A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.7 Environmental Statement – Appendix 10.2 Water Framework Directive Assessment

Part A

APFP Regulation 5(2)(a)

Planning Act 2008

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

June 2020

Infrastructure Planning

Planning Act 2008

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

The A1 in Northumberland: Morpeth to Ellingham
Development Consent Order 20[xx]

Environmental Statement - Appendix

Regulation Reference:	APFP Regulation 5(2)(a)
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Author:	A1 in Northumberland: Morpeth to Ellingham Project Team, Highways England

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EXECUTIVE SUMMARY

The Water Framework Directive (WFD) Assessment informs **Chapter 10: Road Drainage and the Water Environment**, **Volume 2** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/6.2**) and supports the Development Consent Order (DCO) application for the A1 Northumberland: Morpeth to Ellingham Scheme (the Scheme) for Part A: Morpeth to Felton (Part A). This report contains an assessment of the potential impacts associated with Part A on the water environment and the ability of surface water features within the Study Area to meet the objectives of the Water Framework Directive (WFD) (2000/06/EC).

Part A is located across four surface water WFD catchments: 'Wansbeck from Font to Bothal Burn', 'Lyne from Source to Tidal Limit', 'Longdike Burn Catchment (trib of Coquet)' and 'Coquet from Forest Burn to Tidal Limit'. The assessment indicates that there would be no detrimental impact or change to the WFD status of these catchments with the appropriate mitigation measures implemented, as detailed within the **Outline Construction Environmental Management Plan** (**Outline CEMP**) (**Application Document Reference: TR010041/APP/7.3**) and embedded within the design of the new culverts and extended culverts, widening of the bridge over the River Coquet and the new outfalls. As a result, Part A is compliant with WFD objectives.

There are opportunities to improve the performance of certain structures across Part A, for example where no natural bed is provided within the existing culverts or the base of the culvert is perched above the bed of the watercourse. New structures would also achieve these design principles to maintain connectivity. As a result, Part A would not prevent the WFD catchments from achieving the status objectives for each catchment.

Part A is located within the Northumberland Carboniferous Limestone and Coal Measures WFD groundwater catchment. The assessment indicates that there would be no detrimental impact or change to the WFD status with the appropriate mitigation measures implemented, as detailed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and the proposed surface water drainage strategy.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

1.1.1. The Applicant has undertaken a Water Framework Directive (WFD) assessment to support and inform the Environmental Statement (ES) and Development Consent Order (DCO) application for the A1 in Northumberland: Morpeth to Ellingham Scheme (the Scheme) for Part A: Morpeth to Felton (Part A). This report provides an assessment of the potential impacts associated with Part A on the water environment and the ability of surface water and groundwater features within the Study Area to meet the objectives of the WFD (2000/06/EC) (**Ref. 10.2.1**).

1.1.2. The assessment includes the following:

a. A summary of the current baseline conditions.
b. A qualitative assessment of the potential impacts associated with Part A.
c. Identification of possible mitigation measures which could reduce any likely significant impacts that may arise as part of the proposed works.

1.1.3. A detailed assessment of Part A regarding the existing and future flood risk has been undertaken separately to the WFD assessment. This is presented within **Appendix 10.1**: **Flood Risk Assessment** (**FRA**), **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). The FRA has been undertaken in accordance with the National Policy Statement for National Networks (NPS NN) (**Ref. 10.2.2**), the National Planning Policy Framework (NPPF) (**Ref. 10.2.3**) and Planning Practice Guidance (PPG) (**Ref 10.2.4**). A summary of the key findings is presented within this assessment to assess compliance against the WFD objectives.

1.1.4. The results of the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.2.5**) Method A and Method D assessments are discussed within this report to assess compliance against the WFD objectives. The full assessment is provided in **Appendix 10.3: Drainage Network Water Quality Assessment, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

1.1.5. A geomorphology study of the River Coquet was undertaken and is provided in **Appendix 10.4: Geomorphology Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). A summary of the findings is presented within this report. In addition, construction impacts are evaluated as part of the WFD assessment, due to both the duration of the construction works and the potential impacts upon the WFD quality elements and WFD status.

1.2 SCHEME DESCRIPTION

1.2.1. The Scheme is located within the County of Northumberland and forms part of the Applicant’s strategic road network. Part A is located between Warreners House Interchange at Morpeth and the dual carriageway at Felton and is approximately 12.6 km in length. Part

A comprises a combination of online improvements consisting of carriageway widening and the creation of a new offline section of road. The bypassed existing A1 between Priest's Bridge and Burgham Park (hereafter referred to as the de-trunked section) would be transferred to the ownership and responsibility of Northumberland County Council (NCC). Part A is designed to enhance resilience and improve journey times and safety along the route. A more detailed description of Part A is found in **Chapter 2: The Scheme, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**). The approximate location of Part A is shown in **Figure 1-1** below.

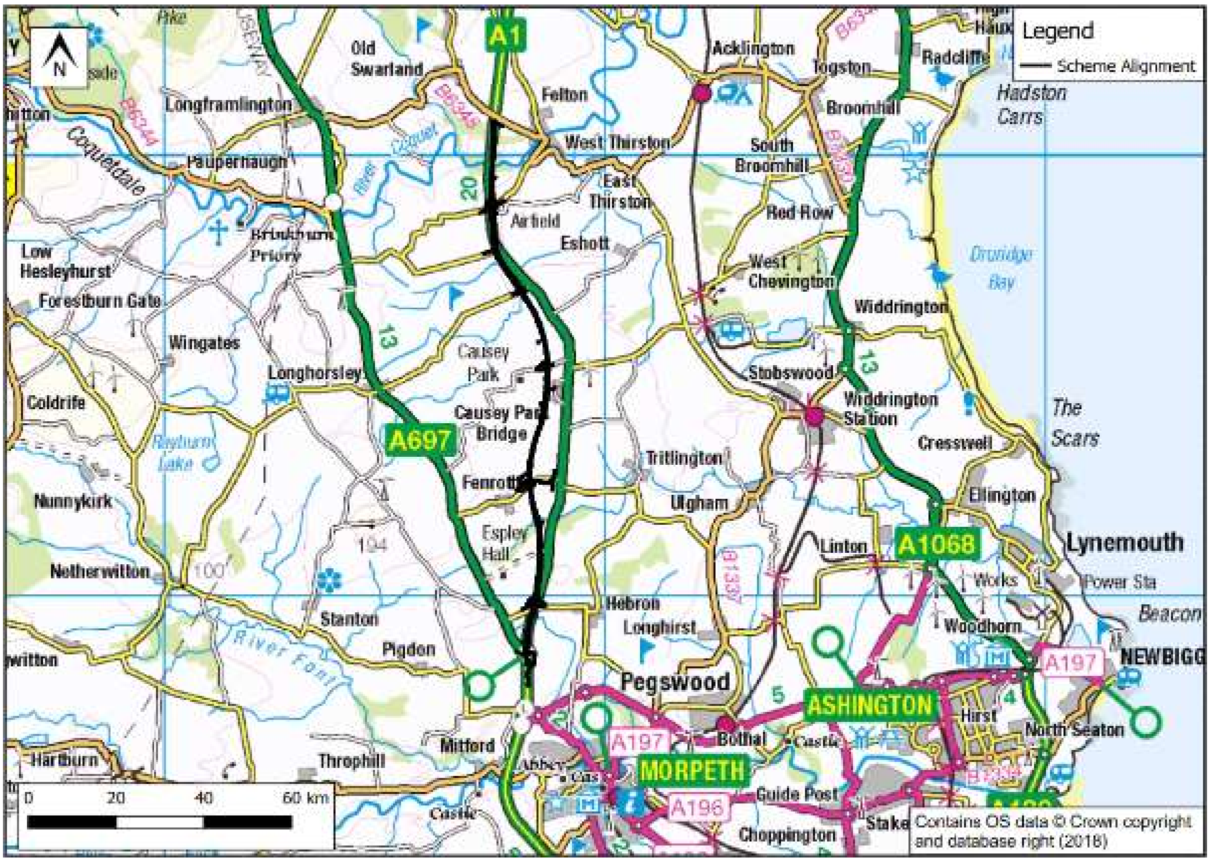

Figure 1-1 - Site Location

1.2.2. With specific regard to the water environment, Part A includes the following works from south to north as set out in **Figure 1-2** below (the numbers in brackets relate to the approximate location of the works):

a. The replacement of the three existing circular culverts along Cotting Burn, downstream of the existing A1 and slip road with two new box culverts (1).
b. The replacement of the existing culvert along Shieldhill Burn with a new circular culvert (2).
c. The replacement of the existing arch culvert along Floodgate Burn with a new circular culvert (3).
d. The construction of a new culvert where Part A crosses the River Lyne (4).

e. The removal of the existing culvert along the tributary of Fenrother Burn, and the construction of two new culverts where Fenrother Burn crosses Fenrother Lane. The Fenrother Burn would be diverted along the west side of Part A between the two new culverts (5).
f. Construction of two new box culverts where Part A crosses Earsdon Burn, the first situated beneath the new A1 alignment and the second beneath a new access road that runs along the western side of the A1 (6).
g. The diversion and channel realignment of an unnamed watercourse to a new confluence with the Earsdon Burn. This would include a new circular culvert beneath a new access road upstream of the realignment and culverting of the downstream half of the diversion via the construction of a new circular culvert adjacent to the main A1 alignment (7).
h. Modification of the headwall of the existing culvert along Longdike Burn (8).
i. The extension of the existing culvert at Longdike Burn (and the Poxtondean Burn that discharges into the Longdike Burn) (9).
j. Construction of a new circular culvert where Part A crosses a surface water flow path south of Felmoor Park (10).
k. Replacement of the culvert that drains agricultural land to the west of Eshott Airfield (11).
l. Extension of the existing culvert on an unnamed watercourse which drains to the Thirston Burn (12).
m. New bridge crossing the River Coquet to the immediate east of the existing bridge (13).
n. Extension of the existing culvert on Bradley Brook (14).
o. Installation of new drainage infrastructure to accommodate increased runoff rates and volume from the increase in impermeable area and construction of runoff detention basins to manage surface water flow from the drainage network.

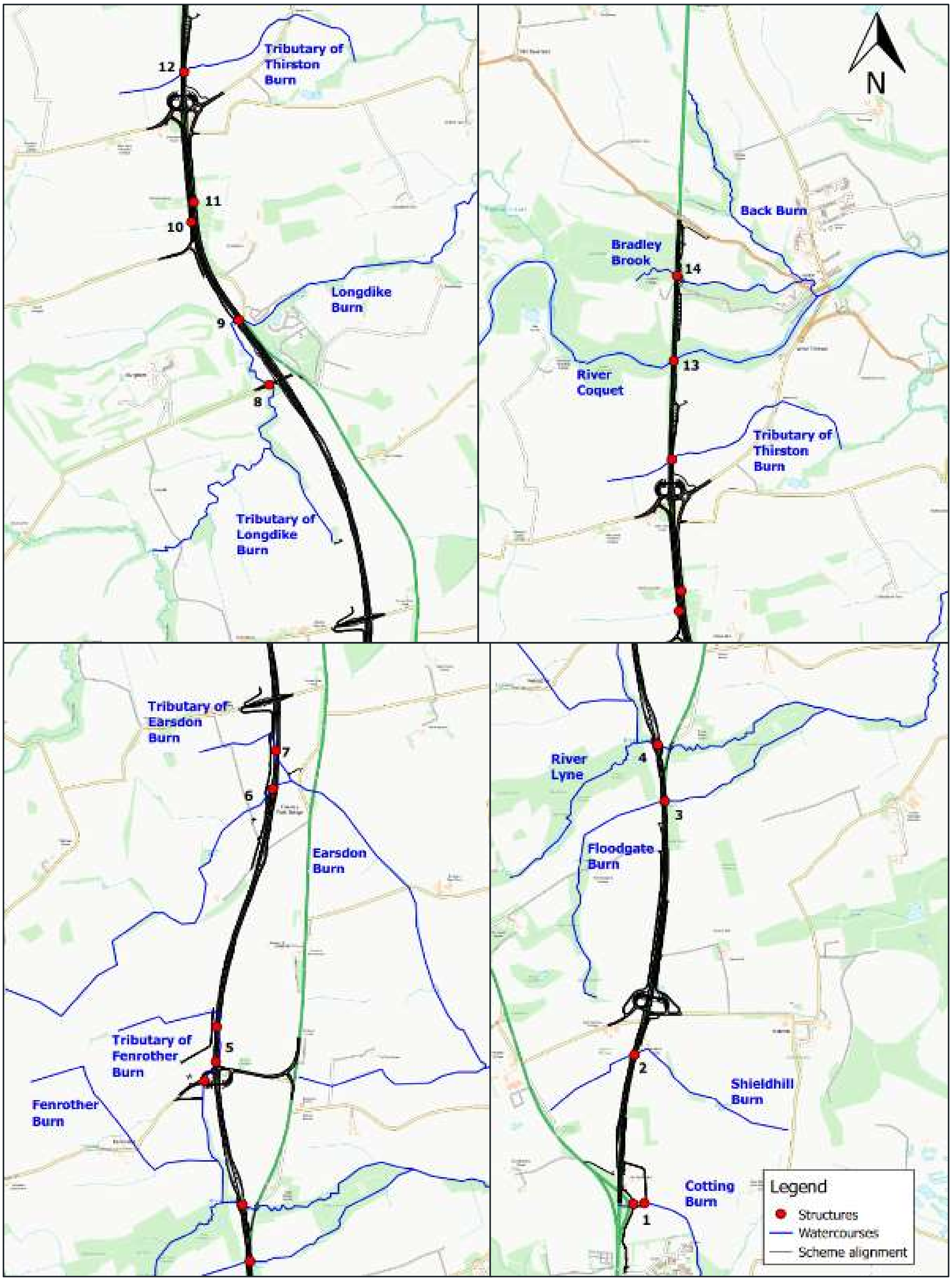

Figure 1-2 – Part A Extent and Proposed Works with Regards to the Water Environment

1.3 STUDY AREA

1.3.1. The Study Area encompasses surface water features 0.5 km from the Order Limits of Part A. This distance is considered appropriate for the assessment of direct effects (i.e. associated with overland migration of pollutants directly to surface features, pollutants conveyed in drainage systems, and works within a river channel).

1.3.2. Features that are in hydraulic connectivity with Part A have also been considered, including downstream watercourses. Based on professional judgement and current knowledge of the area, features located 1 km from the Order Limits of Part A has been considered. This distance is considered appropriate for the assessment of indirect effects, although if important features located further than 1 km from the Order Limits of Part A are identified to be at risk, these features have also been considered within the assessment.

1.3.3. The Study Area encompasses groundwater features 0.5 km from the Order Limits of Part A and groundwater abstractions 1 km from the Order Limits of Part A. This distance is considered appropriate for the assessment of surface-borne pollutants migrating to groundwater features, although if sensitive features located further than 1 km from the Order Limits of Part A have been identified to be at risk, these features have also been considered within the assessment.

1.3.4. The Study Area for the assessment of flood risk has been defined by the extent by which flood risk may be influenced and the extent of the relevant flood zones. This is driven by the need to consider the impact of Part A to people and property elsewhere, regardless of their location, although for a project such as this it is typical to consider risks a distance of 1 km from the Order Limits of Part A. If the assessment indicated an increased risk at a distance further than 1 km from the Order Limits of Part A, the Study Area would be extended accordingly.

1.4 LEGISLATIVE FRAMEWORK AND GUIDANCE

1.4.1. The coordination of policies for the water environment is managed by the UK Government. Many flood risk and water quality requirements are set at European level, which are then transposed into UK law.

EUROPEAN LEGISLATION

Water Framework Directive (2000/60/EC)

1.4.2. The overall objective of the WFD (**Ref. 10.2.1**) (together with its daughter directive, the Groundwater Directive (2006/118/EC) (**Ref. 10.2.6**)) is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reaches ‘Good’ status (in terms of ecological and chemical quality and water quantity, as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and droughts. Specifically, each European country must ensure the following:

a. Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters.
b. Aim to achieve at least 'Good' status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve 'Good' status by 2021 or 2027.
c. Meet the requirements of WFD Protected Areas.
d. Promote sustainable use of water as a natural resource.
e. Conserve habitats and species that depend directly on water.
f. Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment. The WFD (**Ref. 10.2.1**) includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances.
g. Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.
h. Contribute to mitigating the effects of floods and droughts.

Determination of 'Good Status'

1.4.3. Under the WFD (**Ref. 10.2.1**), surface water bodies are classified in accordance with their ecological (quality) status and chemical (quality) status, which are combined to provide an overall status. The chemical status is based on assessment against the defined list of priority substances and EU dangerous substances, and the ecological status is assessed considering the quality of the supporting elements including biological, general chemical, physico-chemical, and hydromorphological elements.

1.4.4. For surface waters, the 'Good' status is determined from the combined ecological and chemical status of surface waters. Ecological status is determined from a number of individual quality elements, as follows:

i. Biological quality elements (e.g. fish, benthic invertebrates, aquatic flora).
j. Supporting hydromorphological quality elements (e.g. flow regime, river continuity and substrate of the river bed).
k. Supporting physical-chemical quality elements (e.g. temperature, oxygenation and nutrient conditions).

1.4.5. The chemical quality refers to environmental quality standards for river basin specific pollutants and the priority substances specified under the WFD (**Ref. 10.2.1**). These standards specify maximum concentrations for specific water pollutants. The WFD (**Ref. 10.2.1**) works on a 'one out, all out' basis, so if one such concentration is exceeded, then the water body would not be classed as having a 'Good' status. The chemical status of surface waters is therefore classified as 'Good' or 'Fail'.

1.4.6. The ecological status of surface waters is classified as being 'High', 'Good', 'Moderate', 'Poor' or 'Bad'. Water bodies that have been modified (e.g. canals or which contain significant flood defences) are classed as 'Heavily Modified Water bodies' (HMWB) and have to reach at least 'Good ecological potential' by their objective year. **Figure 1-3** below is extracted from the Classification Method Statement (**Ref. 10.2.7**), and illustrates the classification approach for surface water features.

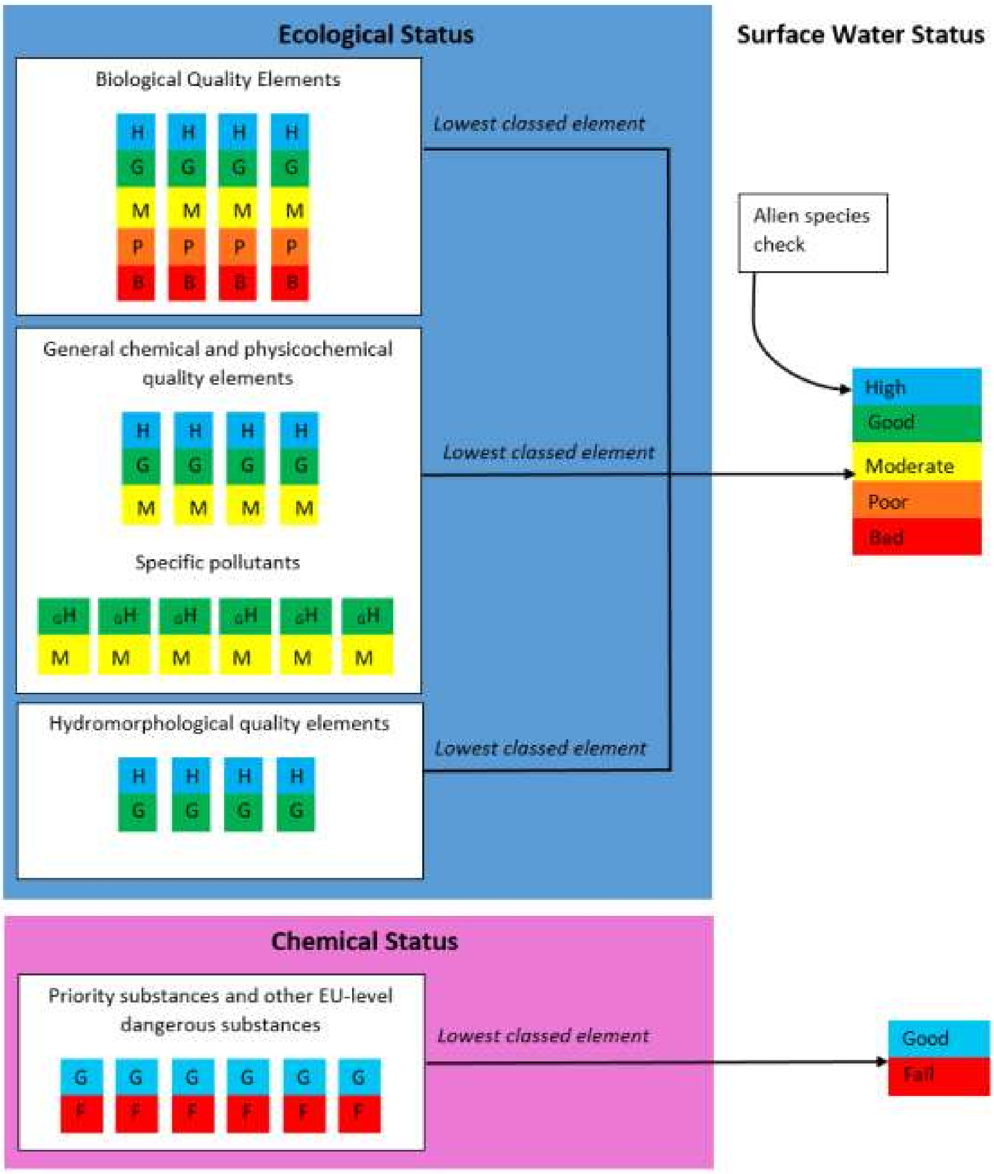

Figure 1-3 - WFD Surface Waterbody Classifications

1.4.7. Under the WFD (**Ref. 10.2.1**), groundwater bodies are classified in accordance with their quantity (quality) status and chemical (quality) status, which are combined to provide an overall status. The quantity status considers elements such as impacts of saline intrusion, ability to serve ground and surface water abstractions, and ability to support dependent ecosystems. The chemical status is based on assessment against the defined list of priority substances and EU dangerous substances. **Figure 1-4** below is extracted from the Classification Method Statement (**Ref. 10.2.7**) and illustrates the classification approach for groundwater bodies.

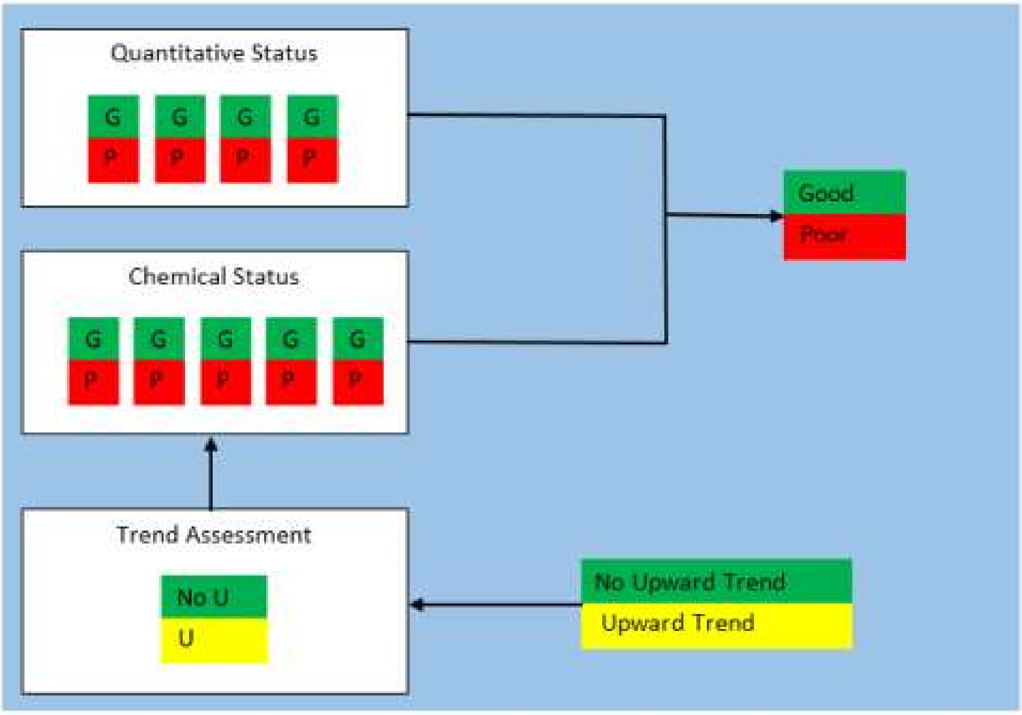

Figure 1-4 - WFD Roundwater classification

1.4.8. The WFD (**Ref. 10.2.1**) also contains provisions for controlling discharges of dangerous substances to surface waters and groundwater and includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the Directive is to eliminate pollution from List I substances and reduce pollution from List II substances.

1.4.9. The WFD (**Ref. 10.2.1**) is transposed into law in England and Wales by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 2017 Regulations) (**Ref. 10.2.8**). The 2017 Regulations (**Ref. 10.2.8**) revoke and replace The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (subject to transitional provisions in article 38 of the 2017 Regulations).

Article 4.7

1.4.10. Article 4.7 of the WFD (**Ref. 10.2.1**) sets out reasons why physical modifications or activities may be allowed to cause deterioration in quality status or prevent 'Good' status being achieved (for example, where activities are in the overriding public interest). If a project or activity is predicted to cause deterioration in water body status or prevent the water body from meeting any of its objectives, then assessment is required against the conditions listed in WFD Article 4.7, all of which must be met for Part A to proceed without contravening the WFD (**Ref. 10.2.1**). The impact of Part A or activity on other water bodies within the River Basin District (RBD) must also be considered (Article 4.8) and protection given by existing Community Legislation to any Protected Areas must also be maintained (Article 4.9).

Water Framework Directive Assessments

1.4.11. WFD Assessments are undertaken to demonstrate that proposed works (at strategy level, detailed design or implementation stage) may be undertaken without impacting the status of water bodies or preventing future works to enable the water bodies to achieve 'Good' status or potential.

1.4.12. Determination of WFD compliance comprises a series of steps intended to establish the potential impacts of the proposed works, at an appropriate level of detail, and then to examine whether the identified impacts contravene the conditions of the WFD (**Ref. 10.2.1**).

1.4.13. The following assessment objectives (derived from the Environmental Objectives of the Directive) are used to determine whether the planned development, in and around the water environment, which is affected by the planned development, comply with the overarching objectives of the WFD (**Ref. 10.2.1**):

a. Objective 1: To prevent deterioration in the ecological status of the water body.
b. Objective 2: To prevent the introduction of impediments to the attainment of Good WFD status for the water body.
c. Objective 3: To ensure that the attainment of the WFD objectives for the water body are not compromised.
d. Objective 4: To ensure the achievement of the WFD objectives in other water bodies within the same catchment are not permanently excluded or compromised.

1.4.14. The assessment process is as follows:

a. Screening of the preferred option against the ecological, chemical and quantitative status objectives and elements to determine if the project has any impact on the criteria identified for any water bodies.
b. Detailed assessment for those criteria where a potential adverse effect has been identified to determine the effects on quality elements.
c. Identified impacts are then considered in relation to the ecological and supporting chemical and hydromorphological status objectives.

d. For HMWBs, the preferred option is then also assessed against their relevant mitigation measures.
e. Article 4.7 test: if the preferred option is predicted to cause deterioration in water body status or prevent the water body from meeting any of its objectives, then assessment is required against the conditions listed in WFD Article 4.7, all of which must be met for the preferred option to proceed without contravening the WFD (**Ref. 10.2.1**). The impact of the preferred option on other water bodies within the RBD must also be considered (Article 4.8) and protection given by existing Community legislation to any Protected Areas must also be maintained (Article 4.9).

Groundwater Directive (2006/118/EC)

1.4.15. This Groundwater Directive (**Ref. 10.2.6**) aims to set groundwater quality standards and introduce measures to prevent or limit pollution of groundwater, including those listed with the 'List of Priority Substances'. The Directive has been developed in response to the requirements of Article 17 of the WFD (**Ref. 10.2.1**), specifically the assessment of chemical status of groundwater and objectives to achieve 'Good' status.

LOCAL POLICY

Northumbria River Basin Management Plan

1.4.16. The WFD (**Ref. 10.2.1**) introduced RBDs to better manage water bodies without administrative and political boundaries. Each river basin is managed to achieve the objectives of the WFD through the development River Basin Management Plans (RBMPs), which provide a clear indication of the way the objectives set for the river basin are to be reached within the required timescale, and set out a programme of measures. All watercourses along Part A are located within the Northumbria RBD (**Ref. 10.2.9**).

2 ASSESSMENT METHODOLOGY

2.1 OVERVIEW

2.1.1. In brief, the methodology used for this WFD assessment comprises:

a. Site visits completed for Part A on 7-8 June 2018 and to the River Coquet on 5 December 2018.
b. Sediment sampling of the River Coquet was undertaken on 20 February 2019.
c. Review of available relevant baseline information and consultation with the Environment Agency to confirm status of the surface water features and groundwater resources within the Study Area and agree principles for the mitigation measures.
d. Review of the proposed works and the potential impacts to the identified surface and groundwater features, i.e. impacts that could reduce the WFD status of the feature and affect the ability of the waterbodies to meet the objectives of the WFD (discussed in greater detail below).

2.2 WATER FRAMEWORK DIRECTIVE ASSESSMENT METHODOLOGY

2.2.1. Determination of WFD compliance for Part A comprises a series of steps intended to establish the potential impacts of the proposed works at an appropriate level of detail using available information, and then to examine whether the identified impacts contravene the objectives of the WFD.

2.2.2. The general assessment process is as follows:

a. Identify WFD water bodies in the Study Area with potential to be affected by Part A.
b. Obtain information to identify the current status and objectives for the water bodies, important features such as linked protected areas and relevant habitats, and improvement measures set out in the RBMP.
c. Identify the aspects of Part A with potential to affect WFD water bodies, mitigation included in Part A proposals and consideration of further mitigation where necessary.
d. For those criteria where a potential adverse effect has been identified, assessment of Part A (including relevant mitigation) against the individual quality elements to determine if these effects are sufficient to cause a deterioration in the quality status of each element.
e. Assessment of Part A (including relevant mitigation) to determine if Part A would impact upon the proposed mitigation measures and objectives for the water bodies and objectives for individual quality elements.
f. Assessment of Part A against the wider catchment objectives and aims of the WFD (**Ref. 10.2.1**).
g. Where applicable, application of the Article 4.7 test.

2.2.3. This assessment is a qualitative assessment of potential impacts of Part A against WFD quality elements and measures.

2.3 GEOMORPHOLOGY METHODOLOGY

2.3.1. A 1.2 km study reach of the River Coquet, upstream of Felton, was surveyed; the existing and new River Coquet bridge being located at approximately mid-point (refer to **Figure 2-1**). The reach combines two meander wavelengths and falls between two weir features, which mark step changes in bed level. The study reach was sub-divided into two distinct reaches, roughly situated either side of the existing bridge. Full details of the geomorphological assessment are provided in **Appendix 10.4: Geomorphology Assessment – River Coquet, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). A summary of the methodology is provided below.

2.3.2. The geomorphological assessment comprised a desk-study, a river reconnaissance survey, sediment sampling survey and associated data analysis and interpretation. Hydraulic modelling was scoped out of the assessment due to the proposed construction methodology of the new River Coquet bridge; this was agreed with the Environment Agency. Consequently, existing data, coupled with field survey data, was used to inform the geomorphological analyses.

2.3.3. Sediment sampling was undertaken from approximately 200 m upstream of the existing bridge to 300 m downstream of the existing bridge. The standard Wolman pebble count method (**Ref. 10.2.10**) was adopted using the Wentworth particle size scale. Two separate sediment samples were collected: 1) a Reference Reach pebble count; and 2) a Riffle-bar Reach pebble count, including a largest particle on bar.

2.3.4. The purpose of the Reference Reach sampling was to characterise the sediment characteristics of the study reach. Sampling was undertaken at ten transects across the channel and angled perpendicular to the flow. The transects were distributed across one meander wavelength and located to sample a proportionate representation of the channel morphology and bedforms, such as riffles and pools. Four transects were located upstream of the existing bridge, one at the existing crossing and five downstream.

2.3.5. The Riffle-bar Reach sampling was to determine the particle size distribution specifically within the construction zone for Part A and to determine the likelihood of impacts on sediment transport, erosion and deposition processes as a result of Part A. The zig-zag sampling technique was applied with ten transects being sampled from approximately 100 m upstream of the existing bridge to 125 m downstream of the existing bridge.

2.3.6. A minimum of 100 sediment samples were recorded for both the Reference Reach and the Riffle-bar Reach. Particle size distribution analysis was undertaken and the data used to inform the sediment transport assessment.

2.3.7. Geomorphological dynamics assessments were undertaken to determine potential impacts of Part A specifically on fluvial erosion, deposition and sediment transport processes. These analyses comprised the calculation of stream power, shear stress, and sediment transport potential. Sediment transport calculations were based on Hjulström (**Ref. 10.2.11**) and the

Schoklitsch formula (**Ref. 10.2.12**), revised by Bathurst et al. (**Ref. 10.2.13**), as described in Knighton (**Ref. 10.2.14**).

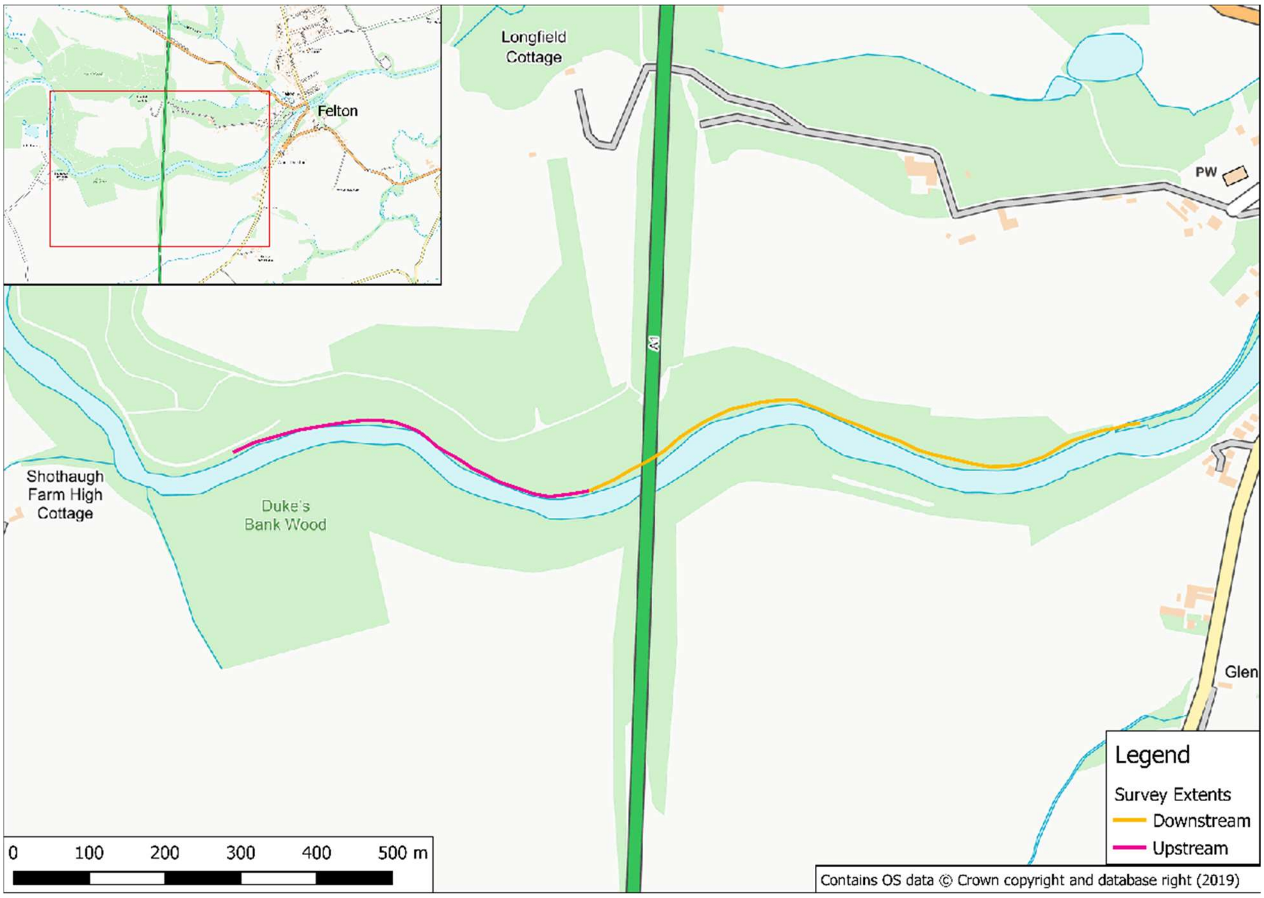

Figure 2-1 - Study Reach for the Fluvial Geomorphology Survey Showing the Upstream and Downstream Sub-Reaches

2.4 DATA SOURCES

2.4.1. Baseline information to inform the desktop study has been obtained from the following sources:

a. Environment Agency's online Flood Map for Planning (accessed July 2018) (**Ref. 10.2.15**).
b. Environment Agency's online Long Term Flood Risk Map (accessed July 2018) (**Ref. 10.2.16**).
c. Environment Agency's groundwater data available on MAGIC online mapping (accessed July 2018) (**Ref. 10.2.17**).
d. Environment Agency's Catchment Data Explorer (accessed July 2018) (**Ref. 10.2.18**).
e. Northumbria River Basin Management Plan (dated December 2015) (**Ref. 10.2.9**).

f. Observations made from site walkovers (June 2018, December 2018 and February 2019).
g. **Appendix 11.2: Ground Investigation Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) (dated September 2018).
h. **Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) of this ES (dated March 2018).
i. **Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) (dated August 2018).
j. British Geological Survey (BGS) Geology of Britain viewer (accessed July 2018) (**Ref. 10.2.19**).
k. BGS Geoindex online dataset (accessed July 2018) (**Ref. 10.2.20**).
l. Cranfield University's Soilscapes (accessed July 2018) (**Ref. 10.2.21**).
m. Historical maps (accessed December 2018) (**Ref. 10.2.22**).
n. Aerial imagery (Google Earth) (accessed December 2018).
o. Hydrological and land use data (Centre for Ecology and Hydrology (CEH)) (accessed December 2018) (**Ref. 10.2.23**).
p. Geotechnical report undertaken by Halcrow (dated 2008) (**Ref. 10.2.24**).
q. Geomorphological assessment undertaken by CH2MHill (dated 2014) (**Ref. 10.2.25**).
r. Ordnance Survey (OS) mapping.
s. MAGIC online mapping (accessed July 2018) (**Ref. 10.2.17**).

2.4.1. **Appendix 9.3**: **Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) and **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) was required for the ecological assessment. During the initial ecological walkover surveys the habitat suitability to potentially support specific species was identified. For more information regarding the ecological surveys refer to **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).

2.5 CONSULTATION

2.5.1. Consultation has been undertaken with the following authorities:

a. Meeting held with the Environment Agency in January 2018 to discuss stakeholder requirements and review the available WFD information and agree (in principle) the methodology, appropriate mitigation and management options during the construction and operation phases.
b. Meeting held with the Environment Agency in September 2018 to review the methodology, Part A proposals and proposed mitigation and discuss and address specific areas of concern.
c. Meeting held with the Environment Agency in November 2018 to discuss the Part A proposals for the River Coquet bridge crossing.

d. Two meetings held with the Environment Agency in December 2018 to discuss the geomorphological assessment requirements for the River Coquet bridge crossing.

2.5.2. The meeting minutes have been included in **Appendix 4.2: Environmental Consultation**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**).

2.6 POTENTIAL IMPACTS

2.6.1. A review of the proposed works and the potential impacts to the identified surface and groundwater bodies has been undertaken by identifying the impacts that could reduce the WFD status or affect the ability of the water bodies to meet the objectives of the WFD (**Ref. 10.2.1**).

2.6.2. The following factors have been considered when determining whether the potential adverse effects of Part A are likely to lead to a deterioration in status or prevent objectives being met:

a. Whether the impact is temporary (such as short-term construction impacts) or permanent and long term.
b. The characteristics and sensitivity of the specific water features affected by Part A which may be different to the designated WFD water body).
c. The scale and importance of the specific water features affected by Part A to the designated WFD water body.
d. The nature, scale and extent of potential impact in the context of the existing pressures and proposed measures for the water body.

3 ASSESSMENT OVERVIEW

3.1 SITE DESCRIPTION

3.1.1. Land surrounding Part A generally consists of woodland and agricultural land, with the Eshott Airfield located approximately 2 km to the south of Felton. The most notable urban areas surrounding Part A is the town of Morpeth to the south and the village of Felton to the north.

3.1.2. A detailed description of the surrounding areas to each watercourse is provided in more detail below within **Sections 4 to 14** below.

3.2 EXISTING SURFACE WATER FEATURES

3.2.1. Part A alignment crosses ten watercourses and associated tributaries that would be impacted by Part A. This are listed below from south to north:

a. Cotting Burn
b. Shieldhill Burn
c. Floodgate Burn
d. River Lyne
e. Fenrother Burn
f. Earsdon Burn
g. Longdike Burn
h. Unnamed tributary of Thirston Burn
i. River Coquet
j. Bradley Brook

3.2.2. The watercourses listed above are located across four WFD catchments as listed below:

a. Wansbeck from Font to Bothal Burn
b. Lyne from Source to Tidal Limit
c. Longdike Burn Catchment (trib of Coquet)
d. Coquet from Forest Burn to Tidal Limit

3.2.3. The location of these catchments in relation to Part A is shown in **Figure 3-1** below.

3.2.4. The summary of baseline information and Part A design is organised as a separate section for each watercourse. This is due to the extent of Part A and the large number of watercourses and associated tributaries that are crossed by Part A.

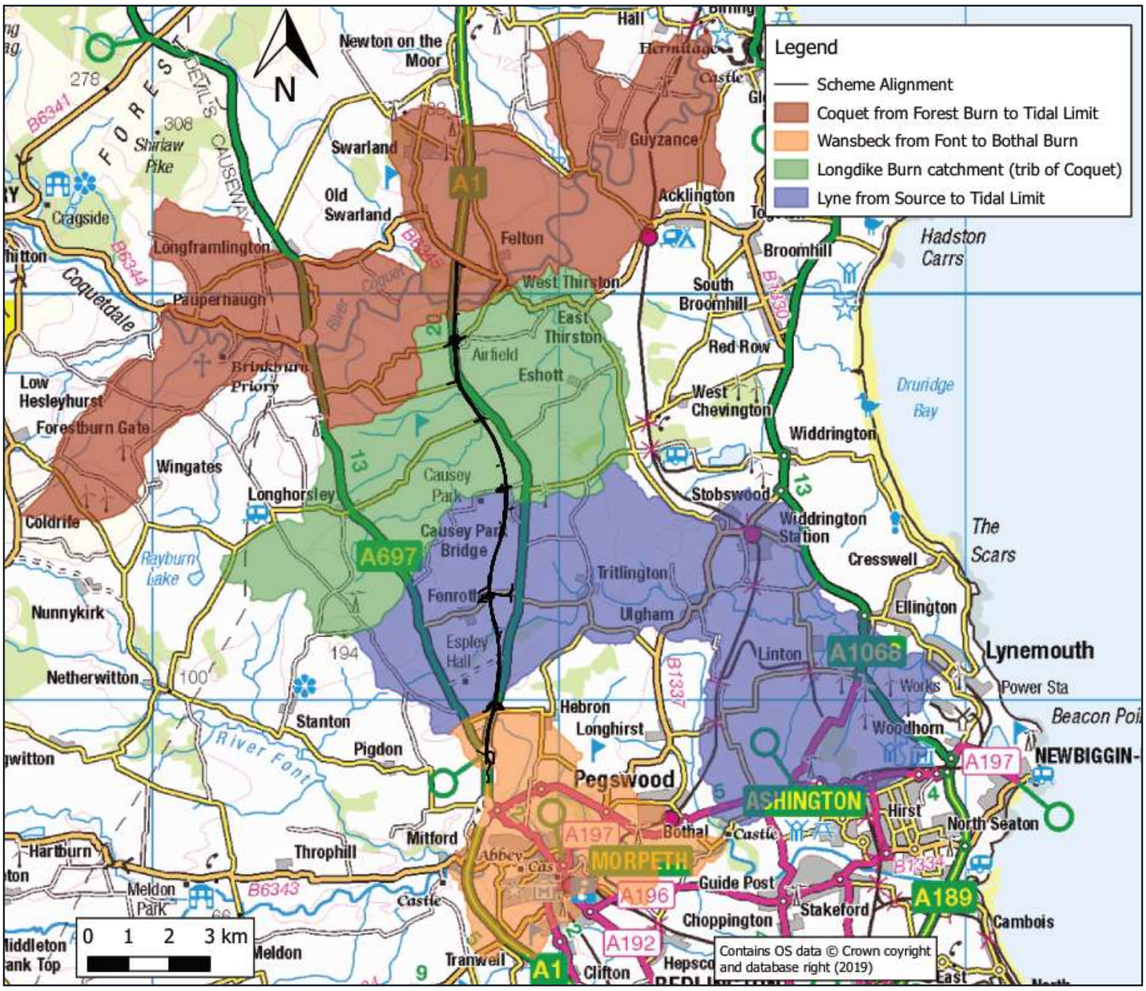

Figure 3-1 - WFD Catchments

3.2.5. Potential impacts associated with both the construction and operation phases of Part A for all watercourses are discussed in **Chapter 10: Road Drainage and the Water Environment, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**). A combined assessment for all of the watercourses, except the River Coquet, has been undertaken due to the similar nature of these watercourses. A separate assessment is presented for the River Coquet due to its sensitive nature and Site of Special Scientific Interest (SSSI) designation.

4 COTTING BURN

4.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

4.1.1. The source of Cotting Burn is just upstream of the existing A1 alignment. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.75 km^2, consisting primarily of agricultural land. Cotting Burn flows in a west to east direction underneath the existing A1 alignment at the junction with the A697. The Cotting Burn eventually discharges into the River Wansbeck approximately 3 km to the south-east of Part A. The Cotting Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as Lead Local Flood Authority (LLFA) for this area.

4.1.2. The estimated Q95 for Cotting Burn at the location of Part A proposals is 0.001 m^3/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for Cotting Burn at the location of Part A proposals is 0.51 m^3/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

4.1.3. Analysis of historical maps (**Ref 10.2.22**) dating back to the 1860s indicates that the alignment of Cotting Burn has not altered to the present day. The watercourse appears to have been realigned along field boundaries pre-dating the historical mapping.

Contemporary Channel Characteristics

4.1.4. During the site walkover it was noted that the river bed comprised clay and silt material. Cotting Burn flows through five existing culverts within close proximity of Part A, as identified and numbered in **Figure 4-1** below.

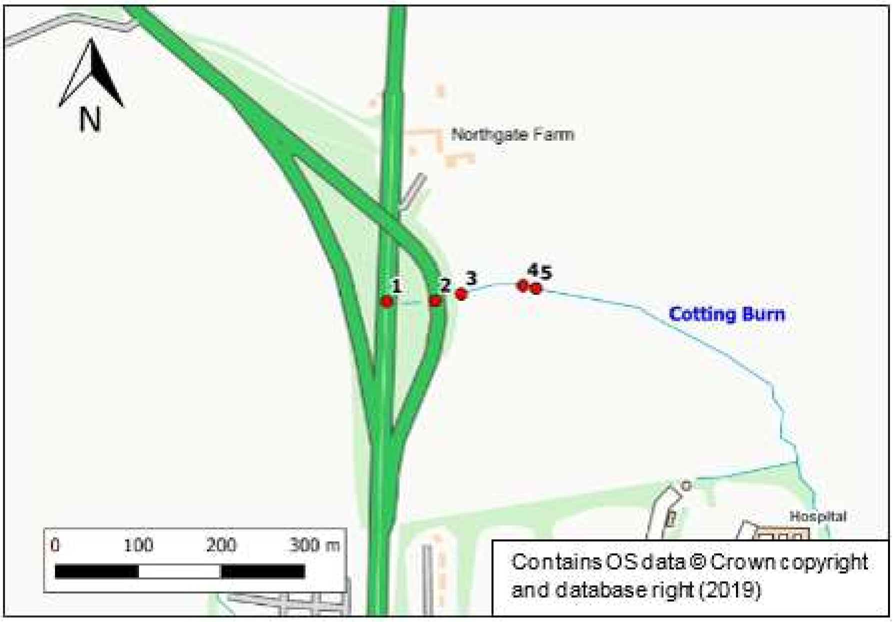

Figure 4-1 - Location of Cotting Burn Culverts

4.1.5. Cotting Burn flows through a culvert underneath the A1, identified as number one within **Figure 4-1**. **Figure 4-2** shows the outlet of this circular concrete culvert, with a diameter of approximately 900 mm. The culvert is approximately 28 m in length.

4.1.6. Cotting Burn then flows through a culvert underneath the eastern slip road which joins with the A697, identified as number two within **Figure 4-1**. **Figure 4-3** shows this outlet of the circular 900 mm diameter concrete culvert, which is approximately 41 m in length.

4.1.7. **Figure 4-4** shows the downstream face of the culvert underneath the farm access track just downstream of the crossing underneath the A697 slip road, identified as number three within **Figure 4-1**. The culvert is a circular concrete pipe with a diameter of approximately 350 mm and approximately 7 m in length. There is approximately 80 m of open channel before Cotting Burn flows through another circular concrete 350 mm pipe underneath a farm access track, as shown in **Figure 4-5**. This culvert is identified as number four within **Figure 4-1**.

4.1.8. Cotting Burn then flows underneath an access track immediately downstream of culvert number four through a circular 450 mm diameter and 15 m long culvert, identified as number five within **Figure 4-1**. **Figure 4-6** shows the top of the access track. During the site visit it was noted that the culvert appeared to be blocked and assessed to be in a poor condition.

Figure 4-2 - Outlet of Cotting Burn culvert (1)

Figure 4-3 - Outlet of Cotting Burn Culvert (2)

Figure 4-4 - Outlet of Cotting Burn Culvert (3)

Figure 4-5 - Inlet of Cotting Burn Culvert (4)

Figure 4-6 - Cotting Burn Crossing (Upstream)

4.1.9. No fish surveys have been undertaken along Cotting Burn as it was determined that the watercourse supported unsuitable habitat (refer to **Appendix 9.3: Aquatic Ecology Survey Report,** of **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). This is due to the presence of a septic tank along Cotting Burn that is assumed to be affecting water quality. During the site walkover the septic tank was identified adjacent to the outlet of culvert three (as shown in **Figure 4-1**). The outfall of the tank is assumed to discharge into the Cotting Burn just downstream of the culvert. **Figure 4-7** below shows the septic tank and outfall in relation to Cotting Burn. No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 4-7 - Septic Tank Location

4.1.10. The Cotting Burn is monitored directly against the objectives of the WFD (**Ref 10.2.1**) and is located within the 'Wansbeck from Font to Bothal Burn' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref 10.2.18**) indicates an overall quality of 'Moderate' with the ecological quality assessed as 'Moderate' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'heavily modified'. **Tables 4-1** and **4-2** below present the ecological and chemical classifications ranging from 2013 to 2016 for the 'Wansbeck from Font to Bothal Burn' WFD catchment, as classified by the Environment Agency.

Table 4-1 – Ecological Classifications for Wansbeck from Font to Bothal Burn

	2013	2014	2015	2016
Overall	Moderate	Good	Moderate	Moderate
Ecological	Moderate	Good	Moderate	Moderate
Supporting elements (surface water)	-	-	Moderate	Moderate

	2013	2014	2015	2016
Biological quality elements	Moderate	Good	Good	Good
Hydromorphological supporting elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	High	High	High	Good
Specific pollutants	High	High	-	-

Table 4-2 – Chemical Classifications for Wansbeck from Font to Bothal Burn

	2013	2014	2015	2016
Overall	Moderate	Good	Moderate	Moderate
Chemical	Good	Good	Good	Good
Priority substances	Good	Good	-	-
Other pollutants	-	-	-	-
Priority hazardous substances	Good	Good	-	-

4.1.11. The Waterbody Summary Report (**Ref 10.2.26**) for the 'Wansbeck from Font to Bothal Burn' WFD catchment identifies the reason for not achieving 'Good' overall status as physical modification of the watercourses, and notes that there are pressures associated with flood protection in the catchment. The report also provides a number of actions and measures set out by the Environment Agency to improve the hydromorphological and ecological quality of the catchment. The mitigation measures include fish easement / passage and weir removal.

4.1.12. **Table 4-3** below shows the current status for each element and the status objectives for the 'Wansbeck from Font to Bothal Burn' WFD catchment.

Table 4-3 – Status Objectives for Wansbeck from Font to Bothal Burn

Element	Current Status	Status Objective
Ecological		
Biological	Moderate	Good by 2027

Element	Current Status	Status Objective
Hydromorphology	Supports Good	Supports Good
Physico-chemical / specific pollutants	Good	Good
Chemical		
Priority substances	Good	Good

4.2 SCHEME DESIGN

4.2.1. The following section describes the proposed new culverts to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 4-8** below shows the alignment of Part A and proposed access tracks serving Warreners House, Northgate Farm and Capri Lodge. Existing culverts one and two as shown in **Figure 4-1** would be retained as part of Part A with no amendments made. Existing culverts three, four and five as shown in **Figure 4-1** would be replaced as discussed below.

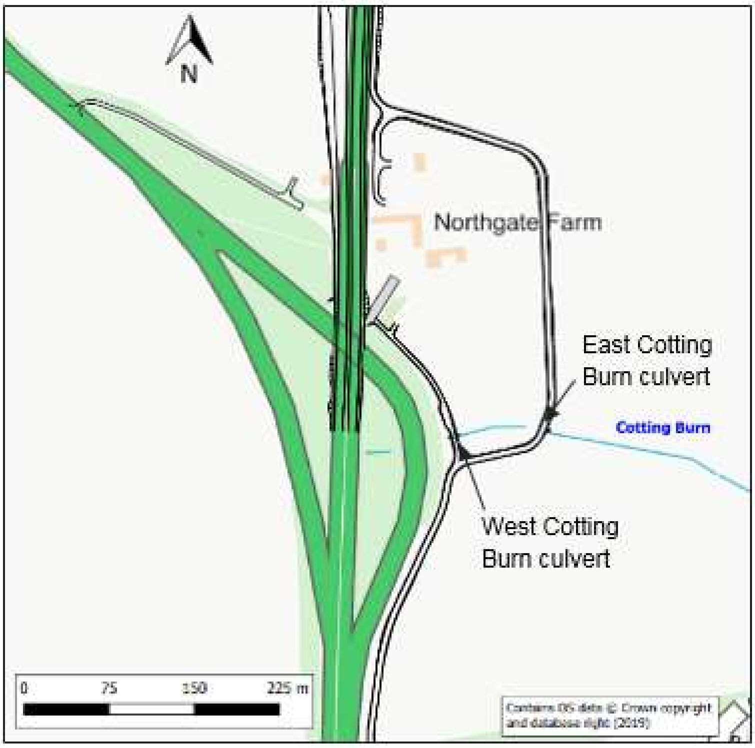

Figure 4-8 – Proposed Cotting Burn culverts

West Cotting Burn Culvert (1.4)

4.2.2. This new culvert would be located at chainage 10800 to the east of Part A, to accommodate the Warreners House proposed access track and replaces the existing culvert three, as shown in **Figure 4-1**. The box culvert would have a height of 1.25 m, a width of 2.70 m and would be 12.8 m in length.

4.2.3. It would include a 250 mm natural bed to encourage fish passage and would not include mammal passage provision due to the likely low risk of mammal casualty with it being a private access with low usage.

East Cotting Burn Culvert (1.5)

4.2.4. This new culvert would be located at chainage 10800 to the east of Part A, to accommodate the Northgate Farm and Capri Lodge proposed access track and replaces the existing culverts four and five as shown in **Figure 4-1**. This box culvert would have a height of 1.2 m, a width of 3 m and would be 12.8 m in length.

4.2.5. It would include a 200 mm natural bed to encourage fish passage and would not include mammal passage provision due to the likely low risk of mammal casualty with it being a private access with low usage.

Culvert Summary

4.2.6. **Table 4-4** below provides a summary of the existing and proposed culvert dimensions.

Table 4-4 - Existing and Proposed Cotting Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing culvert 1	28	Circular	0.3	-
Existing culvert 2	41	Circular	0.9	-
Existing culvert 3	7	Circular	0.35	-
Existing culvert 4	4	Circular	0.35	-
Existing culvert 5	15	Circular	0.45	-
Proposed West Cotting Burn culvert (1.4)	12.8	Box	2.7	1.25
Proposed East Cotting Burn culvert (1.5)	12.8	Box	3.0	1.20

Surface Water Drainage

4.2.7. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into Cotting Burn. **Table 4-5** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 4-5 – Cotting Burn Proposed Surface Water Drainage System

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
1	Filter drain located within the verge of the carriageway	50 %
	Kerb and gully drainage	30 %
	Combined kerb drainage	20 %
2	Grassed storage swale which would have a permanent wet area	100 %

5 SHIELDHILL BURN

5.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

5.1.1. The source of Shieldhill Burn is approximately 0.8 km to the west of the existing A1 alignment, adjacent to the A697. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.94 km², consisting primarily of agricultural land. Shieldhill Burn flows in a west to east direction and flows underneath the existing A1 alignment approximately 1 km to the north of the A697 junction. The Shieldhill Burn discharges into Cotting Burn approximately 2.5 km downstream from the existing A1 crossing. The Shieldhill Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

5.1.2. The estimated Q95 for Shieldhill Burn at the location of Part A proposals is 0.001 m³/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for Shieldhill Burn at the location of Part A proposals is 0.24 m³/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

5.1.3. Analysis of historical maps (**Ref 10.2.22**) dating back to the 1860s indicates that the alignment of Shieldhill Burn has not changed to the present day. Modification to this watercourse pre-dates the historical map record. The watercourse is culverted beneath fields and, where it lies within an open channel, it is realigned along field boundaries within a straight and trapezoidal channel.

Contemporary Channel Characteristics

5.1.1. Upstream of the existing crossing of the A1, the Shieldhill Burn enters a 300 mm diameter below ground pipe that conveys the watercourse to the existing culvert. The culvert comprises an arch culvert approximately 1.2 m in width, 1 m in height and 30 m in length. **Figures 5-1** and **5-2** below show the upstream and downstream ends of the culvert.

5.1.2. During the site walkover, a 300 mm pipe was observed at the outlet of the culvert. The watercourse enters this pipe immediately downstream of the culvert and is conveyed below ground for approximately 210 m at which point the watercourse returns to an open channel. A review of satellite imagery and flood mapping indicates that when the capacity of the pipe is exceeded, the watercourse flows overland along what is assumed to be the natural alignment to re-join the open channel downstream.

Figure 5-1 - Shieldhill Burn Culvert, Upstream

Figure 5-2 - Shieldhill Burn Culvert, Downstream

5.1.3. During the site walkover, it was noted that the banks were heavily vegetated.

5.1.4. No fish surveys have been undertaken along Shieldhill Burn as it was determined that the watercourse supported unsuitable habitat (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). This is due to the long-culverted and piped section along Shieldhill Burn. The watercourse also has very low flows, especially during the summer months. **Figure 5-3** below shows the outlet of the culvert previously described with overland flow visible. No evidence of otters was identified during the mammal surveys (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 5-3 – Shieldhill Burn Downstream of Culvert

5.1.5. Shieldhill Burn is not monitored against the objectives of the WFD (**Ref. 10.2.1**) but is located within the 'Wansbeck from Font to Bothal Burn' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Moderate' with the ecological quality assessed as 'Moderate' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'heavily modified'. **Tables 4-1**, **4-2** and **4-3** in **Section 4** present the ecological and chemical classifications ranging from 2013 to 2016 and the status objectives for the 'Wansbeck from Font to Bothal Burn' WFD catchment, as classified by the Environment Agency. The Waterbody Summary Report (**Ref. 10.2.26**) for the 'Wansbeck from Font to Bothal Burn' WFD catchment identifies the reason for not achieving 'Good' overall status as physical modification of the watercourses, and notes that there are pressures associated with flood protection in the catchment.

5.2 SCHEME DESIGN

5.2.1. The following section describes the proposed (replacement) culvert to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 5-4** below shows the location of the new culvert to replace the existing one.

Figure 5-4 - Proposed Shieldhill Burn Culvert

Shieldhill Culvert (1A)

5.2.2. The existing culvert located to the south of Highlaws Junction at chainage 11815 would be replaced to accommodate the proposed increased width of the Scheme alignment of Part A.

5.2.3. The culvert would provide uniform shape throughout and would maintain the existing discharge. It would be circular with a diameter of 1.2 m, and a length of 43.4 m. Scour protection would be provided. It would include a 150 mm natural bed to encourage fish passage.

5.2.4. A 600 mm diameter wildlife culvert (Wildlife Shieldhill Culvert) would also be provided adjacent to the replacement culvert at chainage 11810 to allow for mammal passage.

Culvert Summary

5.2.5. **Table 5-1** below provides a summary of the existing and proposed culvert dimensions.

Table 5-1 – Existing and Proposed Shieldhill Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing culvert	30	Arch	1.2	1
Proposed Shieldhill Culvert (1A)	43.4	Circular	1.2	-

Surface Water Drainage

5.2.6. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into Shieldhill Burn. **Table 5-2** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 5-2 – Shieldhill Burn Proposed Surface Water Drainage System

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
1	Filter drain located within the verge of the carriageway	50 %
	Kerb and gully drainage	25 %
	Combined kerb drainage	25 %
2	Grassed storage swale which would have a permanent wet area	100 %

6 FLOODGATE BURN

6.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

6.1.1. The source of Floodgate Burn is approximately 1.5 km to the south-west of the existing A1 alignment within the Spruce Plantation. The catchment of the watercourse is relatively flat with an approximate catchment area of 2 km^2, consisting primarily of agricultural land. Floodgate Burn flows in a south-west to north-east direction underneath the existing A1 alignment through an arch culvert. Approximately 1.3 km downstream of the watercourse crossing, the Floodgate Burn discharges into the River Lyne. The Floodgate Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

6.1.2. The estimated Q95 for Floodgate Burn at the location of Part A proposals is 0.00113 m^3/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for Floodgate Burn at the location of Part A proposals is 1.25 m^3/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

6.1.3. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1860s indicates that the alignment of Floodgate Burn has not changed to the present day. Prior to the 1860s, the watercourse was realigned along field boundaries and has a predominantly straightened planform. The cross-sectional profile is typically trapezoidal. Evidence suggests that the watercourse has sufficient energy for natural adjustment, indicated by localised sinuosity and bank erosion and sediment deposition processes operating.

Contemporary Channel Characteristics

6.1.4. During the site walkover, it was noted that the river bed comprised clay and silt material with gravels also present. Floodgate Burn flows under the A1 through an arch culvert (approximately 1.9 m wide and 1 m high) which is 26 m in length, as shown in **Figure 6-1**. Approximately 50 m downstream of this culvert, the watercourse flows underneath a farm access track through a circular 900 mm diameter culvert, which is 7 m in length. This is shown in **Figure 6-2**.

6.1.5. The fish surveys identified the presence of 3-spined stickleback within Floodgate Burn, which are a common species (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 6-1 - Floodgate Burn Culvert Underneath the A1, Downstream

Figure 6-2 - Floodgate Burn Culvert Underneath Farm Access Track, Downstream

6.1.6. Floodgate Burn is not monitored against the objectives of the WFD (**Ref. 10.2.1**) but is located within the 'Lyne from Source to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'. **Tables 6-1** and **6-2** below present the ecological and chemical classifications ranging from 2013 to 2016 for the 'Lyne from Source to Tidal Limit' WFD catchment, as classified by the Environment Agency.

Table 6-1 – Ecological Classifications for Lyne from Source to Tidal Limit

	2013	2014	2015	2016
Overall	Poor	Poor	Poor	Poor
Ecological	Poor	Poor	Poor	Poor
Biological quality elements	Poor	Poor	Poor	Poor
Hydromorphological supporting elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	-	-	Good	Good
Specific pollutants	High	High	High	High

Table 6-2 – Chemical Classifications for Lyne from Source to Tidal Limit

	2013	2014	2015	2016
Overall	Poor	Poor	Poor	Poor
Chemical	Fail	Fail	Good	Good
Priority substances	Good	Good	Good	Good
Other pollutants	-	-	-	-
Priority hazardous substances	Fail	Fail	Good	Good

6.1.7. The Waterbody Summary Report for the 'Lyne from Source to Tidal Limit' WFD catchment (**Ref. 10.2.27**) identifies the reason for not achieving 'Good' overall status as diffuse pollution as a result of poor soil management from the surrounding agricultural land. **Table 6-3** below shows the current status for each element and the status objectives for the 'Lyne from Source to Tidal Limit' WFD catchment.

Table 6-3 – Status Objectives for Lyne from Source to Tidal Limit

Element	Current Status	Status Objective
Ecological		
Biological	Moderate	Good by 2027
Hydromorphology	Supports Good	Supports Good
Physico-chemical / specific pollutants	Good	Good
Chemical		
Priority substances	Good	Good

6.2 SCHEME DESIGN

6.2.1. The following section describes the proposed (replacement) culvert to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 6-3** below shows the location of the replacement culvert. The existing culvert underneath the farm access track would be retained as part of Part A with no amendments made.

Figure 6-3 - Proposed Floodgate Burn Culvert

Paradise Culvert (3)

6.2.2. The existing 26 m long arch culvert of Floodgate Burn, located just to the south of Priests Bridge at chainage 13660, would be demolished to accommodate the proposed increased width of the Scheme alignment of Part A, and a new precast concrete pipe constructed in its place, which would extend the culvert by 13 m on the inlet (west) side.

6.2.3. The culvert would be circular with a diameter of 1.8 m and a length of 32.7 m. Scour protection would be provided. Precast concrete wing walls and head beams would be provided at either side of the culvert to retain the road embankments. As an alternative, reinforced earth may be used on the embankments.

6.2.4. A 150 mm natural bed would be included to encourage fish passage. The culvert would also allow for mammal passage. The mammal ledge would be set 950 mm above the pipe invert level. **Table 6-4** below shows the 1 in 2 year water level that the mammal ledge has been designed to and the headroom above the ledge for both the inlet and outlet of the proposed structure. A minimum of 600 mm headroom is required for mammal passage.

Table 6-4 – Paradise Culvert Mammal Ledge

	1 in 2 year Flood Level (m AOD)	Headroom (m)
Inlet	84.29	1.05
Outlet	84.3	0.86

Culvert Summary

6.2.5. **Table 6-5** below provides a summary of the existing and proposed culvert dimensions.

Table 6-5 – Existing and Proposed Floodgate Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing culvert underneath A1	26	Arch	1.9	1
Existing culvert underneath access track	7	Circular	0.9	-
Proposed Paradise Culvert (3)	32.7	Circular	1.8	-

Surface Water Drainage

6.2.6. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into Floodgate Burn. **Table 6-6** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 6-6 – Floodgate Burn Proposed Surface Water Drainage System

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
1	Filter drain located in the northbound verge	50 %
	Combined kerb drainage	35 %
	1.5 m drainage channel in the central reservation	15 %
2	Grassed detention basin that would have a permanent wet area	100 %

7 RIVER LYNE

7.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

7.1.1. The source of the River Lyne is approximately 1.2 km to the west of the A1, near to Gorfenletch Wood. Gorfen Letch and Heronsclose Burn confluence together before becoming the River Lyne. The catchment of the River Lyne is gently sloping from the west to the east and has a catchment area of 8.27 km², consisting primarily of agricultural land and woodland. The River Lyne flows underneath the existing A1 alignment through a culvert at Priest's Bridge, flowing in a west to east direction. The River Lyne has a number of significant tributaries including Floodgate Burn and Fenrother Burn, before eventually discharging into the North Sea approximately 11.9 km to the east of Part A. The River Lyne is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

7.1.2. The estimated Q95 for the River Lyne at the location of Part A proposals is 0.00608 m³/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for the River Lyne at the location of Part A proposals is 4.72 m³/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

7.1.3. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1860s indicates that the alignment of the River Lyne has not changed to the present day. Up until 1924, a ford crossing was marked across the River Lynn near to Priest's Bridge House. Upstream of the A1, the river shows evidence of historical realignment, where the river was straightened along field boundaries; this modification pre-dates the historical map record.

Contemporary Channel Characteristics

7.1.4. The River Lyne flows underneath the existing A1 alignment through a concrete culvert. As shown in **Figures 7-1** and **7-2**, the inlet of the culvert is circular and the outlet is an arch structure. The culvert is 34 m in length and approximately 2 m wide and 2.6 m high.

Figure 7-1 - River Lyne Culvert, Upstream

Figure 7-2 - River Lyne Culvert, Downstream

7.1.5. During the site walkover, upstream of the existing A1 crossing it was noted that the river bed comprised gravels, with the adjacent land predominately woodland and agricultural. Areas of deep standing water were also observed. Downstream of the A1, the river bed comprised gravel and sand. It was also noted that the highway drainage system discharges surface water adjacent to the watercourse and that this was eroding a new channel between the outfall and the main watercourse, approximately 1.5 m in length. **Figure 7-3** below shows the outfall and erosion below.

Figure 7-3 – Evidence of Erosion Underneath Outfall

7.1.6. The fish survey identified the presence of stickleback and bullhead within the River Lyne (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). Bullhead is considered to be a notable species but is not a protected species under UK legislation. Stickleback is not a protected or notable species. No evidence of otters was identified during the mammal surveys (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

7.1.7. The River Lyne is monitored against the objectives of the WFD (**Ref. 10.2.1**) and is located within the 'Lyne from Source to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'. **Tables 6-1**, **6-2** and **6-3** in **Section 6** present the ecological and chemical classifications ranging from 2013 to 2016 and the status objectives for the 'Lyne from Source to Tidal Limit' WFD catchment, as classified by the Environment Agency. The Waterbody Summary Report for the 'Lyne from Source to

Tidal Limit' WFD catchment (**Ref. 10.2.27**) identifies the reason for not achieving 'Good' overall status as diffuse pollution as a result of poor soil management from the surrounding agricultural land.

7.2 SCHEME DESIGN

7.2.1. The following section describes the proposed new culvert to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 7-4** below shows the location of the new culvert. The existing culvert would be left in-situ.

Figure 7-4 – Proposed River Lyne Culvert

Priest's Bridge Culvert (4)

7.2.2. A new culvert would be provided at chainage 14050 to accommodate the River Lyne underneath the proposed offline section of Part A, where open channel currently exists. The box culvert would have a height of 3.75 m and a width of 4 m and would be 53 m in length. The proposed culvert would be a precast reinforced concrete box culvert, assuming local ground conditions meet the specification of the precast manufacturer. Upon further investigation at detailed design, it may be necessary to supply piled or reinforced concrete foundations. The same culvert design principles would be maintained (i.e. proposed height, width, fish passage and mammal passage).

7.2.3. It would comprise a 100 mm natural bed within a 250 mm low flow channel to encourage fish passage. A 500 mm wide shelf would be fixed to the culvert, 1.31 m above the culvert invert, to allow mammal passage. **Table 7-1** below shows the 1 in 2 year water level that the mammal ledge has been designed to and the headroom above the ledge for both the inlet and outlet of the proposed structure. A minimum of 600 mm headroom is required for mammal passage.

Table 7-1 – Priest's Bridge Culvert Mammal Ledge

	1 in 2 year Flood Level (m AOD)	Headroom (m)
Inlet	80.53	2.24
Outlet	80.45	2.23

Existing Priest's Bridge (4.1)

7.2.4. The existing culvert located at chainage 14020 would be modified slightly to improve fish passage through the culvert. It is proposed to retrofit baffles along the base of the culvert.

Culvert Summary

7.2.5. **Table 7-2** below provides a summary of the existing and proposed culvert dimensions.

Table 7-2 – Existing and Proposed River Lyne Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing Priest's Bridge (4.1)	34	Circular inlet / Arch outlet	1.95	2.66
Proposed Priest's Bridge Culvert (4)	53	Box	4.0	3.75

Surface Water Drainage

7.2.6. A detailed description of the surface water drainage strategy is provided **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into the River Lyne. **Table 7-3** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 7-3 – River Lyne Proposed Surface Water Drainage System

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
1	Filter drain located in the verges	90 %
	Kerb and gully drainage	10 %

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
2	Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin	100 %

8 FENROTHER BURN

8.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

8.1.1. The source of Fenrother Burn is approximately 2.5 km to the west of where the Fenrother Burn discharges into the River Lyne, just to the south of Longhorsley Moor. The catchment of the watercourse gently slopes towards the east with an approximate catchment area of 3 km^2, consisting primarily of agricultural land. Fenrother Burn flows underneath Fenrother Lane just to the west of the A1 in a predominantly north to south direction. Fenrother Burn then discharges into the River Lyne approximately 1 km downstream from the Fenrother Lane watercourse crossing. The Fenrother Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

8.1.2. The estimated Q95 for Fenrother Burn at the location of Part A proposals is 0.001 m^3/s. Q95 is defined as the flow equalled or exceeded for 95% of the flow record and is a low flow parameter. The estimated Qmed for Fenrother Burn at the location of Part A proposals is 2.06 m^3/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

8.1.3. Analysis of historical maps (**Ref 10.2.22**) dating back to the 1860s indicates that the alignment of Fenrother Burn has not changed to the present day. The watercourse shows evidence of being realigned along field boundaries, with the modification to the planform and cross-sectional profile pre-dating the historical map record. The channel is trapezoidal with resectioned banks and an over-deepened channel.

Contemporary Channel Characteristics

8.1.4. During the site walkover it was noted that the river bed comprised clay, and the watercourses act as field drainage ditches. Fenrother Burn flows underneath Fenrother Lane through a stone circular culvert, as pictured in **Figure 8-1** below. The culvert has an approximate diameter of 500 mm and is approximately 120 m in length.

8.1.5. No fish surveys have been undertaken along Fenrother Burn as it was determined that the watercourse supported unsuitable habitat for aquatic species due to heavily shaded areas and the small volume of water within the watercourse (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal survey (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 8-1 – Fenrother Burn Culvert, Upstream

8.1.6. Fenrother Burn is not monitored against the objectives of the WFD (**Ref. 10.2.1**) but is located within the 'Lyne from Source to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Poor', with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

8.1.7. **Tables 6-1**, **6-2** and **6-3** in **Section 6** present the ecological and chemical classifications ranging from 2013 to 2016 and the status objectives for the 'Lyne from Source to Tidal Limit' WFD catchment, as classified by the Environment Agency. The Waterbody Summary Report for the 'Lyne from Source to Tidal Limit' WFD catchment (**Ref. 10.2.27**) identifies the reason for not achieving 'Good' overall status as diffuse pollution as a result of poor soil management from the surrounding agricultural land.

8.2 SCHEME DESIGN

8.2.1. The following section describes the proposed culverts and realigned watercourse channel to be provided as part of Part A. The existing culvert would be infilled. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**).

Realignment of Fenrother Burn

8.2.2. The Fenrother Burn would be diverted adjacent to the A1 to reduce the total length of the new culverts required, as illustrated in **Figure 8-2** below. The design of the new channel would maintain a similar channel profile and dimensions to the existing watercourse to mimic existing conditions. As shown in **Figure 8-3** below, rock armour (boulders) would be placed within the new channel to provide varied substrate features and flow dynamics within the watercourse channel and assist the movement of aquatic species. The design would be further developed during the detailed design stage.

8.2.3. The alignment of the new channel is spatially constrained by the side road adjacent to the main carriageway.

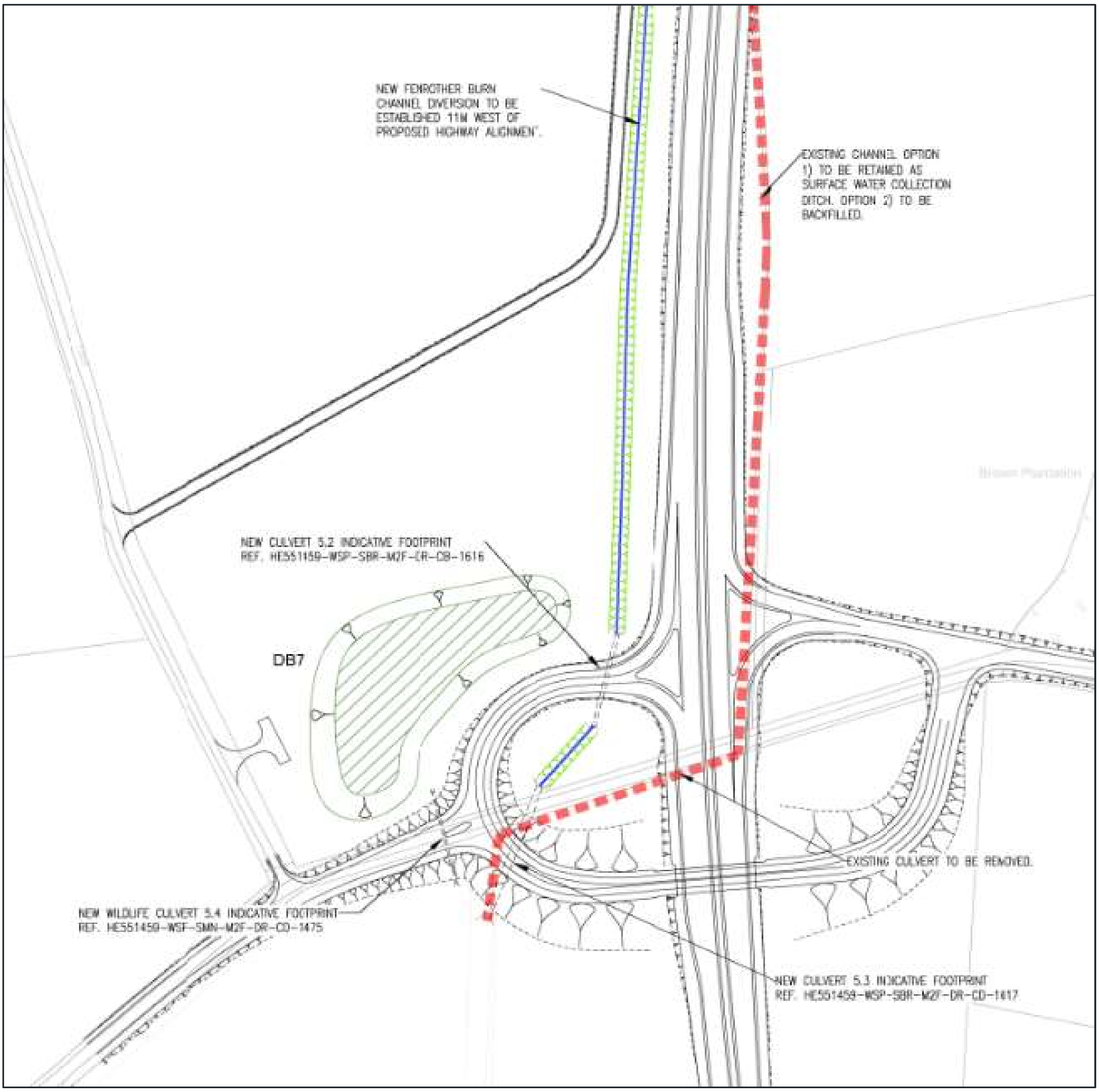

Figure 8-2 – Fenrother Burn Part A Proposals

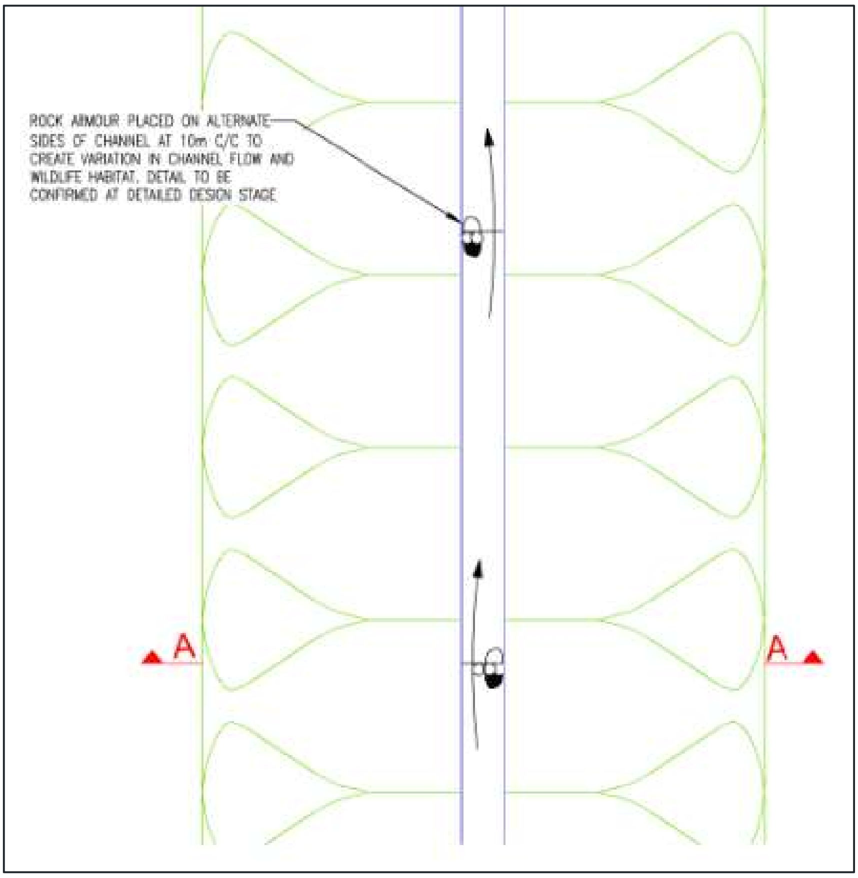

Figure 8-3 – Design of Realigned Fenrother Burn

North Fenrother Burn Culvert (5.2)

8.2.4. The new culvert would be located to the south of the proposed Fenrother Junction, underneath the realigned Fenrother Road (west) as it approaches the junction. This is shown in **Figure 8-2** above.

8.2.5. The culvert would be located at chainage 15000 and would be a twin box culvert, with a height of 1.25 m and a width of 1.5 m and would be 33.1 m in length. It would comprise a 250 mm natural bed to encourage fish passage. Scour protection would be provided.

South Fenrother Burn Culvert (5.3)

8.2.6. The new culvert would be located to the south of the proposed Fenrother Junction, underneath the realigned Fenrother Road (west) as it approaches the junction. This is shown in **Figure 8-2** above.

8.2.7. The culvert would be located at chainage 14930. The box culvert would be rectangular, have a height of 1.75 m, a width of 3 m and would be 52.7 m in length. It would include a 250 mm natural bed to encourage fish passage. A separate wildlife culvert would be provided at this location.

Culvert Summary

8.2.8. **Table 8-1** below provides a summary of the existing and proposed culvert dimensions.

Table 8-1 – Existing and Proposed Fenrother Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing culvert underneath A1	120	Circular	0.5	-
Proposed Northern Fenrother Burn Culvert (5.2)	33.1	Twin box	1.5 (each culvert)	1.25 (each culvert)
Proposed Southern Fenrother Burn Culvert (5.3)	52.7	Box	3.0	1.75

Surface Water Drainage

8.2.9. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into a tributary of Fenrother Burn. **Table 8-2** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 8-2 – Tributary of Fenrother Burn Proposed Surface Water Drainage System

<table>
<tr><th>Stage</th><th>Proposed Attenuation and Treatment</th><th>Percentage of Surface Water Runoff Received</th></tr>
<tr><td rowspan="2">1</td><td>Filter drain located in the verges</td><td>90 %</td></tr>
<tr><td>Kerb and gully drainage</td><td>10 %</td></tr>
<tr><td>2</td><td>Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
</table>

9 EARSDON BURN

9.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

9.1.1. The source of Earsdon Burn is approximately 2.5 km to the south-west of the existing A1 alignment, to the south of the village Fieldhead. The catchment of the watercourse is relatively flat with an approximate catchment area of 4.2 km^2, consisting primarily of agricultural land. Earsdon Burn and its tributaries flow in a predominantly west to east direction, beneath the existing A1 alignment at Causey Park Bridge and underneath the local side road to the west. Earsdon Burn eventually discharges into the River Lyne approximately 4.2 km downstream of the existing watercourse crossings. The Earsdon Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

9.1.2. The estimated Q95 for Earsdon Burn at the location of Part A proposals is 0.00335 m^3/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for Earsdon Burn at the location of Part A proposals is 2.87 m^3/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

9.1.3. Analysis of historical maps (**Ref 10.2.22**) dating back to the 1860s indicates that the alignment of Earsdon Burn has not changed to the present day. The 1866 map record shows the upper reaches to have a more natural planform with a sinuous channel. By 1898, there is evidence of channel realignment of this reach with a significantly reduced sinuosity. Downstream of Causey Park Bridge, the watercourse has been straightened along field boundaries since the historical map records began.

Contemporary Channel Characteristics

9.1.4. During the site walkover, it was noted that the river bed of Earsdon Burn and its tributaries comprised gravels. Earsdon Burn has a number of smaller tributaries to the west of the existing A1 alignment. The nearest one to Part A discharges into Earsdon Burn approximately 70 m upstream of the closest adjacent unnamed road. Earsdon Burn flows through two culverts and one bridge underneath the adjacent unnamed roads and the existing A1 alignment, as identified in **Figure 9-1** below.

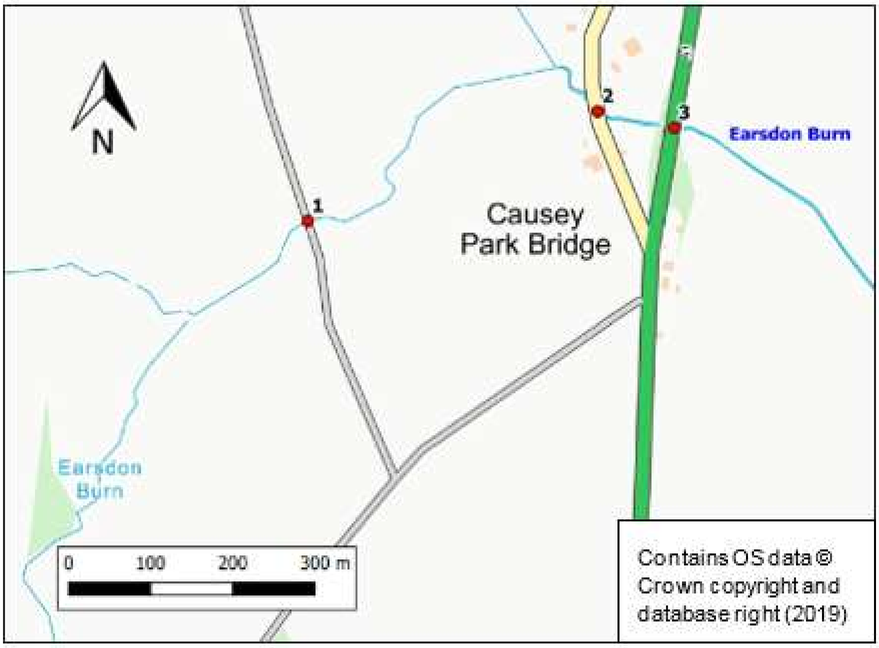

Figure 9-1 - Earsdon Burn Existing Structures

9.1.5. Earsdon Burn flows through a culvert underneath an unnamed road to the west of the A1, identified as number one within **Figure 9-1**. **Figure 9-2** below shows the inlet of the triple circular parallel concrete culverts. The diameter of each culvert (from left to right) is approximately 450 mm, 650 mm and 650 mm respectively. The culvert is approximately 10 m in length.

9.1.6. **Figure 9-3** shows the bridge crossing over Earsdon Burn underneath the unnamed road to the west of the existing A1, identified as number two within **Figure 9-1**. The bridge crossing is approximately 5.8 m wide and 29 m in length. The walls of the bridge are made of concrete.

9.1.7. Earsdon Burn flows underneath the existing A1 alignment through a 3 m wide and 32 m long concrete culvert, as identified as number three within **Figure 9-1**. **Figure 9-4** shows the inlet of the culvert.

Figure 9-2 - Earsdon Burn Culvert (1)

Figure 9-3 - Earsdon Burn Crossing (2)

Figure 9-4 - Earsdon Burn Culvert (3)

9.1.8. No fish surveys have been undertaken along Earsdon Burn or any of its tributaries as it was determined that the watercourses supported unsuitable habitat for aquatic species due to the relatively shallow water depth (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The mammal survey identified the presence of otters along the Earsdon Burn (**Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). Otters are a European protected species and are listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (**Ref, 10.2.28**) and are considered to be of principal importance.

9.1.9. Earsdon Burn and its tributaries are not monitored against the objectives of the WFD (**Ref, 10.2.1**) but are located within the 'Lyne from Source to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref, 10.2.18**) indicates an overall quality of 'Poor,' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

9.1.10. **Tables 6-1**, **6-2** and **6-3** in **Section 6** present the ecological and chemical classifications ranging from 2013 to 2016 and the status objectives for the 'Lyne from Source to Tidal Limit' WFD catchment, as classified by the Environment Agency. The Waterbody Summary Report for the 'Lyne from Source to Tidal Limit' WFD catchment (**Ref, 10.2.27**) identifies the reason for not achieving 'Good' overall status as diffuse pollution as a result of poor soil management from the surrounding agricultural land.

9.2 SCHEME DESIGN

9.2.1. The following section describes the proposed culverts to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 9-5** below shows the location of the proposed culverts described below. The existing culverts would be left in-situ.

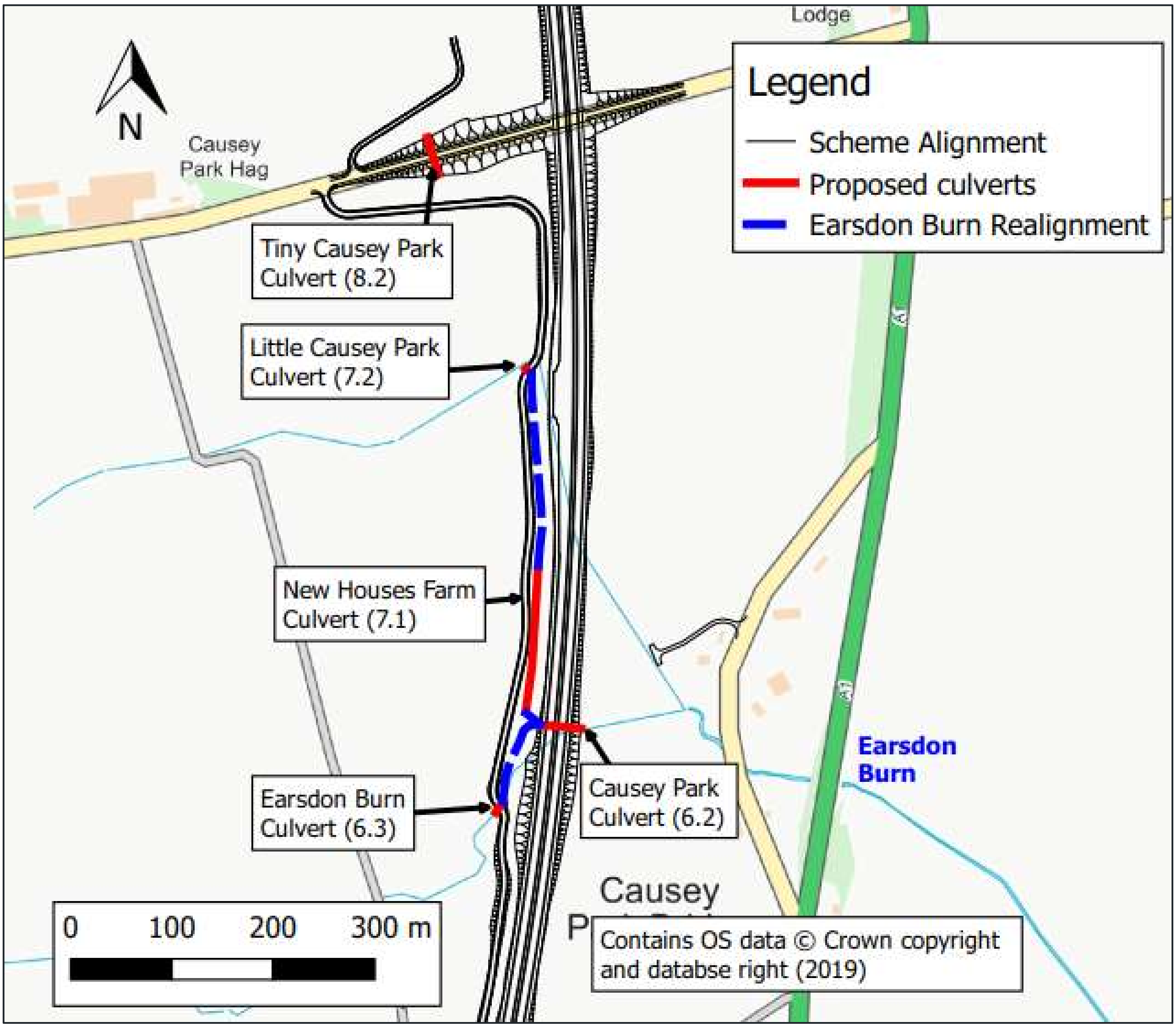

Figure 9-5 – Proposed Earsdon Burn Culverts

Causey Park Culvert (6.2)

9.2.2. A new culvert would be provided at chainage 17070 to accommodate Earsdon Burn underneath the proposed offline section of Part A. It would be a rectangular shape, have a height of 2.1 m and a width of 3 m, and would be 36.2 m in length. The proposed culvert would be a precast reinforced concrete box culvert. Precast wingwalls would be provided at both ends of the culvert.

9.2.3. It would include a 150 mm natural bed to encourage fish passage. A wildlife ledge would also be provided 950 mm above the culvert invert level, to allow mammal passage. Scour protection would be provided. **Table 9-1** below shows the 1 in 2 year water level that the mammal ledge has been designed to and the headroom above the ledge for both the inlet and outlet of the proposed structure. A minimum of 600 mm headroom is required for mammal passage.

Table 9-1 – Causey Park (South) Culvert Mammal Ledge

	1 in 2 year Flood Level (m AOD)	Headroom (m)
Inlet	77.96	1.15
Outlet	77.84	1

Earsdon Burn Culvert (6.3)

9.2.4. A new culvert would be provided at chainage 17000 to accommodate Earsdon Burn underneath the New Houses Farm proposed access track. It would be a rectangular shape, have a height of 2.1 m, a width of 3 m and would be 11 m in length.

9.2.5. It would include a 150 mm natural bed to encourage fish passage. A wildlife ledge would also be provided 1 m above the culvert invert level to allow for mammal passage. Scour protection would be provided. **Table 9-2** below shows the 1 in 2 year water level that the mammal ledge has been designed to and the headroom above the ledge for both the inlet and outlet of the proposed structure. A minimum of 600 mm headroom is required for mammal passage.

Table 9-2 – Earsdon Burn Culvert Mammal Ledge

	1 in 2 year Flood Level (m AOD)	Headroom (m)
Inlet	78.59	1.08
Outlet	78.57	1.10

New Houses Farm Culvert (7.1)

9.2.6. As part of Part A, the unnamed tributary that flows into Earsdon Burn would be diverted parallel to the west of Part A, to the south of the proposed Causey Park Overbridge. The design of the new channel would maintain a similar channel profile and dimensions to the existing channel to mimic existing conditions. Rock armour (boulders) would be placed within the new channel to provide varied substrate features and flow dynamics and assist the movement of aquatic species.

9.2.7. A new culvert for this watercourse would be provided at chainage 17150, where it would pass through elevated topography. The culvert would be a circular shape with a diameter of 1.6 m and would be 148 m in length. There is insufficient baseflow within this watercourse to consider fish passage measures. Furthermore, mammal passage would not be included within this culvert as there would be no highway above and therefore no risk of casualty.

Little Causey Park Culvert (7.2)

9.2.8. A new culvert would be provided at chainage 17440, to the south of Causey Park Overbridge, to accommodate the unnamed tributary that flows into Earsdon Burn underneath the New Houses Farm proposed access track.

9.2.9. The culvert would be a circular shape with a diameter of 1.6 m and would be 9 m in length. There is insufficient baseflow within this watercourse to consider fish passage measures. The culvert would not include mammal passage provision due to the likely low risk of mammal casualty with it being a private access with low usage.

Tiny Causey Park Culvert (8.2)

9.2.10. This new culvert would be located at chainage 17720 to the west of Part A and immediately downstream of Causey Park Wildlife Culvert (8.1) to accommodate a private access track. It would be a circular in shape and have a diameter of 600 mm. The length of the culvert would be confirmed at the detailed design stage.

9.2.11. There are currently two informal drainage ditches located either side of the unnamed road located to the north of Earsdon Burn. The construction of the embankments of the overbridge would remove the ditches. The culvert is proposed to accommodate the surface water runoff from the adjacent unnamed road and is not required to convey a watercourse. Fish passage is therefore not required and the culvert would not include mammal passage provision due to the likely low risk of mammal casualty with it being a private access with low usage.

Culvert Summary

9.2.12. **Table 9-3** below provides a summary of the existing and proposed culvert dimensions and refers to the existing structure numbers identified in **Figure 9-1**.

Table 9-3 – Existing and Proposed Earsdon Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing unnamed road culvert (1)	10	Triple circular pipes	0.45, 0.65 and 0.65	-
Existing unnamed road bridge (2)	29	Square bridge	5.8	-
Existing A1 bridge (3)	32	Rectangular culvert	3	-
Proposed Causey Park Culvert (6.2)	36.2	Box	3	2.1

Structure	Length (m)	Shape	Width (m)	Height (m)
Proposed Earsdon Burn Culvert (6.3)	11	Box	3	2.1
Proposed New Houses Farm Culvert (7.1)	148	Circular	1.6	-
Proposed Little Causey Park Culvert (7.2)	9	Circular	1.6	-
Proposed Tiny Causey Park Culvert (8.2)	To be confirmed at detailed design stage	Circular	0.6	-

Surface Water Drainage

9.2.13. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge directly into Earsdon Burn and another two outfalls that would discharge into tributaries of Earsdon Burn. **Table 9-4** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage for both outfalls.

Table 9-4 – Earsdon Burn Proposed Surface Water Drainage System

<table>
<tr><th>Outfall</th><th>Stage</th><th>Proposed Attenuation and Treatment</th><th>Percentage of Surface Water Runoff Received</th></tr>
<tr><td rowspan="3">9 and 11</td><td rowspan="2">1</td><td>Filter drain located in the verges</td><td>90 %</td></tr>
<tr><td>Kerb and gully drainage</td><td>10 %</td></tr>
<tr><td>2</td><td>Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
<tr><td rowspan="2">20</td><td>1</td><td>Kerb and gully drainage</td><td>100 %</td></tr>
<tr><td>2</td><td>Grassed detention basin that would operate as a dry basin when not attenuating rainfall with a</td><td>100 %</td></tr>
</table>

Outfall	Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
		sediment forebay located at the inlet of the basin	

10 LONGDIKE BURN

10.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

10.1.1. The source of Longdike Burn is approximately 5.9 km to the south-west of the existing A1 alignment just to the west of Longhorsley Moor. The catchment of the watercourse gently slopes towards the north-east with an approximate catchment area of 23.4 km², consisting primarily of agricultural land. Eshott Airfield is located to the north-east of Part A where it crosses Longdike Burn. Longdike Burn flows in a predominantly south-west to north-east direction, flowing underneath the existing A1 alignment just downstream of where the Bywell Letch discharges into Longdike Burn. Approximately 2.7 km downstream of the existing A1 watercourse crossing, Longdike Burn discharges into Thirston Burn. The Longdike Burn is classified as a main river and under the jurisdiction of the Environment Agency.

10.1.2. The estimated Q95 for Longdike Burn at the location of Part A proposals is 0.014 m³/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for Longdike Burn at the location of Part A proposals is 11.36 m³/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

10.1.3. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1860s indicates that the alignment of Longdike Burn has undergone only localised channel realignments since 1866. Modifications to straighten the watercourse, both along field boundaries and beneath the existing A1, are evident on the 1978 map record.

Contemporary Channel Characteristics

10.1.4. During the site walkover, it was noted that the river bed comprised silt and gravels.

10.1.5. Approximately 0.5 km upstream of the existing A1 watercourse crossing, the Longdike Burn flows underneath Burgham Park Road to the south of Burgham Park Golf Club through a concrete arch culvert known as Burgham culvert. **Figure 10-1** below shows the outlet of the culvert; as shown in the photograph there are wooden baffles along the base of the culvert to facilitate fish passage. The culvert is approximately 3.4 m wide and 4.8 m high, and approximately 30 m in length. The base of the culvert is set above the adjacent bed level creating a potential obstruction to fish passage (refer to **Figure 10-1** below).

10.1.6. **Figure 10-2** below shows Longdike Burn flowing underneath the existing A1 alignment through Bockenfield Bridge. The concrete arch bridge is approximately 6.6 m wide and 2.4 m high, and approximately 30.6 m in length.

10.1.7. Downstream of Bockenfield Bridge, during the site walkover there was evidence of fluvial erosion (refer to **Figure 10-3**). The erosion is located along outer edge of the meander and the presence of vegetation denotes it did not occur recently.

10.1.8. The A1 also crosses a tributary of Longdike Burn approximately 850 m to the north of Bockenfield Bridge. The structure inlet or outlet was not found during the site walkover. It is assumed that there is an existing structure at this location. Further investigation is required to determine the form and alignment of the structure is at detailed design, as a new structure (which is referred to as Blackwood Hall) is proposed in this location.

Figure 10-1 - Burgham Culvert, Outlet

Figure 10-2 - Bockenfield Bridge

Figure 10-3 – Evidence of Erosion along Longdike Burn

10.1.9. Fish surveys identified a number of aquatic species within Longdike Burn (**Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). Brown trout, lamprey and European eel were identified during the survey and all are protected species listed under Section 41 of the NERC Act 2006 (**Ref. 10.2.28**) and are considered to be of principal importance. Brown trout and European eel are also listed in the Northumberland Local Biodiversity Action Plan (LBAP) (**Ref. 10.2.29**). Other freshwater species identified along Longdike Burn were stone loach, stickleback and minnow. The mammal survey identified the presence of otters along

Longdike Burn (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). Otters are a European protected species and are listed under Section 41 of the NERC Act 2006 (**Ref. 10.2.28**).

10.1.10. Longdike Burn is directly monitored against the objectives of the WFD (**Ref. 10.2.1**) and is located within the 'Longdike Burn Catchment (trib of Coquet)' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Moderate', with the ecological quality assessed as 'Moderate' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'. **Tables 10-1** and **10-2** below present the ecological and chemical classifications ranging from 2013 to 2016 for the 'Longdike Burn Catchment (trib of Coquet)' WFD catchment, as classified by the Environment Agency.

Table 10-1 – Ecological Classifications for Longdike Burn Catchment (trib of Coquet)

	2013	2014	2015	2016
Overall	Moderate	Moderate	Moderate	Moderate
Ecological	Moderate	Moderate	Moderate	Moderate
Biological quality elements	Moderate	Moderate	Moderate	Moderate
Hydromorphological supporting elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	-	-	Moderate	Moderate
Specific pollutants	High	High	-	-

Table 10-2 – Chemical Classifications for Longdike Burn Catchment (trib of Coquet)

	2013	2014	2015	2016
Overall	Moderate	Moderate	Moderate	Moderate
Chemical	Good	Good	Good	Good
Priority substances	Good	Good	-	-

	2013	2014	2015	2016
Other pollutants	-	-	-	-
Priority hazardous substances	Good	Good	-	-

10.1.11. The Waterbody Summary Report for the ‘Longdike Burn Catchment (trib of Coquet)’ WFD catchment (**Ref. 10.2.30**) identifies the reason for not achieving ‘Good’ overall status as diffuse pollution from the surrounding agricultural land and rural land management practices. **Table 10-3** below shows the current status for each element and the status objectives for the ‘Longdike Burn Catchment (trib of Coquet)’ WFD catchment.

Table 10-3 – Status Objectives for Longdike Burn Catchment (trib of Coquet)

Element	Current Status	Status Objective
Ecological		
Biological	Moderate	Good by 2027
Hydromorphology	Supports Good	Supports Good
Physico-chemical / specific pollutants	Moderate	Good by 2027
Chemical		
Priority substances	Good	Good

10.2 SCHEME DESIGN

10.2.1. The following section describes the proposed new and extended culverts to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 10-4** below shows the location of the culverts.

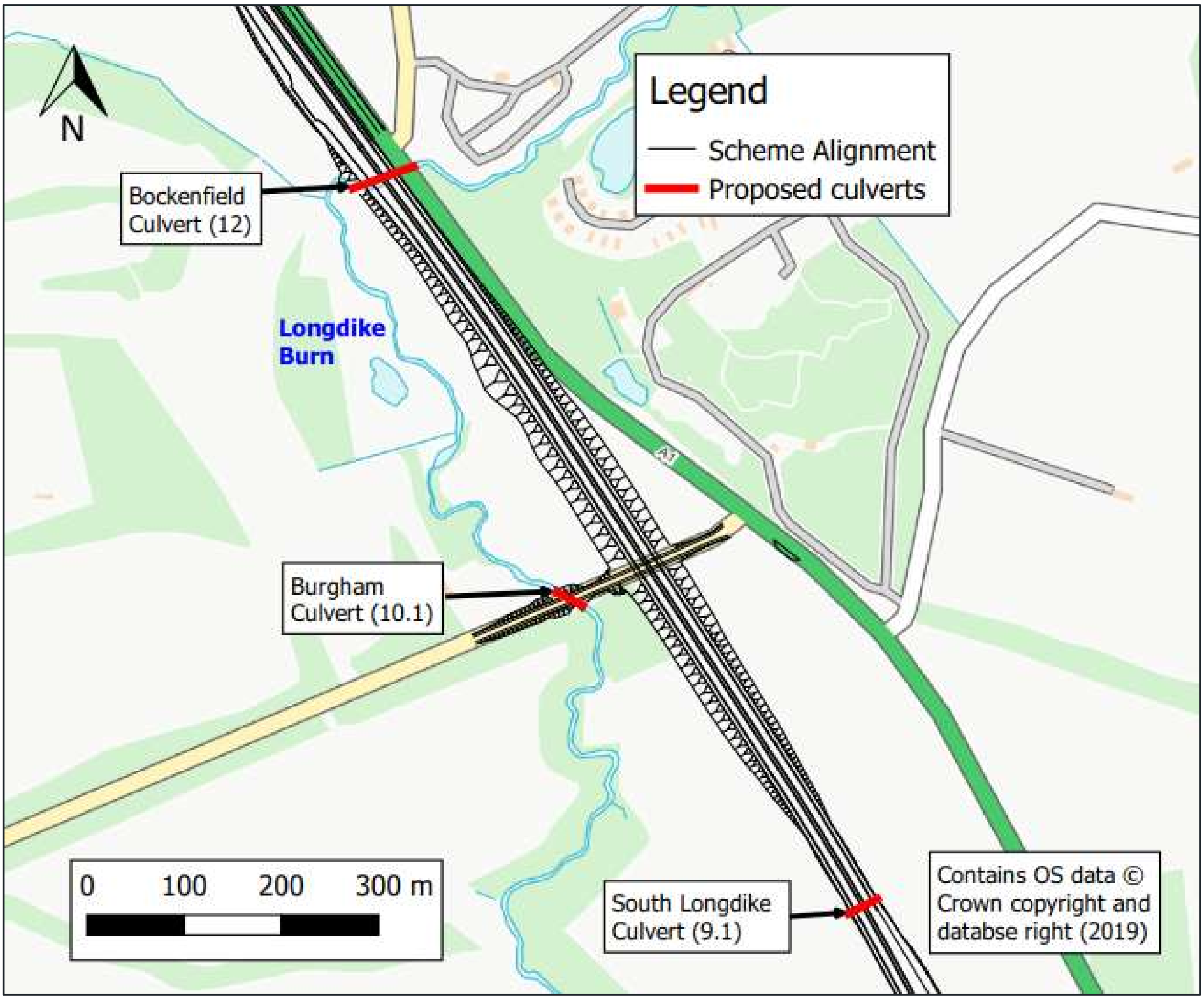

Figure 10-4 – Proposed Longdike Burn Culverts

Burgham Culvert (10.1)

10.2.2. The existing culvert of Longdike Burn beneath Burgham Park Road at chainage 19520, located to the west of the proposed Burgham Park Underbridge, would be retained in-situ and not extended. It is likely that headwalls and wingwalls would be modified. The existing timber baffles that facilitate fish passage would be replaced with a more robust arrangement. A new mammal ledge is also proposed.

Bockenfield Culvert (12)

10.2.3. The existing Bockenfield Bridge over Longdike Burn, located to the north of the proposed Burgham Park underbridge at chainage 20000, would be extended to accommodate the proposed increased width of Part A alignment. The extension would mimic the existing structure dimensions and would comprise an arch bridge, have a height of 2.49 m and a width of 6.1 m and would be 34.4 m in length.

10.2.4. The Longdike Burn would be realigned through the extension and the new channel would mimic the existing channel dimensions.

10.2.5. The bridge would maintain a natural bed to encourage fish passage, and a new wildlife ledge 1.7 m above the river bed level would allow mammal passage. Scour protection would be provided.

10.2.6. Precast wingwalls and spandrel walls would be provided at the west end of the bridge to retain the watercourse and road embankments. A sloped earth embankment would extend from the edge of the pavement to the base of the wingwall. Minor works to the existing bridge would be required for the connection between the extension and the existing bridge.

South Longdike Culvert (9.1)

10.2.7. An existing overland flow path that joins Longdike Burn to the west of Part A is located at chainage 19090, just south of the proposed Burgham Park Underbridge. A new culvert would be provided at this location to accommodate this overland flow. The culvert is therefore not required to convey a watercourse.

10.2.8. The new culvert would be circular in shape with a diameter of 1.2 m and would be 39 m in length. At the west of Part A, a headwall would be constructed from which an open ditch would be created towards the west.

Blackwood Hall Culvert (13.1)

10.2.9. A new culvert would be provided at chainage 20880 to the south of Blackwood Hall to accommodate an existing ditch located approximately 0.9 km to the north of Bockenfield Bridge. The ditch is a small tributary that flows in an easterly direction and discharges into the Longdike Burn approximately 2 km to the east of the A1. **Figure 10-5** below shows the location of the new culvert.

10.2.10. Three circular culverts would be provided, all with a diameter of 450 mm and 56 m in length. The ditch would flow in open channel to the east. Fish passage would not be included due to the ditch only being a field drainage ditch and therefore ephemeral.

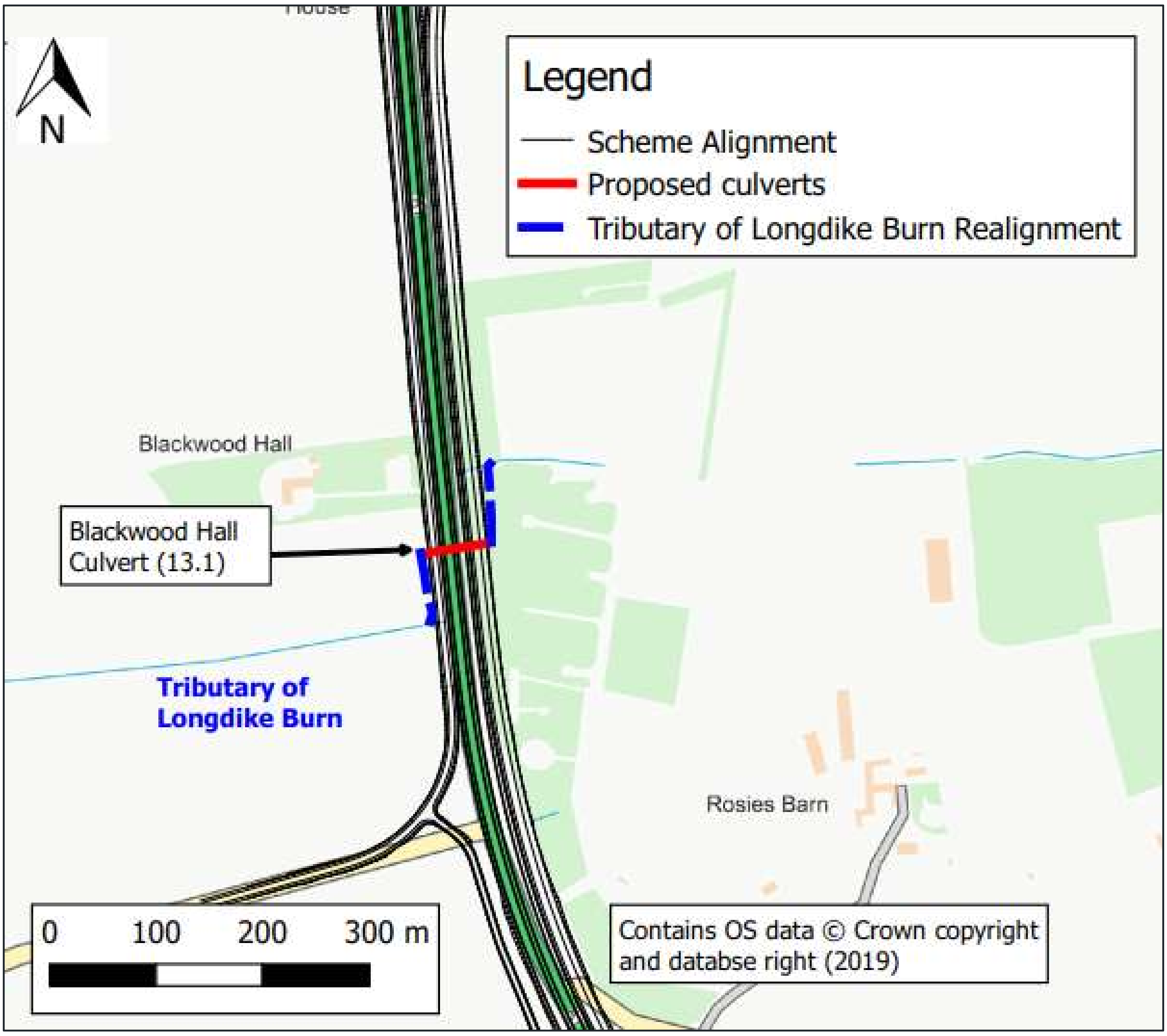

Figure 10-5 – Blackwood Hall Culvert

Culvert Summary

10.2.11. **Table 10-4** below provides a summary of the existing and proposed culvert dimensions.

Table 10-4 – Existing and proposed Longdike Burn Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing Burgham culvert (10.1)	30	Arch	3.4	4.8
Existing Bockenfield Bridge Culvert (12)	30.6	Arch	6.6	2.4
Proposed Bockenfield Bridge (12)	34.4	Arch	6.6	2.4

Structure	Length (m)	Shape	Width (m)	Height (m)
Proposed South Longdike Culvert (9.1)	39	Circular	1.2	-
Proposed Blackwood Hall Culvert (13.1)	56	Three circular culverts	0.45	-

Surface water drainage

10.2.12. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There are two new outfalls proposed to discharge directly into Longdike Burn and another outfall that would discharge into the tributary of Longdike Burn. **Table 10-5** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage for all of the proposed outfalls.

Table 10-5 – Longdike Burn Proposed Surface Water Drainage System

<table>
<tr><th>Receiving Watercourse</th><th>Stage</th><th colspan="2">Proposed Attenuation and Treatment</th><th>Percentage of Surface Water Runoff Received</th></tr>
<tr><td rowspan="3">Tributary of Longdike Burn</td><td rowspan="2">1</td><td colspan="2">Filter drain located in the verges</td><td>90 %</td></tr>
<tr><td colspan="2">Kerb and gully drainage</td><td>10 %</td></tr>
<tr><td>2</td><td colspan="2">Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
<tr><td rowspan="3">Longdike Burn</td><td rowspan="2">1</td><td colspan="2">Filter drain located in the verges</td><td>90 %</td></tr>
<tr><td colspan="2">Kerb and gully drainage</td><td>10 %</td></tr>
<tr><td>2</td><td colspan="2">Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
<tr><td rowspan="2">Longdike Burn</td><td rowspan="2">1</td><td rowspan="2">Detention basin 15</td><td>Filter drain located in the verge</td><td>75 %</td></tr>
<tr><td>1.5 m drainage channel in the central reservation</td><td>25 %</td></tr>
</table>

Receiving Watercourse	Stage	Proposed Attenuation and Treatment		Percentage of Surface Water Runoff Received
		Detention basin 15a	Kerb and gully drainage	100 %
	2	Grassed detention basins 15 and 15a would operate as a dry basin when not attenuating rainfall. There would be no standing water within the basins due to the proximity of the airfield. The grassed detention basins would also have a granular trench running through the centre to ensure that standing water is not an issue and would also provide additional treatment.		100 %

11 UNNAMED TRIBUTARY OF THIRSTON BURN

11.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

11.1.1. The source of the unnamed tributary of Thirston Burn is approximately 0.5 km to the west of the existing A1 alignment. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.7 km^2, consisting of agricultural land. The unnamed tributary of Thirston Burn flows in a west to east direction and underneath the existing A1 alignment 0.7 km to the south of the River Coquet bridge. Approximately 2.1 km downstream of the A1 watercourse crossing, the unnamed tributary discharges into the Thirston Burn. The Thirston Burn and its tributaries are classified as ordinary watercourses and under the jurisdiction of NCC as LLFA for this area.

11.1.2. The estimated Q95 for the unnamed tributary of Thirston Burn at the location of Part A proposals is 0.00159 m^3/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for the unnamed tributary of Thirston Burn at the location of Part A proposals is 0.021 m^3/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

11.1.3. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1890s indicates that the alignment of the unnamed tributary of Thirston Burn has not changed, except for a culvert being installed for the existing A1. The watercourse is extensively modified, with the modifications pre-dating the historical map record. The channel has a predominantly straight planform and trapezoidal cross-sectional profile with an over-deepened channel.

Contemporary Channel Characteristics

11.1.4. **Figure 11-1** below shows the precast concrete circular culvert that conveys the watercourse beneath the A1 with a diameter of approximately 1.2 m and 24.3 m in length. The base of the culvert has been reinforced with concrete and a cover slab.

11.1.5. No fish surveys have been undertaken along Thirston Burn as it was determined that the watercourse supported unsuitable habitat for aquatic species due to an abundance of terrestrial grasses and low water levels (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 11-1 - Unnamed Tributary of Thirston Burn Culvert

11.1.6. The unnamed tributary of Thirston Burn is not monitored directly against the objectives of the WFD (**Ref. 10.2.1**) but is located within the 'Longdike Burn Catchment (trib of Coquet)' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Moderate', with the ecological quality assessed as 'Moderate' and the chemical quality assessed as 'Good'.

11.1.7. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'. **Tables 10-1**, **10-2** and **10-3** in **Section 10** present the ecological and chemical classifications ranging from 2013 to 2016 and the status objectives for the 'Longdike Burn Catchment (trib of Coquet)' WFD catchment, as classified by the Environment Agency. The Waterbody Summary Report for the 'Longdike Burn Catchment (trib of Coquet)' WFD catchment (**Ref. 10.2.30**) identifies the reason for not achieving 'Good' overall status as diffuse pollution from the surrounding agricultural land and rural land management practices.

11.2 SCHEME DESIGN

11.2.1. The following section describes the proposed extended culvert to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 11-2** below shows the location of the culvert.

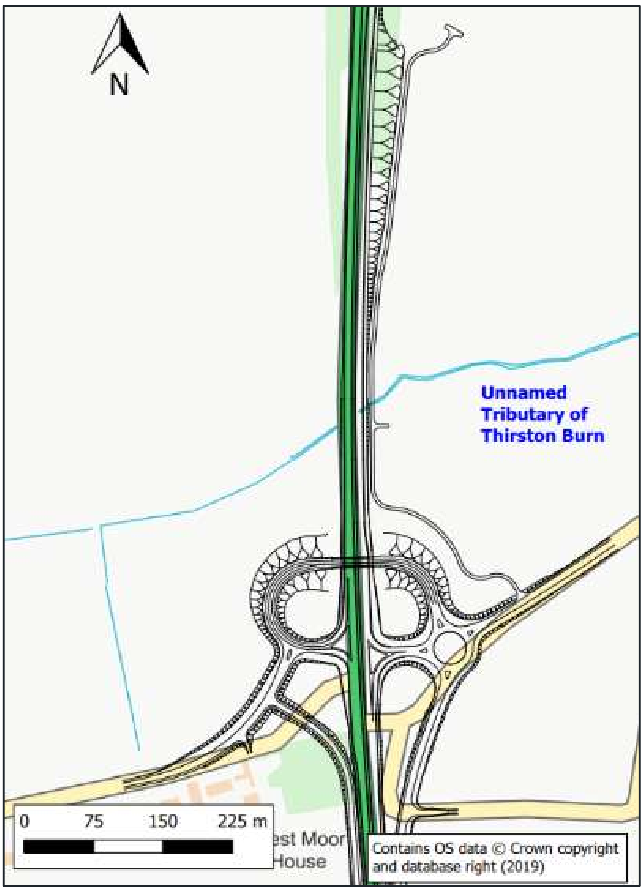

Figure 11-2 – Unnamed Tributary of Thirston Burn Culvert

Glenshotton Culvert (14)

11.2.2. The existing culvert of the unnamed tributary that flows into Thirston Burn, located to the south of the River Coquet at chainage 21860, would be extended by approximately 23.3 m to the east in order to accommodate the proposed increased width of Part A alignment. The size and shape of the culvert would be maintained, thereby being a circular shape with a diameter of 1.35 m and with a total length of 47.6 m.

11.2.3. Scour protection would be provided. As the size of the culvert has been determined by flood risk parameters, and the vertical alignment of the highway provides a number of design constraints, mammal passage has not been included in the design.

11.2.4. The extended culvert would require the construction of a reinforced concrete base and cover slab that would be cast in-situ around a precast pipe. Precast headwalls would be provided at the east end of the culvert and precast training walls would run parallel to the watercourse.

Culvert Summary

11.2.5. **Table 11-1** below provides a summary of the existing and proposed culvert dimensions.

Table 11-1 – Existing and Proposed unnamed Tributary of Thirston Burn Culvert dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing A1 culvert	24.3	Circular	1.2	-
Proposed Glenshotton Culvert (14)	47.6	Circular	1.35	-

Surface Water Drainage

11.2.6. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There are two new outfalls proposed to discharge into the tributary of Thirston Burn. **Table 11-2** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 11-2 – Tributary of Thirston Burn Proposed Surface Water Drainage System

<table>
<tr><th>Outfall</th><th>Stage</th><th>Proposed Attenuation and Treatment</th><th>Percentage of Surface Water Runoff Received</th></tr>
<tr><td>17a/17b</td><td>1</td><td>Two grassed detention basins that would have a permanent wet area with sediment forebays located at the inlets of the basins</td><td>100 %</td></tr>
<tr><td rowspan="3">17</td><td rowspan="2">1</td><td>Filter drain located in the verges</td><td>25 %</td></tr>
<tr><td>Kerb and gully drainage</td><td>75 %</td></tr>
<tr><td>2</td><td>Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
</table>

12 RIVER COQUET

12.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

12.1.1. The River Coquet rises at Coquet Head within the Cheviot Hills, in Northumberland National Park at 440 m AOD, which is approximately 40 km to the north-west of the existing A1 alignment. The catchment is characterised by a steep, deep valley with land use dominated by agricultural, woodland and upland vegetation with a number of small rural communities. Urban land use occupies less than 1 % of the catchment with grassland being the dominant land use. The catchment area is approximately 486 km².

12.1.2. Within the Study Area, the River Coquet flows under the existing A1 bridge and flows in a predominantly south-west to north-east direction. It discharges into the North Sea approximately 17 km downstream of the bridge by the town of Amble. The River Coquet is classified as a main river and under the jurisdiction of the Environment Agency. The study reach lies within a deep v-shaped valley, with heavily vegetated steep slopes with managed coniferous and deciduous woodland on the northern face and ancient woodland dominating the southern face (Dukes Bank Wood).

12.1.3. Within the upper catchment of the River Coquet, the solid geology is dominated by low permeability bedrock; moderate permeability bedrock is more prevalent in the lower reaches of the catchment. Mixed permeable deposits dominate the superficial geology. Low permeability bedrock affects the flood hydrograph, which reflects the response of a river to rainfall. Thus, low permeability results in faster rising water levels following rainfall in the catchment. The River Coquet, consequently, has a flashy hydrological regime with the river typically rising and falling within a four-hour period following rainfall.

12.1.4. The soils are dominated by Cambisols with a soil texture of predominantly clay to sandy loam and are cohesive. Thus, the soils are resistant to fluvial erosion processes.

Historical Channel Changes

12.1.5. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1860s indicates that the alignment of the River Coquet has not changed or has been modified. The river valley shows characteristic signs of post-glacial adjustment following the Pleistocene glaciation, with distinct terrace formations and the channel being bound by the deep-cut valley with bedrock controls. During the post-World War II period, the mapping record reveals a reduction in woodland cover on the valley sides. Legacy industrial activities within the catchment include mills, which were powered by the river.

Contemporary Channel Characteristics

12.1.6. The River Coquet flows beneath the existing A1 bridge alignment within Dukes Bank Wood. **Figure 12-1** below shows a photograph of the bridge facing downstream. The as-built drawing for the bridge has been included in **Figure 10.2: River Coquet Bridge As-Built Drawing, Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**).

Figure 12-1 - River Coquet Bridge, Looking Downstream

12.1.7. The River Coquet is designated as part of the River Coquet and Coquet Valley Woodlands SSSI. The SSSI was last surveyed in August 2010 and was found to be in an 'unfavourable – recovering' condition. The site is designated for Atlantic salmon, brook lamprey and sea lamprey. The citation for the River Coquet and Coquet Valley Woodland SSSI states that the riverside shingle habitats support an important assemblage of ground beetles with several nationally scarce species.

12.1.8. Due to the assumed presence of migratory species able to reach the spawning grounds in the tributaries and the large size of the River Coquet, it was deemed unnecessary to assess fish populations as part of the assessment (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). For further information regarding fish population refer to **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**). The mammal survey identified the presence of otters along the River Coquet (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). Otters are a European protected species and are listed under Section 41 of the NERC Act 2006 (**Ref. 10.2.28**) and are of principal importance.

12.1.9. Data obtained from the Environment Agency during consultation returned the following records of fish:

a. Atlantic salmon
b. Brown/sea trout
c. European eel
d. Stone loach

e. Minnow
f. Three-spined stickleback

12.1.10. Atlantic salmon, brown/sea trout and European eel are all protected species listed under Section 41 of the NERC Act 2006 (**Ref. 10.2.28**) and are of principal importance. Brown trout and European eel are also listed in the Northumberland Local Biodiversity Action Plan (LBAP) (**Ref. 10.2.29**).

12.1.11. The River Coquet is monitored against the objectives of the WFD (**Ref. 10.2.1**) and is located within the 'Coquet from Forest Burn to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Good', with the ecological quality assessed as 'Good' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'. The hydromorphological status and the hydrological regime currently 'Supports Good'. **Tables 12-1** and **12-2** below present the ecological and chemical classifications ranging from 2013 to 2016 for the 'Coquet from Forest Burn to Tidal Limit' WFD catchment, as classified by the Environment Agency.

Table 12-1 – Ecological Classifications for Coquet from Forest Burn to Tidal Limit

	2013	2014	2015	2016
Overall	Good	Moderate	Good	Good
Ecological	Good	Moderate	Good	Good
Biological quality elements	Good	Moderate	Good	Good
Hydromorphological supporting elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	High	High	Good	Good
Specific pollutants	High	High	High	High

Table 12-2 – Chemical Classifications for Coquet from Forest Burn to Tidal Limit

	2013	2014	2015	2016
Overall	Good	Moderate	Good	Good
Chemical	Good	Good	Good	Good

	2013	2014	2015	2016
Priority substances	Good	Good	Good	Good
Other pollutants	Good	Good	Good	Good
Priority hazardous substances	Good	Good	Good	Good

12.1.12. The overall form of the river valley is controlled by the underlying geology and topography. Here, bedrock controls exert a significant control on the river planform and cross-sectional profile. The river has a sinuous planform (sinuosity index of 1.09) with lateral adjustment of the channel being confined by the valley form and geology. Where the valley is less confined, point bar development has occurred along the River Coquet. Some undercutting of the banks was observed during site visits; however, the rates of bank erosion are assessed as low and insignificant. This assessment is supported by the cohesive nature of the soils forming the river banks, coupled with the dominance of bedrock within both the channel and banks.

12.1.13. Instability of the valley slopes, dating back to the Pleistocene glaciation, is active within the Study Area. Geotechnical failures observed include shallow slides and rotational slips. Slope instability is also recorded within the Made-ground constructed for the existing A1 bridge.

12.1.14. Flow types within the study reach are dominated by runs, glides and riffles. Channel substrate is dominated by bedrock with poorly graded large boulders and cobbles present. Gravels make up a small fraction of the channel substrate with very coarse gravels being recorded within the riffles, and medium to very coarse gravels recorded within the runs and pools. At the location of the existing and proposed new River Coquet bridge, bedrock was observed spanning bank-to-bank across the channel. Overall, the River Coquet sediment appears to be supply limited.

12.1.15. At the location of the existing and proposed new River Coquet bridge, the river was observed to be a sediment deposition zone with accumulations of cobbles and boulders. These accumulations of coarse substrates were typically moss-covered and vegetated, indicating very low mobility of these particles and stability of the mid-channel bar feature they form.

12.1.16. The study reach was observed to be predominantly free of modifications, except for the existing A1 bridge and associated piers and revetments, and the presence of weirs along the watercourse.

12.1.17. Additional baseline information in relation to the geomorphology of the River Coquet is available in **Appendix 10.4: Geomorphology Assessment – River Coquet, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

12.2 SCHEME DESIGN

12.2.1. A new bridge over the River Coquet would be constructed parallel to the eastern side of the existing bridge. Refer to the River Coquet Bridge drawing (refer to **Structures Engineering Drawings and Sections** (**Application Document Reference: TR010041/APP/2.8**). The existing bridge would carry northbound traffic and the new bridge would carry southbound traffic.

12.2.2. The new bridge would comprise a three-span composite steel / concrete continuous bridge deck with two upright supports referred to as piers.

12.2.3. The proposed piers would be on the same alignment as the existing piers on the existing northbound bridge. The proposed southern abutment on the new bridge would also be on the same alignment as the existing southern abutment on the existing bridge. The proposed northern abutment on the new bridge would be approximately 27 m further north than the northern abutment on the existing bridge to mitigate for the presence of deep-seated geological slip concerns on the north bank of the valley.

12.2.4. The new structure would be located outside of the normal water levels of the River Coquet. The southern pier may become inundated during high flow events.

Surface Water Drainage

12.2.5. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). There is one new outfall proposed to discharge into the River Coquet. **Table 12-3** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 12-3 – River Coquet Proposed Surface Water Drainage System

Stage	Proposed Attenuation and Treatment	Percentage of Surface Water Runoff Received
1	Filter drain located in the verges	90 %
	Kerb and gully drainage	10 %
2	Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin	100 %

13 BRADLEY BROOK

13.1 BASELINE CONDITIONS

CATCHMENT OVERVIEW

13.1.1. The source of Bradley Brook is approximately 0.3 km to the west of the existing A1 alignment within Park Wood. The catchment of the watercourse is small with a catchment area of less than 0.5 km², consisting primarily of woodland. Bradley Brook flows in a west to east direction and flows underneath the existing A1 alignment through a culvert within Park Wood. Bradley Brook discharges into Back Burn approximately 0.9 km downstream of the existing culvert. Bradley Brook and Back Burn are classified as ordinary watercourses and under the jurisdiction of NCC as LLFA for this area.

13.1.2. The estimated Q95 for the unnamed tributary of Bradley Brook at the location of Part A proposals is 0.0014 m³/s. Q95 is defined as the flow equalled or exceeded for 95 % of the flow record and is a low flow parameter. The estimated Qmed for the unnamed tributary of Bradley Brook at the location of Part A proposals is 0.038 m³/s. Qmed is defined as the median annual flow rate for the 1 in 2 year flood event.

Historical Channel Changes

13.1.3. Analysis of historical maps (**Ref. 10.2.22**) dating back to the 1890s indicates that the alignment of Bradley Brook has not changed.

Contemporary Channel Characteristics

13.1.4. During the site walkover, it was noted that the river bed comprised silt and gravels and the watercourse is located within a heavily wooded area. Bradley Brook flows underneath the existing A1 alignment through a precast concrete circular culvert as shown in **Figures 13-1** and **13-2**. The culvert has a diameter of approximately 1.2 m at the inlet and is 125 m in length. The base of the culvert has been reinforced with concrete and a cover slab. At the outlet of the culvert, the diameter is reduced to 900 mm for approximately 20 m. It is assumed that the culvert was previously extended to enable construction of an above ground attenuation area. There is a smaller circular pipe just above the main culvert as shown in **Figure 13-1**, which has an approximate diameter of 300 mm.

13.1.5. The fish surveys undertaken did not identify any freshwater species (**Appendix 9.3: Aquatic Ecology Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (**Appendix 9.17: Water Vole and Otter Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Figure 13-1 - Bradley Brook Culvert, Outlet

Figure 13-2 - Bradley Brook Culvert, Inlet

13.1.6. Bradley Brook is not directly monitored against the objectives of the WFD (**Ref. 10.2.1**) but is located within the 'Coquet from Forest Burn to Tidal Limit WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of 'Good', with the ecological quality assessed as 'Good' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

13.1.7. **Tables 12-1** and **12-2** in **Section 12** present the ecological and chemical classifications ranging from 2013 to 2016 for the 'Coquet from Forest Burn to Tidal Limit' WFD catchment, as classified by the Environment Agency.

13.2 SCHEME DESIGN

13.2.1. The following section describes the proposed extended culvert to be provided as part of Part A. Refer to the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). **Figure 13-3** below shows the location of the proposed culvert extension.

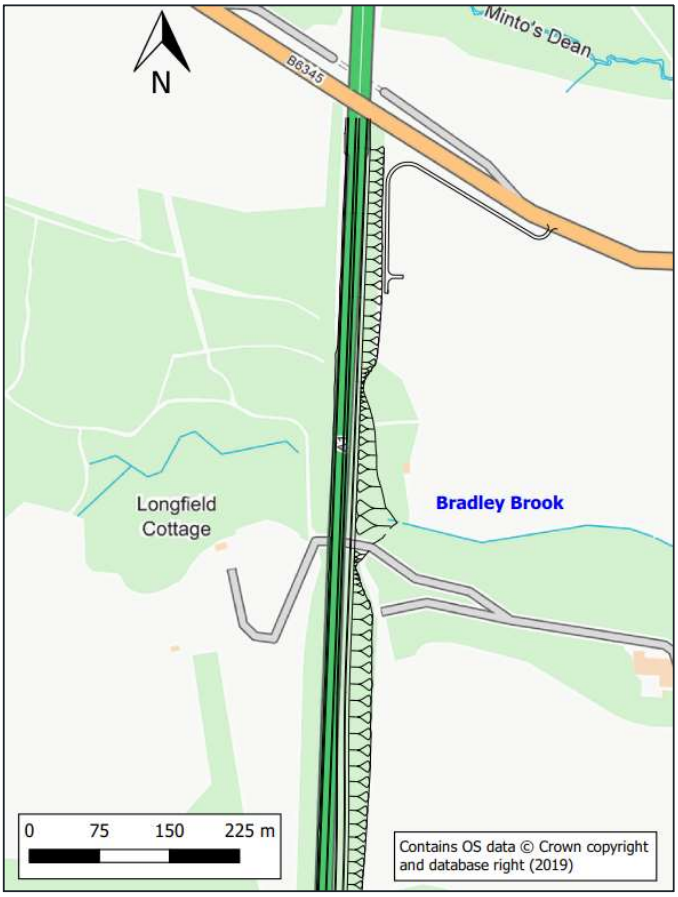

Figure 13-3 – Bradley Brook Proposed Culvert Extension

Parkwood Culvert (16)

13.2.2. The existing culvert of Bradley Brook located at the northern extent of Part A at chainage 23140 would be extended by approximately 20 m to the east to accommodate the proposed increased width of the Scheme alignment of Part A. The extension would match the upstream culvert size and comprise a circular culvert with a diameter of 900 mm. The total length of the existing and proposed extension would be 145 m. The culvert extension would comprise a precast reinforced concrete pipe.

13.2.3. The downstream culvert extension would include a 150 mm natural bed to encourage fish passage due to future proofing, and scour protection would be provided.

Culvert Summary

13.2.4. **Table 13-1** below provides a summary of the existing and proposed culvert dimensions.

Table 13-1 – Existing and Proposed Bradley Brook Culvert Dimensions

Structure	Length (m)	Shape	Width (m)	Height (m)
Existing A1 culvert	125	Circular	1.2 at the inlet 0.9 at the outlet	-
Proposed Parkwood Culvert (16)	145	Circular	0.9	-

Surface Water Drainage

13.2.5. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). There are two new outfalls proposed to discharge into Bradley Brook.

13.2.6. **Table 13-2** below shows the different stages of treatment provided and the percentage of surface water runoff that would pass through each stage.

Table 13-2 – River Coquet Proposed Surface Water Drainage System

<table>
<tr><th>Outfall</th><th>Stage</th><th>Proposed Attenuation and Treatment</th><th>Percentage of Surface Water Runoff Received</th></tr>
<tr><td rowspan="3">19</td><td rowspan="2">1</td><td>Filter drain located in the verges</td><td>65 %</td></tr>
<tr><td>Surface water channel</td><td>35 %</td></tr>
<tr><td>2</td><td>Grassed detention basin that would have a permanent wet area with a sediment forebay located at the inlet of the basin</td><td>100 %</td></tr>
<tr><td rowspan="2">21</td><td>1</td><td>Filter drain located in the verges</td><td>100 %</td></tr>
<tr><td>2</td><td>Detention tank</td><td>100 %</td></tr>
</table>

14 GROUND CONDITIONS

14.1 BASELINE CONDITIONS

14.1.1. A review of the British Geological Survey (BGS) 1:50,000 data (**Ref. 10.2.20**) indicates that the majority of Part A is underlain by bedrock geology of the Stainmore Formation comprising mudstone, siltstone and sandstone. A seam of the Northern England Late Carboniferous Tholeiitic Dyke-Swarm (Quartz-microgabbro) comprising igneous bedrock is located to the north of Causey Park. There is also a small deposit of Corbridge Limestone located along the River Coquet to the north of Part A.

14.1.2. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.2.17**) indicates that the majority of the bedrock geology is classified as Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The seam of Tholeiitic Dyke-Swarm is classified as Secondary B Aquifer, described as predominantly lower permeability layers which may store and yield amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

14.1.3. A review of BGS 1:50,000 data (**Ref. 10.2.20**) indicates that superficial deposits within the Study Area are mostly glacial till with an area of glacial sands and gravels located to the north of Part A surrounding the River Coquet. There are also alluvium deposits consisting clay, silt, sand and gravel associated with the Longdike Burn and the Earsdon Burn.

14.1.4. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.2.17**) indicates that the majority of the superficial deposits are classified as a Secondary (Undifferentiated) Aquifer. The sands and gravels are classified as a Secondary A Aquifer along the River Coquet and Longdike Burn.

14.1.5. A review of the Cranfield University Soilscapes database (**Ref. 10.2.21**) indicates that soils within the Study Area are slowly permeable loamy and clayey soils.

14.1.6. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.2.17**) indicates that the southern section of the Study Area, just to the north of Morpeth, is located within a total catchment (Zone 3) groundwater Source Protection Zone (SPZ). Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. SPZs are typically used to protect abstractions for public water supply. The quality of surface water runoff discharged to ground within designated SPZs is of key importance.

14.1.7. Groundwater quality has been assessed against the objectives of the WFD (**Ref. 10.2.1**). Part A is located within the Northumberland Carboniferous Limestone and Coal Measures groundwater catchment area. A review of the Environment Agency’s Catchment Data Explorer (2016 results) (**Ref. 10.2.18**) indicates an overall quality of ‘Poor’, with the quantitative quality assessed as 'Poor' and the chemical quality assessed as 'Poor'. **Table 14-1** below presents the quantitative quality and chemical quality classifications ranging from 2013 to 2016 for the Northumberland Carboniferous Limestone and Coal Measures groundwater catchment area, as classified by the Environment Agency. The Environment Agency identifies the reason for not achieving 'Good' overall status as point source pollution from an abandoned mine.

Table 14-1 – WFD Classifications for Northumberland Carboniferous Limestone and Coal Measures Operational Catchment

Year	Overall	Quantitative	Chemical	Chemical Drinking Water Protected Area	General chemical test	Chemical GWDTEs test	Chemical dependant surface water body status	Chemical Saline Intrusion
2013	Poor	Good	Poor	Good	Good	Good	Poor	Good
2014	Poor	Good	Poor	Good	Good	Good	Poor	Good
2015	Poor	Good	Poor	Good	Good	Good	Poor	Good
2016	Poor	Good	Poor	Good	Good	Good	Poor	Good

14.1.8. The ground investigation work undertaken in 2018 (**Appendix 11.2: Ground Investigation Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) to build upon previous work included groundwater monitoring of sixteen locations where groundwater strikes had previously been recorded during investigation work. The groundwater monitoring indicated that groundwater levels are relatively stable between 0.5 and 1 m below ground level (bgl).

14.1.9. The glacial deposits along Part A within the Study Area recorded groundwater levels between 1.5 and 2.5 m bgl. All of the groundwater monitoring results therefore indicate that that groundwater levels are relatively high across the Study Area. This is of particular note in locations near to watercourses and areas at high risk of surface water flooding, as discussed below in **Section 15.3**.

Sections of Part A to the north and to the east are located within the Coal Authority's reporting area. The online Coal Authority's screening tool (**Ref. 10.2.31**) indicates that Part A is not located within a constraint area that requires further investigation regarding surface water drainage development proposals as identified by the Coal Authority regarding specific mining or groundwater.

15 IMPACT ASSESSMENT

15.1 CONSTRUCTION PHASE

INCREASED SEDIMENTATION

15.1.1. Site runoff during the construction phase containing elevated suspended particles may result from land clearance, excavation, dewatering of excavations, stockpiles, wheel washings and movement of materials to and from the site. Runoff with high sediment loads may have direct adverse effects on adjacent water bodies through increasing turbidity (thus reducing light penetration and reducing plant growth), and by smothering vegetation and bed substrates (thus impacting on invertebrate and fish communities through the destruction of feeding areas, refuges and breeding and/or spawning areas). Organic sediments can also have indirect effects on physico-chemical properties such as dissolved oxygen demand and pH. The impacts would be direct and temporary. Water quality within the affected water body would improve over time as sediments settle or are trapped by vegetation, and vegetation adapts to the new bed conditions.

15.1.2. The magnitude of the impact is likely to be greatest when working in areas adjacent to the identified surface water features, and in periods of heavy rainfall. Notwithstanding the in-channel works, the greatest risk to increased sedimentation is most likely to be associated with runoff from earth stockpiles or occur during the construction of the online improvements and the new offline section of road, drainage detention basins and outfalls that are located within approximately 10 m of any watercourses.

15.1.3. There would be a number of topsoil stores located along the Scheme alignment of Part A, dependant on adjacent ground levels and local surface water flow paths.

15.1.4. Increased sedimentation may also be caused by sediment (particularly from construction plant) that may migrate to the site drainage systems that outfall directly to the adjacent watercourses.

15.1.5. For the River Coquet, the increase in fine sediment resulting from vegetation clearance, runoff, plant and vehicle washing, and excavation works is a key risk. Fine sediment that may be released into the channel is likely to be held in suspension given the flow velocities within the study reach. However, settling of fine sediment may occur, especially in the shallow water zones and raised bed areas that are common within the study reach. This may cause localised smothering of the river bed with resulting alteration to the bed morphology.

15.1.6. Removal of vegetation may also result in localised negative impacts on aquatic ecology due to the loss of channel shading and input of food sources from overhanging vegetation. Construction activities may also disrupt the migration of fish species within the catchment due to noise, vibration and water quality issues resulting from fine sediment release.

15.1.7. Weather conditions would also influence the severity of impacts. This includes the occurrence of high flows during construction, especially if dry working areas for new culverts and bridges (including the new bridge pier construction for the River Coquet) became inundated. Many of these impacts would worsen with intense or prolonged rainfall events during the construction phase. If excavations became flooded, the water contained within the excavation area would be laden with fine sediments, which may be released into the adjacent watercourse.

POLLUTION RISKS

15.1.8. The release of hydrocarbons into on-site drainage systems, or from direct runoff and spillages into watercourses, is the second most common form of pollution after increased sediment loading. Hydrocarbons form a film on the surface of the water body, deplete oxygen levels and may be toxic to fish. Even at very low concentrations, the film may negatively affect the visual appearance of the water body. The impact would be direct and temporary. Water quality within the affected water body would improve over time as pollutants disperse and are treated by natural processes. The risk is likely to increase during the construction period due to a larger number of vehicles accessing the site, refuelling of vehicles and plant, leakage from oil and fuel storage tanks, and accidental spillages.

15.1.9. The use of hazardous products on site may present a pollution risk because of the potential for accidental spillages and the uncontrolled release of washdown water and runoff. If materials and activities are not stored and carried out in designated areas, runoff and washdown may enter a water body, adversely affect the aquatic environment or contaminate surface and groundwater water abstractions. The most common source of pollution is from concrete and cement products. These products are highly alkaline and corrosive. Fish may be physically damaged and their gills blocked, and both vegetation and the bed of the receiving water body may be smothered. For the most part, it is only when large quantities of hazardous substances are spilled, or the spillage is directly into the water body, that a significant risk of acute toxicity would arise in the receiving water. The magnitude of any impact would depend on the scale and nature of any potential incident and, is therefore, difficult to predict. Generally, impacts would be direct and temporary to long term. Water quality within the affected water body would improve over time as pollutants are dispersed and diluted. However, a significant direct spillage of a toxic substance could cause long-term damage to the receiving water body.

15.1.10. Construction compounds are likely to pose the greatest risk in terms of hazardous products, although appropriate site management and spill containment measures would minimise this risk. There would be two compounds for Part A: one located adjacent to the Westmoor Junction; and a satellite compound adjacent to the Fenrother Junction.

15.1.11. The dispersion and impact of hydrocarbons and hazardous products that enter groundwater resources is dependent on geology, depth to groundwater table and characteristics of the aquifer. Groundwater contamination is difficult to treat and may have an adverse indirect effect on the quality of watercourses that receive groundwater baseflow and or are in hydraulic connectivity to groundwater. The relatively low permeability of geology within most of the Study Area would limit the ability of pollutants to affect groundwater resources. Excavations and boreholes, most notably those that would be required to construct the new bridge piers, may pose greatest risk to groundwater resources, particularly in the alluvial deposits in close proximity to the watercourse. However, general good site practice would reduce this risk and it is considered unlikely that pollution of groundwater resources would occur.

WORKS WITHIN WATERCOURSES

15.1.12. Works that are proposed within or immediately adjacent to the river channels have the potential to impact the chemical, ecological and hydromorphological quality of the watercourses associated with increased sedimentation, pollution spillages, removal of existing bankside habitat, damage to existing substrate, and changes to the hydraulic profile of the watercourse.

SEDIMENT TRANSPORT AND EROSION PROCESSES

15.1.13. A detailed assessment of the potential impacts associated with Part A to the River Coquet has been undertaken in **Appendix 10.4: Geomorphology Assessment – River Coquet, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). A summary of this assessment is provided below.

15.1.14. The geomorphological dynamics assessment of the River Coquet revealed an increase in flow velocity during construction under flows that are high enough to inundate the proposed construction zone. Here, the flow velocity was shown to increase from 0.77 m/s^{-1} under baseline conditions to 1.07 m^3/s during construction during a high frequency and low magnitude event. This may result in an alteration from gravels and finer particle sizes being mobile to small cobbles having the potential to be mobilised during the construction period. During a low frequency and high magnitude event, the analyses revealed that the velocity would potentially increase from 1.26 m^3/s to 1.77 m^3/s, which could mobilise small-to-medium boulders. However, the low shear stress values suggest any entrainment and transport would only be very localised and occur over short distances as bedload.

15.1.15. Should high flows encroach on the construction zone, there may be slight increases in flow velocity, stream power and sediment transport capability due to less friction with the river bed and increased water depth. During such flow conditions, the cross-sectional area and wetted perimeter within the construction zone would be reduced compared with the baseline. Thus, the hydraulic radius, which is a function of the cross-sectional area divided by the wetted perimeter, would also be altered through the construction zone. This could result in potential increased efficiency of the river to transport sediment due to reduced bed friction, with a system response of higher flow velocity. However, following a geomorphological dynamics assessment, the risk of larger particles (cobbles and boulders), becoming mobilised during the construction period was assessed as low. Large substrate sizes are only likely to be mobilised during extreme, high magnitude flow event.

15.1.16. The removal of vegetation may impact on bank stability and could increase erosion of the exposed bare earth, which is composed of sand, silts and clays. The vegetation clearance may cause a local destabilising factor, which could trigger further slope instability and landslip activity.

15.1.17. The potential erosion of exposed earth is a key issue during construction due to the potential for the release of fine sediment into the river. Vegetation removal and earthworks to regrade slopes, create a haul road and excavation for the pier foundations is a major source of fine sediments. Whilst fine sediment is likely to be rapidly transported by the river, and primarily as suspended load, it may have detrimental impacts further downstream and potentially extend beyond the study reach with impacts at the wider water body scale. An increase in fine sediments into the channel could, consequently, have a negative impact on ecology, including habitats for Atlantic salmon, brook lamprey, sea lamprey and exposed riverine sediment for ground beetle, which are noted to be among the best nationally.

CONSTRUCTION PHASE MITIGATION AND ASSESSMENT SUMMARY

All Watercourses

15.1.18. The culvert construction methodology is included in **Appendix 2.3: Culvert Construction Methodology, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**). The construction methodology is divided into two sections; online and offline culverts. The demolition of existing culverts, extensions to existing culverts, and the construction of new culverts along the offline section of Part A would all be undertaken within a dry construction area. The construction methodology for the River Coquet is discussed separately below.

15.1.19. For works to the online section of Part A, the dry construction area would be created by diverting flows through an adjacent culvert, pipe or drainage channel. If this is deemed infeasible by the main contractor, then a temporary sump is proposed. The sump would be excavated on the upstream side of the existing structure, and a pump would be used to divert flows through a pipe suspended above the base of the culvert.

15.1.20. However, for the Longdike Burn where flows are too large for a temporary sump and due to the presence of notable aquatic species, an individual construction plan would be developed during the detailed design phase in consultation with the Environment Agency during the application for an Environmental Permit (Flood Risk Activities Permit). This would ensure that an appropriate method of construction in line with the sensitivity of the watercourse can be developed.

15.1.21. For works to the offline section of Part A, where new culverts are not located along the alignment of a watercourse, provision for the first flush through the structures would be considered. Where new culverts are located along the alignment of a watercourse, a dry construction area would be created by diverting flows through an adjacent pipe or drainage channel. If this is deemed infeasible by the main contractor, then a temporary sump is proposed.

15.1.22. The new sections of culvert would be made from precast concrete or pipes to reduce the potential for polluting the watercourses.

15.1.23. Measures would be detailed in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and would include the following:

- **a.** Measures to deal with the first flush once flows are diverted through the new culverts.
- **b.** An exclusion zone of 8 m from the watercourses should be maintained as far as practicable.
- **c.** Avoid the positioning of stockpiles near to watercourses, ensure they are located outside of the flood zone. Stockpiles should be located a minimum of 8 m from the top of bank.
- **d.** Cover stockpiles when not in use.
- **e.** Contain the stockpiles with bunds or sediment fences.
- **f.** Do not wash vehicles near to the watercourses.
- **g.** Avoid undertaking works adjacent to the watercourses, where practicable. When working adjacent to a watercourse is required, maintain the maximum distance possible from the watercourse along with appropriate mitigation outlined above for fine sediment management.
- **h.** Avoid works during high flow events and intense rainfall to reduce the risk of fine sediment release.
- **i.** Limit the clearance of vegetation on the channel banks and riparian zone. Where practicable, maintain a vegetated buffer strip between the construction zone and the watercourse. Ideally, a minimum buffer strip of 8 m should be retained where possible.
- **j.** Use seeded biodegradable fibre matting to encourage re-vegetation after works on, or near, the banks. This is more applicable to the larger watercourses such as the Longdike Burn.
- **k.** Maintaining, where possible, vegetation cover on the banks close to the rivers and prompt reinstatement of vegetation to minimise the impact of reduced roughness, thus potentially reducing stream power, flow velocity and sediment transport capability through the construction zone.
- **l.** Avoid critical periods for fish migration and spawning. This is important for the watercourses where notable or protected species of fish have been identified.
- **m.** Mitigation for the potential impacts outlined should be included within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and should be adhered to. The **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) should include measures to control runoff during construction.

This may include creating temporary drainage systems to both alleviate flood risk and help to prevent sediment laden runoff entering the watercourse.

n. The main contractor shall be required to comply with the relevant sections of British Standard (BS) 6031:2009 Code of Practice for Earthworks (**Ref. 10.2.32**) with respect to protection of water quality and control of site drainage including washings, dewatering, abstractions and surface water.

o. Best practice measures associated with storage of oils and fuels shall be followed and included within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**).

p. Concrete mixing and washing areas shall be located more than 10 m from any watercourse; have settlement and re-circulation systems for water reuse; have a contained area for washing out of concrete batching plant or ready-mix lorries; collect wash-waters and, where necessary, contain wash-water for authorised off-site disposal. Wash-water from concrete shall not be discharged into a watercourse.

RIVER COQUET

15.1.24. Construction access would be via haul roads down the valley sides on both banks. Tower cranes located at the top of bank, as defined by the normal river level, would be used to construct the pier-base and stem construction and for servicing the deck construction. Haul routes and laydown areas would not encroach on the adjacent SSSI and environmental measures would be in place to avoid potential impacts from construction activities; these measures would be detailed in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**), as detailed in **Appendix 10.4: Geomorphology Assessment – River Coquet, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

15.1.25. A sheet-piled cofferdam would be installed to construct the southern pier base, which would avoid entering the watercourse under normal flow conditions. This would be installed using a tracked piling rig; some pre-augering may be required to drive the piles to the required level, depending on the quality of the underlying rock. The bore piled rig wall would be installed to bedrock level.

15.1.26. Due to the sensitivity of the River Coquet, additional information regarding construction mitigation is provided below and in **Table 15-1**. All the mitigation measures listed above are also applicable to the River Coquet.

Table 15-1 – Mitigation Measures for the Construction of the new River Coquet Bridge

Source of Impact	Mitigation Measure	Type of Mitigation
Suspended solids – fine sediment	Provide sediment barriers between earth works and the construction zone and the watercourse to prevent sediment from washing into the river. Silt management needs to be considered not only adjacent to the watercourse, but also up the valley sides and at the valley	Reduction

Source of Impact	Mitigation Measure	Type of Mitigation
	top to minimise fine sediment input into the watercourse. An exclusion zone of 8 m from the watercourse and top of the valley sides should be maintained as far as practicable.	
	Use a sediment trap to treat surface runoff.	Reduction
	Avoid works during high flow events to reduce the risk of fine sediment release.	Reduction
Vegetation clearance	Use seeded biodegradable fibre matting to encourage re-vegetation after works on, or near, the banks.	Reduction
	During construction, vegetation would be maintained for roughness during flows that exceed the assumed bankfull channel. This would potentially reduce the flow velocities and stream power through the construction zone compared with total vegetation clearance.	Reduction
	The creation of a dry-working area outside of the assumed bankfull channel would minimise the risk of potential impacts on flow during construction. Impacts on flow would only be incurred should out-of-bank flows that encroach on the construction zone occur.	Reduction
Timing of works	In river works would be restricted to daylight hours to reduce the impacts to fish including salmon and brown trout.	Reduction
	In river works would not occur during high flows. Monitoring of flows and rainfall within the upstream catchment should be undertaken and action taken to holt works should high flows be anticipated due to prevailing weather conditions.	Reduction

15.1.27. **Table 15-2** below provides an assessment of the potential for Part A to cause deterioration in the current ecological and chemical WFD potential of all the watercourses along Part A during construction. The assessment considers appropriate and best practice mitigation that would be implemented to minimise any adverse impacts. Longer term impacts associated with permanent changes to the hydraulic profile of the watercourses are discussed as operational impacts.

15.1.28. A detailed assessment of the potential impacts to aquatic ecology and riparian habitat associated with Part A is presented in **Chapter 9: Biodiversity**, **Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).

Table 15-2 - Potential for Part A to Cause Deterioration in the Current Ecological and Chemical Potential of Identified Watercourses During Construction

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Ecological					
Biological	Fish Invertebrates Macrophytes	Impacts and changes to the watercourses during construction of Part A as a result of increased diffuse pollution and sedimentation.	Prior to construction, an **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would be produced by the main contractor to manage environmental impacts during construction. The CEMP would set out how construction activities would be undertaken in accordance with appropriate good practice guidance, such as CIRIA's control of water pollution from construction sites (C532) (**Ref. 10.2.33**). Although withdrawn, the Pollution Prevention Guidelines (PPG) (**Ref. 10.2.34**) published by the Environment Agency still provide good practice guidance, particularly PPG1 - General guide to the prevention of water pollution, PPG 5 - Works in, near or liable to affect watercourses and PPG 6 - Working at construction and demolition sites. Measures that should be outlined in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) for managing risks to the water environment should include the following: – Locating topsoil stores and construction compounds away from the banks of watercourses. – Covering and or seeding topsoil stores to further prevent sediment entering the watercourses during periods of heavy rainfall. – All loose materials would be covered so as not to increase sediment load to the drainage network. – Dewatering watercourses to maintain a dry construction area and passing any water generated by the dewatering process through silt busters or sediment tanks prior to returning this water to the watercourses. The **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would contain an ecological mitigation strategy to identify measures to mitigate the impact on ecological assets and a strategy of pollution prevention, which would include details of fuel storage, spillage management, disposal of contaminated drainage and	Some increase in sedimentation is likely to occur due to the proximity of the works to the river channels and works required within the river channels. Given the low sensitivity of the majority of watercourses to increased sedimentation and specific fish mitigation measures along the Longdike Burn, the impact is not considered to pose a risk of failing current WFD status or preventing watercourses from meeting future WFD objectives.	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
			measures for highlighting pollution prevention awareness within the workforce. The gravel bed of the new culverts and (where feasible) increased culvert size would improve connectivity for fish passage and mammal passage. Where notable or protected aquatic species have been identified in the baseline conditions, it is proposed to carry out fish rescues prior to commencing any construction. Further information regarding this can be found in **Chapter 9: Biodiversity**, **Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).		
	River Coquet: Fish Macrophytes Macro-invertebrates	Construction activities, such as noise and vibration may impact on fish migration. Suspended solids, vegetation clearance and construction activities may result in the input of fine sediment into the channel. The potential for spillages may also cause pollution of the watercourse with detrimental impacts on the aquatic ecology.	Mitigation, both embedded into design and included within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**), would be implemented to minimise and, where practicable, eliminate impacts. Construction activities in or close to watercourses that support fish would avoid fish migration and spawning periods. Control of fine sediment release would be crucial in minimising potential impacts on the biological quality elements and WFD status.	With mitigation in place, no adverse impacts or change to the WFD status are anticipated.	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Hydromorphology	Hydrological regime Morphology	Temporary diversions of watercourses to create dry working areas, changing upstream and downstream flow dynamics. Mobilisation of sediment during construction phase. Temporary loss of riparian habitat. Loss of connectivity for aquatic species.	The **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would detail and confirm the construction methodology for the removal of existing culverts and the construction of the new culverts. The flows would be diverted to create a dry working area. Where possible, a temporary channel would be created adjacent to the existing / permanent one to maintain connectivity during the construction phase. Some change to flow dynamics during construction would be inevitable but a review of the affected watercourses indicates that this would not pose risk of changing current WFD status or failure of WFD objectives. The change in flow dynamics may alter sediment processes upstream and downstream of the works, but this is not considered likely to have a notable impact on upstream or downstream morphological conditions that would pose risk to not meeting the objectives of the WFD. A number of watercourses along the Scheme have small catchments where flows are minimal so changes would not be significant enough to impact WFD status. The Longdike Burn has a large catchment and greater flows. As a result a temporary diversion may not be feasible. Specific mitigation for Longdike Burn would be developed during the detailed design stage in line with consultation with the Environment Agency to ensure WFD compliance. Riparian habitats temporarily lost are expected to re-establish within 2 years once construction has been completed. The removal of riparian habitats would be minimised as much as possible.	Some impact to the hydromorphology of the watercourses is likely to occur due to the works required within the river channels. Given the low sensitivity of the majority of watercourses and the development of specific mitigation measures along the Longdike Burn, the impact is not considered to pose a risk of failing current WFD status or preventing watercourses from meeting future WFD objectives. The alternative construction methodology for Longdike Burn that could be proposed if overpumping is not deemed appropriate during the Environmental Permit (FRAP) application would be to install a temporary structure along the proposed watercourse alignment around which the proposed structure can be built. This could, for example, comprise temporary precast concrete box culverts that sit on top of the proposed natural bed of the realigned watercourse channel. The flow from the existing watercourse can be diverted through the temporary structure along the new alignment, with baffles placed within the temporary structure to assist fish passage if deemed required by the Environment Agency. The use of a temporary structure would allow the permanent bridge to be constructed around the temporary structure in a dry construction area and significantly reduce risk to water quality. On completion of the works the temporary structure can be removed and the watercourse allowed to flow through the permanent structure. Improvements would also be provided to the existing Burgham culvert along Longdike Burn to the baffles to improve the long-term impact of Part A.	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
	River Coquet: Quantity and dynamics of flow River continuity River depth and width variation Structure and substrate of the river bed Structure of the riparian zone	Increased flow velocities, stream power and discharge during construction, with the potential to alter the sediment transport capability of the river. Disturbance to fish migrations due to noise and vibration. Localised alteration to the cross-sectional area and channel depth within the construction zone, with potential associated impacts on flow velocities, stream power and sediment transport capability. Potential for fine sediment input, altering the structure and substrate mix of the river bed. Potential for larger particles sizes to become mobilised under high flows during construction. However, mobilisation of the large substrate fractions is only likely during extreme events. Loss of riparian habitat due to vegetation clearance within the construction zone. Consequential impacts on reduced roughness, increased flow velocity, stream power, and the ability for the river to erode and transport sediment.	Mitigation, both embedded into design and included within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**), would be implemented to minimise and, where practicable, eliminate impacts. In river works would not occur during high flows. Vegetation clearance would be minimised as far as practicable. Reinstate vegetation, with an appropriate native species mix, as soon as practicable.	As above	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Physico-chemical / specific pollutants	Acid neutralising capacity Ammonia BOD Dissolved oxygen pH Phosphate Temperature Copper Zinc	Increase in concentration of elements due to accidental spillage of materials during construction or contaminants in site surface water discharge during construction. Increase in sediment-laden runoff with the potential to increase BOD, reduce dissolved oxygen, change pH and elevate phosphates.	All site works and ground works would be undertaken in accordance with the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) to ensure the risk of contamination during construction is mitigated. Measures that should be included in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) for managing risks to the water environment should include consideration to the following: – Management of surface water runoff to intercept and, where necessary, treat runoff to prevent the migration of pollutants to receiving water features. – Management of polluting substances that are being brought on site and used as part of the construction process. – Where practicable, all works would remain at least 8 m from the watercourse and from the top of the valley sides. – Similar mitigation to that discussed above for the control of increased sedimentation to ensure that flow would be maintained along the watercourses as discussed above which would assist in the dispersion of pollution.	Some increase in pollution is likely to occur due to the proximity of the works to the river channels and works required within the river channels. Given the low sensitivity of the majority of watercourses to pollution and the fact that a lot of the watercourses receive runoff from adjacent agricultural land that is likely to introduce sediment laden runoff with high organic loading, the impact is not considered to pose a risk of failing current WFD status or preventing watercourses from meeting future WFD objectives.	Yes
	River Coquet: As above	As above	As above	As above	As above

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Chemical					
Priority substances / Other pollutants / Priority hazardous substances	Lead Nickel Cadmium	Increase in concentration of elements due to accidental spillage of materials during construction or contaminants in site surface water discharge during construction.	All site works and ground works would be undertaken in accordance with the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) to ensure the risk of contamination during construction is mitigated. Measures that should be included in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) for managing risks to the water environment should include consideration to the following: – Management of surface water runoff to intercept and, where necessary, treat runoff to prevent the migration of pollutants to receiving water features. – Management of polluting substances that are being brought on site and used as part of the construction process. – Where practicable, all works would remain at least 8 m from the watercourse and from the top of the valley sides. – There is likely to be two construction compounds for Part A. The main compound would be approximately 50,000 m² located adjacent to the Thirston Burn. The second compound would be a satellite compound and approximately 20,000 m², located to the east of Fenrother Burn. The compound is approximately 200 m away from the watercourse.	None predicted	Yes
	River Coquet: As above.	As above.	As above.	As above.	As above.

15.2 OPERATION PHASE

CULVERTS

15.2.1. The replacement of existing culverts and the introduction of new culverts has the potential to significantly impact the hydromorphological quality of the watercourses along Part A. This could be because of increasing or reducing flow velocity, changing flow depth, removing natural bed and bank habitat. Culverts may pose a barrier to the movement of aquatic species along the river. If the hydromorphological characteristics of the existing watercourses are not retained or improved, this could consequently affect the ecological quality of the river.

15.2.2. The design of the culverts has taken hydromorphological considerations into account, where appropriate. All culverts would tie into the existing channel and a gravel bed would be created throughout the length of the new culverts. Further analysis of flow dynamics would be undertaken during the detailed design stage to inform the selection of the most appropriate material size and grading. A brief summary of the additional mitigation measures for each watercourse regarding mammal passage through the culverts and baffles to facilitate the movement of aquatic species is provided in **Table 15-3** below.

Table 15-3 – Summary of Additional Mitigation Measures

Culvert	Natural Gravel Bed	Mammal Ledge	Baffles	Low Flow Channel
West Cotting Burn Culvert (1.4)	Yes	No	No	No
East Cotting Burn Culvert (1.5)	Yes	No	No	No
Shieldhill Culvert (1A)	Yes	Adjacent wildlife culvert	No	No
Paradise Culvert (3)	Yes	Yes	No	No
Priest's Bridge Culvert (4)	Yes	Yes	Yes (retrofitted to existing culvert)	Yes
North Fenrother Burn Culvert (5.2)	Yes	Adjacent wildlife culvert	No	No

Culvert	Natural Gravel Bed	Mammal Ledge	Baffles	Low Flow Channel
South Fenrother Burn Culvert (5.3)	Yes	Adjacent wildlife culvert	No	No
Causey Park Culvert (6.2)	Yes	Yes	No	No
Earsdon Burn Culvert (6.3)	Yes	Yes	No	No
New Houses Farm Culvert (7.1)	No	No	No	No
Little Causey Park Culvert (7.2)	No	No	No	No
Tiny Causey Park Culvert (8.2)	No	Adjacent wildlife culvert	No	No
Burgham Culvert (10.1)	Yes	No	Yes (replacing existing wooden baffles with more robust arrangement)	No
Bockenfield Culvert (12)	Yes	Yes	No	No
South Longdike Culvert (9.1)	No	No	No	No
Blackwood Hall Culvert (13.1)	No	No	No	No
Glenshotton Culvert (14)	No	No	No	No
Parkwood Culvert (7)	Yes	No	No	No

15.2.3. The replacement of the existing culverts would offer opportunity to improve the performance of certain culverts, for example, where no natural bed is currently provided, and where the base of some culverts are perched above the bed of the watercourses. Additionally, some culverts were identified to be fully or partially blocked during the site walkover and this would be addressed as part of the works.

15.2.4. The realigned sections of the Fenrother Burn and Earsdon Burn would be diverted adjacent to the A1 to reduce the total length of the new culverts required. The design of the new channel would maintain a similar channel profile and dimensions to the existing watercourse to mimic existing conditions. Rock armour (boulders) would be placed within the new channel to provide varied substrate features and flow dynamics within the watercourse channel and assist the movement of aquatic species.

15.2.5. The removal of riparian habitat would be kept to a minimum, as previously discussed. The temporary loss of riparian habitats is expected to re-establish naturally within 2 years once construction has been completed. The removal of riparian habitats would be minimised as much as possible.

15.2.6. To compensate for the direct loss of watercourse along Longdike Burn as part of the Bockenfield Bridge extension, the length of the watercourse that falls within the temporary boundary shall be enhanced. This would include nutrient management measures to address adverse impacts of run-off from agricultural land, aquatic planting and bankside stabilisation. Measures would be developed further at detailed design, supported by a target walkover survey to confirm appropriateness of enhancement opportunities. Actions would be developed in partnership with the Environment Agency, with reference to the WFD status and reasons for deterioration.

15.2.7. The 'Wansbeck from Font to Bothal Burn' WFD catchment is assessed by the Environment Agency as having a hydromorphological designation of 'heavily modified'. As a result, the Environment Agency have recommended a number of mitigation measures in order to improve the hydromorphological quality of the catchment be considered as part of the Scheme design of Part A. This is applicable to Cotting Burn and Shieldhill Burn. The mitigation measures include:

a. Fish easement / passage.
b. Weir removal.

15.2.8. The works associated with Part A would not prevent these mitigation measures from being achieved and would help towards improving the suitability of the watercourses for fish passage with natural gravel beds in proposed culverts, and culverts set below bed level.

NEW RIVER COQUET BRIDGE

15.2.9. Potential operational impacts are likely to be localised to the footprint of the new River Coquet bridge.

15.2.10. Input of fine sediment to the watercourse may occur due to the potential for exposed bare earth resulting from vegetation clearance during the construction phase. This impact would reduce over time as the reinstated vegetation establishes and matures. There would be a greater extent of bare earth in comparison to the baseline due to the additional shading impact of the new River Coquet bridge.

15.2.11. The channel cross-sectional area would be locally altered due to the new pier on the south bank, which may cause very localised impacts on stream power, velocity and sediment transport capability. However, these impacts are anticipated to be negligible due to the alignment of the piers with the existing piers and the dominance of bedrock that spans the entire channel at the location of both the existing and proposed new River Coquet bridge. Furthermore, the boulders and cobbles, also present in this location, were assessed to be too large to be mobilised except for during extreme, high magnitude, low frequency events.

15.2.12. There is the potential for erosion of the reinstated made-ground during high flows that may inundate the southern pier. This may increase sediment delivery to the channel, although the potential impact is considered small and the risk would reduce as vegetation re-establishes.

SURFACE WATER DRAINAGE

15.2.13. Surface water runoff has the potential to contain silts and hydrocarbons that are washed off hard paved areas and vehicular areas. These may increase water turbidity, deplete oxygen levels and be toxic to the aquatic environment. Uncontrolled discharge via infiltration to ground may also cause permanent deterioration of groundwater quality. The current surface water drainage system is assumed to provide no treatment.

15.2.14. The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.2.5**) and the Highways Agency [now Highways England] Water Risk Assessment Tool (HAWRAT) has been used to assess the risks to water quality during the operation of Part A. Method A assessed the pollution impacts from routine runoff to surface waters and Method D assessed the pollution impacts from accidental spillage. For more information regarding the methodology refer to **Appendix 10.3: Drainage Network Water Quality Assessment**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Method A

15.2.15. All the single and cumulative assessments pass the HAWRAT assessment for acute and chronic impacts when proposed attenuation and treatment measures are taken into account.

15.2.16. The assessment of long term pollution impacts to the receiving water environment considers the annual average pollutant concentrations associated with Part A against the Environmental Quality Standards (EQS) threshold values set out under the WFD (**Ref. 10.2.1**). All the annual average pollutant concentrations, for both zinc and copper, are below the EQS threshold values. The values range from 0.00 µg/l to 0.45 µg/l for copper and from 0.00 µg/l to 1.76 µg/l for zinc, taking into account proposed attenuation and treatment measures. This shows that the proposed mitigation measures go beyond the minimum standards required in order to pass the HAWRAT Method A assessment.

Method D

15.2.17. The results of the Method D assessments for outfalls 1 to 17 and for outfall 19 indicate an annual probability of a significant pollution risk occurring in the event of spillage of between 0.019 % and 0.005 %, taking the proposed mitigation measures into account, which is well below the recommended threshold of 1 %. The Method D assessment for outfall 18 (that discharges to the River Coquet) indicates an annual probability of 0.01 %, taking into account the proposed mitigation measures, which is well below the recommended threshold of 0.5 % for outfalls that discharge to a sensitive water environment.

15.2.18. **Table 15-4** below provides an assessment of the potential for Part A to cause deterioration in the current ecological and chemical potential of the watercourses during operation. The assessment considers appropriate and best practice mitigation that would be implemented in order to minimise any adverse impacts.

Table 15-4 - Potential for the Part A to Cause Deterioration in the Current Ecological and Chemical Potential of Watercourses during Operation

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Ecological					
Biological	Fish Invertebrates Macrophytes	Changes to the hydromorphological quality of a watercourse could result in a barrier to the movement of aquatic species. Increased discharge of sediment laden runoff from the operational highway drainage system that could increase turbidity and smother bed substrates.	A natural bed would be provided within the new culverts to assist potential fish passage. The proposed culverts would tie into the existing channel. Baffles would be provided along the River Lyne and Longdike Burn as these watercourses were identified as priorities for the catchment during consultation with the Environment Agency. Vegetation would be reinstated as soon as practicable post-construction. Once vegetation is established, fine sediment inputs would reduce to baseline conditions, or near to baseline conditions. The surface water drainage system passes Method A and Method D HAWRAT assessments for all watercourses when taking the mitigation and treatment measures into consideration.	None predicted	Yes
	River Coquet: Fish Macrophytes Macro-invertebrates	Fine sediment input could continue to have detrimental impacts without appropriate mitigation	As above	None predicted	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Hydromorphology	Hydrological regime Morphology	Increase in surface water runoff as a result of increased impermeable area. Changes to the hydromorphological quality of watercourses due to new culverts and culvert extensions.	The design of the culverts has taken hydromorphological considerations into account where appropriate. All the culverts would tie into the existing channel and a gravel bed would be created throughout the length of the new culverts. **Table 15-3** summarises the additional mitigation measures for each watercourse regarding mammal passage and baffles to assist the movement of aquatic species. The realigned sections of the Fenrother Burn and Earsdon Burn would be diverted adjacent to the A1 to reduce the total length of the new culverts required. The design of the new channel would maintain a similar channel profile and dimensions to the existing watercourse to mimic existing conditions. Rock armour (boulders) would be placed within the new channel to provide varied substrate features and flow dynamics within the watercourse channel and assist the movement of aquatic species. The removal of habitat would be kept to a minimum, as discussed as part of the construction impact summary. Riparian habitat would be reinstated naturally within 2 years once construction has been completed.	None predicted	Yes
	River Coquet: Quantity and dynamics of flow River depth and width variation Structure and substrate of the river bed Structure of the riparian zone	Locally constrained channel due to the new pier during high flows that may inundate the bridge piers on the southern bank. Continued fine sediment input due to exposed bare earth on the valley sides. Loss of the riparian zone within the area cleared.	Vegetation would be reinstated as soon as practicable post-construction. Once vegetation is established, fine sediment inputs would reduce to baseline conditions, or near to baseline conditions. The riparian zone would be reinstated with a structure to resemble the baseline. Made-ground would comprise an appropriate mix of cohesive material, capped with a compacted angular mix of gravels to small cobbles with a minimum intermediate axis of 40 mm.	None predicted	Yes

Element	Indicator	Potential Impact of Part A on Receptor	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Physico-chemical / specific pollutants	Acid neutralising capacity Ammonia BOD Dissolved oxygen pH Phosphate Temperature Copper Zinc	Increase in diffuse pollution and discharge of contaminants into receiving watercourses due to highway contributing area.	HAWRAT has been used to assess the potential pollution impacts of routine runoff from Part A on the water quality. The results indicate that there would be no short term or long-term impacts on the water quality. As mentioned above, the proposed drainage strategy has incorporated the use of a management train to improve the water quality of the road discharge.	None predicted	Yes
	River Coquet: Acid neutralising capacity Ammonia BOD Dissolved oxygen pH Phosphate Temperature Copper Zinc	As above.	As above.	As above.	As above.
Chemical					
Priority substances / Other pollutants / Priority hazardous substances	Lead Nickel Cadmium	Increase in diffuse pollution and discharge of contaminants into receiving watercourses as a result of the increase in highway contributing area.	The proposed drainage strategy has incorporated the use of SuDS to improve the water quality of the road discharge. As discussed above, HAWRAT has been used to assess the potential pollution impacts of routine runoff from Part A on the water quality. The results indicate that there would be no short term or long-term impacts on the water quality.	None predicted	Yes
	River Coquet: As above	As above	As above	As above	As above

15.3 GROUNDWATER

15.3.1. **Table 15-5** below provides an assessment of the potential for Part A to result in deterioration in the current quantitative and chemical potential of the Northumberland Carboniferous Limestone and Coal Measures Groundwater Operational WFD Catchment, with consideration of appropriate mitigation measures that would be implemented to minimise any adverse impacts.

Table 15-5 – Assessment of the Potential for Part A to Result in Deterioration in the Current Quantitative and Chemical Potential of the Northumberland Carboniferous Limestone and Coal Measures Groundwater Operational Catchment

Element	Receptor	Potential Impact of Part A	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Quantitative					
Quantitative elements	Impact on dependent surface water bodies. Water balance	Part A would not involve any significant changes in land use when considered in the context of the wider catchment area and, therefore, would not impact on groundwater recharge or water balance and the overall quantitative elements.	None	None predicted	Yes
Chemical					

Element	Receptor	Potential Impact of Part A	Part A Proposal (Including Mitigation)	Detrimental Impact or Change to WFD Status	Compliant with WFD Objectives
Chemical elements	Drinking water protected area. General chemical test. Impact on surface waters.	Due to the relatively localised scale of the proposed works, no alteration in the regional groundwater quality due to contaminants in site surface water discharge or accidental spillages of materials during construction is expected.	All site works and ground works would be undertaken in accordance with the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) to ensure the risk of contamination during construction is mitigated. The surface water drainage strategy does not include discharging to ground and the grassed detention basins would be lined.	None predicted	Yes

16 CONCLUSION

16.1.1. Part A is located across four WFD catchments: ‘Wansbeck from Font to Bothal Burn’, ‘Lyne from Source to Tidal Limit’, ‘Longdike Burn Catchment (trib of Coquet)’ and ‘Coquet from Forest Burn to Tidal Limit’. The assessment indicates that there would be no detrimental impact or change to the WFD status of these catchments with the appropriate mitigation measures implemented, as detailed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and embedded within the design of the new culverts and extended culverts. As a result, Part A is complaint with WFD objectives.

16.1.2. There are opportunities for Part A to improve the performance of certain existing structures, for example, where no natural bed is provided within the existing culverts or the base of the culvert is perched above the bed of the watercourse. As a result, Part A would not prevent the WFD catchments from achieving the status objectives for each catchment.

16.1.3. Part A is located within the Northumberland Carboniferous Limestone and Coal Measures WFD groundwater operational catchment. The assessment indicates that there would be no detrimental impact or change to the WFD status with the appropriate mitigation measures implemented, as detailed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and the proposed surface water drainage system.

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