4.17. The site has been in use as an existing roadway. We are satisfied that this use does not pose significant pollution potential to the water / land environment and do not therefore have any comments to make in relation to land contamination in the ES.

13.4.18. Flood Risk Activity Permit - Under the terms of the Environmental Permitting Regulations 2016, a Flood Risk Activity Permit or exemption may be required for any proposed works or structures, in, under, over or within 8 m of the River Nene designated a ‘main river’.

Peterborough City Council

13.4.19. There were no specific responses within the Scoping Opinion (**TR010039/APP/6.6**) made by Peterborough City Council in relation to ‘Road Drainage and the Water Environment’.

Environment Agency

13.4.20. The Environment Agency were consulted in 2018, 2020 and again in 2021. Comments made in 2018 are summarised below:

- Any loss of floodplain should be compensated for on a level for level, volume for volume basis (i.e. re-grade the land at the same level as that taken up by the Proposed Scheme) therefore providing a direct replacement for the lost storage volume. The location of any compensation works must relate hydraulically and hydrologically to the location of the site, and excavation of the compensation must be complete before infilling commences.

- For discharge into the River Nene (Main River), the discharge rate will be based on the calculated pre-development (greenfield) runoff rate for the site. For a simple control structure this will be based on the QBAR rate. Complex discharge controls should reflect the original discharge or runoff rates from the site across the range of storm events.
- Investigation into improving fish, eel and otter passage through the existing A47 culvert should be carried out.
- Any road drainage which is being retained and discharges to the River Nene, without passing through interceptors, from the existing carriageway and is not be upgraded will require justification as to why this is not considered a pollution risk.
- Modelled streamflow and baseflow contributions for Mill Stream and Wittering Brook were provided under wet, average and dry scenarios, indicating that the streams receive upward leakage from superficial deposits and bedrock along the watercourse routes, and that groundwater levels are close to ground level in these areas. Modelled groundwater flows within the Sutton Heath and Bog SSSI, indicate rapid infiltration of effective rainfall through the Lincolnshire Limestone principal aquifer outcrop. Groundwater subsequently emerges as springs at the base of the Lincolnshire Limestone, along the western boundary, feeding into Wittering Brook. Further details of the information provided by the Environment Agency on surface water – groundwater interactions are provided in Appendix 13.4 (Groundwater Assessment) (**TR010039/APP/6.3**).
- As the principal Lincolnshire Limestone aquifer supports spring and river baseflows, the ES will have to demonstrate that the Proposed Scheme would not have a detrimental impact on this.

*Consultation undertaken after the Scoping Opinion (**TR010039/APP.6.6**)*

Environment Agency

13.4.21. The Environment Agency were consulted on the impacts on the WFD in relation to the culverting proposed on Wittering Brook and Mill Stream in November 2020. They noted the following:

- Wansford Sluice ~~Wittering Brook~~ culvert should be opened up, replacing the old culvert as well, to allow full mammal access, this would also improve fish and eel connectivity
- if throttling of the flow was required then the flow should be attenuated upstream using natural flood management techniques
- ~~full mammal passage would also be required at the A1 culvert~~
- the biggest risk to the WFD status would be water quality during construction and operation, and there was a need to demonstrate that there would not be an increase in pollution.

- outside of the Proposed Scheme boundary there's opportunity to create a new wetland between the A1 and Sacrewell Farm and to re-meander the straightened section of the millstream watercourse to create improved riverine habitat and improve water quality and increase biodiversity.

13.4.22. The Environment Agency and Peterborough City Council were further consulted in November 2020 to discuss the Wittering Brook A47 culvert and associated flood risk and WFD. They noted the following:

- removing the throttle created by the existing culvert was agreed to be the preferred option as the model demonstrates it was not impacting the flow and therefore there was minimal impact expected downstream
- the existing Environment Agency Lower Nene model was revised with new climate change allowances to 35% to estimate the design flood level. This would inform estimates for required flood compensatory storage.

13.4.23. The Environment Agency were consulted on the impacts to groundwater in relation to road drainage discharges on 11 November 2020, and specifically the method for the detailed assessment. They noted the following concerns, that are to be considered as part of the detailed assessment for routine runoff to groundwater:

- that shallow groundwater levels may reduce the potential effectiveness of the infiltration basins, should groundwater mounding occur, for example
- spillage containment should be included for the infiltration features

13.4.24. The Environment Agency were consulted again in March 2021 to review the River Nene flood compensation assessment and the Wittering Brook hydraulic model and report. The Environment Agency stated they were satisfied in principle with the proposals for floodplain compensation for the River Nene. Overall, the Environment Agency accepted the findings of the hydraulic model and report, however they also required additional information which has subsequently been addressed in the FRA and its annexes:

- the origin of the 1 in 50 year stage used in one of the sensitivity tests at the downstream boundary of the Wittering Brook model was queried
- whether any flows from the River Nene could have any impacts upstream in Wittering Brook with the proposed A47 culvert was also queried
- further justification, beyond being a conservative approach, for the use of ReFH 2.3 was requested

13.4.25. The Environment Agency provided comments on the draft FRA on 15 April 2021 requesting that flood compensation assessment calculations and cross-section drawings are included in the FRA and confirming the details of flood warnings and flood alerts areas near the Proposed Scheme.

Peterborough City Council

13.4.26. Peterborough City Council provided agreement in principle to the proposed drainage strategy in November 2020. Peterborough City Council requested that a condition survey of the Mill Stream and Wittering Brook would be required to ensure that both are free flowing and to provide details of any existing assets or structures. This should be undertaken to inform the detailed design and can be addressed as a walkover survey with photographs to satisfy Peterborough City Council.

13.4.27. Peterborough City Council were consulted on the proposed methodology for flood modelling of the A47 Wansford ~~Sluice Extension~~Sluice replacement~~Wittering Brook~~ culvert in May 2020 and their advice was incorporated into the subsequent assessments. It was agreed a simple approach to hydraulic assessment of the existing and extended culverts would be undertaken for the A1 Mill Stream culvert.

13.4.28. Peterborough City Council were consulted again in March 2021 via Cambridgeshire County Council to review the Wittering Brook hydraulic report and assessment. Cambridgeshire County Council confirmed they would not raise any objection to the proposed culvert option but have requested more information regarding the detriment across the floodplain of Wittering Book during the 10% AEP event so the impacts can be fully understood. The queries and information requested are provided within the FRA (Appendix 13.1 (**TR010039/APP/6.3**)).

Assessment criteria

13.4.29. This assessment identifies the water features within the study area (and any downstream water bodies) and determines the importance (value) of the features as set out in DMRB LA 113.

Value of receptor

13.4.30. The conservation value of water resources is in part defined by legislation which protects all controlled waters in England and Wales and, in effect, protects all water bodies (surface water or groundwater). Thus, there cannot be any water feature which has negligible value. The value of controlled waters was defined by considering the use and conservation importance of the water body. The criteria used in this assessment to determine the value / importance of each

water feature and its attributes are set out in Table 13.1, based on the definitions provided in Table 3.70 in DMRB LA 113.

13.4.31. The value / importance of water environment attributes within the study area are defined in Table 13.6 in section 13.4, based on definitions provided in Table 13.1.

Table 13.1 Criteria for Estimating the Importance of Water Environment Attributes

Value	Criteria	Examples
Very High	Nationally significant attribute of high importance	**Surface Water**: Watercourse having a WFD classification shown in a RBMP and Q95 ≥ 1 .0m^3/s. Site protected / designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water) / Species protected by EC legislation Ecology and Nature Conservation **Groundwater**: Principal aquifer providing a regionally important resource and / or supporting a site protected under EC and UK legislation Ecology and Nature Conservation. Groundwater locally supports GWDTE SPZ1. **Flood Risk**: Essential infrastructure or highly vulnerable development.
High	Locally significant attribute of high importance	**Surface Water**: Watercourse having a WFD classification shown in a RBMP and Q95 <1.0m^3/s. Species protected under EC or UK legislation Ecology and Nature Conservation **Groundwater**: Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE SPZ2 **Flood Risk**: More vulnerable development
Medium	Of moderate quality and rarity	**Surface Water**: Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s. **Groundwater**: Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3. **Flood Risk**: Less vulnerable development
Low	Lower quality	**Surface Water**: Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m^3/s **Groundwater**: Unproductive strata **Flood Risk**: Water compatible development

Magnitude of impact

13.4.32. Definitions for the magnitude of impact are given in Table 13.2 and are based on values set out in Table 3.71 of DMRB LA 113, and the typical examples should be used as a gauge.

Table 13.2 Estimating the Magnitude of an Impact on an Attribute

Magnitude	Criteria	Examples
Major adverse	Results in loss of attribute and / or	**Surface Water** Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT and compliance failure with EQS values. Calculated risk of

Magnitude	Criteria	Examples
	quality and integrity of attribute	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. **Ground Water** 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 (> 100mm).
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 related 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. **Ground Water** Partial loss or change to an aquifer. Degradation of 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. **Ground Water** 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	The proposed project is unlikely to affect the integrity of the water environment. **Surface Water** No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). Risk of pollution from spillages <0.5%.

Magnitude	Criteria	Examples
		Ground Water No measurable impact upon an aquifer and / or groundwater receptors and risk of pollution from spillages <0.5%. **Flood Risk** Negligible change to peak flood level (≤ + / - 10mm).
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	**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 (when existing spillage risk is <1% annually). **Ground Water** Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually). Reduction of 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. **Ground Water** Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). Contribution to 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 level1 (> 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. **Ground Water** Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of 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

13.4.33. The overall significance of effect was determined using the significance matrix provided in Table 3.8.1 in DMRB LA 104 (provided in Chapter 4 (Environmental Assessment Methodology) Table 4.2 (**TR010039/APP/6.1**)) using professional judgement to consider site specific factors that may be of relevance. Effects can be beneficial or adverse. Effects that are moderate, large, or very large, are considered significant effects. Effects that are slight or neutral are not significant. A description of the significance category is provided in Table 3.7 of DMRB LA 104 and is set out in Chapter 4, Environmental Assessment Methodology Table 4-1 (**TR010039/APP/6.1**).

13.5. Assessment assumptions and limitations

13.5.1. Temporary drainage design during construction is to be confirmed. A reasonable assumption is that the main site compound runoff would be collected within a ditch surrounding the compound and be redirected to settlement ponds before being discharged to a surface watercourse or ground. Although it is assumed that satellite compounds and other worksite welfare and compound areas would not have temporary drainage systems, any welfare areas would have their own waste storage that would be maintained on a regular basis.

~~13.5.2. The site investigation is still outstanding and the preliminary design changes for the proposed A1 Mill Stream culvert extension (or replacement) has yet to be agreed. However, it is assumed there would be no increase in flood risk to the Proposed Scheme and others from the culvert design. In addition to this, a natural bed would be installed in the base of the culvert and a mammal ledge provided to maintain connectivity of habitat.~~

~~13.5.3.~~13.5.2. It is assumed that no significant adverse effects are predicted deriving from the vulnerability of the Proposed Scheme to risks of major accidents and / or disasters (e.g. major road traffic accident, structure collapse, ground instability, terrorist attack, fire, chemical spillage). This is due to the design, construction and operation of the Proposed Scheme which must comply with relevant health and safety legislation, current design standards and a response to any major incident would be in accordance with Highways England's Traffic Incident Management and Contingency Planning framework.

~~13.5.4.~~13.5.3. The Groundwater assessment (see Appendix 13.4 (**TR010039/APP/6.3**)) is constrained by the information available. Whilst the ground investigation has provided comprehensive data relating to the geology and hydrogeology within the Site (the Proposed Scheme boundary), data is limited outside of this. The data collected may therefore not necessarily fully

represent the regional hydrogeological conditions, particularly with respect to hydraulic gradients and direction of groundwater flow.

~~13.5.5.~~13.5.4. Since the ground investigation was undertaken the position of the proposed A47 realignment has moved northwards between Sutton Heath Road and Upton Road. There is therefore limited information directly beneath the Proposed Scheme in this area. Other areas, such as proposed below-ground structures, may also require further investigation and monitoring to ascertain accurate hydraulic properties and groundwater level ranges in order to better understand any potential dewatering requirements and subsequent impacts of construction. Further details of construction methods would also be required to assess the associated groundwater control requirements. The information available at this stage is considered sufficient for the purposes of this assessment.

~~13.5.6.~~13.5.5. In addition, whilst over a year of groundwater level monitoring data has been collected, there is the possibility that this does not reflect long term seasonal maximums and minimums. The groundwater assessment in this chapter reviews monitoring data in relation to long term groundwater level monitoring provided by the Environment Agency, and comments on the likely seasonal maximum groundwater levels. Conservative values are used throughout the assessment to provide a worst-case scenario. Additional groundwater monitoring information is therefore unlikely to affect the assessment of likely significant effects.

~~13.5.7.~~13.5.6. Further limitations in the datasets used include the extents of the groundwater flooding susceptibility dataset, which is limited to a 500m corridor around the existing road, and restricted location descriptions for unlicensed groundwater abstractions due to General Data Protection Regulations.

13.6. Study Area

13.6.1. The study area must encompass groundwater and surface water features that would potentially be affected by the Proposed Scheme. The study area is based on professional judgement to ensure that effects are sufficiently identified and comprises a 1km corridor surrounding the footprint of the main construction area of the Proposed Scheme boundary. As the assessment of the proposed works at Upton Drift Road has been scoped out, as described in 13.4.7, this is not included within the study area. Where appropriate, the study area has been extended to include features further downstream (surface water features) or down-gradient (groundwater features) that may also be impacted, should a potential pathway or linkage be identified. This can be important for identifying groundwater dependent terrestrial ecosystems that rely on groundwater originating from within the Proposed Scheme boundary, for example. The study

area is shown in Figures 13.1 to 13.7 (**TR010039/APP/6.2**) along with the key surface water and groundwater features. The surface water and groundwater features included in the assessment are also described in Section 13.7.

13.7. Baseline conditions

Surface water

Surface water features

13.7.1. There are various water features located within the vicinity of the Proposed Scheme, including 29 small lakes and ponds in the neighbouring fields and ten drainage channels. The main surface water features within the study area that have the potential to be either directly or indirectly affected by the Proposed Scheme are shown in Figure 13.1 (**TR010039/APP/6.2**). A summary of these features is provided below:

13.7.2. The River Nene is an Environment Agency designated main river and is located to the south of the Proposed Scheme, within the study area. It flows in an easterly direction adjacent to, but outside of, the Proposed Scheme boundary until its confluence with Wittering Brook, it then flows to the south. Several large lakes and drainage ditches are present to the south of the main channel which are within the study area.

13.7.3. Wittering Brook, an ordinary watercourse under the jurisdiction of the Lead Local Flood Authority, Peterborough City Council, is located west of Sutton Heath Road and passes through the study area. It flows in a southerly direction through Sutton Heath and Bog Site of Special Scientific Interest and under the existing A47, within the Proposed Scheme boundary, before its confluence with the River Nene.

13.7.4. An ordinary watercourse, which originates from the north-east, flows under the Proposed Scheme at Sutton Heath Road before its confluence with Wittering Brook. There are five drainage ditches located adjacent to Wittering Brook:

- one of these flows adjacent to Wittering Brook and feeds into Wittering Brook, downstream of the Mill Stream confluence
- one flows adjacent to Wittering Brook and feeds into a pond upstream of the confluence with Mill Stream
- the remaining three flow in a south-westerly direction and feed the tributaries of Wittering Brook.

13.7.5. There are three ponds located adjacent to Wittering Brook.

13.7.6. An ordinary watercourse is usually a smaller river or stream on which lead local flood authorities, district councils or Internal Drainage Boards carry out flood risk

management work. The watercourses identified within the study area do not lie within an Internal Drainage Board catchment.The study area is not within an Internal Drainage Board area.

13.7.7. Mill Stream, an ordinary watercourse, is located approximately 0.3km north of the A47 within the study area. It flows in an easterly direction, passing through the Proposed Scheme boundary where it flows beneath the A1 through a culvert (2.05m diameter concrete pipe followed by a 2.15m diameter corrugated steel pipe extension). It then flows through a large mill pond before joining Wittering Brook at the upstream end of Sutton and Heath Bog SSSI. Upstream of the A1, within the study area, Mill Stream splits into two watercourses. Three ponds are located adjacent to the watercourse.

13.7.8. An unnamed watercourse is located to the east of the Proposed Scheme, outside of the Proposed Scheme boundary, but within the study area. It flows in a southerly direction beneath the existing A47and then flows for approximately 2km before its confluence with the River Nene.

13.7.9. There are two drainage ditches located to the north of the A47, west of Upton Road within the study area, which flow in a southerly direction into the Proposed Scheme boundary, and within the permanent construction area to the existing A47. From here they flow in an easterly direction along a drainage ditch, which runs adjacent to the carriageway, towards the unnamed watercourse to the east of the Proposed Scheme.

13.7.10. Two ponds are located within the construction area of the Proposed Scheme, to the west of Upton Road (south of the Proposed Scheme) and west of Wittering Brook (north of the Proposed Scheme). Two ponds are located on Mill Stream, downstream of the A1 crossing, within the Proposed Scheme boundary. Two ponds are located to the west of the A1, within the study area but outside of the Proposed Scheme boundary. An unnamed reservoir is located adjacent to the A1, to the north of the Proposed Scheme. The use of this reservoir is unknown.

13.7.11. There are two gauging stations located within the study area:

- one located to the east of the A1 on the River Nene (32010 - Nene at Wansford), where the Q95 was identified as 2.9 m3/s (National River Flow Archive, 2021a)
- one located near the River Nene confluence on Wittering Brook (32020 – Wittering Brook at Wansford), which is no longer in use, where the Q95 was identified as 0.091 m3/s (National River Flow Archive, 2021b)

13.7.12. Estimated ambient background concentrations for copper in the River Nene hydrometric area have been estimated to be 1.25 µg/l at the 10th percentile (UKTAG, 2012). This is 0.25 µg/l greater than the Environmental Quality

Standard (EQS; UKTAG, 2014) of 1 µg/l. Water quality sampling has been undertaken by the Environment Agency upstream of the Proposed Scheme and within the study area on the River Nene at Wansford Old Road Bridge (Environment Agency, 2021). Results obtained indicate the ambient background concentrations for copper in the River Nene on this river reach is 0.14 µg/l for 2018 and 2019, which is under the freshwater EQS level. There was no water quality data available for any other watercourses within the study area.

13.7.13. There is an Anglian Water pumping station located on the River Nene south of the Proposed Scheme. Water from the River Nene is transferred to Rutland Water, which is located 21km north-west of the Proposed Scheme (Ovens and Sleath, 2008)

Water Framework Directive

13.7.14. The study area is split between two WFD surface water body catchments, both of which are within the Anglian River Basin District:

- Nene - Islip to Tidal WFD water body (WBID: GB105032050381) covers the entire southern part of the study area and northern section east of Sutton Heath Road. The River Nene main river flows through the length of the catchment and an unnamed watercourse to the east of the Proposed Scheme is also located within this catchment. It is a heavily modified water body which is part of the Nene Middle Operational Catchment.
- Wittering Brook WFD water body (GB105032050350) covers the northern part of the study area and contains Wittering Brook and Mill Stream ordinary watercourses. There are no main rivers within the study area that are associated with this water body catchment. It is not designated artificial or heavily modified and is part of the Nene Middle Operational Catchment.

13.7.15. Both catchments are within the Anglian River Basin District and the Nene Management Catchment. Their locations are identified in Figure 13.2 (WFD surface waterbodies) (**TR010039/APP/6.2**) .

13.7.16. Table 13.3 summarises the WFD surface water bodies within the study area and indicates their targets and objectives. The current Anglian River Basin Management Plan (RBMP), as shown by the Environment Agency's Catchment Data Explorer (Environment Agency, 2020b) indicates that:

- Nene - Islip to Tidal WFD water body (WBID: GB105032050381) ecological potential is limited to moderate by the supporting elements (mitigation measures assessment being moderate or less) and physico-chemical quality elements (poor potential for phosphate). The chemical status fails due to the presence of priority hazardous substance, namely,

polybrominated diphenyl ethers (PBDE), perfluorooctane sulphonate (PFOS) and mercury and its compounds. All other aspects of chemical quality are at good status. Reasons for not achieving good potential include physical modifications, sewage discharges (continuous), poor livestock management and poor nutrient management. The overall status is expected to remain at moderate due to unfavourable balance of costs and benefits and disproportionate burdens.

- Wittering Brook water body (WBID: GB105032050350) ecological status is limited to moderate by the biological quality elements (moderate status for macrophytes and phytobenthos combined) and physico-chemical quality elements (poor status for phosphate). The chemical status fails due to the presence of priority hazardous substance, namely, polybrominated diphenyl ethers (PBDE) and mercury and its compounds. All other aspects of chemical quality are at good status. Reasons for not achieving good status include sewage discharges (continuous), transport drainage, poor livestock management and poor nutrient management. The overall status is expected to remain at moderate due to disproportionate burdens and no known technical solution being available.

Table 13.3 Summary of WFD surface water bodies within the study area

Water body ID	GB105032050381	GB105032050350
Water body Name	Nene - Islip to Tidal	Wittering Brook
Operational Catchment	Nene Middle	Nene Middle
Management Catchment	Nene	Nene
River Basin District	Anglian	Anglian
Type	River	River
Hydromorphological Status	Heavily Modified	Not designated artificial or heavily modified
Overall Classification (Cycle 2 – 2019)	Moderate	Moderate
Current Ecological Quality (Cycle 2 – 2019)	Moderate	Moderate
Current Chemical Quality (Cycle 2 – 2019)	Fail	Fail
Ecological Objective	Moderate by 2015 (i.e. maintain moderate status)	Moderate by 2015 (i.e. maintain moderate status)
Chemical Objective	Good by 2015*	Good by 2015*
Protected Area (within the study area)	Yes, Nitrates Directive, Conservation of Wild Birds Directive, Drinking Water Protected Area, Urban Waste water Treatment Directive and Safeguard Zone	Yes, Nitrates Directive

*not updated on website

13.7.17. Northern parts of the study area are within the Lincoln Limestone (S382) Nitrate Vulnerable Zone (NVZ) and Southern parts of the study area are within the Northampton Sands (G165) NVZ. The entirety of the study area is within the

River Nene NVZ (surface water 382). The southern and south-eastern area is located within a drinking water safeguard zone (surface water) SWSGZ1006 is designated at risk from pesticides (metaldehyde, propyzamide and quinmerac) (Environment Agency, 2020c).

Groundwater

Geology

13.7.18. The bedrock and superficial geology within the study area briefly comprises sandstone, siltstones and fireclays of the Rutland Formation in the east of the study area, underlain by oolitic limestone of the Upper and Lower Lincolnshire Limestone Formation which is found across the majority of the study area. This is underlain by silts and sands of the Grantham Formation which itself is underlain by mudstones and shales of the Whitby Mudstone Formation. Both the Grantham Formation and the Whitby Mudstone Formation are found along the route of the River Nene and Wittering Brook.

13.7.19. Superifical deposits of alluvium and River Terrace Deposits are found along the course of the River Nene.

Aquifer designations

13.7.20. Aquifer designations are presented in Figure 13.3 (Aquifer and environmental designations) (**TR010039/APP/6.2**). The extents of individual superficial deposits are also presented in Figure 13.3 (Aquifer and environmental designations) (**TR010039/APP/6.2**). The Lincolnshire Limestone is classified by the Environment Agency as a Principal Aquifer. Principal Aquifers supply water resources and / or baseflow at a strategic scale.

13.7.21. Alluvium and the River Terrace Deposits are classified by the Environment Agency as a Secondary A Aquifer, which are described as formations that provide locally important water resources and may support baseflow to rivers.

13.7.22. The Rutland Formation is classified by the Environment Agency as a Secondary B Aquifer, described as predominantly lower permeability layers which may contain localised groundwater contained within fissures or thin permeable horizons.

13.7.23. Head and the Grantham Formation are classified by the Environment Agency as a Secondary (undifferentiated) Aquifer. Secondary (undifferentiated) Aquifers are classified as such due to the formation previously designated as both a minor aquifer and non-productive strata in different locations due to variable characteristics.

13.7.24. The Whitby Mudstone is classified by the Environment Agency as Unproductive strata which is described as rock layers or superficial deposits with low permeability that have negligible significance for water supply or river baseflow.

Aquifer properties

13.7.25. The properties of the aquifer define its capacity to release water and the ability of groundwater flow to be transmitted with ease.

13.7.26. The main bedrock aquifer units in the study area are the Lincolnshire Limestone Formation, where saturated, and the Grantham Formation. Groundwater was also observed within the Whitby Mudstone Formation.

13.7.27. The Lincolnshire Limestone Formation Principal Aquifer appears to be mostly unsaturated within the study area. Groundwater modelling indicates that there is a downwards groundwater flow direction resulting from rapid infiltration and the permeable nature of the Lincolnshire Limestone Formation. This is apparent on higher ground away from streams where the formation is dry. However, springs issue from the contact point between the Lincolnshire Limestone Formation and the underlying Grantham Formation / Whitby Mudstone Formation and flow towards either the Mill Stream, Wittering Brook or the River Nene. This further highlights its permeable nature and importance as a source of water for superficial deposits beneath the River Nene, and ultimately also the River Nene. The permeability of the Lincolnshire Limestone Formation was recorded to be in the order of 2 to 9 x 10^{-5}m/s in infiltration testing. The Lincolnshire Limestone is noted by (Griffiths *et al.*, 2006) as having low primary intergranular porosity and permeability, in the range of 10^{-4}m/d (10^{-9}m/s) and high secondary permeability resulting from fracturing of tectonic origin which is enhanced by karstic weathering. BGS records (Griffiths *et al.*, 2006) indicate that transmissivity within the Lincolnshire Limestone can range from 100 to 250 m^2/day when unconfined and 2000 to 10000 m^2/day when confined. The permeability of other bedrock formations was not tested.The Lincolnshire Limestone Formation and Grantham Formation are assumed to be in hydraulic continuity, although the Lincolnshire Limestone Formation is significantly more permeable. Similarly, the overlying Rutland Formation is also assumed to be in hydraulic continuity with the Lincolnshire Limestone Formation.

13.7.28. Permeability in the superficial deposits is likely variable depending on local characteristics. Infiltration tests conducted in the river terrace deposits obtained results in the range of 3x10^{-2} to 1x10^{-1} m/s which is considered to be a high result for sands and gravels (Freeze and Cherry, 1979).

Groundwater levels and flows

13.7.29. Groundwater level monitoring was carried out following the 2018 ground investigation between September 2018 and January 2019 (Soils Limited, 2019) and also between September 2020 and February 2021 . This is detailed further in Appendix 13.4 (Groundwater assessment) (**TR010039/APP/6.3**), with a summary of findings given below.

13.7.30. Groundwater levels in the area are controlled by springs emerging from the base of Lincolnshire Limestone Formation, and possibly also fracturing within the top of the Grantham Formation. Groundwater levels within the Grantham Formation generally range between 2.5 and 7.3m below ground level (mbGL) (17.2 and 23.5 metres above Ordnance Datum (maOD)) although are found to be much closer to ground at the northern extents of the Proposed Scheme, adjacent to Mill Stream. Groundwater levels must also be influenced by surface water as discussed below in Section 13.7.32.

13.7.31. To the east of Sutton Heath Road, groundwater has been identified within the Rutland Formation at depths of 5 mbGL or deeper. Groundwater levels in the overlying river terrace deposits range between 2.75 and 5.26 mbGL, although may be up to 0.4m higher.

Groundwater quality

13.7.32. Groundwater quality results from the 2019 ground investigation indicate elevated ammoniacal nitrogen and boron, which may be reflective of anthropogenic influences on the unconfined aquifer, as is typical for the Lincolnshire Limestone (Griffiths *et al.*, 2006).

Groundwater vulnerability

13.7.33. The bedrock and superficial aquifers have a combined groundwater vulnerability classification of high risk in areas where there is limited cover of superficial deposits and the Lower Lincolnshire Limestone is exposed. This is found in the vicinity of the A1 / A47 junction in the west of the site and along Sutton Heath Road in the east. Areas of medium to high risk are associated with exposure of the Grantham Formation in the west of the site and the Upper Lincolnshire Limestone in the east. Areas of medium to low risk are associated with cover of alluvium and river terrace deposits in the vicinity of the River Nene. Soluble rock risk is associated with the Limestone bedrock under the entire site.

Surface water features supplied by groundwater

13.7.34. The River Nene, Wittering Brook and Mill Stream all receive a moderate baseflow supply from groundwater. This is likely to be either directly from the

underlying superficial deposits and bedrock aquifer, or indirectly via seasonal springs.

13.7.35. Lowland fen priority habitats are located along the River Nene and the floodplain to the south. Lowland fens receive water and nutrients from the underlying soil, rock and groundwater. They are recognised as a priority habitat under the UK Biodiversity Action Plan (Joint Nature Conservation Committee, 2016). The following priority habitats have been identified;

- A lowland fen (TG 08128 99399) is located on the south bank of the River Nene immediately east of A1 carriageway and west of a small track that comes off the A1 and heads north-east. It is underlain by, and likely fed by, river terrace deposits
- A lowland fen (TG 07428 99346) is located on the other side of this track and includes the River Nene and an area on the south bank. This continues towards Sutton Drift Road to the east. It is underlain by, and likely fed by, alluvium and river terrace deposits

13.7.36. A county wildlife site (Sutton Marshes North CWS) has been identified within the study area which is associated with both fen habitats listed above. As there is likely hydrogeological connection between the Proposed Scheme and these groundwater dependent terrestrial ecosystems, these are considered further in the Groundwater Dependent Terrestrial Ecosystems assessment (see Appendix 13.4 Groundwater assessment) (**TR010039/APP/6.3**). Other county wildlife sites within the study area contain either woodland or flood meadow wet grassland habitats that are not considered to be groundwater dependent terrestrial ecosystems.

13.7.37. Within the 1km study area there are three Sites of Special Scientific Interest (SSSI). These are:

- Sutton Heath and Bog SSSI (Natural England, 1983) found on the north side of the A47 adjacent to Sutton Heath Road in the middle of the study area
- Wansford Pasture SSSI (Natural England, 1985) approximately 0.5km south-west of the A1 / A47 junction
- West, Abbot's and Lound Woods (Natural England, 1987) approximately 0.6km to the west of the A1, near the northern extent of the Proposed Scheme boundary

13.7.38. Sutton Heath and Bog SSSI sits directly on the Lincoln Limestone Formation outcrop, giving way to the underlying Grantham Formation and Whitby Mudstone to the western boundary. As discussed in Appendix 13.4 (Groundwater assessment) (**TR010039/APP/6.3**), the Environment Agency believe the bog is likely to be entirely rainfall-dependent with rapid rainfall infiltration through the

Lincolnshire Limestone Formation, which re-emerges as springs downslope at the boundary of the Lincolnshire Limestone Formation and the Grantham Formation / Whitby Mudstone Formation.

13.7.39. Wansford Pasture SSSI is noted as overlying an outcrop of the Lower Lincolnshire Limestone on the upper part of its south-facing slope. Springs and a flush are noted at the junction with the Lower Lincolnshire Limestone and beds of the "Upper Estuarine Series exposed below" (Natural England, 1985). This is interpreted as the Grantham Formation (previous known as the Lower Estuarine Series). The springs flow eastwards towards the River Nene and as such the Wansford Pasture SSSI is not considered to be down-gradient of the Proposed Scheme.

13.7.40. Hydrogeological connection between the study area and the above groundwater dependent terrestrial ecosystems is considered further in the Groundwater Dependent Terrestrial Ecosystems assessment (see Appendix 13.4 Groundwater assessment) (**TR010039**/**APP**/**6.3**).

13.7.41. West, Abbot's and Lound Woods SSSI is designated for its woodland habitat and is not considered to be groundwater dependent. Therefore, it has not been taken forward for further assessment.

13.7.42. There are no Ramsar sites, Special Areas of Conservation (SAC), Special Protection Areas (SPA), Local Nature Reserves (LNR) or National Nature Reserves (NNR) within the 1km study area.

Water Framework Directive

13.7.43. The aquifers underlying the application site are included in:

- Welland Limestone Unit A groundwater body (GB40501G445900) within the Welland Limestone Unit A operational catchment
  - Associated with presence of the Lincolnshire Limestone Formation in the western half of the study areas and around the Sutton Heath Road junction.
- Nene Mid Lower Jurassic Unit groundwater body (GB40502G402400) within the Nene Mid Lower Jurassic Unit operational catchment
  - Located in the middle of the Site where the Grantham Formation and Whitby Mudstone cross the A47, and generally follows the route of the River Nene.
- Northampton Sands groundwater body (GB40501G445500) within the Northampton Sands operational catchment
  - Located along the A47 from Sutton and where the Rutland Formation is present.

13.7.44. All of the groundwater bodies are found within the Anglian GW management catchment (Environment Agency, 2020b). Details of the groundwater bodies are summarised in Table 13.4.

13.7.45. The Nene Mid Lower Jurassic Unit groundwater body has 'Good' Chemical and Quantitative status as indicated by the 2019 cycle 2 assessment.

13.7.46. The Northampton Sands groundwater body has 'Good' Chemical and Quantitative status as indicated by the 2019 cycle 2 assessment.

13.7.47. The Welland Limestone Unit A groundwater body has 'Poor' Chemical and 'Good' Quantitative status as indicated by the 2019 cycle 2 assessment. The Chemical status is limited by the Chemical Drinking Water Protected Area and General Chemical Test criteria, which both scored poorly as a result of pollution associated with waste treatment and disposal in the form of landfill leaching. Objectives are to achieve 'Good Chemical Status by 2027 by natural recovery.

Table 13.4 Summary of WFD groundwater bodies within the study area

Water body ID	GB40502G402400	GB40501G445500	GB40501G445900
Water body Name	Nene Mid Lower Jurassic Unit	Northampton Sands	Welland Limestone Unit A
Operational Catchment	Nene Mid Lower Jurassic Unit operational catchment	Northampton Sands operational catchment	Welland Limestone Unit A operational catchment
Management Catchment	Anglian GW Management Catchment	Anglian GW Management Catchment	Anglian GW Management Catchment
River Basin District	Anglian	Anglian	Anglian
Overall Classification (Cycle 2 – 2019)	Good	Good	Poor
Current Ecological Quality (Cycle 2 – 2019)	Good	Good	Good
Current Chemical Quality (Cycle 2 – 2019)	Good	Good	Poor
Chemical Objective	Good (by 2015)	Good (by 2015)	Good (by 2027)
Protected Areas	Drinking Water Protected Area Nene Mid Lowe Jurassic Unit, UKGB40502G402400 Nitrates Directive Lincolnshire Limestone, G69 Northampton Sands, G165	Drinking Water Protected Area Northampton Sands, UKGB40501G445500 Nitrates Directive Bedford Great Oolite, G74	Drinking Water Protected Area Welland Limestone Unit A, UKGB40501G445900 Nitrates Directive Lincolnshire Limestone, G69

Water body ID	GB40502G402400	GB40501G445500	GB40501G445900
		Lincolnshire Limestone, G69 Northampton Sands, G165	

Licensed and unlicensed abstractions

13.7.48. Details of the source protection zones and licensed and unlicensed abstractions are given in Figure 13.5 (Groundwater abstractions, discharges and source protection zones) and Figure 13.1 (Surface water features, abstractions and fluvial flood risk) (**TR010039/APP/6.2**).

13.7.49. A source protection zone (SPZ) 2 (Outer Protection Zone) is found along the northern boundary of the study area. This is associated with groundwater abstractions to the north of the study area.

13.7.50. Details of unlicensed abstractions were requested from the three local district councils intersected by the Proposed Scheme (Peterborough City Council, East Northamptonshire Council and Huntingdonshire District Council). There are no licensed or unlicensed groundwater abstractions within the 1km study area. There are two unlicensed groundwater abstractions just outside the western extent of the study area, however. These are to the west of the A1 and based on local borehole records and 1:50,000 geological mapping (BGS, 2020), are likely abstracted from the Lower Lincolnshire Limestone, although they are not situated down-gradient of the Proposed Scheme.

13.7.51. There are nine surface water abstractions within the study area, six of these abstractions are taken from a given reach within the watercourse and three abstractions are taken from point source within the watercourse. These are summarised below in Table 13.5.

Table 13.5 Summary of licensed surface water abstractions.

Licensed surface water abstraction location	Grid reference	Use
Watercourse at Sacrewell	Reach (507800, 301800 to 508900, 299700)	Milling & Water Power Other Than Electricity Generation
Stream at Sacrewell	Reach (507400, 300100 to 508800, 300100)	Spray Irrigation - Direct
Tributary of the River Nene	Reach (506500, 300900 to 507400, 300100)	Spray Irrigation - Direct
Tributary of River Nene	Reach (507400, 300100 to 505800, 299900)	Spray Irrigation - Direct
River Nene at Sibson	Reach (509350, 298621 to 509300, 298030)	Spray Irrigation - Direct

Licensed surface water abstraction location	Grid reference	Use
River Nene at Sibson	Reach (509020, 299261 to 509120 , 299041)	Spray Irrigation - Direct
Thornhaugh Beck at Thornhaugh	507900, 300000	Spray Irrigation - Storage
River Nene at Sibson	507890, 299482	Spray Irrigation - Storage
River Nene - Wansford	508160, 299580	Transfer Between Sources (Post Water Act 2003)

13.7.52. There are no known unlicensed surface water abstractions within the study area.

Consented discharges

13.7.53. Data provided by the Environment Agency indicates there are no consented discharges to surface water or groundwater within the study area. Due to this, attributes associated with recreation have not been considered for surface water features (see Table 13.6).

13.7.54. A request was made to Peterborough City Council, Huntingdonshire District Council and East Northamptonshire Council in July 2020 to supply information on unconsented discharges to the study area. No unconsented discharges was identified from this consultation.

Existing drainage

13.7.55. HA DDMS (Highways England, 2021) provides details on the existing drainage network. The pollution risk is defined by HEWRAT according to the priority outfall risk assessment process defined on HA DDMS. The existing drainage network is summarised below:

- The catchment draining the A1 discharges highway runoff via one outfall to Mill Stream and is currently classified as pollution risk addressed (priority X) according to HA DDMS (2021). Risk status 'X' represents a risk that has been addressed - either through actions undertaken (for example, remedial work) or through assessment which concludes that risk to surface water is minimal.
- The catchment draining the A47 from the A1, at the west of the Proposed Scheme, to the east of Wittering Brook is drained via a cluster of 12 outfalls currently classified as pollution risk addressed (priority X). Both baseline assessment and information provided on HA DDMS suggests these assets are in a catchment with soakaways and may not be an outfall. Due to this they were assessed as soakaways in 2020 (Highways England, 2021).
- The catchment draining the east of the Proposed Scheme discharges highway runoff from the A47 to an unnamed watercourse to the east, outside of the Proposed Scheme boundary. It is drained via two outfalls,

also located outside of the Proposed Scheme boundary, currently classified as very high pollution risk (priority A).

- There are 13 soakaway chambers within the study area, all classified as pollution risk addressed (priority X).

13.7.56. The existing drainage network, including the outfalls and soakaways identified above, require verification via the drainage survey.

13.7.57. A number of catch-pits and gully pots were identified on HA DDMS (Highways England, 2021) to the east and west of the Proposed Scheme, within the Proposed Scheme boundary. To the west they are located along the A1 and its junction with the A47. To the east they are located where the existing A47 is a dual carriageway. Existing filter drains and vegetated ditches are identified from the Upton Road roundabout on the A47 to outside of the eastern extent of the study area. To the west, filter drains were identified on the A1 / A47 sliproads. No other surface water outfalls, soakaways or attenuation features were identified within the study area. Furthermore, HADDMS did not indicate the presence of any additional pollution control devices or oil / petrol interceptors within the study area.

Flood risk

13.7.58. According to the Environment Agency's Flood Map for Planning (Environment Agency, 2020d), the majority of the study area is located within Flood Zone 1. This can be seen in Figure 13.1 (Surface water features, consented discharges and fluvial flood risk) (**TR010039/APP/6.2**). Flood Zone 1 is associated with a low risk of flooding from fluvial sources (an annual probability of less than 1 in 1,000 (0.1%) of river flooding).

13.7.59. The land immediately surrounding the River Nene, Wittering Brook and Mill Stream is primarily designated as Flood Zones 2 and 3 (Environment Agency, 2020d). The flood zones are associated with fluvial sources and the Proposed Scheme is located approximately 23km upstream of the tidal limit and it is not at risk of flooding from tidal sources. The Proposed Scheme crosses three sections of Flood Zone 2 and 3; where the A1 crosses Mill Stream, where the A47 crosses Wittering Brook and immediately to the west of Wittering Brook crossing. The Proposed Scheme runs adjacent to Flood Zones 2 and 3 associated with the River Nene, within the Proposed Scheme boundary. The flood zones are defined as:

- Flood Zone 2 is associated with a medium risk of flooding (land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of flooding (1%-0.1%) in anyone year).

- Flood Zone 3 is associated with high risk of flooding (land assessed as having a 1 in 100 year or greater annual probability of river flooding (>1%) in any year).

13.7.60. Flood Zone 3 is split into two separate zones; 3a and 3b:

- Flood Zone 3a comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding.
- Flood Zone 3b comprises of land assessed as having a 1 in 20 or greater annual probability of flooding and is classified as active floodplain. This area requires water to flow or be stored in times of flood.

13.7.61. According to the Huntingdon District Council Level 1 and 2 Strategic Flood Risk Assessment (SFRA) (JBA, 2017) and Peterborough SFRA (Royal HaskoningDHV, 2018) the land surrounding the River Nene has been identified within Flood Zone 3b. Flood Zone 3 associated with both Wittering Brook and Mill Stream are identified to be within Flood Zone 3a.

13.7.62. Hydraulic modelling has been undertaken to characterise the baseline conditions of Wittering Brook and its floodplain upstream, this includes the A47 culvert (Appendix 13.1 Flood risk assessment) (**TR010039/APP/6.3**). Predictions from the flood risk model confirm that under baseline conditions:

- the 1 in 100-year event shows water rising up the north side of the A47 embankment, however, flows do not overtop the A47 carriageway
- there is no out of bank flow over the left bank and the properties to the north-east of the A47 culvert are not predicted to flood
- flow is throttled by the A47 culvert and remains in-bank south of the A47 before discharging to the River Nene
- the existing A47 culvert (1.83m x 1.64m) was modelled for the 1 in 100-year plus 65% climate change which indicated the maximum predicted depth to be 1.64m both upstream and downstream

13.7.63. Hydraulic modelling of the A1 Mill Stream culvert was undertaken using HY-8 v7.6 (Federal Highway Administration, 2020). The HY-8 model was used to determine the upstream headwater depth, downstream tailwater depth and peakflow under a range of summer peak flows. The results indicated the headwater depth increases from ~~20.26 maOD~~1.83m, for the 1 in 100-year event, to 2.32~~1.14 maOD~~m when 65% climate change allowance was included on that event. The tailwater depths increased from ~~19.62 maOD~~1.08m to ~~19.71~~1.31 ~~maOD~~m when 65% climate change allowance was incuded on the 1 in 100-year event. Details of this can be found in the Flood risk assessment (Appendix 13.1) (**TR010039/APP/6.3**).

13.7.64. The Proposed Scheme is within an area that receives flood alerts (Lower Nene and Middle Nene area) and warnings (areas near the River Nene from Elton to Wansford). There are no flood defences, areas benefiting from defences or flood storage areas within the study area (Environment Agency, 2020d).

13.7.65. The Environment Agency's indicative long-term flood risk map (Environment Agency, 2020e) shows that the majority of the Proposed Scheme is at very low risk of surface water flooding (see Figure 13.6 (Surface water flood risk) (**TR010039/APP/6.2**). However, there are areas of low to high risk of surface water flood risk. These are classified by the Environment Agency as:

- Low - each year, the area has between 1 in 1000 (0.1%) and 1 in 100 (1%) chance of pluvial flooding in any given year.
- Medium - each year, the area between 1 in 100 (1%) and 1 in 30 (3.3%) chance of pluvial flooding in any given year.
- High - each year, the area has greater than 1 in 30 (3.3%) chance of pluvial flooding in any given year.

13.7.66. The Proposed Scheme crosses areas of low to high surface water flood risk; where the A1 crosses Mill Stream, where the A47 crosses Wittering Brook and where Sutton Heath Road crosses an unnamed ordinary watercourse. Ponding is identified within the permanent construction area of the Proposed Scheme to the west of Wansford ~~Sluice Extension~~Sluice replacement~~Wittering Brook~~ culvert and at the proposed Sutton Heath Road roundabout.

13.7.67. Isolated areas of low to high flood risk associated with surface water flow pathways are identified along the Proposed Scheme. East of the A47 Wansford ~~Sluice Extension~~Sluice replacement~~Wittering Brook~~ culvert a flow pathway is identified which runs in a northerly direction. East of the Sutton Heath Road roundabout flow pathways are identified which drain in an easterly direction towards an unnamed watercouse to the east which is located outside of the Proposed Scheme boundary.

13.7.68. Land within the immediate vicinity of the River Nene is at low to medium surface water flood risk with small sections of high risk. Elevated areas of medium to high surface water flood risk are located at the eastern extents of the Proposed Scheme area which appear to be associated with localised ponding.

13.7.69. Outside of the Proposed Scheme boundary, areas within the vicinity of Wittering Brook are associated with low to medium surface water flood risk, with small sections identified as high risk. Land within the immediate vicinity of Mill Stream is also associated with low to medium surface water flood risk. Areas of high risk are identified to the west and east of the A1, up and downstream of the A1 culvert.

13.7.70. The proposed compounds and material stores are located within Flood Zone 1 and are within areas of very low surface water flood risk.

13.7.71. The Environment Agency's Historic Flood Map (Environment Agency 2020f) indicates the immediate land associated with the River Nene as an area of historic flooding within the Proposed Scheme and study area. This is in agreement with both SFRAs (JBA, 2017; Royal HaskoningDHV, 2018).

13.7.72. HA DDMS (Highways England, 2021) identified six previous surface water flooding events on the existing A47 and A1 carriageways within the Proposed Scheme boundary. Three of these historic instances were identified to be of medium severity and three low severity. Details of these instances of flooding can be found in the Flood risk assessment (see Appendix 13.1) (**TR010039/APP/6.3**).

13.7.73. The Environment Agency's indicative flood risk map (Environment Agency, 2020e) also shows that there is risk of flooding from reservoir failure where the Proposed Scheme crosses Mill Stream, Wittering Brook and adjacent to the River Nene. The indicative flood risk map indicates the risk at Mill Stream and Wittering Brook originates from White Water Reservoir and an unnamed reservoir located adjacent to the A1 to the north of the Proposed Scheme.

13.7.74. Peterborough SFRA (Royal HaskoningDHV, 2018) identifies one incident of foul water sewer flooding within the Proposed Scheme boundary associated with the housing estate to the west of the A1. The SFRA indicated there have been two instances of flooding within the postcode area to the east and south-east of Wittering Brook and seven to the west. However, it is unclear where the exact location of sewer flooding occurred. Anglian Water confirmed there are no records of flooding in the vicinity that can be attributed to capacity limitations in the public sewerage system.

Groundwater flooding

13.7.75. The study area is at risk from groundwater flooding. This can be seen in Figure 13.7 (Susceptibility to groundwater flooding) (**TR010039/APP/6.2**). BGS records indicate that most of the site to the east of Wansford East Roundabout is susceptible to groundwater flooding of properties situated below ground level. In addition, several areas are susceptible to groundwater flooding at surface, generally coincident with the location of watercourses (Wittering Brook and the River Nene).

Aquatic ecology

13.7.76. Through potential impacts on the water environment, the Proposed Scheme has the potential to have an indirect impact on the aquatic ecology of the study area.

The impact on such features has been assessed in detail in Chapter 8 (Biodiversity) (**TR010039/APP/6.1**).

13.7.77. There are two Site of Special Scientific Interest (SSSI) sites associated with the water environment located within the study area:

- Sutton Heath and Bog SSSI located adjacent to Wittering Brook and adjacent to the Proposed Scheme boundary
- Wansford Pastures SSSI located to the west of Wansford

13.7.78. There are nine coastal and floodplain grazing marsh priority habitat sites located along the banks of the River Nene, and three lowland fen priority habitat sites on the south bank of the River Nene, to the south of the Proposed Scheme. There are no other water-dependent priority habitats within the study area. Priority habitats have been allocated an importance value of high as they are nationally significant (as identified in Chapter 8 (Biodiversity)) (**TR010039/APP/6.1**).

13.7.79. Water voles have been confirmed in Wittering Brook within the vicinity of the existing culvert under the A47 and in Mill Stream at Sacrewell Farm. Spined loach and Bullheads have been confirmed in the River Nene within the study area. The assessment and mitigation for these features is outlined in Chapter 8 (Biodiversity) (**TR010039/APP/6.1).**

13.7.80. There are no Ramsar sites, Special Areas of Conservation (SAC), Local Nature Reserves (LNR), Special Protected Areas (SPA) or National Nature Reserves (NNR) within the study area or immediately downstream of the study area.

13.7.81. Outside of the study area, Castor Flood Meadows SSSI is present on both sides of the River Nene 3.8km downstream of the study area. The River Nene flows into the Nene Washes (SSSI / SAC / SPA / Ramsar), located 10km east of the Proposed Scheme, which is a washland habitat that supports water fowl and wetland plants.

Recreation and human health

13.7.82. It is understood that the River Nene is used for recreation including navigation, kayaking and angling.

13.7.83. There is no information relating to recreation, navigation or angling on Wittering Brook, the unnamed watercourse located to the east, Mill Stream or any of the ponds in the study area. All other drainage ditches are assumed to have negligible recreation, navigation or angling use.

13.7.84. Due to this, attributes associated with recreation have not been considered for surface water features other than the River Nene (see Table 13.6).

Events

13.7.85. The SFRAs (JBA, 2017 and Royal HaskoningDHV, 2018) historic events date back to 1947. Other than what has been identified above, no major accidents, disasters, or pollution events and spills have been identified within the study area.

Climate change

13.7.86. The Meteorological Office regional climate summary for eastern England (Met Office, 2016) indicates the current climate baseline within the study area to be:

- Mean annual temperatures ranging from 9.5°C to around 10.5°C in the low-lying areas with mean daily minimum temperatures of 1°C in winter and mean daily maximum temperatures of 20°C to 23°C in summer.
- Average annual sunshine durations over eastern England range from over 1,600 hours in Norfolk, Suffolk and Essex to less than 1,450 hours in East Yorkshire and Lincolnshire.
- Eastern England has a more even annual distribution of rainfall when compared with the rest of the UK with an average of 30 rain days in winter and less than 25 days in summer.
- The average number of days with snow falling is about 20 per year in low lying areas.
- Eastern England is one of the more sheltered parts of the UK in terms of wind.

13.7.87. The associated online climate change allowance (Environment Agency, 2020a) states that to allow for residual uncertainty in assessing the impacts of climate change on future flood risk, peak fluvial flow rates should be increased by 65%. The climate change allowance to allow for residual uncertainty in assessing the impacts of climate change on future peak rainfall intensity is 40%. This refers to the 'Upper End' categories for the Anglian Region and a time horizon of 2080s (2070 to 2115), as the Proposed Scheme is classed as 'essential infrastructure' partly lying in Flood Zone 3.

13.7.88. The climate change projections do not affect the overall annual recharge volumes for groundwater, although the groundwater recharge season is likely to be shorter and more intense, leading to more variable groundwater levels and a greater drought vulnerability (Environment Agency, 2019).

Importance of receptors

13.7.89. The following receptors or features have been identified that could potentially be affected by the construction and/or operation of the Proposed Scheme. In

accordance with DMRB LA 113, the importance of these features in terms of their attributes is summarised in Table 13.6 below.

13.7.90. Mill Stream and Wittering Brook ordinary watercourses have been assessed individually as there are significant works proposed to be undertaken on and near to these watercourses. The River Nene, a main river, has also been assessed individually.

13.7.91. Ordinary watercourses (which include the unnamed watercouse to the east and Wittering Brook tributary, which flows through Sutton Heath and Bog SSSI) and drainage ditches within the Nene – Islip to Tidal and Wittering Brook WFD water body catchment have been considered together as they all lie within the same WFD Operational Catchment.

Table 13.6 Importance of water environment attributes in the study area

Feature	Attribute	Importance	Reason for assigned value
Mill Stream	Water supply and quality	Medium	Abstractions for agriculture and milling and water power. WFD failure chemical status.
	Value to economy	Medium	Abstractions for agriculture and milling and water power. No known recreational use.
	Conveyance of flow	Medium	Q95 unknown but assumed to be similar to Wittering Brook (0.091 m^3/s). Few areas local to Flood Zone 2 and 3 consist of more vulnerable development.
	Biodiversity	High	Water voles confirmed within the study area.
Wittering Brook	Water supply and quality	Medium	Abstractions for agriculture and milling and water power. WFD failure chemical status.
	Value to economy	Medium	Abstractions for agriculture and milling and water power. No known recreational use.
	Conveyance of flow	Medium	Q95 is 0.091 m^3/s. Areas local to Flood Zone 2 and 3 do not consist of any development.
	Biodiversity	Very High	SSSI within the study area. Water voles have been confirmed in this location.
River Nene	Water supply and quality	High	Abstractions for agricultural use and water supply. WFD failure chemical status.
	Recreation	Medium	Some recreational uses including navigation, kayaking and angling
	Value to economy	High	Abstractions for agricultural use and water supply. Recreational use include navigation, kayaking and angling.

Feature	Attribute	Importance	Reason for assigned value
	Conveyance of flow	Very High	Q95 is 2.9 m^3/s. Areas local to Flood Zone 2 and 3 consist of more vulnerable development.
	Biodiversity	Very High	Priority habitats, spined loach and bullhead within the study area
Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low	No known abstractions, WFD failure chemical status.
	Value to economy	Low	No known abstractions or recreational use
	Conveyance of flow	Low	Q95 is 0.0011 m^3/s on the unnamed watercourse to the east of the Proposed Scheme boundary (calculated from Low Flow 2 software) and 0.002 m^3/s on the tributary of Wittering Brook draining through Sutton Heath and Bog SSSI
	Biodiversity	Very High	Sutton Heath and Bog SSSI (Wittering Brook tributary). No other designated sites within the study area.
Mill Stream Floodplain	Conveyance of flow	High	Areas local to Flood Zone 2 and 3 consist of more vulnerable development.
Wittering Brook Floodplain	Conveyance of flow	Low to Medium	Areas local to Flood Zone 2 and 3 and consists of water compatible development (woodland) and less vulnerable development (agricultural).
River Nene Floodplain	Conveyance of flow	High	Areas local to Flood Zone 2 and 3 consist of more vulnerable development.
Ponds	Water supply and quality	Low	No abstraction points within the study area. WFD failure chemical status.
	Value to economy	Low	No abstraction points within the study area. Limited know use of the water bodies.
	Biodiversity	Low	No priority habitats within the study area.
Lincolnshire Limestone Formation	Water supply and quality	High to very high	Principal aquifer, WFD objectives for good status by 2027 (Welland Limestone Unit A). Two unlicensed abstractions are located within the study area. It is believed these abstract from the Lincolnshire Limestone.
	Soakaway	High	Eight existing soakaways to Lincolnshire Limestone in the west of the Study Area.
	Vulnerability	Very high	Combined aquifer groundwater vulnerability of high risk in areas with limited superficial cover with soluble rock risk associated with the limestone (i.e. solution features may enable rapid movement of pollutants).
	Economic Value	Medium	Supports an economically important river system.

Feature	Attribute	Importance	Reason for assigned value
	Conveyance of flow	Very High	Watercourses in the area (River Nene, Mill Stream and Wittering Brook) are known to have a baseflow contribution indicating there are hydraulic pathways to surface waters.
	Biodiversity	High	Sutton Heath and Bog SSSI and Wansford Pastures SSSI assessed to be high importance (see Appendix 13.4 Groundwater assessment) (**TR010039/APP/6.3**).
Grantham Formation	Water supply and quality	Medium	Secondary (undifferentiated) aquifer supporting local water supply. No known abstractions.
	Soakaway	Low	No soakaways to Grantham Formation in the study area.
	Vulnerability	High	Combined aquifer groundwater vulnerability of medium to high risk in areas where the Grantham Formation is exposed.
	Economic value	Medium	Potentially in hydraulic continuity with the Lincolnshire Limestone, locally supporting an economically important river system.
	Conveyance of flow	Very High	Potentially in hydraulic continuity with the Lincolnshire Limestone Principal aquifer locally supporting base flow to River Nene and designated sites
	Biodiversity	High	Sutton Heath and Bog SSSI and Wansford Pasture SSSI assessed to be high importance (see Appendix 13.4 Groundwater assessment) (**TR010039/APP/6.3**).
Rutland Formation	Water supply and quality	Medium	Secondary B aquifer supporting local water supply. No known abstractions.
	Soakaway	Low	No soakaways to Rutland Formation in the study area.
	Vulnerability	Medium	Combined aquifer groundwater vulnerability of medium to high risk in areas where the Rutland Formation is exposed.
	Economic value	Medium	Potentially in hydraulic continuity with the Lincolnshire Limestone, locally supporting an economically important river system.
	Conveyance of flow	Very High	Potentially in hydraulic continuity with the Lincolnshire Limestone Principal aquifer locally supporting base flow to River Nene and designated sites
	Biodiversity	High	Sutton Heath and Bog SSSI assessed to be high importance (see Appendix 13.4 Groundwater assessment) (**TR010039/APP/6.3**). Rutland Formation found along eastern boundary of SSSI.

Feature	Attribute	Importance	Reason for assigned value
River Terrace Deposits and Alluvium	Water supply and quality	High	Secondary A aquifers supporting local water supply. No known abstractions.
	Soakaway	High	Three existing soakaways discharge to River Terrace Deposits in the east of the Study Area.
	Vulnerability	High	Combined aquifer groundwater vulnerability of medium to high risk in areas where River Terrace Deposits outcrop.
	Economic value	Medium	Supports an economically river system (River Nene)
	Conveyance of flow	High	Likely supporting base flow to River Nene and designated sites
	Biodiversity	Medium	Lowland fens and Sutton Meadows North CWS assessed to be moderate importance (see Appendix 13.4 Groundwater assessment) (**TR010039/APP/6.3**).

13.8. Potential impacts

13.8.1. This section considers the potential impacts on surface water, including flood risk, and groundwater receptors, prior to the implementation of mitigation measures.

13.8.2. Where the impact of the Proposed Scheme on a receptor would result in significant effect this has been assessed below. This assessment is based on the design elements provided in Chapter 2 (The Proposed Scheme) (**TR010039/APP/6.1**).

Construction

Surface water

13.8.3. There is the potential for mobilisation of sediment and contaminants from surface water runoff to watercourses and ponds from road construction activities such as earthworks, construction dewatering, plant and vehicle washing.

13.8.4. Construction activities, including the demobilisation of site compounds, increase the risk of a pollution incident from accidental spillages or leakage of fuels, oils, chemicals, wastewater, concrete or cement admixtures used. Such accidental spillages are likely to impact directly on surface water features including Mill Stream, Wittering Brook, the River Nene, the unnamed watercourse to the east of the Proposed Scheme boundary, ordinary watercourses, drainage ditches and ponds where works are in close proximity. This, in turn, may have a negative

impact on downstream aquatic environments, recreation, water supply and quality and recreation.

13.8.5. Construction works would have the greatest potential to impact on the surface water environment when they take place within, adjacent, over or close to surface water features, including the fluvial floodplain. The placement of construction materials, washing of plant, cleaning areas of hardstanding, for example increases the potential for mobilisation of sediment and contaminants from surface water runoff to drainage ditches and ponds. These activities could adversely impact on water quality, recreational users, value to the economy and the aquatic ecology aspects of surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary flowing through the Sutton Heath and Bog SSSI), drainage ditches and ponds, where works are in close proximity.

13.8.6. Water quality impacts are likely to be short term during the construction period. However, some potential construction impacts, such as the deposition of sediments in watercourses, can have longer term consequences. Especially with respect to aquatic ecology, where increased sediment loading of streams and changes to turbidity can have a negative impact. The Geomorphological assessment (Appendix 13.5) (**TR010039/APP/6.3**) notes the Wittering Brook, Mill Stream and the River Nene do not appear to have limited capacity for sediment conveyance. However, there are reaches along Mill Stream that have been overdeepened and silted up due to channel realignment. An increase in sedimentation caused by construction activites may impact on the river reaching good ecological status. The WFD ecological quality elements that could be impacted include:

- physicochemical quality elements (ammonia, dissolved oxygen, pH, phosphate and temperature, and acid neutralising capacity for the Nene – Islip to Tidal only)
- biological quality elements (invertebrates and macrophytes and phytobenthos for Wittering Brook only, invertebrates and fish for the Nene - Islip to Tidal)

13.8.7. During construction there would be a requirement to work within, adjacent, over or close to water bodies, watercourses, or the fluvial floodplain in order to complete the construction of:

- proposed highway drainage and outfalls, including two new outfalls to the River Nene, one new outfall to Wittering Brook and new attenuation basins, with pollution control devices, to control discharges to local watercourses

- A47 Wansford ~~Sluice Extension~~Sluice replacement crossing Wittering Brook and associated minor watercourse realignment
- A1 Mill Stream culvert extension ~~or replacement~~
- creation of two ponds connected by a ditch and wetland features adjacent to Mill Stream
- creation of new ditch from Mill Stream with bank features for the loss of water vole habitat associated with Wansford ~~Sluice Extension~~Sluice replacement
- River Nene flood compensation area
- drainage ditch interception along the Proposed Scheme to the east of Upton Road

13.8.8. This may cause an increase in risk of fluvial flooding to the Proposed Scheme or other receptors due to obstruction or changes in the flow within the channels and within the floodplain. Additionally, this could adversely impact upon downstream flood-sensitive receptors, aquatic environments, value to economy, water quality and recreational users of surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary), and drainage ditches. Due to the Proposed Scheme being hydraulically disconnected from ponds, it is considered there would be no impact caused by this activity.

13.8.9. There is potential to impact on habitat and ecology of the local environment during construction of:

- proposed highway drainage and outfalls, including two new outfalls to the River Nene, one new outfall to Wittering Brook and new attenuation basins, with pollution control devices, to control discharges to local watercourses
- A47 Wansford ~~Sluice Extension~~Sluice replacement crossing Wittering Brook and associated minor watercourse realignment
- A1 Mill Stream culvert extension ~~or replacement~~
- creation of two ponds connected by a ditch and wetland features adjacent to Mill Stream
- creation of new ditch from Mill Stream with bank features and natural meanders for the loss of water vole habitat associated with Wansford ~~Sluice Extension~~Sluice replacement
- River Nene flood compensation area
- drainage ditch interception along the Proposed Scheme to the east of Upton Road

13.8.10. Disturbance or removal of this habitat could negatively impact upon the water quality and biodiversity of the Mill Stream, Wittering Brook, the River Nene, the unnamed watercourse to the east , ordinary watercourses, ponds and drainage ditches. The WFD ecological quality elements that could be impacted include:

- physicochemical quality elements (ammonia, dissolved oxygen, pH, phosphate and temperature, and Acid neutralising capacity for the Nene – Islip to Tidal only)
- biological quality elements (invertebrates and macrophytes and phytobenthos for Wittering Brook only, invertebrates and fish for the Nene - Islip to Tidal)
- hydromorphological quality elements (hydrological regime and morphological conditions)

13.8.11. During construction, there is an increased risk of flooding during and following extreme rainfall events, including those areas identified as at risk of surface water flooding. Works may lead to temporary changes in the surface water runoff regime by the alteration of ground elevations and overland flow pathways, pond infilling (two for the construction of the Proposed Scheme), construction of embankments or the construction of above ground structures acting as a barrier to flow. This could cause localised flooding to the Proposed Scheme and nearby receptors due to changes in surface water flow pathways. Indirectly, overloading of the temporary drainage system could adversely impact on surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east of the Proposed Scheme boundary and the Wittering Brook tributary that flows through the Sutton Heath and Bog SSSI), drainage ditches and ponds where works are in close proximity. This, in turn, may have a negative impact on down gradient flood-sensitive receptors, aquatic environments, value to economy, water quality and recreational users.

13.8.12. During construction there would be an increase in new hardstanding areas, including the compounds and infilling of ponds, which, if not mitigated, would increase the volume and flow rate of runoff from the construction areas. This could result in increased localised flooding to the Proposed Scheme and other flood-sensitive downstream receptors. Additionally, this could adversely impact upon downstream flood-sensitive receptors, aquatic environments, value to economy, water quality and recreational users of surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary), drainage ditches and ponds.

13.8.13. The construction of the Proposed Scheme would also result in the loss of two ponds and any aquatic biodiversity associated with them:

- one pond west of Wansford ~~Sluice Extension~~Sluice replacement adjacent to the existing A47 where the Proposed Scheme would be constructed
- one pond located west of Upton Road, adjacent to the existing A47 where the Proposed Scheme would be constructed

Groundwater

13.8.14. Drainage of construction areas where topsoil has been removed may result in surface water contaminated by construction materials (primarily as a result of accidental spillages and leakages) discharging to groundwater. This is also a risk within site compounds, where temporary drainage is collected in unlined drainage ditches. The greatest risk is likely to occur where where there is no low permeability superficial cover and infiltration may occur directly into the Lincolnshire Limestone Principal Aquifer and Grantham Formation Secondary Aquifer. Such infiltration of construction materials may subsequently migrate to associated indirect receptors (River Nene, Mill Stream and Wittering Brook, down-gradient abstractions and designated sites).

13.8.15. The removal of significant thicknesses of the unsaturated zone within excavations, such as at the Sacrewell Farm Underbridge (S05) or for utilities diversions, has the potential to increase the vulnerability of underlying aquifers from accidental spillages, especially if fractures are present within the exposed Limestone aquifer as these can act as preferential pathways for contaminants. Existing road drainage soakaways may also act as a pathway for accidental spillages or leakages, especially where these are within the construction footprint but are no longer required.

13.8.16. Excavations required for the construction of underpasses may also result in contamination of groundwater through direct contact with construction materials. The Sacrewell Farm Underbridge (S05) and the Wansford NMU Underpass (S02) may intercept saturated aquifer units. This poses a significant risk to down-gradient receptors, such as the River Nene, Mill Stream and Wittering Brook, the unlicensed abstractions and the designated sites.

13.8.17. Groundwater control activities such as dewatering may be required for underbridge construction. Dewatering has the potential to adversely impact direct groundwater receptors (the aquifers) and indirect groundwater receptors dependent on groundwater supply (groundwater dependent terrestrial ecosystems) in terms of groundwater levels and flow. Construction dewatering discharges may contain suspended solids that have the potential to contaminate the receiving water body. Details of the risk to GWDTEs from dewatering at the Sacrewell Farm Underbirdge (S05) and the Wansford NMU Underpass (S02) are provided within Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).

13.8.18. Although dewatering requirements are to be confirmed by further supplementary ground investigations, the radius of influence of dewatering activities has been calculated using conservative values to give a worst case indication of potential impact. The radius of influence was calculated to be 86.70m at the Sacrewell Farm Underbridge (S05), and 72.25m at the Wansford NMU Underpass (S02). Sutton Heath and Bog SSSI falls within the radius of influence for the Wansford NMU Underpass (S02) excavation. Although other GWDTEs and groundwater receptors are outside of the worst case radius of influence from dewatering, the loss of any springs within the radius of influence may have an impact on water availability for downstream receptors such as Sutton Meadows North CWS (see Appendix 13.4 Groundwater Assessment (**TR010039/APP/6.3**), Annex A Location Plan).

13.8.19. Discharge water from construction dewatering activities are likely to contain suspended solids and may therefore result in contamination of a receiving water body. Although not confirmed, this is likely to be either returned to ground via infiltration galleries, or discharged directly to the River Nene.

13.8.20. Further details of these impacts prior to mitigation are included within Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**). An assessment of the significance of construction impacts post-mitigation are presented in Table 13.8.

Operational

Surface water

13.8.21. There is a risk of pollution to surface water features resulting from accidental spillage or pollution incidents. This risk would increase with an increase in traffic volume as a result of the Proposed Scheme. Such accidental spillages could result in short term adverse impacts on water quality, recreational users, value to the economy and aquatic ecology of surface water features, including Mill Stream, Wittering Brook, the River Nene and ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary). Ponds and drainage ditches may also be adversely affected, as indirect receptors.

13.8.22. The Proposed Scheme would result in an increase in highway drainage area discharging to Mill Stream, Wittering Brook, a tributary of Wittering Brook, the River Nene and the unnamed watercourse to the east. The location of the drainage areas and outfalls can be found in Appendix 13.3 Surface water quality assessment (**TR010039/APP/6.3**). This coupled with the associated increase in traffic volumes would result in an increase in pollutant loads associated with highway runoff. This could result in a long-term increase in diffuse pollution, adversely impacting on water quality, recreational users, value to the economy and aquatic ecology of surface water features, including Mill Stream, Wittering Brook, the River Nene and ordinary watercourses (including the unnamed

watercourse to the east and Wittering Brook tributary). Ponds and drainage ditches may also be adversely affected, as indirect receptors.

13.8.23. The WFD ecological and chemical quality elements that could be impacted from accidental spillage or increases in highway drainage area include:

- physicochemical quality elements (ammonia, dissolved oxygen, pH, phosphate and temperature, and acid neutralising capacity for the Nene – Islip to Tidal only)
- biological quality elements (invertebrates and macrophytes and phytobenthos for Wittering Brook only, invertebrates and fish for the Nene - Islip to Tidal)
- specific pollutants (copper and zinc)
- priority substances (potentially all elements for accidental spillages)
- other pollutants (potentially all elements for accidental spillages)
- priority hazardous substances (potentially all elements for accidental spillages)

13.8.24. The Proposed Scheme could lead to a change in the surface water runoff regime by the alteration of ground elevations or overland flow pathways. This could result in the diversion of flow pathways, increased localised flooding next to the Proposed Scheme with potential increased flood risk to the Proposed Scheme and to others. Indirectly, this would potentially affect downstream aquatic environments, recreational users and value to economy associated with surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary), drainage ditches and ponds.

13.8.25. The Proposed Scheme, through creation of the new carriageway hardstanding areas, would result in an increase in impermeable area which, if not mitigated, would increase the peak flow rate of runoff as well as the volume from the carriageway. This could result in increased localised flooding to the Proposed Scheme and to others downstream. Additionally, this would potentially adversely impact upon downstream aquatic environments, recreational users and value to economy associated with surface water features including Mill Stream, Wittering Brook, the River Nene and ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary).

13.8.26. The Proposed Scheme would lead to a change of flow within the floodplain due to the presence of embankments and the construction of the carriagway near Wittering Brook, A47 Wansford ~~Sluice Extension~~Sluice replacement ~~culvert~~, A1 Mill Stream culvert extension ~~or replacement~~ and outfalls acting as a barrier to flow. The design of the Proposed Scheme would result in a loss of floodplain

storage from the River Nene and Wittering Brook floodplains with a potential increase in flood risk to the Proposed Scheme and to others. In addition, this could adversely affect downstream aquatic environments, recreational users (Nene) and value to economy for surface water features including Mill Stream, Wittering Brook, the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary) and drainage ditches.

13.8.27. The proposed outfalls would discharge highway drainage from the Proposed Scheme with the potential to cause river erosion. The location of the outfalls can be found in Appendix 13.3 Surface water quality assessment (**TR010039/APP/6.3**). The outfall structure itself, if not set back into the river bank, can create localised turbulent flows which could lead to erosion of the bed and bank. In turn this can impact on channel stability, cause structural damage and result in an increase in sediment in the downstream reaches, leading to degradation of the watercourse habitat. This could adversely affect Mill Stream, Wittering Brook, the River Nene, and ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary). Due to the Proposed Scheme being hydraulically disconnected from ponds and drainage ditches, it is considered there would be no impact caused by this activity.

13.8.28. The proposed A47 Wansford ~~Sluice Extension~~Sluice replacement culvert (which is 54~~60~~m in length and 2.5~~45~~m in high, 2.5m widet), associated minor watercourse diversions and the A1 Mill Stream culvert extension ~~or replacement~~ would result in the loss or deterioration of channel and riparian habitat. In turn they have the potential to impact on channel morphology and reduce hydromorphological complexity. This can lead to degradation of Mill Stream and Wittering Brook habitat and supporting ecological features, including impeding aquatic species movement. In turn, this could adversely impact on WFD ecological and hydromorphological quality elements of Wittering Brook and indirectly the River Nene, ordinary watercourses (including the unnamed watercourse to the east and Wittering Brook tributary), ponds and drainage ditches. The WFD ecological quality elements that could be impacted include:

- physicochemical quality elements (ammonia, dissolved oxygen, pH, phosphate and temperature, and acid neutralising capacity for the Nene – Islip to Tidal only)
- biological quality elements (invertebrates and macrophytes and phytobenthos for Wittering Brook only, invertebrates and fish for the Nene - Islip to Tidal)
- hydromorphological quality elements (hydrological regime and morphological conditions)

13.8.29. The Proposed Scheme would also result in the loss of two ponds (as identified in the construction section above). The loss of these surface water features would result in the loss of any aquatic biodiversity associated with them.

Groundwater

13.8.30. Road drainage design incorporates unlined road drainage in the form of filter drains as well as infiltration to ground through infiltration basins. A detailed groundwater quality and road runoff assessment has been completed and the results are presented in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).

13.8.31. Routine road runoff has the potential to impact on the water quality of the receiving groundwater body, and indirect groundwater receptors such as the River Nene and its associated priority habitats and Mill Stream. Infiltration features discharging to the Lincolnshire Limestone have the potential to affect the water quality of springs flowing towards and also baseflows to surface watercourses such as Mill Stream and the River Nene. This is especially the case where groundwater levels are shallow and there is limited potential for natural attenuation within the unsaturated zone.

13.8.32. Filter drains to the east of Sutton Heath Road discharge to the Rutland Formation. The groundwater conditions and flow pathways are not fully understood in this area and are subject to supplementary GI. At this stage it is assumed that the Rutland Formation has a low permeability, and as such there is a risk that groundwater mounding beneath filter drains may result in water quality impacts for down-gradient receptors such as the Witttering Brook and River Nene.

13.8.33. Road drainage at the northern tie-in of the Sutton Heath Road junction discharges, via an outfall, to a ditch along the eastern boundary of the Sutton Heath and Bog SSSI. Road drainage is, therefore, likely to infiltrate into the Lincolnshire Limestone Formation at this location. As such untreated road drainage has the potential to impact on water quality within the Lincolnshire Limestone Formation, the springs that discharge from it, and ultimately the Wittering Brook.

13.8.34. Permanent subsurface drainage may be required for the underbridge and underpass, and has the potential to adversely impact direct groundwater receptors (the aquifers) and indirect groundwater receptors dependent on groundwater supply (groundwater dependent terrestrial ecosystems) in terms of groundwater levels and flow. As with the worst case, radius of influence calculations for potential dewatering requirements during construction, Sutton Heath and Bog SSSI falls within the worst case, radius of influence for the

Wansford NMU Underpass (S02). Although other GWDTEs and groundwater receptors are outside of the worst case radius of influence from dewatering, the loss of any springs within the radius of influence may have an impact on water availability for downstream receptors such as Sutton Meadows North CWS (see Appendix 13.4 Groundwater Assessment (**TR010039/APP/6.3**), Annex A Location Plan).

13.9. Design, mitigation and enhancement measures

13.9.1. This section provides details of the following measures:

- 'Essential mitigation' measures – these are critical for the delivery of the Proposed Scheme and that can be acquired through statutory powers. They are generally incorporated into construction activities through the appropriate selection of construction methods and materials, adoption of best practice measures and monitoring, and also long term maintenance.
- 'Embedded mitigation' measures – these are incorporated into the Proposed Scheme design in order to avoid or prevent adverse environmental effects. They are generally incorporated into operation of the Proposed Scheme, as part of the design.

13.9.2. An overview of embedded mitigation is also reported in Chapter 2 (The Proposed Scheme) (**TR010039/APP/6.1**). A schedule of mitigation to be implemented during construction and operation is set out in the Environmental Management Plan (EMP) (**TR010039/APP/7.5**).

Construction

13.9.3. During construction, best practice methods for pollution prevention and water management would be implemented as part of the EMP (**TR010039/APP/7.5**). Guidance on best practice in relation to pollution prevention and water management is set out in CIRIA guidelines (C741 Charles and Edward, 2015; C648 Murnane *et al.*, 2006) and the Environment Agency's approach to groundwater protection (Environment Agency, 2017a) and groundwater protection guides (Environment Agency, 2006, 2017b). Best practice methods specific to the identified potential impacts are discussed further below.

Surface water

13.9.4. The design and construction of all above ground structures shall aim to minimise the potential to impact on surface water features and flood risk. Specific mitigation measures to achieve this include both embedded and essential mitigation and are described below.

13.9.5. The potential for impacts to occur as a result of contamination from accidental spillages shall be minimised by the following measures:

- Appropriate storage of construction materials, including bunding of storage tanks, use of silt fencing and covering stockpiles.
- Spill kits should be located on sites near to ordinary watercourses and within the works compounds and staff should be trained in their use.
- Emergency response procedures included in the EMP (**TR010039/APP/7.5**) to handle any leakages or spillages of potentially contaminating substances.

13.9.6. No pollution pathways shall be created between the construction sites, including material lay down areas, and ordinary watercourses. Measures shall be implemented to prevent surface water runoff containing suspended sediment reaching watercourses through overland flow during rainfall events. This shall include an appropriate treatment train to prevent accidental spillages reaching groundwater, removal of sediment and other contaminants as well as attenuating runoff. This must be specified as part of a temporary surface water drainage strategy within the EMP (second iteration).

13.9.7. Mill Stream, Wittering Brook and River Nene are designated as a NVZ for surface water and for groundwater. The unnamed watercourse to the east is also designated as a NVZ for surface water. Wittering Brook and the Nene – Islip to Tidal WFD water bodies are prevented from achieving good ecological potential due to the phosphate concentrations found in the catchment. Where construction activities have the potential to mobilise nitrate and phosphate during, for example, earthworks in areas of agriculture, there is a potential to increase nitrate and phosphate concentrations within the surface water features or to groundwater. The risk of nitrate and phosphate mobilisation would be managed by the implementation of best practice construction measures through the EMP (**TR010039/APP/7.5**).

13.9.8. Temporary drainage from the main construction compound would typically be collected within a ditch surrounding the compound and redirected to settlement ponds before being discharged to either a surface watercourse or ground. Discharges to groundwater, surface water and / or sewer must only be made with the appropriate consents or permits in place. Any non-compliant discharges must be collected and disposed of off-site at a licensed facility.

13.9.9. The above measures would mitigate impacts to WFD physicochemical and biological quality elements of Wittering Brook and the Nene – Islip to Tidal water bodies caused by construction activities and spillages.

13.9.10. There are construction activities proposed within Mill Stream, Wittering Brook and their floodplains, ordinary watercourse and drainage ditches. This includes the construction of the proposed drainage including outfalls, A1 Mill Stream culvert extension ~~or replacement~~, Mill Stream ditch creation and pond / wetland creation, A47 Wansford ~~Sluice Extension~~Sluice replacement culvert and associated watercourse diversion and drainage ditch interception. Approval must be sought for a land drainage (ordinary watercourse) consent from Peterborough City Council before any construction works is undertaken. There are construction activities planned within 8m of an Environment Agency designated main river (River Nene) and its floodplain. This includes the construction of new outfalls, embankments and the Proposed Scheme. As such, consent in the form of a Flood Risk Activity Permit must be obtained from the Environment Agency. The potential increase in flood risk and negative impacts on surface water receptors must be managed by the implementation of a construction-phase drainage system, where the construction shall take place offline.

13.9.11. The potential impacts from the construction of the Proposed Scheme including drainage, crossings and associated features shall be managed through the phased construction plan. The A47 Wansford ~~Sluice Extension~~Sluice replacement culvert, the minor watercourse diversions associated with the new culvert, drainage ditch interception, Mill Stream ditch creation and pond / wetland creation, A1 Mill Stream culvert extension ~~or replacement~~, and the River Nene flood compensation area must be designed to minimise impacts on water quality and ensure there is no loss of habitat or biodiversity. In-river sediment controls (for example, straw matting) shall be used and it shall be undertaken during low flows to minimise sediment transport. The CIRIA guidelines on control of water pollution on linear construction sites (C648) and environmental best practice on-site (C741). Adherence to C786 – Culvert, Screen and Outfall Manual guidelines should be adhered to during construction. The Proposed Scheme has been designed to minimise impacts on the water environment:

- The proposed A47 Wansford ~~Sluice Extension~~Sluice replacement culvert at Wittering Brook and the A1 Mill Stream culvert extension ~~or replacement~~ must accommodate natural river bed material in the base of the culverts, including a mammal ledge for the A47 Wansford ~~Sluice Extension~~Sluice replacement above the design flood level, to maintain habitat connectivity as per DMRB standards.
- The Mill Stream ditch creation and pond / wetland creation must provide suitable water depth for water voles.
- Length-for-length de-culverting is not considered feasible in this case for both A47 Wansford ~~Sluice Extension~~Sluice replacement and the A1 culvert extension ~~or replacement~~. Therefore, riparian planting, the creation of Mill Stream ditch and the pond / wetland creation adjacent to Mill Stream shall offset any negative impacts of the additional culverting.

This will be a length-for-length replacement based on the additional length of both proposed structures.

13.9.12. These measures would also mitigate impacts to WFD physicochemical and biological quality elements of Wittering Brook and the Nene – Islip to Tidal water bodies.

13.9.13. Works would lead to temporary changes in overland flow and volume by the alterations of ground elevations due to re-profiling, pond infilling and construction of above ground structures and embankments acting as a barrier to flow. This increased flood risk and negative impacts on surface water receptors must be managed by the implementation of a construction-phase drainage strategy. A temporary surface water drainage strategy must be developed and be incorporated into the EMP (second iteration) to prevent increased flood risk to people and property elsewhere, and to manage pollution risks. Drainage must be constructed in the early stages of the Proposed Scheme.

13.9.14. Increased flood risk and negative impacts on surface water receptors caused by an increase in impermeable area, leading to an increase in the peak flow rate, volume or change in the direction of surface water runoff, must be managed by the implementation of a temporary surface water drainage strategy The strategy shall adopt SuDS principles to attenuate runoff to greenfield runoff rates, or as a minimum existing runoff rates as well as provide water treatment; this must be incorporated into the EMP (second iteration). This would prevent increased flood risk to people and property elsewhere and manage any impacts on aquatic environment, recreation and value to economy.

13.9.15. The provision of one replacement pond is required for each pond lost in the location of the Proposed Scheme (a total of two ponds lost). The replacement pond shall be constructed prior to the existing ponds being lost. This shall mitigate the potential negative impact on biodiversity and aquatic ecology caused by the loss of these water features. The location of the replacement ponds within the Proposed Scheme boundary is shown on the Environmental Masterplan (**TR010039/APP/6.8**).This has been discussed, along with detailed mitigation requirements of the replacement ponds in Chapter 8 (Biodiversity) (**TR010039/APP/6.1**).

13.9.16. Monitoring of surface water features at risk from pollution, including the River Nene, Wittering Brook and its tributary, the unnamed watercourse to the east of the Proposed Scheme boundary and Mill Stream shall be carried out prior to and during the construction phase, subject to confirmation with the Environment Agency, requirements would be outlined in the EMP. This would comprise visual assessments for oil and silt, as well as watercourse monitoring where necessary typically for a year prior to construction. Whilst construction works are in

progress, selected watercourses shall be sampled at locations up and downstream of the works (and tested for suspended solids, pH changes and hydrocarbons).

Groundwater

13.9.17. The potential for impacts to occur as a result of contamination from accidental spillages and leakages within areas where topsoil has been removed or within excavated areas must be minimised by the following measures:

- Appropriate storage of construction materials, including bunding of storage tanks, use of silt fencing and covering stockpiles.
- Spill kits located on sites near to ordinary watercourses or drainage ditches and within the works compounds and staff should be trained in their use.
- Emergency response procedures included in the EMP (**TR010039/APP/7.5**) to handle any leakages or spillages of potentially contaminating substances.
- Existing road drainage soakaways no longer required as part of the proposed drainage design must also be backfilled.

13.9.18. The EMP (**TR010039/APP/7.5**)must highlight high risk areas, in the vicinity of the A1/A47 Wansford junction in the west of the site and along Sutton Heath Road in the east, where there is limited cover of superficial deposits and the Lower Lincolnshire Limestone Principal Aquifer is exposed and infiltration to ground must be avoided in these areas.

13.9.19. The design and construction of all below ground structures must aim to minimise the potential to impact on groundwater quality during construction. Specific mitigation measures to achieve this include both embedded and essential mitigation and these are discussed in further detail below.

13.9.20. Construction method statements and risk assessments must be approved by the Environment Agency where construction activities are likely to intercept the saturated aquifer, especially adjacent to S05 Sacrewell Farm Underbridge (S05). The construction method statements must include the use of best practice methods to minimise creation of contamination pathways and generation of suspended solids. Monitoring of down-gradient receptors must be undertaken before, during and after construction.

13.9.21. Where groundwater control is required, isolation techniques shall be considered in preference to dewatering, if feasible, in order to limit impacts to baseflow, spring flows and any down-gradient designated sites. Any dewatering activities are subject to approval from the Environment Agency and obtaining the relevant licences and permits. Further investigations, including water features surveys to

identify springs within the radius of influence for dewatering activities, and impact assessments will be required as part of the licensing process to confirm rates of abstraction and area of influence and identify potential receptors within the area of influence.

13.9.22. Groundwater monitoring (levels and quality) between the dewatering locations and down-gradient receptors is likely to be a condition of the dewatering licence. Careful consideration of the dewatering discharge points would be required to minimise both the resource impacts on the groundwater catchment and quality impacts on the receiving water body. Discharges will only be made with the appropriate consents or permits in place and any non-compliant discharges will be collected and disposed of off-site at a licensed facility.

13.9.23. Inspections and audits, along with general monitoring and reporting of effectiveness of control measures to be carried out throughout the construction programme, are incorporated into the EMP **(TR010039/APP/7.5).** The mitigation strategies implemented shall be reviewed regularly to best suit the practices being undertaken on-site.

13.9.24. Monitoring of groundwater features at risk from pollution shall be carried out prior to and during the construction phase, subject to confirmation with the Environment Agency and these requirements outlined in the EMP (**TR010039/APP/7.5**). This would comprise groundwater level and quality monitoring at suitable points between activities on-site that may result in groundwater impacts and the down-gradient receptors identified that are at risk of these impacts. Activities likely to require groundwater monitoring include any construction activities intercepting the saturated aquifer, those identified as having the potential to impact on groundwater quality at down-gradient receptors, and dewatering activities.

Operational

Surface water

13.9.25. The Drainage Strategy (Appendix 13.2) (**TR010039/APP/6.3**) proposes the road drainage would drain to groundwater and surface water. Road drainage discharging surface water shall discharge to seven locations, utilising five new outfalls; the exact location of the existing outfalls are to be confirmed through a drainage survey. The receiving watercourses include Mill Stream, Wittering Brook, a tributary of Wittering Brook, River Nene and the unnamed watercourse to the east of the Proposed Scheme. The location of the outfalls can be found in Appendix 13.3 (Surface water quality assessment) (**TR010039/APP/6.3**). Prior to discharging to the watercourses, the runoff from the Proposed Scheme's highway drainage must be routed through attenuation basins.

13.9.26. The potential water quality impacts of routine runoff on surface water receptors has also been assessed using DMRB LA 113 HEWRAT assessment (assessment of pollution impacts from routine runoff to surface waters), as described in Appendix 13.3 (Surface water quality assessment) (**TR010039/APP/6.3**). The assessment shows that there is a negligible impact following dilution in the channel for both soluble and sediment-bound pollutants for Mill Stream, Wittering Brook and the River Nene. Moderate beneficial significance of effects are predicted after vegetated drainage basins are included as mitigation for the drainage catchment P123. Catchment P123 is directed through the vegetated drainage basin before it drains into the existing drainage system and discharges to the unnamed watercourse to the east of the Proposed Scheme boundary.

13.9.27. There is an intention in the proposed drainage design to include filter drains and vegetated attenuation basins on other drainage catchments that do not require mitigation as additional enhancement measures. The provision of filter drains shall be considered further during detailed design. These will provide additional treatment for suspended solids, dissolved copper and dissolved zinc. As much of the Proposed Scheme is online and currently without or with only limited attenuation and treatment, the measures noted above will provide water quality betterment at Mill Stream, Wittering Brook and the River Nene.

13.9.28. The potential water quality impacts of accidental spillages on surface water bodies were assessed using HEWRAT spillage assessment, as described in Appendix D of DMRB LA 113. All outfalls passed this assessment with the results indicating all drainage areas would have <0.5% annual risk of pollution. The output from these assessments can be found in Appendix 13.3 (Surface water quality assessment) (**TR010039/APP/6.3**). Pollution control devices such as penstocks shall also be provided on all catchments to provide additional pollution protection and betterment, as described in Appendix 13.2 (Drainage strategy) (**TR010039/APP/6.3**).

13.9.29. The above mentioned embedded mitigation measures would mitigate against impacts to WFD physicochemical, biological, specific pollutant, quality elements, priority substances, other pollutants and priority hazardous substances of Wittering Brook and the Nene – Islip to Tidal water bodies.

13.9.30. The Proposed Scheme has a footprint greater than 1 ha and is within Flood Zone 3, therefore a Flood risk assessment (Appendix 13.1) (**TR010039/APP/6.3**) has been prepared. The pattern of flood risk impacts and the required mitigation depends on the location of the proposed works, as discussed below.

13.9.31. Any increase in runoff associated with the alteration of ground elevation due to the re-profiling and construction of embankments shall be intercepted using

appropriately designed drains along the Proposed Scheme. Further details can be found in the Flood Risk Assessment (Appendix 13.1) (**TR010039/APP/6.3**). Any increase or redirection of flow associated with the Proposed Scheme crossing two drainage ditches located west of Upton Road would be intercepted using appropriately designed drains (designed to convey flood flows for 1 in 100-year events, with the inclusion of climate change) at the toe of the Proposed Scheme embankment. This would divert the flow from the drainage ditches to the east, along the toe of the embankment and would tie into the existing drainage design, discharging to an unnamed watercourse to the east of the Proposed Scheme boundary. This would ensure the existing natural catchment drainage pathways shall be maintained. Any diversion shall ensure no increase in flood risk to others. The exact location of the drainage ditches and the connectivity with the existing drainage is to be confirmed once drainage and topographical surveys have been undertaken at Stage 5 (detailed design), further details can be found in the Drainage strategy (Appendix 13.2) (**TR010039/APP/6.3**).

13.9.32. The proposed increase in areas of hard standing and alteration of ground elevations due to re-profiling would result in an increase in peak flow rates and volumes discharging to the Mill Stream, Wittering Brook and its tributary, the River Nene and the unnamed watercourse to the east of the Proposed Scheme via the existing drainaige, particularly within areas of Flood Zones 2 and 3. Any increase in surface water runoff shall be attenuated using detention basins or oversized pipes. Where the existing drainage is being adapted, the drainage shall be designed to attenuate to existing runoff rates and includes a 1 in 100-year storm event plus 20% climate change allowance to allow for changes in peak rainfall intensity. Where carriagway widening or realignment occurs the additional contributing area shall be attenuated to greenfield runoff rates up to a 1 in 100-year storm event plus 40% climate change. Where an attenuation basin is not required and other SuDs solutions are inappropriate, attenuation would be in the form of flow controls and oversized pipes. This shall ensure there is no increase in peak surface water runoff rates resulting from the Proposed Scheme and no increase in flood risk from the Proposed Scheme drainage. Further details can be found in the Drainage strategy (Appendix 13.2) (**TR010039/APP/6.3**).

13.9.33. The A47 Wansford ~~Sluice Extension~~Sluice replacement culvert, the A1 Mill Stream culvert extension~~ or replacement~~, embankments and the widening of the carriageway near Wittering Brook has the potential to alter the conveyance of flow in the floodplain. The flood risk impact of the Proposed Scheme has been fully assessed using hydraulic modelling.The details of the assessment and impacts are presented in the Appendix 13.1 (Flood risk assessment) (**TR010039/APP/6.3**) and summarised below.

13.9.34. As part of the Proposed Scheme a section of Wittering Brook watercourse would be culverted 10m west from the existing culvert with a minor watercourse realignment. The proposed box culvert is approximately ~~60~~54m in length, box shaped with a width of 2.5m and height of 2.45m and is designed to convey a 1 in 100-year peak flow (including a 65% climate change allowance) with a freeboard exceeding 600mm. A natural bed shall be installed in the base of the culvert and a mammal ledge provided to maintain connectivity of habitat.

13.9.35. The hydraulic modelling analysis was initally carried out for a 2.5m x 2.5m box shaped culvert for a length of 60m. The design was later refined to the dimensions stated in Section 13.9.34. The predicted changes between the two culverts were found to be negligible. Where changes occurred, the reduction in culvert size caused a reduction in maximum water depth, flooded area and flooded volumes. The following results and referenced flood maps are true for the 2.5m x 2.5m culvert, and remain accurate for the final proposed dimensions stated in Section 13.9.34:

~~13.9.34.~~13.9.36. During the proposed 1 in 100-year including a 65% climate change allowance scenario a reduction in maximum water depth of 0.58 and 0.18m was observed at the culvert inlet and outlet, respectively, when compared to the baseline (modelled for the 1 in 100-year plus 65%). When compared to the baseline a freeboard increase of 1.44m upstream and 1.04m downstream was also observed. The flood detriment maps, as presented in the Flood risk assessment (Appendix 13.1) (**TR010039/APP/6.3**) indicated that when compared to the baseline the proposed 1 in 100-year plus 65% showed an overall reduction of maximum depth observed in the floodplain. The maximum flood depth observed during the baseline scenario (modelled to 1 in 100-year plus 65% climate change) ranged from 1.25 – 1.5m compared to the proposed scenario of 1 – 1.25m. A small area along the edge of the embankment demonstrated an increase in maximum flood depths and ranged between 1.25 – 2m during the proposed scenario. However, this area is associated with a ditch and is not representative of the remaining floodplain.

~~13.9.35.~~13.9.37. To consider the requirement for flood compensation in the Wittering Brook floodplain, a detriment analysis using the 1 in 100-year plus 35% climate change event was undertaken. Detriment was predicted in the Wittering Brook floodplain up to a maximum of 0.2m for all design events. The culvert design mitigates the volume of floodplain lost and removes the requirement for floodplain compensation. Peterbourgh County Council and Cambridgeshire County Council, were satisfied that increases in flood depths remained below 0.2m and agreed there would be no need to provide flood compensatory storage.

~~13.9.36.~~13.9.38. The sensitivity of the design was considered using the Environment Agency's H++ climate change scenario. The peak flow allowance for the H++ scenario for the Anglian region is 80%. Under this scenario, the detriment maps indicated similar flood depths to the 1 in 100-year plus 65% climate change, demonstrating it does not cause additional flooding to flood-sensitive receptors, the carriageway or road users. The Proposed Scheme is not considered to increase risk of flooding to receptors, or to be at risk of flooding or overtopping in any climate change scenario. Due to the water depth levels predicted, it has been assessed that there are large beneficial significance of effects identified on the floodplain and conveyance of flow for Wittering Brook in the design event.

~~13.9.37.~~13.9.39. To ensure there is no increased flood risk created by the Proposed Scheme and no net loss of floodplain associated with the River Nene, flood compensation shall be provided between Flood Zone 3 and the 1 in 100-year plus 35% climate change level, 9.8 and 10.5mAOD respectively. This is on a volume for volume basis in agreement with the Environment Agency. The proposed location for the flood compensation is taken from the left embankment of the River Nene, downstream of the Wittering Brook and River Nene confluence; this has been agreed with the Environment Agency. Once the required volume is excavated, the embankment shall be regraded maintaining at least a 1:3 slope. The embankment shall be constructed to an estimated level of 12.6mAOD. The final specification for the flood compensation is to be confirmed by the Environment Agency.

~~13.9.38. At the time of writing, site investigation is still outstanding and proposed preliminary design of the A1 Mill Stream culvert, including the length it is required to be extended or whether it would be completely replaced, is yet to be agreed. Notwithstanding this, any amendments to the culvert shall not result in an increase in flood risk to or from the Proposed Scheme. This shall be assessed by hydraulic modelling once a preliminary design is completed.~~

~~13.9.39.~~13.9.40. The A47 Wansford ~~Sluice Extension~~Sluice replacement and the A1 Mill Stream culvert extension ~~or replacement~~ would result in the loss of riparian banks and bed including associated habitat. To mitigate against the impacts, the culverts must be constructed to maintain a natural sediment bed at the base of the culvert. Measures to ensure fish and eel passage shall be included. A mammal ledge should be provided above the design flood level for the A47 Wansford ~~Sluice Extension~~Sluice replacement ~~and the A1 Mill Stream culvert although it may not be possible to place the mammal ledge above the design flood level if there is a requirement to throttle flood flows~~. These measure would maintain connectivity of the habitat and allow mammal including otter passage.

~~13.9.40.~~13.9.41. Habitat restoration measures on Wittering Brook and Mill Stream, including riparian planting on both watercourses, and the creation of wetland /

ponds and ditch at Mill Stream must be implemented to mitigate against the additional culverting and loss of watercourse due to the realignment. The proposed ditch shall be provided on a length-for-length replacement based on the additional length of culverting. Additional riparian planting should also be included along the watercourse at the locations of the proposed outfalls. This would mitigate the impacts of the proposed culverts and associated watercourse diversion and outfalls on the channel morphology, including aquatic habitat, and to ensure no reduction in WFD status. The locations of the habitat restoration measures can be seen in the Environmental Masterplan (**TR010039/APP/6.8**).

~~13.9.41.~~13.9.42. These measures noted above would also mitigate impacts to WFD physicochemical, biological and hydromorphological quality elements of Wittering Brook and the Nene – Islip to Tidal water bodies.

~~13.9.42.~~13.9.43. To minimise the risk of erosion of the watercourse banks and bed due to the discharge from the proposed outfalls, flow rates and velocities must be kept to a minimum. All surface water runoff from road runoff must be attenuated to greenfield runoff rates, or no greater than existing where there is no increase in hardstanding, at source using SuDS systems such as attenuation basins. Scour protection downstream of the outfall must be provided to ensure the risk of erosion is minimised. The proposed outfalls must be set back into the bank to minimise the impact on flow conveyance and minimise the impact of erosion and scouring of river banks.

~~13.9.43.~~13.9.44. The provision of one replacement pond is required for each pond lost in the location of the Proposed Scheme (a total of two ponds lost). The replacement pond shall be constructed prior to the existing ponds being lost. This would mitigate the potential negative impact on biodiversity and aquatic ecology caused by the loss of these water features. The location of the replacement ponds within the Proposed Scheme boundary is shown on the Environmental Masterplan (**TR010039/APP/6.8**). This has been discussed, along with detailed mitigation requirements of the replacement pond in Chapter 8 (Biodiversity) (**TR010039/APP/6.1**).

Groundwater

~~13.9.44.~~13.9.45. The potential impacts of routine runoff on groundwater receptors has been assessed, as described in Appendix 13.4 (Groundwater assessment) (**TR010039/APP/6.3**). The assessment shows that whilst there is infiltration capacity beneath the infiltration basins, this has not been confirmed in all areas where filter drains are present. The drainage network includes mitigation for the infiltration basins, in the form of filter drains and/or gullies, and pollution control valves upstream of the infiltration basins to capture pollutants.

~~13.9.45.~~13.9.46. Due to the risks identified from infiltration through the base of filter drains, however, their inclusion in the drainage design should be reviewed at detailed design stage and, should no other solution be identified, the filter drains should be lined with an impermeable barrier to ensure that they can provide primary treatment without posing a risk of discharging untreated road drainage directly to groundwater. Where filter drains are required for subsurface drainage, such as Sacrewell Farm Underbridge (S05), road runoff shall be isolated from the filter drains, and conveyed to the drainage system via carrier drains.

~~13.9.46.~~13.9.47. The HEWRAT spillage assessment, as described in Appendix D of DMRB LA 113 and presented in Appendix 13.3 (Surface water quality assessment) (**TR010039/APP/6.3**) is relevant for assessing the potential water quality impacts of accidental spillages on groundwater bodies. All drainage areas were assessed to have <0.5% annual risk of pollution. Pollution control devices such as penstocks shall also be provided on all catchments to provide additional pollution protection and betterment described in Appendix 13.2 (Drainage strategy) (**TR010039/APP/6.3**).

~~13.9.47.~~13.9.48. Permanent road drainage requirements and the subsequent zone of influence must be confirmed by supplementary ground investigations. Furthermore water features surveys shall be undertaken to confirm springs within the zone of influence.

~~13.9.48.~~13.9.49. Pre- and post construction water level and quality monitoring shall be undertaken to ensure no impacts arise from the proposed drainage design to groundwater receptors, especially Sutton Heath and Bog SSSI, Wittering Brook, Mill Stream and the priority habitats associated with the River Nene.

13.10. Assessment of likely significant effects

13.10.1. Potential effects on surface water and groundwater receptors during construction are summarised in Table 13.7, together with residual impacts after mitigation. The mitigation measures described in Table 13.7 are discussed in detail in Section 13.9.

13.10.2. Potential effects on surface water and groundwater receptors during operation are summarised in Table 13.8, together with residual impacts after mitigation. The mitigation measures described in Table 13.8 are discussed in detail in Section 13.9.

13.10.3. The impact on surface water receptors is based on the outcome of the Flood risk assessment (Appendix 13.1) (**TR010039/APP/6.3**), Surface water quality assessment (Appendix 13.3) (**TR010039/APP/6.3**) and the Geomorphological assessment (Appendix 13.5) (**TR010039/APP/6.3**). These impact assessments

include potential receptors identified in the assessments for groundwater levels and flow and groundwater dependent terrestrial ecosystems detailed in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).

13.10.4. The impact of the Proposed Scheme on the Water Framework Directive status of the affected water bodies is also considered in this section.

13.10.5. No significant adverse residual effects on surface water and groundwater receptors are anticipated during construction or operation of the Proposed Scheme.

Table 13.7 Potential effects on groundwater and surface water receptors during construction of the Proposed Scheme

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
Accidental leakage or spillages	Pollution of surface water features due to accidental spillage or leakage of fuel and oils, or due to placement of construction materials, washing of plant, cleaning areas of hardstanding etc. (suspended solids and dissolved contaminants) Deterioration of downstream aquatic environments and abstraction water quality.	Mill Stream	Water supply and quality	Medium	EMP (**TR010039/APP/7.5**) (pollution prevention measures in the construction drainage design, emergency response procedures and provision of spill kits). Adhere to CIRIA guidelines on control of water pollution on linear construction sites (C648) and environmental best practice on-site (C741) Monitoring plan to include water quality sampling prior to, during and after construction (to be agreed with the Environment Agency).	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		tributary) and drainage ditches	Biodiversity	Very High		Negligible	Slight adverse
		Ponds	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Works within, adjacent, over or close to water bodies, watercourses, ponds or the fluvial floodplain	Pollution of surface water bodies due to placement of construction materials, washing of plant, cleaning areas of hardstanding etc. (suspended solids and dissolved contaminants) Deterioration of downstream aquatic environments.	Mill Stream	Water supply and quality	Medium	Construction design and EMP (**TR010039/APP/7.5**). EMP (pollution prevention measures in the construction drainage design, emergency response procedures and provision of spill kits). Land Drainage Act consent for work on or adjacent to an ordinary watercourse. Environment Agency Flood Risk Activity Permit for works on, over or within 8m of a main river. Monitoring plan to include water quality sampling prior to, during and after construction (to be	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
			Biodiversity	Very High	agreed with the Environment Agency).	Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Ponds	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Works within, adjacent, over or close to water bodies, watercourses, drainage ditches, ponds or the fluvial floodplain	Increased localised flooding to the Proposed Scheme. Increased or redirected flood risk to other and risk to flood-sensitive receptors near to overloaded system and downstream.	Mill Stream	Water supply and quality	Medium	Construction design and EMP (**TR010039/APP/7.5**) (including temporary drainage strategy employing SuDS where appropriate). Land Drainage Act consent for work on or adjacent to an ordinary watercourse. Environment Agency Flood Risk Activity Permit for works on,	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Mill Stream floodplain	Conveyance of flow	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		Wittering Brook	Water supply and quality	Medium	over or within 8m of a main river.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Wittering Brook floodplain	Value to economy	Low to Medium		Negligible	Neutral
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Ordinary watercourses	Water supply and quality	Low		Negligible	Neutral

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		(including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Ponds	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Construction of proposed outfalls, A47 Wansford ~~Sluice Extension~~Sluice replacement culvert and associated minor watercourse realignment, A1 Mill stream culvert extension, drainage ditch interception and flood compensatory area	Deterioration or loss of the aquatic environments and deterioration in water quality. Deterioration of downstream aquatic environment of indirect receptors.	Mill Stream	Water supply and quality	Medium	Construction design and EMP (**TR010039/APP/7.5**). Off-line construction to minimise work within watercourses Monitoring plan to include water quality sampling prior to, during and after construction (to be agreed with the Environment Agency). Land Drainage Act consent for work on or adjacent to an ordinary watercourse.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene	Water supply and quality	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
			Recreation	Medium	Environment Agency Flood Risk Activity Permit for works on, over or within 8m of a main river. In-river sediment controls (for example, straw matting) shall be used and it shall be undertaken during low flows to minimise sediment transport. Adhere to CIRIA guidelines on control of water pollution on linear construction sites (C648) and environmental best practice on-site (C741). Adherence to C786 – Culvert, Screen and Outfall Manual guidelines.	Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
Alteration of ground elevations, diversion of ordinary watercourses and construction of above ground structures acting as a barrier to flow.	Changes in surface water flow pathways resulting in overloading of drainage systems and surface watercourses. Increased or redirected flood risk to other and risk to flood-sensitive receptors near to	Mill Stream	Water supply and quality	Medium	Construction design and EMP (**TR010039/APP/7.5**). (including a temporary surface water drainage strategy). Construct drainage and the River Nene flood compensation in the early stages to	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
	overloaded system and downstream. Deterioration of downstream aquatic environments.	Mill Stream floodplain	Conveyance of flow	High	maintain flood flow pathways.	Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Wittering Brook floodplain	Value to economy	Low to Medium		Negligible	Neutral
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Ponds	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Drainage of additional hardstanding areas (closed drainage system that discharges to outfall).	Increase in the rate and volume of surface water runoff to water features and increased localised flooding to the Proposed Scheme. Increased or redirected flood risk to other and risk to flood-sensitive receptors near to overloaded system and downstream.	Mill Stream	Water supply and quality	Medium	Construction design and EMP (**TR010039/APP/7.5**) (including a temporary surface water drainage strategy).	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Mill Stream floodplain	Conveyance of flow	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
	Deterioration of downstream aquatic environments. Increase in rate and volume impacting downstream consented discharges.	Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Wittering Brook floodplain	Value to economy	Medium		Negligible	Neutral
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Ordinary watercourses	Water supply and quality	Low		Negligible	Neutral

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		(including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Ponds	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Infilling of two ponds due to the location of the Proposed Scheme	Loss of biodiversity habitat and ecology	Ponds	Biodiversity	Low	Provision of one pond to replace each pond lost. Refer to Chapter 8 (Biodiversity) (**TR010039/APP/6.1**) for detailed mitigation. Locations shown on Environmental Masterplan	Negligible	Neutral
Drainage of construction areas	Discharge of surface water contaminated by	Direct receptors:	Water supply and quality	High to very high	Mitigation measures implemented as part of	Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
including excavations, cuttings, utilities diversions and site compounds	construction materials and surface contaminants to groundwater (including accidental spillages and leakages). Removal of topsoil and excavations removing a significant thickness of the unsaturated zone increases the vulnerability of underlying aquifers.	Lincolnshire Limestone Formation, Grantham Formation, Rutland Formation River Terrace Deposits and Alluvium <u>Indirect receptors:</u> Designated sites Downgradient unlicensed abstractions River Nene, Mill Stream and Wittering Brook	Soakaway	High	the EMP (**TR010039/APP/7.5**) (pollution prevention measures in the construction drainage design, emergency response procedures and provision of spill kits). Mitigation measures implemented as part of the EMP (**TR010039/APP/7.5**) should also highlight high risk areas and satellite compounds in high risk areas to avoid infiltration to ground. Road drainage soakaways no longer in use to be backfilled.	Negligible	Slight adverse
			Vulnerability	Very high		Negligible	Slight adverse
			Economic Value	Medium		Negligible	Neutral
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	High		Negligible	Slight adverse
Excavations, including construction of underpasses, infiltration basins and utilities diversions	Contamination of groundwater through direct contact with construction materials	<u>Direct receptors:</u> Lincolnshire Limestone Formation, Grantham Formation, Rutland Formation River Terrace Deposits and Alluvium <u>Indirect receptors:</u> Designated sites Downgradient unlicensed abstractions	Water supply and quality	High to very high	Construction method statements and risk assessments to be approved by the EA where construction activities likely to intercept the saturated aquifer. Water quality monitoring before, during and after construction. Best practice methods to minimise contamination	Negligible	Slight adverse
			Soakaway	High		Negligible	Slight adverse
			Vulnerability	Very high		Negligible	Slight adverse
			Economic Value	Medium		Negligible	Neutral
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	High		Negligible	Slight adverse

Construction Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		River Nene, Mill Stream and Wittering Brook			pathways and generation of suspended solids		
Groundwater control requirements associated with construction of underbridge	Reduction in local groundwater levels and therefore a loss of groundwater flow / resource to nearby receptors Construction dewatering discharges may contain suspended solids and may therefore result in contamination of receiving waterbody.	Direct receptors Lincolnshire Limestone, Grantham Formation Indirect receptors River Terrace Deposits and Alluvium Designated sites River Nene, Mill Stream and Wittering Brook	Water supply and quality	High to very high	Isolation techniques to be considered in preference to dewatering, if feasible. Water features surveys required within zone of influence to confirm presence of springs. Dewatering activities would be subject to approval from the EA. Further investigations and assessments would be required as part of the licensing process, and likely to include monitoring before, during and after construction, and treatment of discharge water.	Negligible	Slight adverse
			Soakaway	High		Negligible	Slight adverse
			Vulnerability	Very high		Negligible	Slight adverse
			Economic Value	Medium		Negligible	Neutral
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	High		Negligible	Slight adverse

Table 13.8 Potential effects on groundwater and surface water receptors during operation of the Proposed Scheme

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
	Pollution of surface water features due to	Mill Stream	Water supply and quality	Medium	None required due to spillages assessment	Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
Accidental leakage or spillages	accidental spillage or leakage. Deterioration of downstream aquatic environments and abstraction water quality.		Value to economy	Medium	results indicating all drainage areas would have <0.5% annual risk of pollution. Pollution control devices would be built upstream of the outfalls as an additional measure.	Negligible	Neutral
			Biodiversity	High		Negligible	Slight beneficial
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight beneficial
		River Nene	Water supply and quality	High		Negligible	Slight beneficial
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight beneficial
			Biodiversity	Very High		Negligible	Slight beneficial
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight beneficial
		Ponds	Water supply and quality	Low		Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Increase in pollutants from routine road runoff	Pollution of surface water features, including an increase in sediment load. Deterioration of downstream aquatic environments	Mill Stream	Water supply and quality	Medium	HEWRAT results indicating there is a negligible impact. Vegetated attenuation basins and filter drains shall be provided as additional enhancement measures.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight beneficial
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight beneficial
		River Nene	Water supply and quality	High		Negligible	Slight beneficial
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight beneficial
			Biodiversity	Very High		Negligible	Slight beneficial
		Ordinary watercourses	Water supply and quality	Low	HEWRAT results indicates there is a	Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		(including the unnamed watercourse to the east of the Proposed Scheme boundary and the Wittering Brook tributary flowing through the Sutton Heath and Bog SSSI) and drainage ditches	Value to economy	Low	negligible impact. A vegetated attenuation basin shall be provided to treat drainage catchment P123. Vegetated attenuation basins on remaining catchments and filter drains shall be provided as additional enhancement measures.	Negligible	Neutral
			Biodiversity	Low (unnamed watercourse) Very High (Wittering Brook tributary)		Minor beneficial (the unnamed watercourse) Negligible (Wittering Brook tributary)	Moderate beneficial to slight adverse
		Ponds (indirect receptor)	Water supply and quality	Low	HEWRAT results indicating all outfalls passed the assessment with the inclusion of filter drains and attenuation basins.	Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Biodiversity	Low		Negligible	Neutral
Alteration of overland flow pathways due to road alignment and alteration of ground levels.	Changes in surface water flow pathways resulting in overloading of drainage systems and surface watercourses. Increased or redirected flood risk to other and risk to	Mill Stream	Water supply and quality	Medium	Proposed Scheme design - surface water flooding flow pathways maintained through appropriately designed drains which shall be designed to 1 in 100-year event plus climate change.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
	flood-sensitive receptors. Deterioration of downstream aquatic environments.	Mill Stream floodplain	Conveyance of flow	High	Drains would be located along the base of the Proposed Scheme to intercept and collect any additional runoff.	Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		Wittering Brook floodplain	Value to economy	Low to Medium		Negligible	Neutral
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
Drainage of additional areas of hardstanding and alteration of ground elevations due to re-profiling	Increase in the rate and volume of surface water runoff to water bodies and watercourses and increased localised flooding to the Proposed Scheme. Increased or redirected flood risk to others and risk to flood-sensitive receptors near to overloaded system and downstream. Deterioration of downstream aquatic environments	Mill Stream	Water supply and quality	Medium	Modified existing drainage to be attenuated to existing rates or below (including a 20% climate change allowance). Where widening or realignment occurs the additional contributing area would be attenuate to greenfield runoff rates up 1 in 100-year event including 40% climate change allowance.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Mill Stream floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		Wittering Brook floodplain	Value to economy	Low to Medium		Negligible	Neutral
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
Proposed A47 Wansford ~~Sluice Extension~~Sluice replacement culvert and	Potential changes to the conveyance of flow in the fluvial floodplain and loss of fluvial floodplain, restriction or	Mill Stream	Water supply and quality	Medium	Wansford ~~Sluice Extension~~Sluice replacement~~Wittering Brook~~ culvert shall be designed to a peak flood level for 1	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
associated minor watercourse realignment, A1 Mill Stream extension, drainage, proposed new outfalls, embankments and drainage ditch interception	redirection of the water body and watercourses causing increased localised flooding to the Proposed Scheme. Increased or redirected flood risk to other and risk to flood-sensitive receptors near to overloaded system and downstream.		Conveyance of flow	Medium	in 100-year plus 65% climate change allowance plus 0.6m freeboard. The culvert design mitigates the volume of floodplain lost and removes the requirement for floodplain compensation River Nene floodplain storage loss must be mitigated through compensatory floodplain storage designed to 1 in 100-year plus 35% climate change peak flood level. Outfalls to avoid impact on channel cross section profile. A1 Mill Stream culvert extension shall be designed to not increase flood risk to, or from, the Proposed Scheme. Severed drainage ditches shall be intercepted and diverted along the base of the embankment.	Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Mill Stream floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Major beneficial	Large beneficial (rather than moderate as major magnitude impacts are predominant)
			Biodiversity	Very High		Negligible	Slight adverse
		Wittering Brook floodplain	Value to economy	Medium		Major beneficial	Large beneficial (rather than moderate as major magnitude impacts are predominant)
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene floodplain	Conveyance of flow	High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
Proposed A47 Wansford ~~Sluice Extension~~Sluice replacement culvert and associated minor watercourse diversion, A1 Mill Stream culvert extension, Mill	Change in channel morphology and reduction in hydromorphological complexity. Deterioration or loss of the aquatic environments and deterioration in water quality.	Mill Stream	Water supply and quality	Medium	Proposed A47 Wansford ~~Sluice Extension~~Sluice replacement and A1 Mill Stream culvert extension shall be designed with a natural sediment bed, ~~and mammal ledge~~ and to allow fish and eel passage. The proposed A47 Wansford ~~Sluice~~	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	High		Minor adverse	Slight adverse (impact minimised due to

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
Stream ditch creation, proposed new outfalls and embankments	Deterioration of downstream aquatic environment of indirect receptors.				~~Extension~~Sluice replacement shall be designed with a mammal ledge above the design flood level. Monitoring plan to include water quality sampling (to be agreed with the Environment Agency). Outfalls to avoid impact on channel cross section profile. Mill Stream wetland, ponds and ditch creation (on a length-for-length replacement basis) to support the required depth for water vole habitat and provide additional aquatic habitat. Riparian planting shall be included to replace lost habitat.		proposed mitigation)
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Conveyance of flow	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook tributary) and drainage ditches	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral
			Conveyance of flow	Low		Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
			Biodiversity	Very High		Negligible	Slight adverse
Discharge from proposed outfalls	Potential risk of erosion impacting on channel stability, causing structural damage and an increase sediment in downstream reaches. Deterioration of downstream aquatic environments.	Mill Stream	Water supply and quality	Medium	Surface water runoff shall be attenuated to greenfield rates (new hardstanding) or existing rates (adapted \ existing) at source using oversized pipes, flow control device and SuDS systems such as attenuation basins. Proposed outfall design shall include erosion protection measures.	Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	High		Negligible	Slight adverse
		Wittering Brook	Water supply and quality	Medium		Negligible	Neutral
			Value to economy	Medium		Negligible	Neutral
			Biodiversity	Very High		Negligible	Slight adverse
		River Nene	Water supply and quality	High		Negligible	Slight adverse
			Recreation	Medium		Negligible	Neutral
			Value to economy	High		Negligible	Slight adverse
			Biodiversity	Very High		Negligible	Slight adverse
		Ordinary watercourses (including the unnamed watercourse and Wittering Brook	Water supply and quality	Low		Negligible	Neutral
			Value to economy	Low		Negligible	Neutral

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
		tributary) and drainage ditches	Biodiversity	Very High		Negligible	Slight adverse
Infilling of two ponds due to the location of the Proposed Scheme	Loss of biodiversity habitat and ecology	Ponds	Biodiversity	Low	Provision of one pond to replace each pond lost. Refer to Chapter 8 (Biodiversity) (**TR010039/APP/6.1**) for detailed mitigation. Locations shown on Environmental Masterplan	Negligible	Neutral
Routine road runoff and accidental spillages discharging to infiltration basins and filter drains	Routine road drainage (including accidental spillages collected by road drainage) may result in contamination of receiving aquifer resulting in the deterioration of downgradient groundwater terrestrial ecosystems and abstraction water quality.	<u>Direct receptors</u> Lincolnshire Limestone, River Terrace Deposits and Alluvium Rutland Formation <u>Indirect receptors</u> Grantham Formation Designated sites Downgradient unlicensed abstractions River Nene, Mill Stream and Wittering Brook	Water supply and quality	High to very high	Filter drains and/or gullies and pollution control valves included upstream of infiltration basins to provide treatment. Use of filter drains to be reviewed in detailed design. If no other solutions are identified, these shall include an impermeable liner to avoid untreated discharges to groundwater. Where filter drains are required for subsurface drainage, road runoff is to be isolated and conveyed to the	Negligible	Slight adverse
			Soakaway	High		Negligible	Slight adverse
			Vulnerability	Very high		Negligible	Slight adverse
			Economic Value	Medium		Negligible	Neutral
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	High		Negligible	Slight adverse

Operation Activity	Potential effects on direct and indirect receptors	Feature	Relevant attributes	Importance (value)	Mitigation	Magnitude of impact after mitigation	Significance of effect after mitigation
					drainage system via carrier pipes. Further water quality monitoring to confirm baseline groundwater quality.		
Permanent road drainage for underbridge and underpass structures	Reduction in local groundwater levels and therefore a loss of groundwater flow / resource to nearby receptors	Direct receptors Lincolnshire Limestone, Grantham Formation Indirect receptors River Terrace Deposits and Alluvium Designated sites Downgradient unlicensed abstractions River Nene, Mill Stream and Wittering Brook	Water supply and quality	High to very high	Water features surveys required within zone of influence to confirm presence of springs. Groundwater level monitoring before, during and after construction.	Negligible	Slight adverse
			Soakaway	High		Negligible	Slight adverse
			Vulnerability	Very high		Negligible	Slight adverse
			Economic Value	Medium		Negligible	Neutral
			Conveyance of flow	Very High		Negligible	Slight adverse
			Biodiversity	High		Minor adverse	Slight adverse (impact minimised due to proposed mitigation)

Water Framework Directive Assessment

13.10.6. This section outlines the assessment of potential construction and operation related impacts on each of the water bodies' quantity and quality elements. It assessed whether these impacts could lead to non-compliance of the WFD and the ability of the relevant WFD water bodies to meet their current objectives.

13.10.7. Groundwater bodies have been considered during the screening and scoping for this assessment.

WFD background and approach

13.10.8. The key objectives of the WFD, provided for in the area River Basin Management Plan (RBMP) (Environment Agency, 2018b), are as follows:

- To prevent deterioration of the status of surface waters and groundwater.
- To achieve objectives and standards for protected areas.
- To aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status.
- To reverse any significant and sustained upward trends in pollutant concentrations in groundwater.
- The cessation of discharges, emissions and losses of priority hazardous substances into surface waters.
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.

13.10.9. The assessment was carried out with due regard to the Planning Inspectorate Water Framework Directive Guidance (Planning Inspectorate, 2017). The assessment process is as follows:

- identification of water bodies that are potentially affected (directly or indirectly) or could be at risk as a result of the Proposed Scheme
- the baseline characteristics of the water bodies concerned
- a description of the Proposed Scheme and the aspects of the development considered within the scope of the WFD assessment
- the methods used to determine and quantify the scale of WFD impacts
- an assessment of the risk of deterioration, as Article 4.7 may apply where is a there is a risk the Proposed Scheme would prevent the achievement of good status or result in deterioration in status
- an explanation of any mitigation required and how its delivery is secured

- an explanation of any enhancements and/or positive contributions to the RBMP objectives proposed and how their delivery would be secured.

13.10.10. The Environment Agency, Peterborough City Council and Cambridgeshire County Council were consulted on issues related to flood risk, Water Framework Directive and geomorphology at meetings in May and November 2020 including email corresponance where discussions focused on the requirements for A47 Wansford ~~Sluice Extension~~Sluice replacement culvert and associated minor watercourse diversions. Outcomes from these consultations have helped inform the WFD assessment and mitigation. However, consultation is ongoing and will continue throughout the detailed design stage.

13.10.11. A screening assessment was undertaken to determine WFD water bodies that should be included in this assessment. Following this, a scoping assessment was undertaken for the receptors that are potentially at risk from the Proposed Scheme. This was outlined in the Scoping Report (**TR010039/APP/6.5**) and has been discussed in detail above. All surface water WFD ecological and chemical quality elements and groundwater WFD quantitative and chemical elements are scoped into the WFD compliance assessment.

Proposed Scheme WFD assessment

13.10.12. Baseline information detailing surface water features, groundwater features and aquatic ecology can be found in in section 13.7.

13.10.13. Wittering Brook WFD water body (GB105032050350) and Nene – Islip to Tidal (GB105032050381) WFD surface water bodies have been considered in this assessment. Nene Mid Lower Jurassic Unit (GB40502G402400), Northampton Sands (GB40501G445500) and Welland Limestone Unit A (GB40501G445900) WFD groundwater bodies have also been considered.

13.10.14. A summary of the WFD surface water and groundwater bodies within the study area, including their targets and objectives was obtained from the current Anglian RBMP, as shown by the Environment Agency's Catchment Data Explorer (Environment Agency, 2020b). This information was based on the 2019 status. The baseline condition of the various WFD elements are provided in section 13.7 and Tables 13.3 and 13.4.

13.10.15. The surface water and groundwater WFD catchments are within the Anglian River Basin District and their locations are identified in Figure 13.2 (WFD surface waterbodies) and Figure 13.4 (WFD groundwater bodies) (**TR010039/APP/6.2**).

13.10.16. A geomorphological site walkover was carried out in May 2020. The walkover surveys were undertaken to ground truth evidence of geomorphic

change and / or instability that may be impacted by the Proposed Scheme, and to identify the dominant geomorphic processes occurring on each river reach to ensure baseline conditions are adhered to, or improved upon, as far as possible. The findings of this assessment are included in Appendix 13.5 Geomorphological assessment (**TR010039/APP/6.3**) and have informed the WFD assessment.

13.10.17. Surface water quality assessments were undertaken to understand the pollution impacts from routine runoff and spillages to surface waters associated with the Proposed Scheme. This assessment assisted with identify the required mitigation to ensure any risks are adequetly reduced. The results of this assessment are included in Appendix 13.3 Surface water quality assessment (**TR010039/APP/6.3**) and have informed the WFD assessment.

13.10.18. Potential impacts on WFD groundwater water bodies are considered using the assessment described in Appendix 13.4 Groundwater assessment (**TR010039/APP/6.3**).

Effects of works

13.10.19. The assessment of the compliance of the Proposed Scheme with the WFD has been split into two sections: assessment of the effects and required mitigation during construction (temporary works) and during operation on the WFD water bodies. These impacts have been in identified in section 13.8 and mitigation measures considered within the design of the Proposed Scheme have been discussed in section 13.9.

13.10.20. Locations of proposed habitat restoration can be seen in the Environmental Masterplan (**TR010039/APP.6.8**).

13.10.21. The assessment of impacts can be seen in Tables 13.7 and 13.8 for construction and operation, respectively. These tables indicate that there would not be any significant effects caused to the water environment from the Proposed Scheme when the mitigation mentioned in section 13.9 is in place. The WFD assessment therefore concludes that the construction and operational activities affecting the WFD water bodies will be compliant with the requirements of the WFD. This assumes the mitigation is implemented and limits the overall effect of the Proposed Scheme to slight adverse and is localised. Due to this, construction and operational activities affecting the WFD surface water and groundwater bodies are not considered to cause deterioration and should not prevent future attainment of WFD water body targets.

13.10.22. Table 13.9 provides a summary of the WFD assessment during the construction and operation of the Proposed Scheme.

Table 13.9 Summary of WFD water body assessment

Water body name ID	WFD aspect		Impacts on status or ability to meet target	Reference
Wittering Brook (GB105032050350)	Ecological	Supporting elements (surface water)	Slight short term construction impact due to spillage or works close to the water features, however, pollution prevention measures in the EMP (**TR010039/APP/7.5**) and large degree of dilution in the river suggests this would not cause deterioration. Slight short term construction and long-term operational impact due to construction of flood compensatory storage, outfalls, culverts and associated watercourse diversions. No other construction related impact due to mitigation outlined in EMP (**TR010039/APP/7.5**). Slight operational impact.	See Table 13.7 and 13.8
		Biological		
		Hydromorphological supporting elements		
		Physico-chemical quality		
		Specific pollutants (including copper and zinc)		
	Chemical	Priority substances	No construction related impact due to mitigation outlined in EMP (**TR010039/APP/7.5**). No operational impact.	See Table 13.7 and 13.8
		Other pollutants		
		Priority hazard substances		
Nene – Islip to Tidal (GB105032050381)	Ecological	Supporting elements (surface water)	Slight short term construction impact due to spillage or works close to the water features, however, pollution prevention measures in the EMP (**TR010039/APP/7.5**) and large degree of dilution in the river suggests this would not cause deterioration. Slight short term construction and long-term operational impact due to construction of flood compensatory storage, outfalls, culverts and associated watercourse diversions. No other construction related impact due to	See Table 13.7 and 13.8
		Biological		
		Hydromorphological supporting elements		
		Physico-chemical quality		
		Specific pollutants (including copper and zinc)		

Water body name ID	WFD aspect		Impacts on status or ability to meet target	Reference
			mitigation outlined in EMP (**TR010039/APP/7.5**). Slight operational impact.	
	Chemical	Priority substances	No construction related impact due to mitigation outlined in EMP (**TR010039/APP/7.5**). No operational impact.	See Table 13.7 and 13.8
		Other pollutants		
		Priority hazard substances		
		Other pollutants		
		Priority hazard substances		
Nene Mid Lower Jurassic Unit (GB40502G402400)	Chemical	Chemical drinking water protected area	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments, and the EMP (**TR010039/APP/7.5**), and obtaining all relevant licences and permits. Negligible operational impact due to mitigation included in Scheme design	See Table 13.7 and 13.8
		General chemical test		
		Chemical GWDTEs test		
		Chemical dependent surface water body status		
		Chemical saline intrusion		
	Quantitative	Quantitative saline intrusion	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments and the EMP (**TR010039/APP/7.5**), and obtaining all relevant licences and permits. Negligible operational impact due to mitigation included in Scheme design	See Table 13.7 and 13.8
		Quantitative water balance		
		Quantitative GWDTEs test		
		Quantitative dependent surface water body status		
Northampton Sands (GB40501G445500)	Chemical	Chemical drinking water protected area	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments, and the EMP (**TR010039/APP/7.5**) and obtaining all relevant licences and permits. Negligible operational impact due to mitigation	See Table 13.7 and 13.8
		General chemical test		
		Chemical GWDTEs test		
		Chemical dependent surface water body status		
		Chemical saline intrusion		

Water body name ID	WFD aspect		Impacts on status or ability to meet target	Reference
			included in Scheme design	
	Quantitative	Quantitative saline intrusion	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments and the EMP (**TR010039/APP/7.5**) and obtaining all relevant licences and permits. Negligible operational impact due to mitigation included in Scheme design	See Table 13.7 and 13.8
		Quantitative water balance		
		Quantitative GWDTEs test		
		Quantitative dependent surface water body status		
Welland Limestone Unit A (GB40501G445900)	Chemical	Chemical drinking water protected area	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments, and the EMP (**TR010039/APP/7.5**) and obtaining all relevant licences and permits. Negligible operational impact due to mitigation included in Scheme design	See Table 13.7 and 13.8
		General chemical test		
		Chemical GWDTEs test		
		Chemical dependent surface water body status		
		Chemical saline intrusion		
	Quantitative	Quantitative saline intrusion	No construction related impact due to best practice mitigation measures outlined in construction method statements, risk assessments and the EMP (**TR010039/APP/7.5**) and obtaining all relevant licences and permits. Negligible operational impact due to mitigation included in Scheme design	See Table 13.7 and 13.8
		Quantitative water balance		
		Quantitative GWDTEs test		
		Quantitative dependent surface water body status		

13.11. Monitoring

13.11.1. There are no significant adverse effects (moderate or above) identified within the assessment. However, monitoring of surface water and groundwater is part of the essential mitigation required to ensure construction works in, or near to, the watercourses such as the construction of the proposed culverts, do not have a significant effect. This has been discussed in section 13.9.

13.12. Summary

13.12.1. The Proposed Scheme is not expected to give rise to significant adverse (moderate or greater) residual effects during the construction or operational phases with the adoption of mitigation measures discussed in section 13.9.

13.12.2. The outcome of this assessment is based on the mitigation measures described in this chapter which will be secured through measures embedded in the design of the Proposed Scheme and the implementation of the Environmental Management Plan (**TR010039/APP/7.5**).

13.13. References

- British Geological Survey (2018) British Geological Survey 1:50,000 and 1:625,000 superficial and bedrock geological map. Available online at Geoindex onshore: [redacted] accessed April 2020
- Charles, P. and Edwards, P. (2015) Environmental good practice on site guide (Fourth Edition). CIRIA C741
- Defra (2020) Defra's 'Magic' interactive map. Available at: http://www.magic.gov.uk/MagicMap.aspx, accessed December 2020
- Department for Transport (2014) National Policy Statement for National Networks. Available at: https://www.gov.uk/government/publications/national-policy-statement-for-national-networks, accessed December 2020
- Environment Agency (2021) Water Quality Archive: R. Nene Wansford Old Rd.Br. Available online at https://environment.data.gov.uk/water-quality/view/sampling-point/AN-NENE550W, accessed January 2021
- Environment Agency (2020a) Flood risk assessments: climate change allowances. Available online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances, accessed December 2020
- Environment Agency (2020b) Catchment Data Explorer. Available at: http://environment.data.gov.uk/catchment-planning/, accessed December 2020
- Environment Agency (2020c) Environment Agency Drinking Water Safeguard Zones and NVZs. Available at: https://environment.data.gov.uk/farmers/, accessed May 2020
- Environment Agency (2020d) Environment Agency Flood Map for Planning. Available at: https://flood-map-for-planning.service.gov.uk/, accessed December 2020
- Environment Agency (2020e) Environment Agency Long Term Flood Risk Map. Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map, accessed December 2020

- Environment Agency (2020f) Environment Agency Historic Flood Maps. Available at: https://data.gov.uk/dataset/76292bec-7d8b-43e8-9c98-02734fd89c81/historic-flood-map, accessed December 2020
- Environment Agency (2019) National groundwater recharge assessment under climate change, project summary SC160018. Available at: https://www.gov.uk/government/publications/national-groundwater-recharge-assessment-under-climate-change, Accessed March 2021
- Environment Agency (2018b) *Anglian River Basin District River Basin Management Plan*. Available at: https://www.gov.uk/government/publications/anglian-river-basin-district-river-basin-management-plan, accessed May 2020
- Environment Agency (2018a) The Environment Agency's approach to groundwater protection version. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/658135/LIT_7660.pdf, accessed April 2020
- Environment Agency (2017a) Protect groundwater and prevent groundwater pollution. Available at: https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution
- Environment Agency (2017b) Groundwater protection technical guidance. Available at: https://www.gov.uk/government/publications/groundwater-protection-technical-guidance
- Environment Agency (2016) Water Framework Directive Risk Assessment. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/522426/LIT_10445.pdf, accessed April 2020
- Federal Highway Administration (2020) US Department of Transportation, HY-8 Version 7.6
- Freeze, R.A. & Cherry, J.A. (1979) Groundwater: Englewood Cliffs, NJ, Prentice-Hall.
- Griffiths, KJ, Shand, P, Marchant, P and Peach 2006. Baseline Report Series 23: The Lincolnshire Limestone British Geological Survey Commissioned Report No. CR/06/060N
- Highways England (2021) Highways Agency Drainage Data Management System v5.12.0 (HA DDMS). Available at: [redacted] accessed January 2021
- Highways England (2020) *Design Manual for Roads and Bridges LA 113 Road Drainage and the Water Environment*. Revision 1. Available at [redacted]
- JBA Consulting (2017) Huntingdon District Council Level 1 and 2 Strategic Flood Risk Assessment. Available at: https://www.huntingdonshire.gov.uk/media/2640/strategic-flood-risk-assessment.pdf, accessed April 2020

- Joint Nature Conservation Committee. (2016) UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Fens. Available online at: http://data.jncc.gov.uk/data/6fe22f18-fff7-4974-b333-03b0ad819b88/UKBAP-BAPHabitats-27-LowlandFens.pdf, accessed January 2021
- Natural England. (1983) Sutton Heath and Bog SSSI citation. Available online at: [redacted] accessed January 2021.
- Natural England. (1985) Wansford Pasture SSSI citation. Available online at: [redacted] accessed January 2021.
- Natural England. (1987) West, Abbot's and Lound Woods SSSI citation. Available online at: [redacted] accessed April 2021.
- National River Flow Archive (2021a) 32010 - Nene at Wansford. Available at: [redacted] accessed January 2021
- National River Flow Archive (2021b) 32020 - Wittering Brook at Wansford. Available at: [redacted] accessed January 2021
- Met Office (2016). Regional climate summary for eastern England. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/eastern-england_-climate---met-office.pdf, accessed January 2021.
- Ministry of Housing, Communities and Local Government (2016) Planning Practice Guidance: Flood Risk and Coastal Change. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change, accessed December 2020
- Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf, accessed December 2020
- Murnane, E., Heap, A. and Swain, A. (2006) Control of water pollution from linear construction projects. Technical guidance. CIRIA C648
- Ovens, R. and Sleath, S. (2008) The Heritage of Rutland Water (2nd impression). Available online: [redacted] accessed February 2021
- Peterborough City Council, Peterborough Local Plan 2016-2036, adopted 2019. Available at: https://www.peterborough.gov.uk/council/planning-and-development/planning-policies/local-development-plan, accessed April 2020

- Peterborough City Council (2018) Peterborough Level 1 Strategic Flood Risk Assessment & Outline Water Cycle Study. Available at: https://www.peterborough.gov.uk/council/planning-and-development/flood-and-water-management/water-data, accessed April 2020
- Peterborough City Council, Peterborough Flood Risk Management Strategy (FMS), adopted 2015. Available at: https://www.peterborough.gov.uk/council/planning-and-development/flood-and-water-management/flood-risk-management-strategy, accessed April 2020
- Soils Limited. (2019) A47 Wansford to Sutton Dualling 2019 Factual Ground Investigation Report.
- The Planning Inspectorate (2017) Advice Note Eighteen: The Water Framework Directive. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2017/06/advice_note_18.pdf, accessed April 2020

13.14. Glossary

Term	Definition
Protected area	Area registered under Article 6 of the 2000/60/EC [Ref 4.N].
Reach	A stretch of a river used in the assessment of river water quality.
River Basin Management Plan	A regional plan that sets out how organisations, stakeholders and communities will work together to improve the water environment and fulfil the requirements of the 2000/60/EC [Ref 4.N]
Routine runoff	The normal runoff from roads including any contaminants washed off the surface in rainfall events which can result in either acute or chronic impacts. NOTE: Routine runoff excludes the effect of spillages and major leaks which usually result in acute impacts.
Soakaway	A special pit or depression in the land surface that allows water to drain into the ground.
Scoping	The process of considering the information required for reaching a (reasoned) conclusion on the likely significant effects of a project on the environment.
Screening	The identification of likely significant effects on the environment and consequential need for an Environmental Impact Assessment.
Simple assessment	The collection and assessment of data and information that is readily available to reach an understanding of the likely environmental effects of a project. NOTE: This informs the final design or need for further 'detailed assessment.
Surface water body	A discrete and significant element of surface water. NOTE: Examples of surface water body can include a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, transitional water or a stretch of coastal water.
WFD Assessment	Assessment to identify how the project has the potential to affect each of the water body's quality/quantity elements and whether it could lead to non-compliance with the 2000/60/EC [Ref 4.N].